



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E Subseasonal Outlook: 21 January 2025

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

UC San Diego



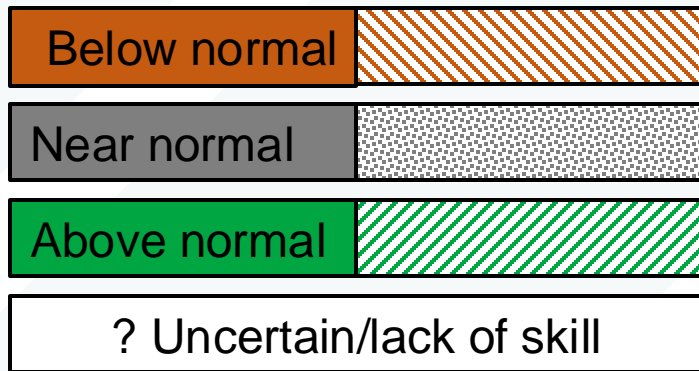
Summary: Subseasonal Precipitation Outlook by Model

This slide shows the CW3E synthesis of subseasonal products by model

Forecasts Initialized 20 Jan 2025

Region	Week 2 (27 Jan – 2 Feb)				Week 3 (3–9 Feb)				Week 4 (10–16 Feb)			
	NCEP ^{1,2}	ECCC ¹	ECMWF ^{1,2}	Multi-Model Forecast	NCEP ^{1,2}	ECCC ¹	ECMWF ^{1,2}	Multi-Model Forecast	NCEP ^{1,2}	ECCC ¹	ECMWF ^{1,2}	Multi-Model Forecast
WA/OR	?	?	Above normal	?	?	Above normal	Above normal	Above normal	Above normal	Above normal	Above normal	Above normal
Northern CA	?	?	Below normal	?	Above normal	Above normal	?	Above normal	Above normal	?	?	?
Central CA	?	?	Below normal	?	Above normal	?	?	?	Above normal	?	?	?
Southern CA	?	?	Below normal	?	?	?	Below normal	?	?	?	Below normal	?

Higher Confidence | Lower Confidence



- Models lean toward near-normal precipitation over all of CA with some uncertainty during Week 2
- Models lean toward near-normal precipitation over Central and Southern CA with some uncertainty during Weeks 3–4
- Over Northern CA, models lean toward above-normal precipitation during Week 3 and near-normal precipitation during Week 4, with some uncertainty

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](#))

IRI's forecast product has not been updated

Summary

MJO/QBO Conditions

- Strong MJO convection is currently located over the Indian Ocean (Phase 3); 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 2–3 (28 Jan – 10 Feb)
- Models forecast MJO will remain strong in the Indian Ocean (Phase 3) in Week 1 (21–27 Jan) and propagate eastward to the Maritime Continent (Phase 4) with weakening amplitude in Week 2 (28 Jan – 3 Feb)
 - Without considering QBO/ENSO conditions, MJO activity over the Indian Ocean during JFM is associated with a statistically significant decrease in wet extremes in CA at lag times of 2–4 weeks

Week 2 Forecasts (27 Jan – 2 Feb):

- Models agree on near-normal to slightly below-normal AR activity over CA
- Models show uncertainty on the location of ridging activity near the US West Coast

Summary

Week 3 Forecasts (3–9 Feb):

