



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E Subseasonal Outlook: 14 January 2025

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

UC San Diego



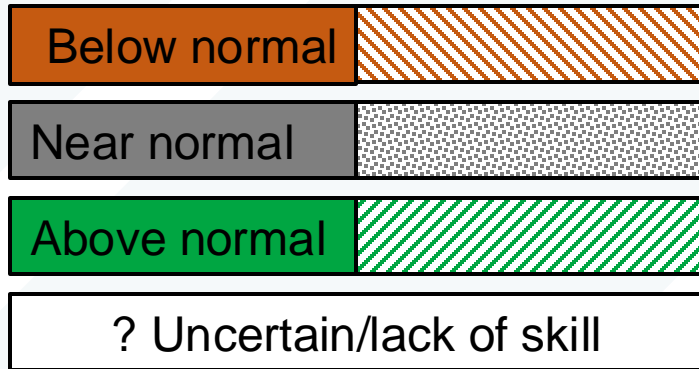
Summary: Subseasonal Precipitation Outlook by Model

This slide shows the CW3E synthesis of subseasonal products by model

Forecasts Initialized 13 Jan 2025

Region	Week 2 (20–26 Jan)				Week 3 (27 Jan–2 Feb)				Week 4 (3–9 Feb)			
	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 ^{1,2}	Multi-Model Forecast
WA/OR	Below normal	Below normal	Below normal	Below normal	Uncertain	Near normal	Uncertain	Uncertain	Above normal	Above normal	Uncertain	Above normal
Northern CA	Below normal	Below normal	Below normal	Below normal	Uncertain	Above normal	Uncertain	Uncertain	Uncertain	Above normal	Uncertain	Uncertain
Central CA	Below normal	Below normal	Below normal	Below normal	Uncertain	Above normal	Below normal	Uncertain	Below normal	Above normal	Uncertain	Uncertain
Southern CA	Uncertain	Below normal	Below normal	Below normal	Uncertain	Near normal	Below normal	Uncertain	Below normal	Above normal	Uncertain	Uncertain

Higher Confidence | Lower Confidence



- Models agree on below-normal precipitation over all of CA during Week 2
- High degree of uncertainty in precipitation over all of CA during Weeks 3–4

Since the last Subseasonal Outlook posted on 7 Jan, models show more disagreement on the timing and possibility of regime shift in Weeks 2–4; Only ECCC is predicting a possible regime shift from dry to wet conditions over CA from Week 2 to Weeks 3–4

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

- Strong MJO convection is currently located over the Western Hemisphere and Africa (Phase 1); QBO is in the westerly phase
 - The above MJO and QBO combinations favor a moderate likelihood (> 40% probability) of above-normal precipitation in Northern and Central CA during Weeks 3–5 (28 Jan–17 Feb)
- Models forecast MJO will remain strong and propagate to the Indian Ocean (Phases 2 & 3) in Week 1 (14–20 Jan) and propagate further eastward to the Maritime Continent (phase 4) with weakening amplitude in Week 2 (21–27 Jan)
 - Without considering QBO/ENSO conditions, MJO activity over the Western Hemisphere and Africa during JFM is associated with statistically significant decrease in wet extremes in Southern CA at lag times of 3 weeks

Week 2 forecasts (20–26 Jan):

- Models agree on slightly below-normal AR activity over Central CA
 - In Northern CA, ECMWF is forecasting below-normal AR activity, while NCEP and ECCO are forecasting slightly below-normal AR activity
 - In Southern CA, NCEP is forecasting near-normal AR activity, while ECCO and ECMWF are forecasting slightly below-normal AR activity
- Models disagree on the likelihood of persistent North-ridge activity during Weeks 1–2 (13–27 Jan)
 - ECMWF is forecasting a moderate likelihood of above-normal North-ridge activity, while NCEP is forecasting below-normal North-ridge activity
- IRI weather regime tool shows moderate-to-high likelihood of West Coast Ridge (below-normal precipitation in CA) during Week 2

Summary

Week 3 Forecasts (27 Jan – 2 Feb):

- Models disagree on AR activity over CA
 - NCEP is forecasting near-normal AR activity over most of CA with slightly below-normal AR activity over a portion of Central CA
 - ECCC is forecasting slightly above-normal AR activity over Northern and Central CA, and near-normal AR activity over Southern CA
 - ECMWF is forecasting slightly below-normal AR activity over CA
- Despite some uncertainty in the location of ridging activity, models agree on the moderate likelihood of above-normal West-ridge activity (dry conditions in Central and Southern CA) during Weeks 3–4 (27 Jan – 10 Feb)
- IRI weather regime tool shows possible regime shift from West Coast Ridge (below-normal precipitation in CA) to Pacific Ridge (near-normal precipitation in CA) around the start of Week 3 with moderate likelihood, and another regime shift back to West Coast Ridge during the middle of Week 3 with low likelihood

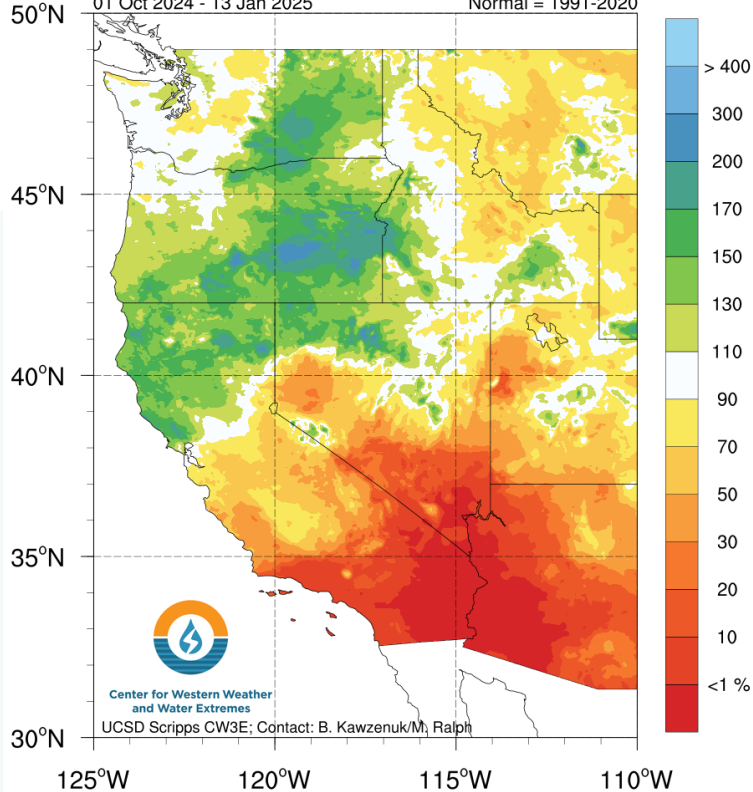
Week 4 Forecasts (3–9 Feb):

- Models disagree on AR activity over CA
 - NCEP and ECCC agree on above-normal AR activity over Northern and Central CA, while ECMWF is forecasting slightly below-normal AR activity over Northern CA and near-normal AR activity over Central CA
 - NCEP and ECMWF agree on near-normal AR activity over Southern CA, while ECCC is forecasting above-normal AR activity
- IRI weather regime tool shows low likelihood of West Coast Ridge (below-normal precipitation in CA) during Week 4

Hydrologic Summary

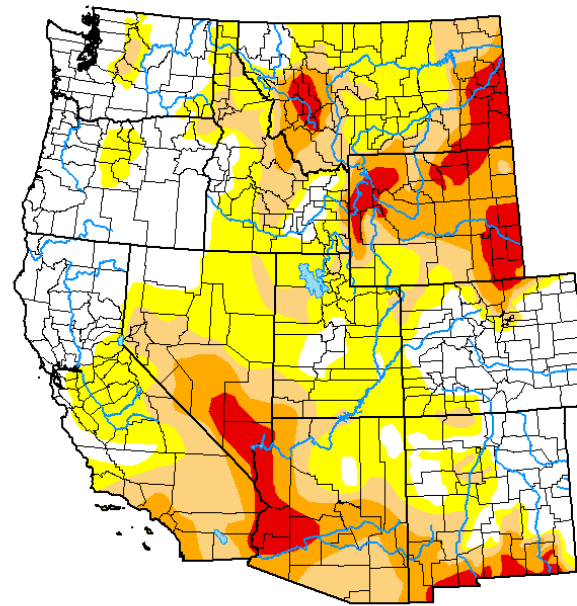
Precipitation

PRISM Water Year to Date Precipitation Anomaly (%)
01 Oct 2024 - 13 Jan 2025 Normal = 1991-2020



Drought Conditions

U.S. Drought Monitor West



January 7, 2025

(Released Thursday, Jan. 9, 2025)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	32.22	67.78	39.02	20.30	6.87	0.00
Last Week 12-31-2024	29.66	70.34	39.86	19.17	6.85	0.00
3 Months Ago 10-08-2024	16.15	83.85	42.54	14.64	3.41	0.18
Start of Calendar Year 01-01-2025	32.22	67.78	39.02	20.30	6.87	0.00
Start of Water Year 10-01-2024	20.06	79.94	37.38	9.85	2.47	0.11
One Year Ago 01-09-2024	48.96	51.04	27.28	13.43	4.57	0.66

Intensity

None	D2 Severe Drought
D0 Abnormally Dry	D3 Extreme Drought
D1 Moderate 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:

Brad Pugh
CPC/NOAA



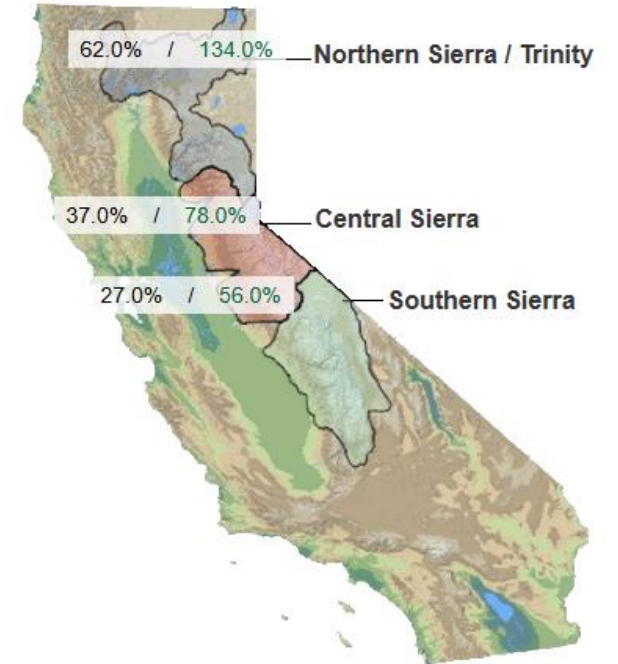
droughtmonitor.unl.edu

Snowpack Conditions

Provided by the California Cooperative Snow Surveys

Data For: 14-Jan-2025

% Apr 1 Avg. / % Normal for this Date

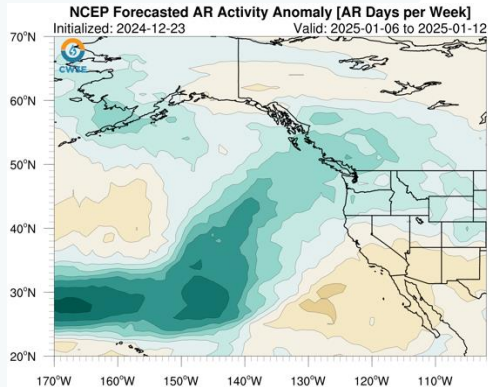
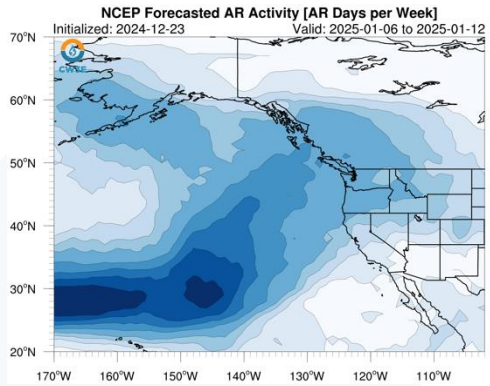


- As of 13 Jan 2025, water-year-to-date precipitation is **above normal (> 130% of normal)** in Northern CA, **slightly below-normal (50–90% of normal)** in Central CA, and **well-below normal (< 20% of normal)** in Southern CA
- The most recent drought monitor update is showing **abnormally dry conditions (D0)** over the San Joaquin Basin, **moderate drought (D1)** over a large portion of Southern CA, and the development of **severe drought (D2)** in the Southern CA coastal zone
- Current snowpack is above-normal (134% of normal) over the Northern Sierra Nevada for this time of year, and below-normal in the Central (78% of normal) and Southern Sierra Nevada (56% of normal)

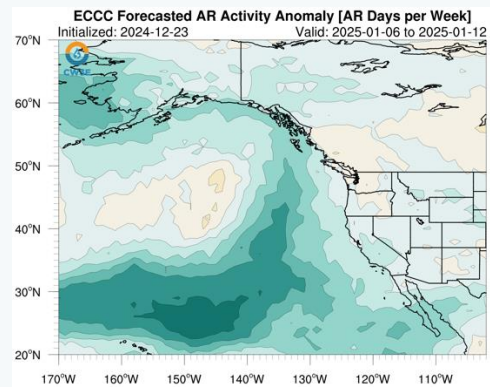
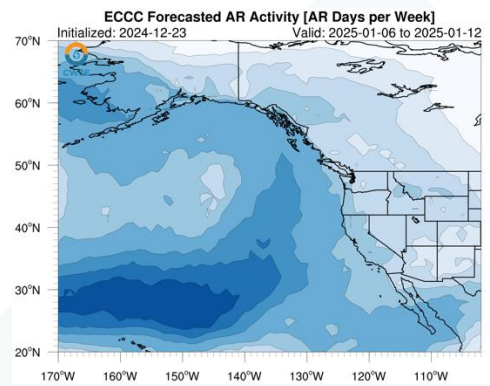
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 23 Dec 2024; Valid: 6–12 Jan 2024

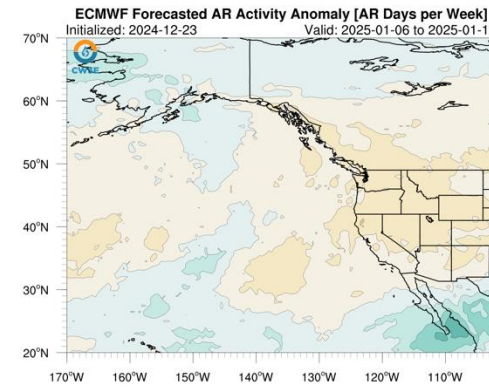
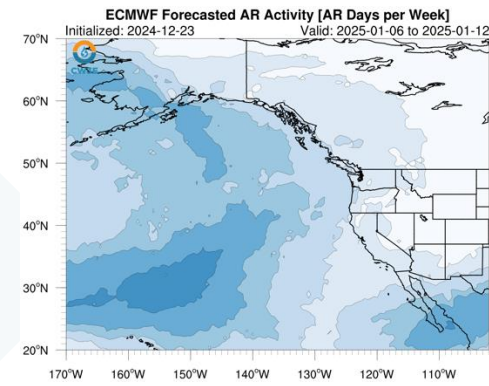
NCEP



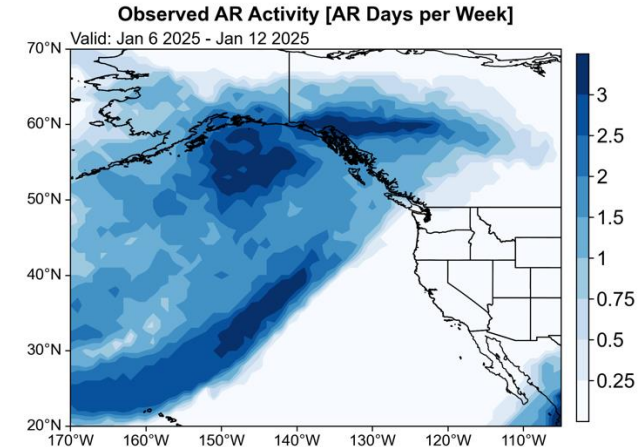
ECCC



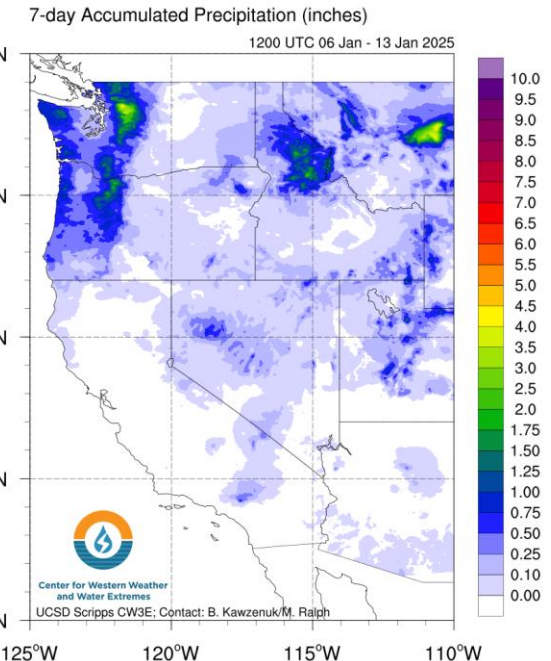
ECMWF



Observed (GFS Analysis)