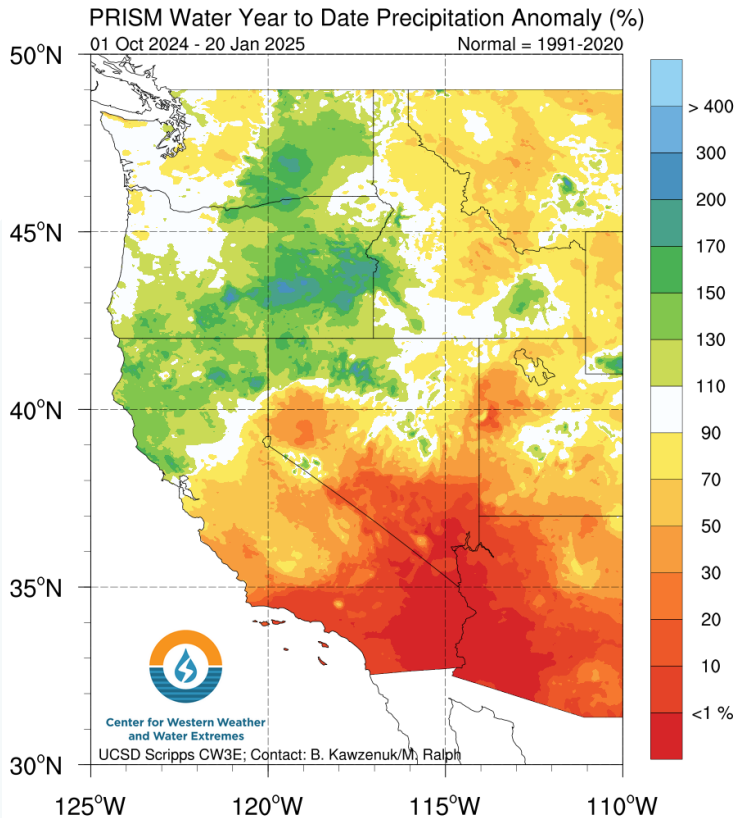
- Models agree on near-normal AR activity over Southern CA
 - NCEP and ECCC are forecasting slightly above-normal AR activity, while ECMWF is forecasting near-normal AR activity over Northern CA
 - Over Central CA, NCEP is forecasting slightly above-normal AR activity, while ECCC and ECMWF are forecasting near-normal AR activity
- Models disagree on the location of ridging activity near the US West Coast during Weeks 3–4
 - ECMWF is forecasting a moderate likelihood of above-normal West-ridge activity and near-normal North- and South-ridge activity
 - NCEP is forecasting above-normal West-ridge activity with low confidence, as well as below-normal North-ridge activity, and near-normal South-ridge activity

Week 4 Forecasts (10–16 Feb):

- Models agree on near-normal AR activity over Southern CA
 - ECCC and ECMWF agree on near-normal AR activity over CA, while NCEP is forecasting slightly above-normal AR activity over Northern and Central CA

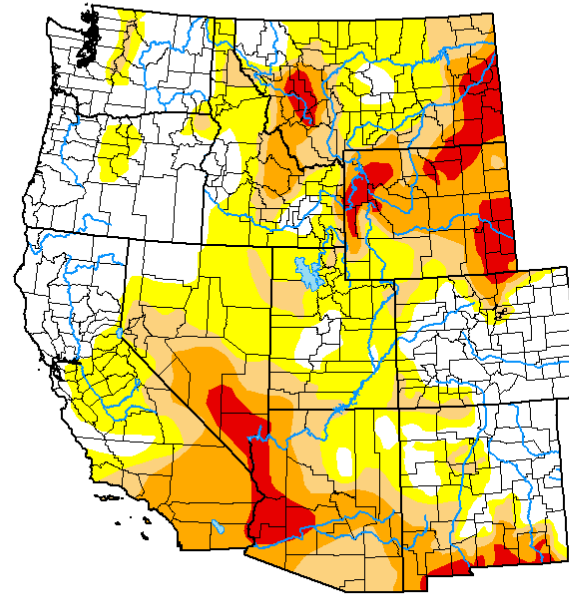
Hydrologic Summary

Precipitation



Drought Conditions

U.S. Drought Monitor West



January 14, 2025

(Released Thursday, Jan. 16, 2025)

Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	32.97	67.03	39.27	23.21	6.87	0.00
Last Week 01-07-2025	32.22	67.78	39.02	20.30	6.87	0.00
3 Months Ago 10-15-2024	12.92	87.08	46.40	18.09	4.53	0.18
Start of Calendar Year 01-07-2025	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 01-16-2024	48.87	51.13	29.11	13.40	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