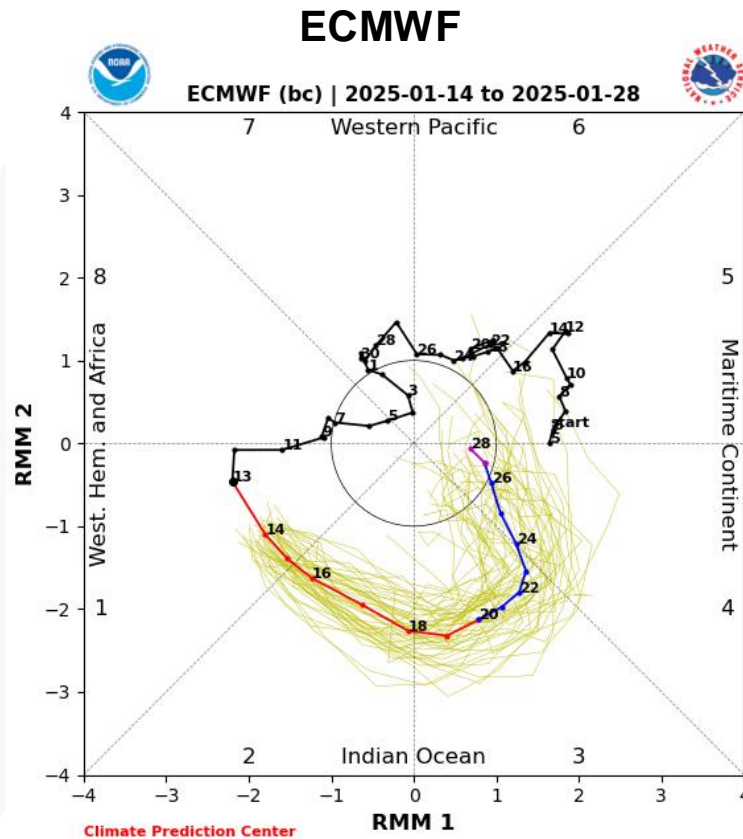
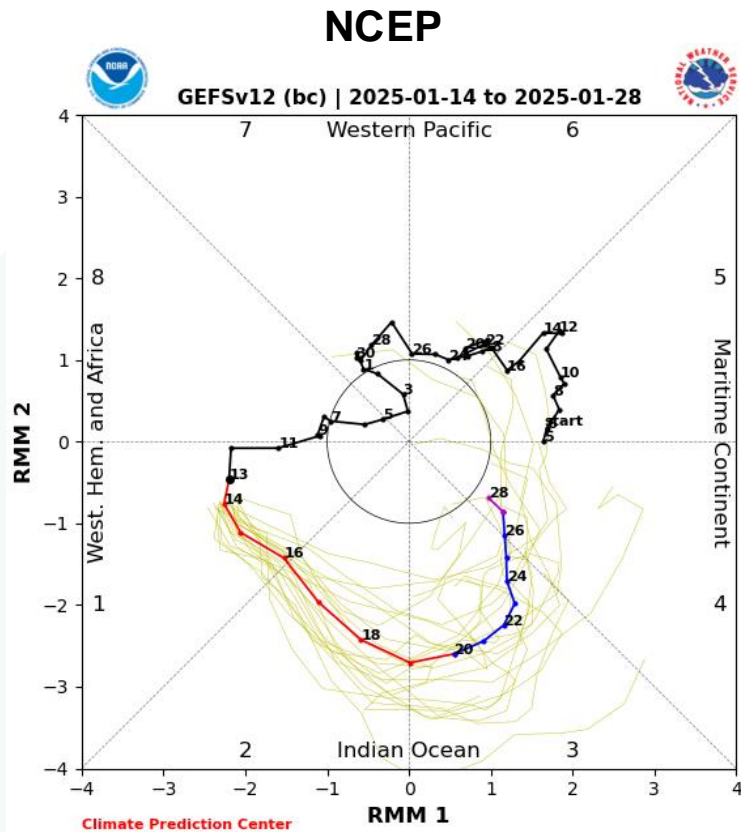
Observed Precipitation



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)

- Although models generally predicted the southwest-to-northeast axis of AR activity, all models overestimated AR activity over the US West Coast, especially NCEP and ECCC
- Observed AR activity was farther north (over British Columbia) due to ridging
- Little-to-no precipitation was observed over CA
- A frontal system produced light precipitation (< 3 inches) over WA/OR

Dynamical Model MJO Forecasts (NCEP vs. ECMWF)



Black: Last 40 days of observations (7–13 Jan); Red: Week 1 (14–20 Jan) ensemble mean; Blue: Week 2 (21–27 Jan) ensemble mean; Yellow: Ensemble members

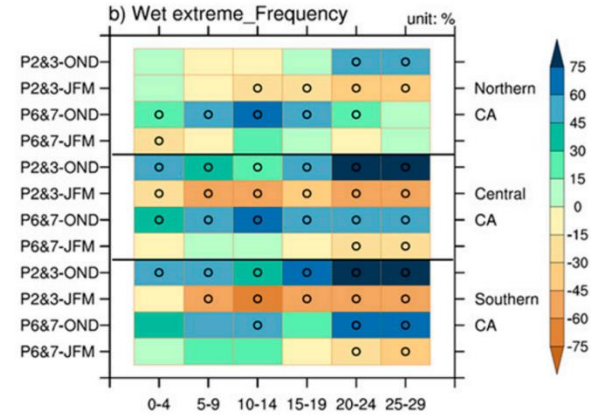


Figure 8 from Wang et al. (2023)

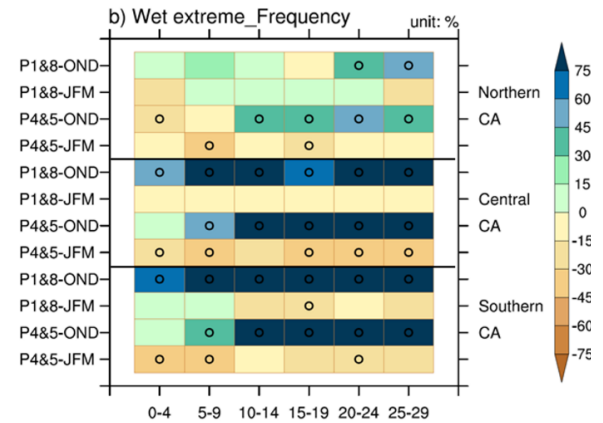
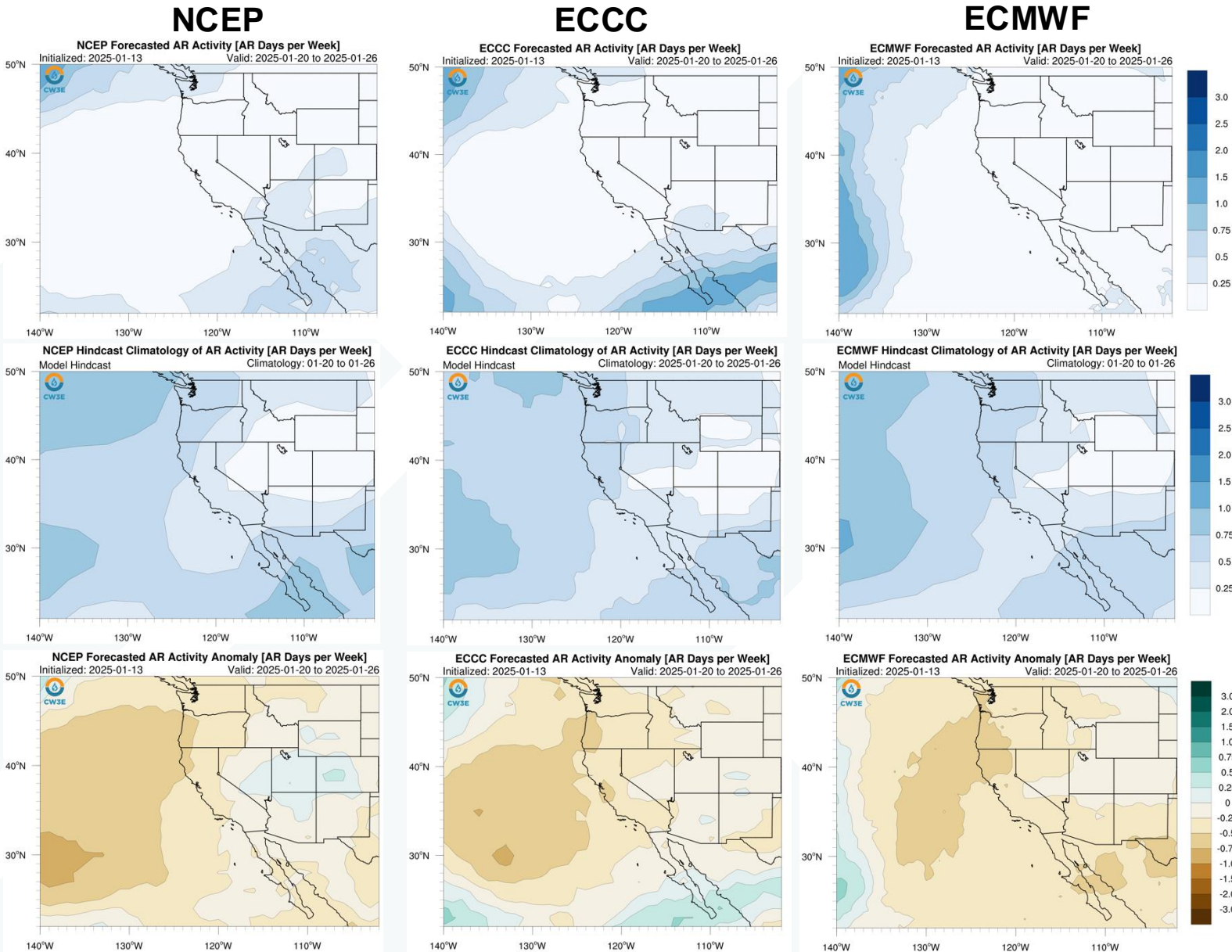


Figure S6 from Wang et al. (2023)

- As of 13 Jan 2025, strong MJO convection was located over the Western Hemisphere and Africa (Phase 1)
- Models agree on the predicted MJO activity in Weeks 1–2: MJO is forecasted to remain strong and propagate to the Indian Ocean (Phases 2 & 3) in Week 1 (14–20 Jan) and propagate further eastward to the Maritime Continent (phase 4) with weakening amplitude by the end of Week 2 (21–27 Jan)
- Without considering QBO/ENSO conditions, MJO activity over the Western Hemisphere and Africa during JFM is associated with statistically significant decrease in wet extremes in Southern CA at lag times of 3 weeks

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

Forecasts Initialized 13 Jan 2025



- All models are forecasting very little AR activity overall in CA and agree on slightly below-normal AR activity over Central CA during Week 2 (20–26 Jan)
- In Northern CA, ECMWF is forecasting below-normal AR activity, while NCEP and ECCC are forecasting slightly below-normal AR activity
- In Southern CA, NCEP is forecasting near-normal AR activity, while ECCC and ECMWF are forecasting slightly below-normal AR activity

Models agree on slightly below-normal AR activity over Central CA during Week 2 (20–26 Jan)

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)

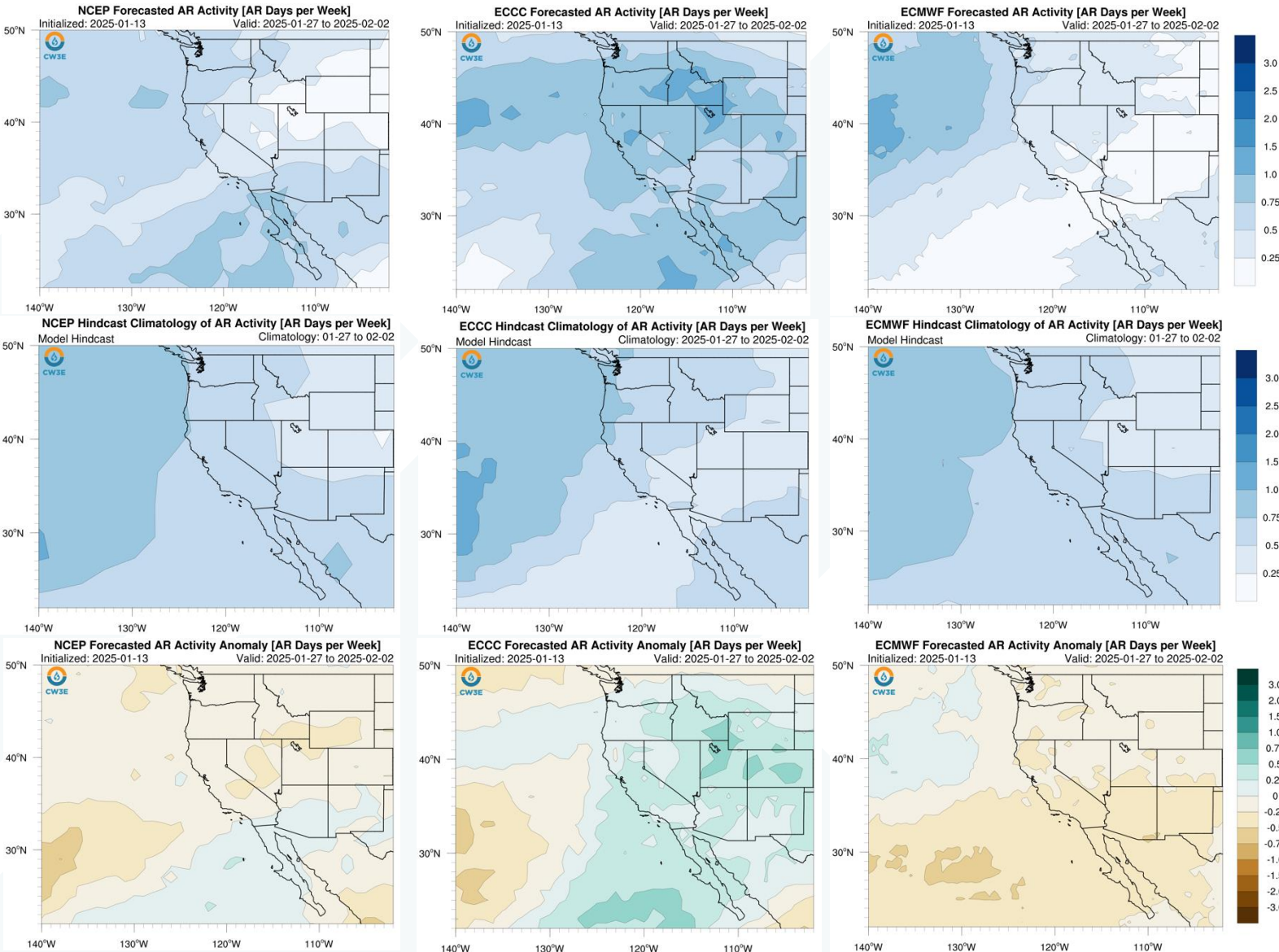
AR Activity Forecasts: Week 3 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 13 Jan 2025

NCEP

ECCC

ECMWF



- NCEP is forecasting near-normal AR activity over most of CA with slightly below-normal AR activity over a portion of Central CA during Week 3 (27 Jan – 2 Feb)
- ECCC is forecasting slightly above-normal AR activity over Northern and Central CA, and near-normal AR activity over Southern CA
- ECMWF is forecasting slightly below-normal AR activity over CA

Models disagree on AR activity over CA during Week 3 (27 Jan – 2 Feb)

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)

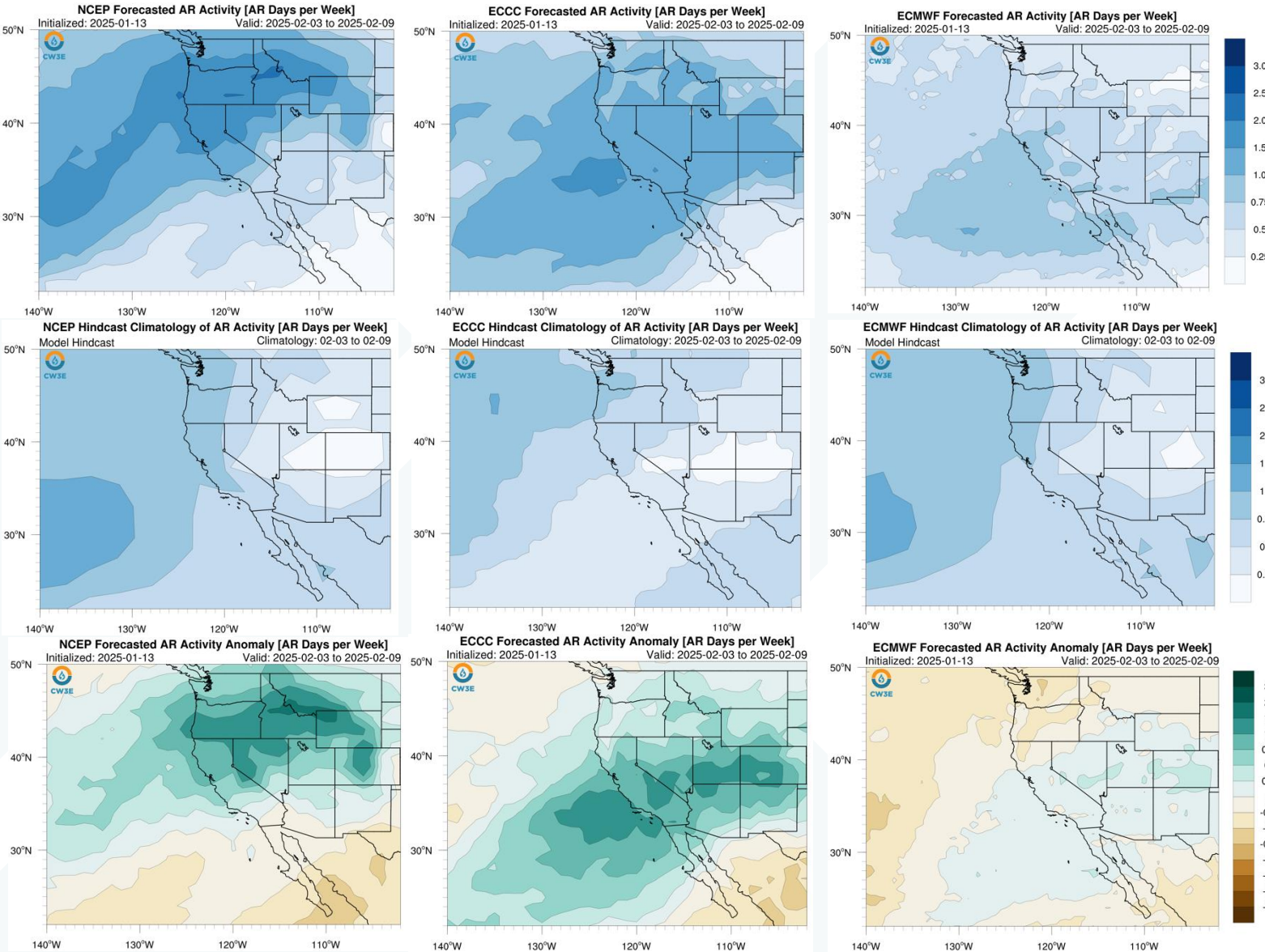
AR Activity Forecasts: Week 4 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 13 Jan 2025

NCEP

ECCC

ECMWF

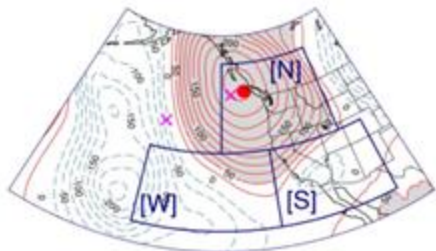


- NCEP and ECCC agree on above-normal AR activity over Northern and Central CA, while ECMWF is forecasting slightly below-normal AR activity over Northern CA and near-normal AR activity over Central CA during Week 4 (3–9 Feb)
- NCEP and ECMWF agree on near-normal AR activity over Southern CA, while ECCC is forecasting above-normal AR activity

Models disagree on AR activity over CA during Week 4 (3–9 Feb)

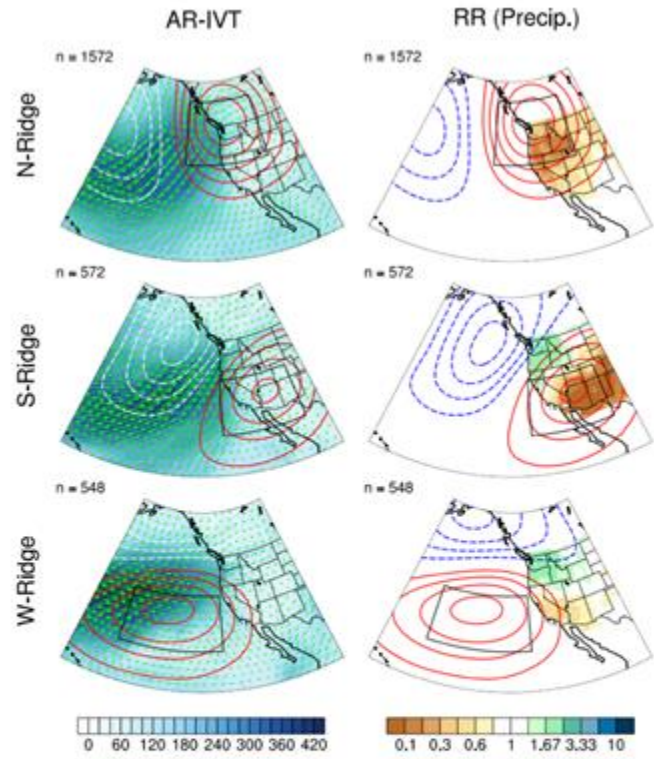
Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

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



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

- 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



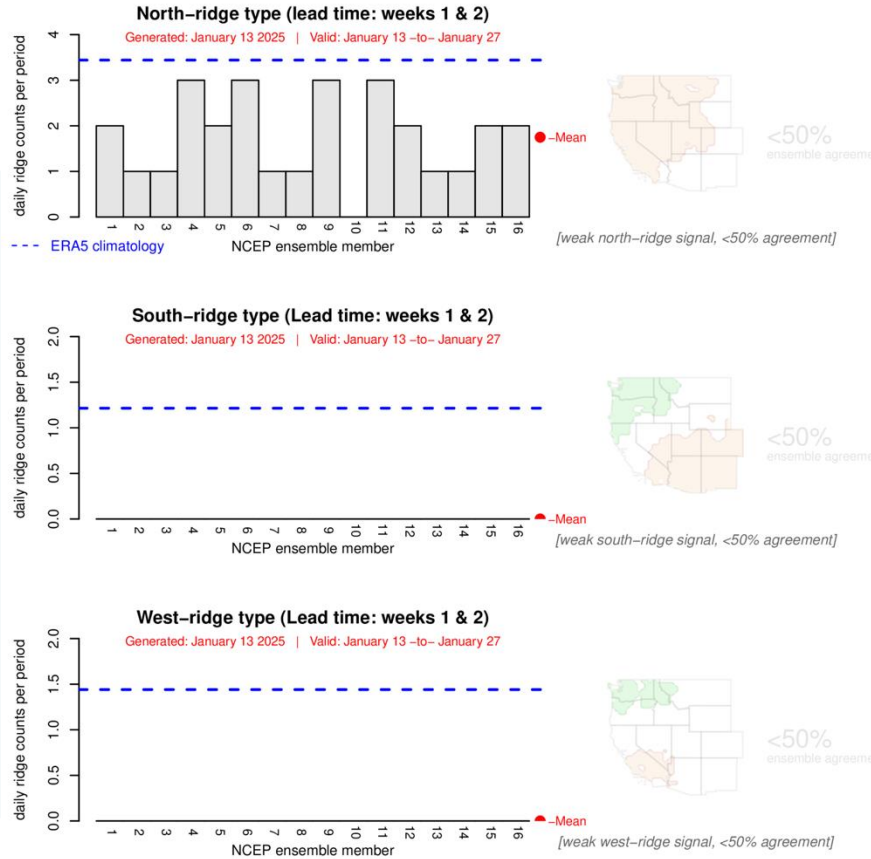
Contact: pgibson@ucsd.edu
Reference: Gibson et al. (2020)
Journal of Climate

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

Forecasts Initialized 13 Jan 2025

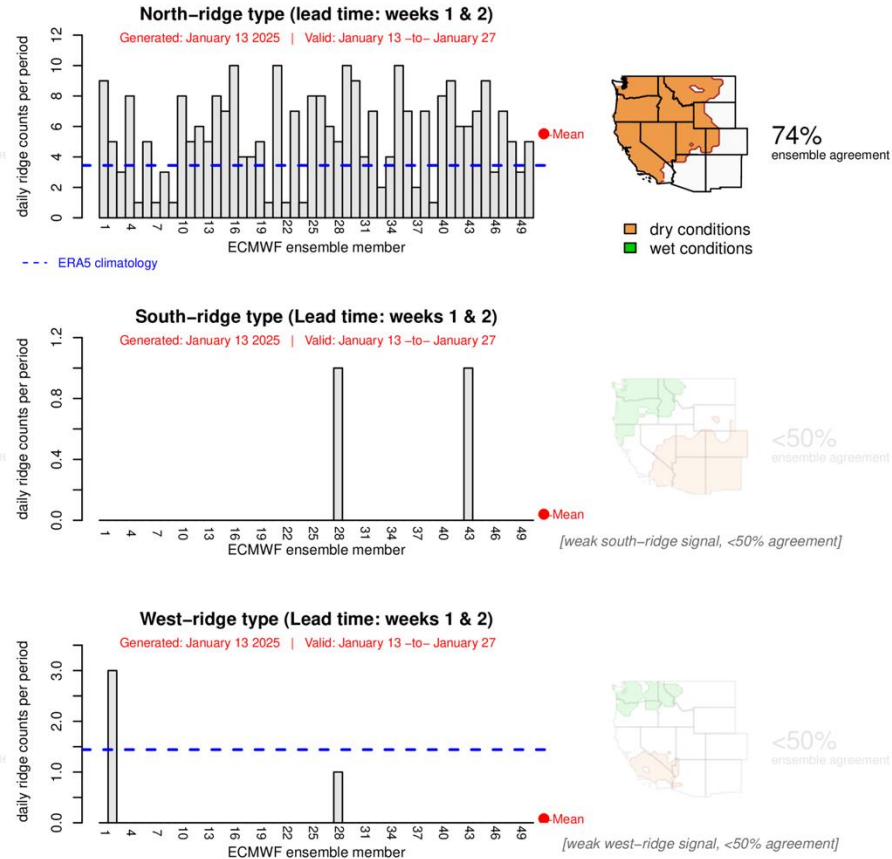
NCEP

CW3E Subseasonal Ridging Forecast
(Uses NCEP CFSv2 model)



ECMWF

CW3E Subseasonal Ridging Forecast
(Uses ECMWF model)



- ECMWF is forecasting a moderate likelihood (74% ensemble agreement) of above-normal North-ridge activity during Weeks 1–2 (13–27 Jan), but NCEP is forecasting below-normal North-ridge activity
- Both models are forecasting very low South-ridge and West-ridge activity



Models disagree on the likelihood of persistent North-ridge activity during Weeks 1–2 (13–27 Jan)

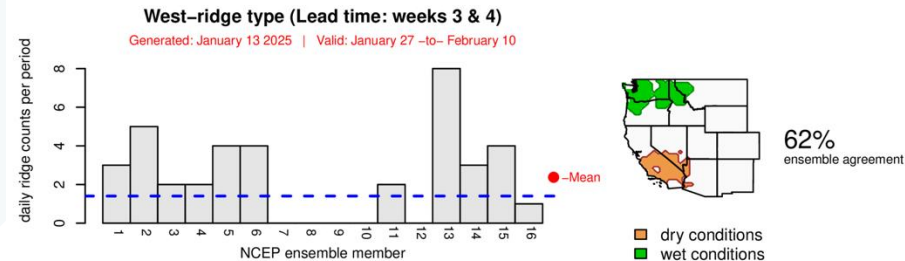
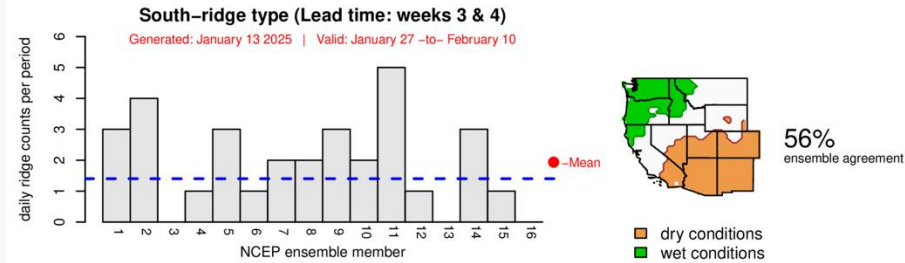
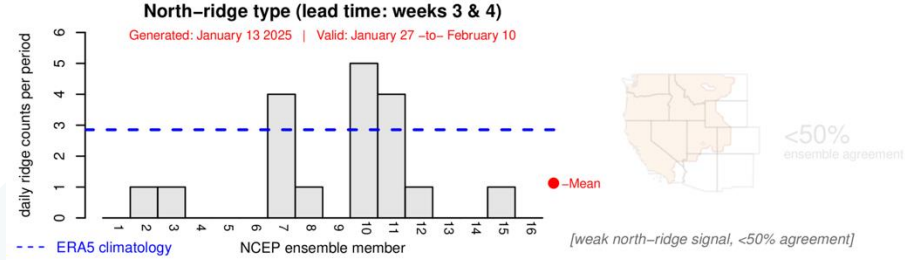


Ridging Forecasts: Weeks 3–4 (NCEP vs. ECMWF)

Forecasts Initialized 13 Jan 2025

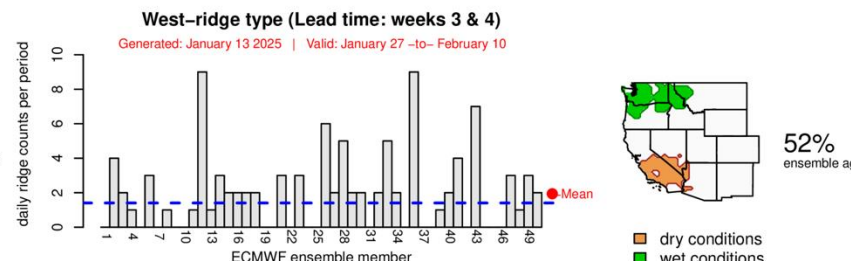
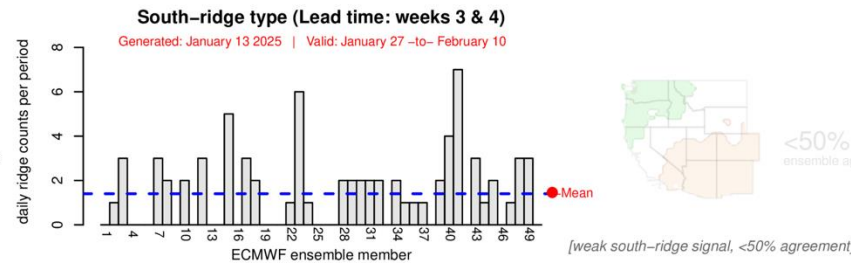
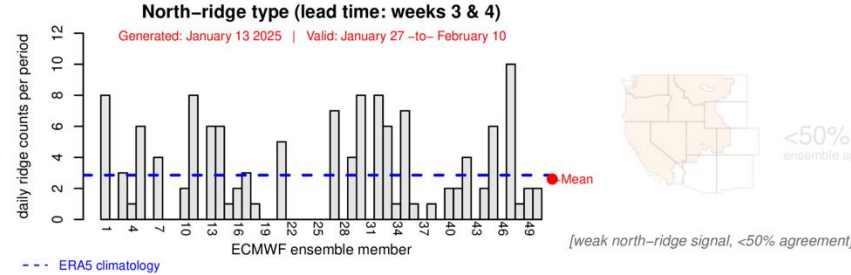
NCEP

CW3E Subseasonal Ridging Forecast (Uses NCEP CFSv2 model)



ECMWF

CW3E Subseasonal Ridging Forecast (Uses ECMWF model)



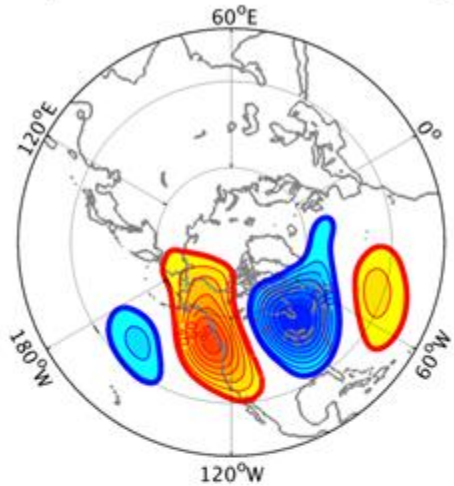
- NCEP is forecasting a moderate likelihood (50%–65% ensemble agreement) of above-normal South-ridge and West-ridge activity during Weeks 3–4 (27 Jan – 10 Feb)
- ECMWF is forecasting a moderate likelihood of above-normal West-ridge activity and near-normal North-ridge and South-ridge activity
- NCEP is forecasting below-normal North-ridge activity

Despite some uncertainties in the location of ridging activity, models agree on the moderate likelihood of above-normal West-ridge activity during Weeks 3–4 (27 Jan – 10 Feb)

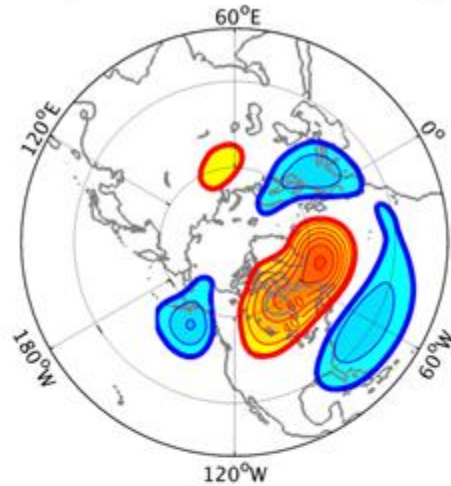


Background Info: IRI Subseasonal Weather Regime Forecasts

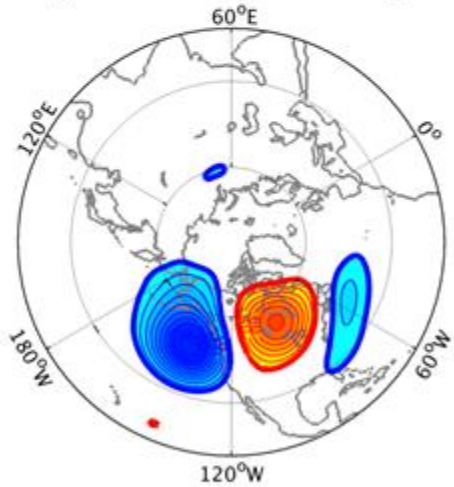
a) WR 1: West Coast Ridge



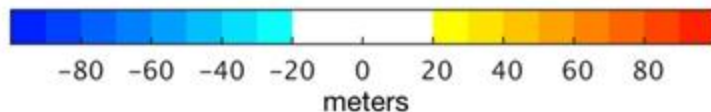
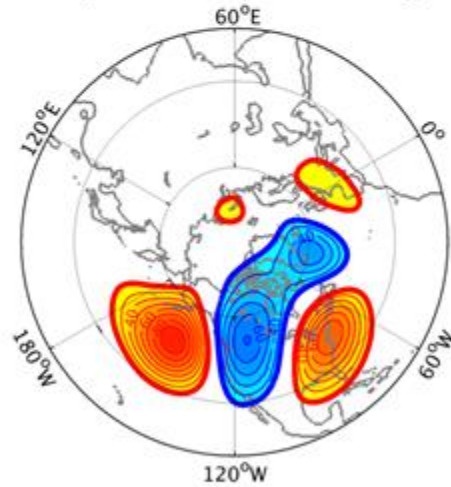
b) WR 2: Greenland High



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)

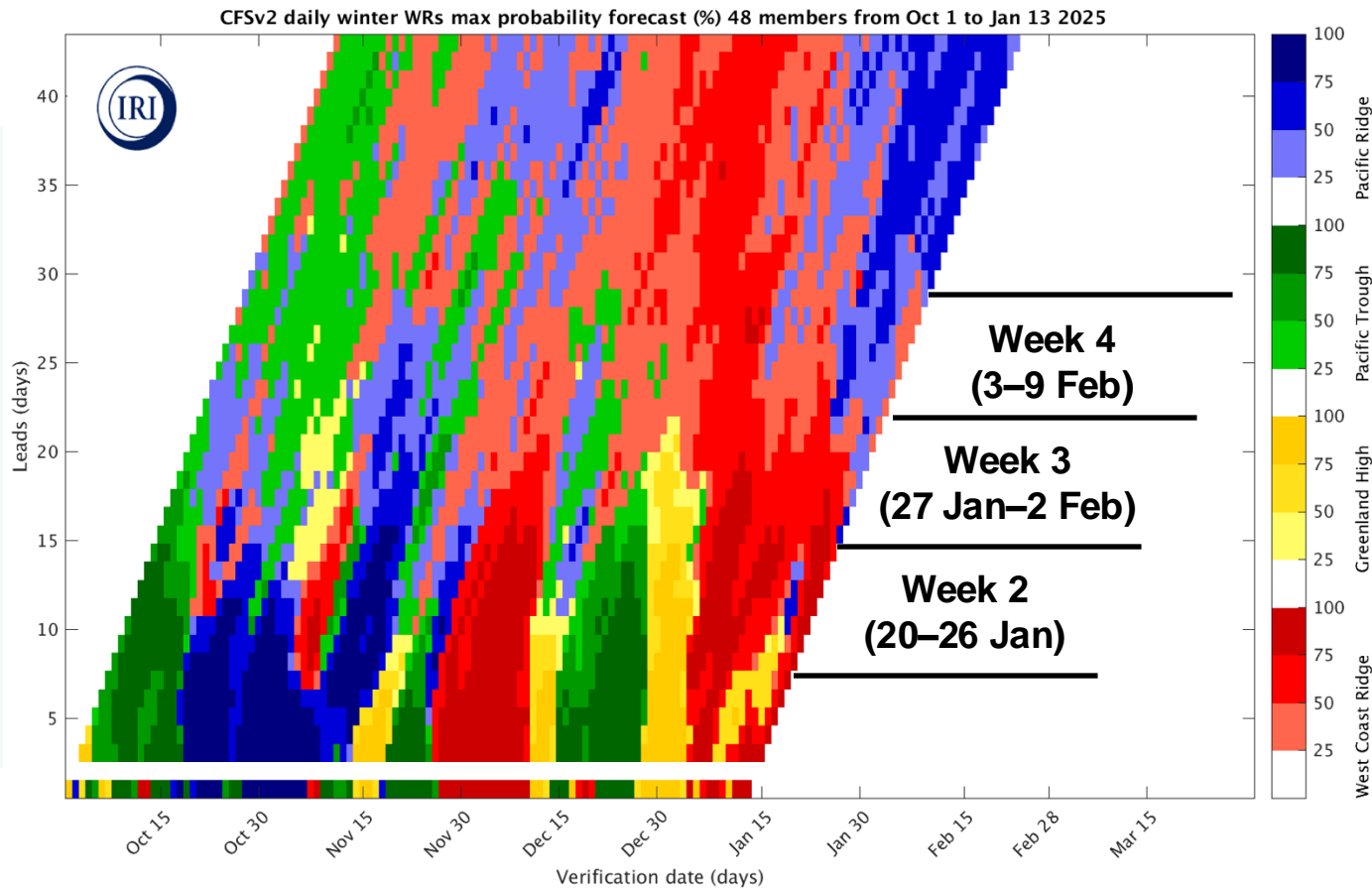
Reference: [Robertson et al. \(2020\)](#)

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 13 Jan 2025



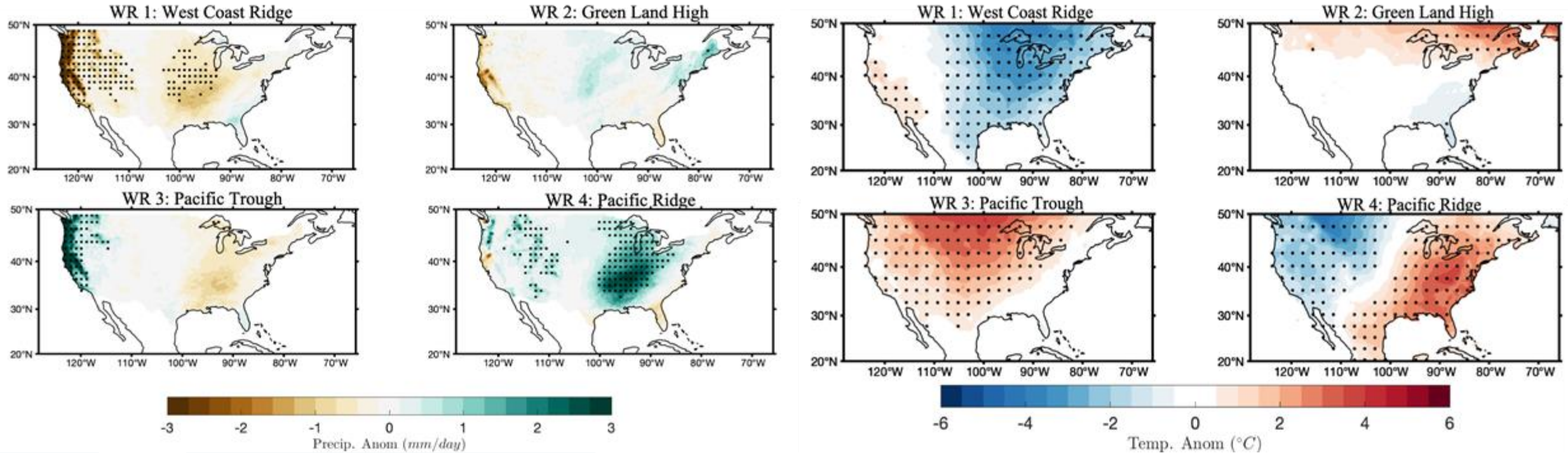
- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- As of 13 Jan, the dominant regime pattern is West Coast Ridge
- Moderate-to-high likelihood (> 50% ensemble agreement) of West Coast Ridge persisting through Week 2 (20–26 Jan)
- Possible regime shift from West Coast Ridge to Pacific Ridge around Week 3 (27 Jan) with moderate likelihood (50–75% ensemble agreement)
- Low likelihood (25–50% ensemble agreement) of regime shift from Pacific Ridge to West Coast Ridge during Week 3 and persisting through Week 4 (3–9 Feb)

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

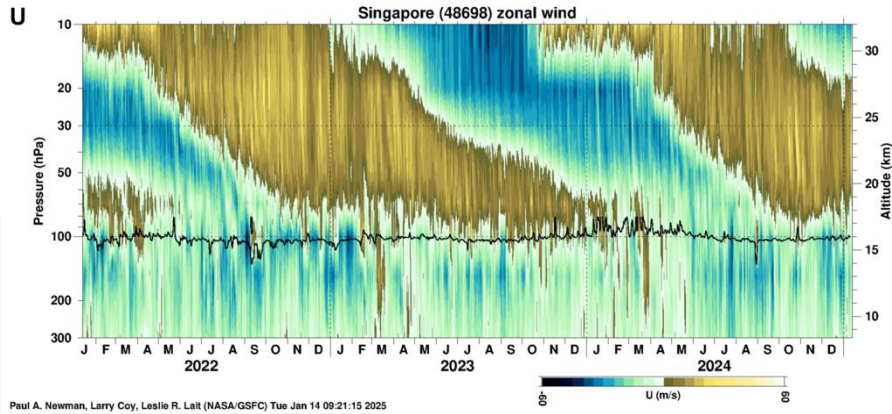


This graphic shows composite mean precipitation (left) and temperature (right) anomalies associated with each weather regime. Stippling (black dots) indicate statistically significant anomalies.

- Below-normal precipitation and above-normal temperature predicted over CA during Week 2 (20–26 Jan) with moderate-to-high confidence
- Near-normal precipitation and below-normal temperature predicted over CA during the end of Jan (27–31 Jan) with low-to-moderate confidence
- Below-normal precipitation and above-normal temperature predicted over CA during early Feb (1–8 Feb) with low confidence

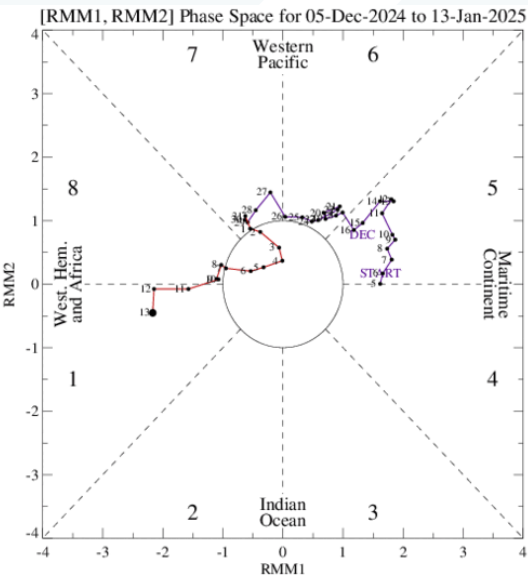
Background Info: AR Activity and Precipitation Based on MJO and QBO

QBO Conditions



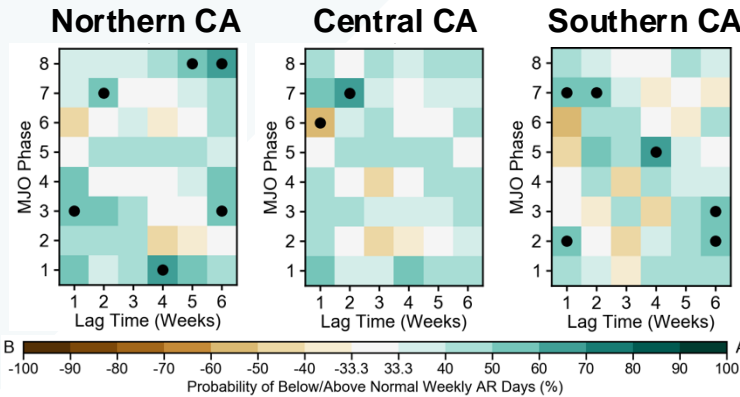
QBO is in the westerly phase at 50-hPa

MJO Conditions

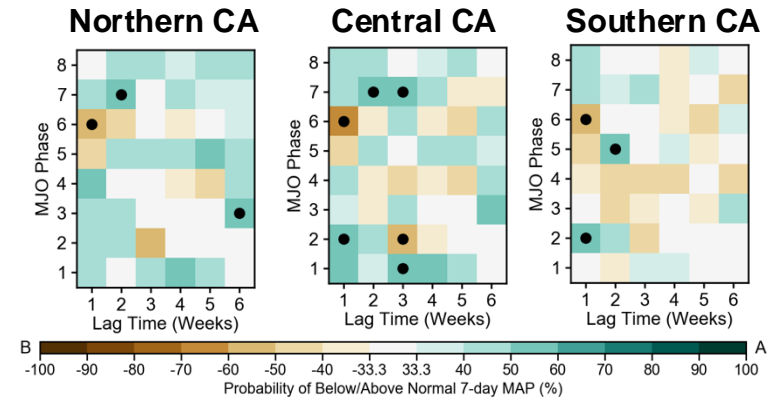


MJO convection is currently located over the Western Hemisphere and Africa (Phase 1)

Probability of Above/Below-Normal AR Occurrence (WQBO in JFM)



Probability of Above/Below-Normal Precipitation (WQBO in JFM)

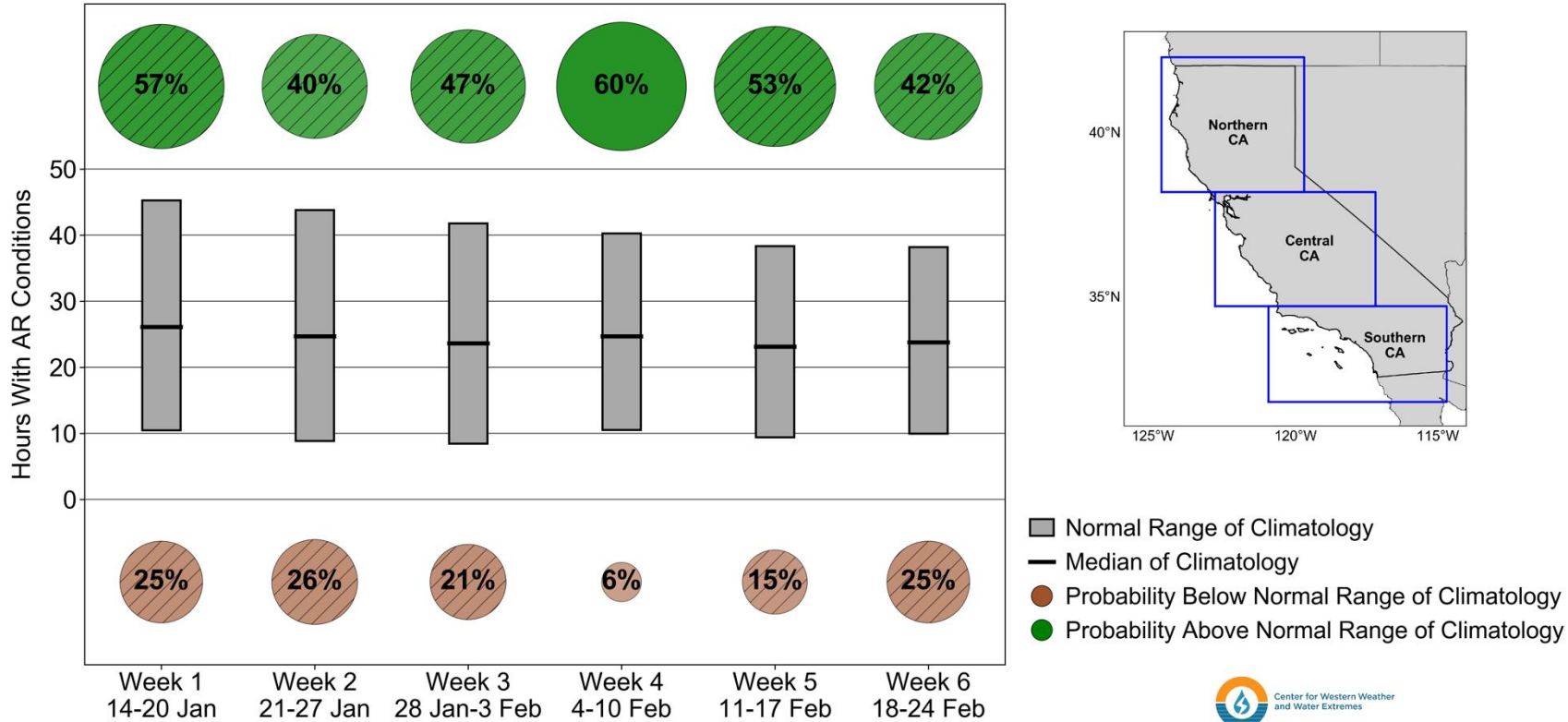


Probability matrices illustrating the weeks 1–6 lagged probability of below-normal (brown shading) or above-normal (green shading) AR occurrence and precipitation for all MJO phases when the QBO is in the westerly phase during JFM in Northern CA (left), Central CA (middle), and Southern CA (right). White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

AR Occurrence: Northern CA

Northern CA Subseasonal AR Occurrence Outlook
Issued: 13 Jan 2025 MJO Phase 1 WQBO



Forecasts Initialized 13 Jan 2024

- CW3E's probabilistic AR occurrence forecast based on current MJO and QBO conditions (see forecast for all regions [here](#))
- Moderate likelihood (> 40% probability) of above-normal AR occurrence in Northern CA during Weeks 3–6 (28 Jan–24 Feb); The anomaly signal (60% probability) and hindcast skill are elevated in Week 4, indicating a potential forecast of opportunity**
- Moderate likelihood (> 40% probability) of above-normal AR occurrence in Central and Southern CA during Weeks 4–6 (4–24 Feb)

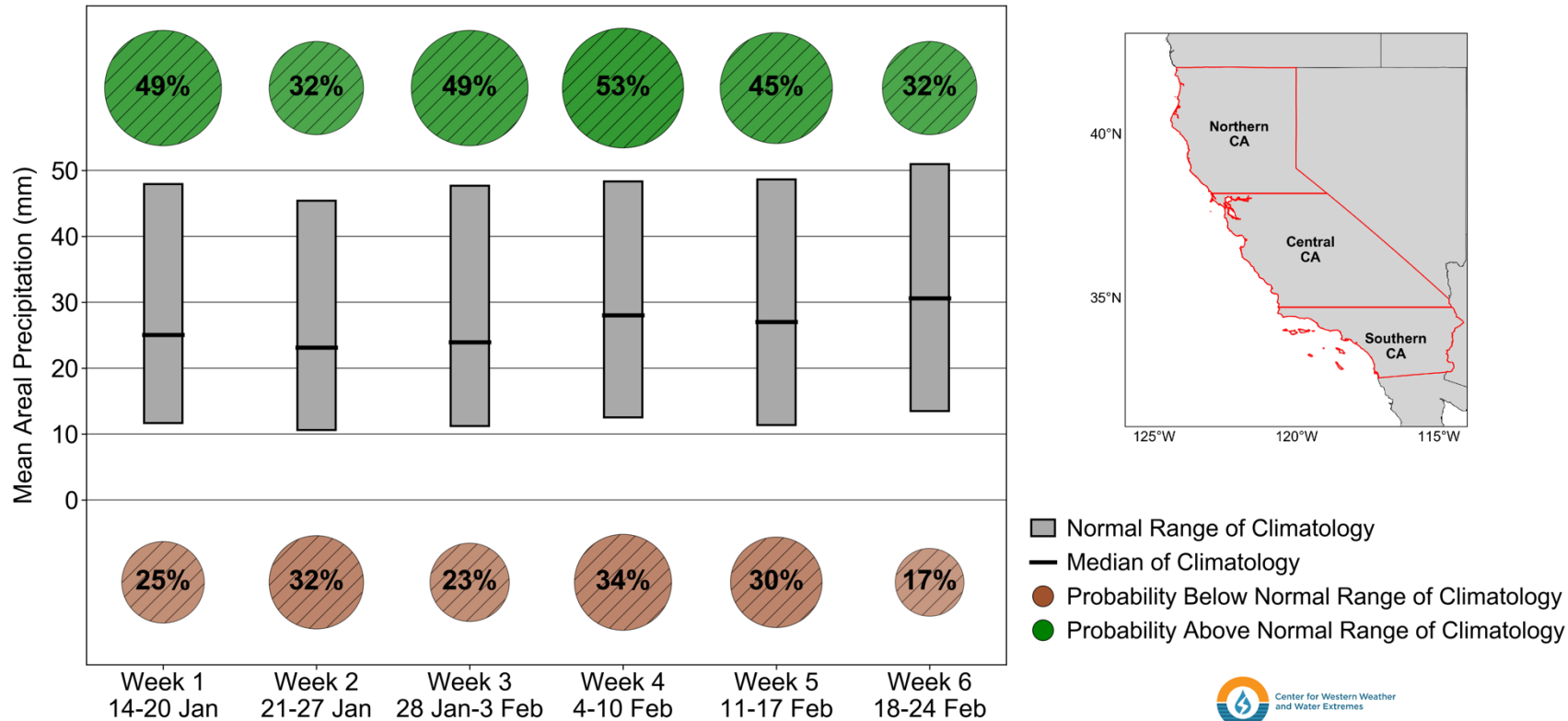
This product shows weekly probabilities of above-normal and below-normal AR occurrence in California. These probabilities are calculated for lead times of 1–6 weeks based on the current season (i.e., OND or JFM) and phases of the Madden-Julian Oscillation (MJO) and Quasi-biennial Oscillation (QBO). If 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 13 Jan 2024

Precipitation: Northern CA

Northern CA Subseasonal Precipitation Outlook
Issued: 13 Jan 2025 MJO Phase 1 WQBO



- CW3E's probabilistic precipitation forecast based on current MJO and QBO conditions (see forecast for all regions [here](#))
- **Moderate likelihood of above-normal precipitation in Northern and Central CA during Weeks 3–5 (28 Jan – 17 Feb)**



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. \(2023\)](#)

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***