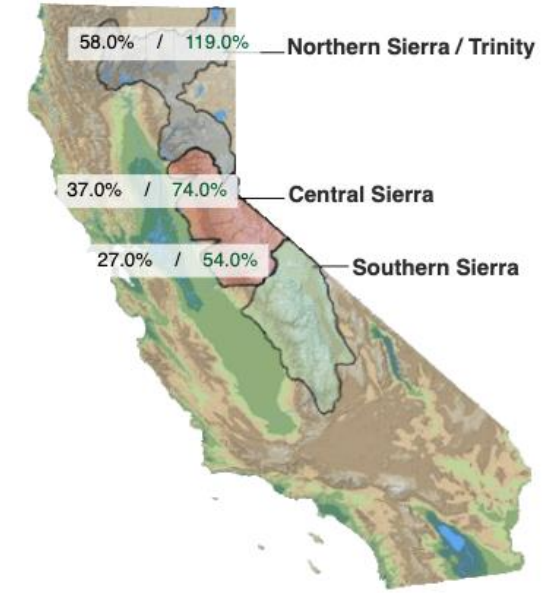
droughtmonitor.unl.edu

Snowpack Conditions

Provided by the California Cooperative Snow Surveys

Data For: 17-Jan-2025

% Apr 1 Avg. / % Normal for this Date



Change Date : 17-Jan-2025

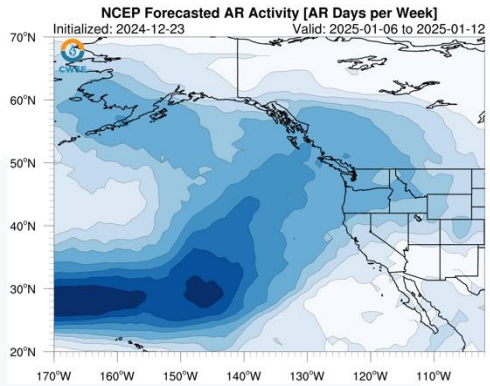
Source: California DWR

- As of 20 Jan 2025, water-year-to-date precipitation is **above normal (> 110% 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) to moderate drought (D1)** over most of Central CA and **Severe Drought (D2)** over Southern CA
- Current snowpack is above-normal (119% of normal) over Northern Sierra Nevada for this time of year, and below-normal in the Central (74% of normal) and Southern Sierra Nevada (54% of normal)

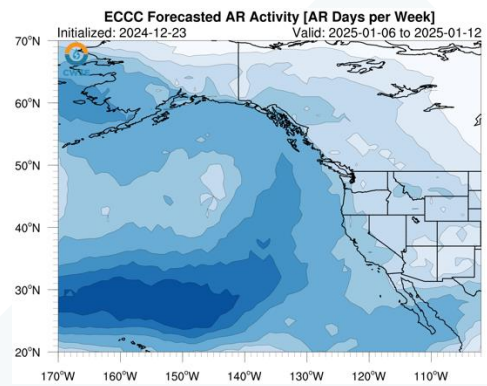
Looking Back: Week 3 AR Activity Forecasts

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

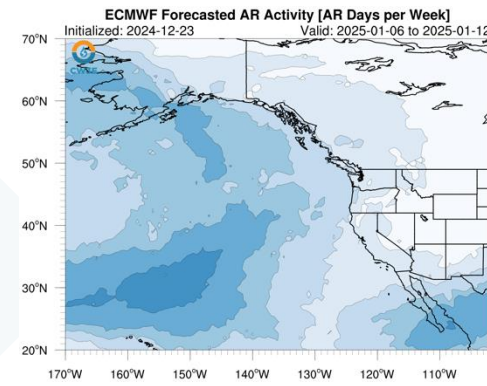
NCEP



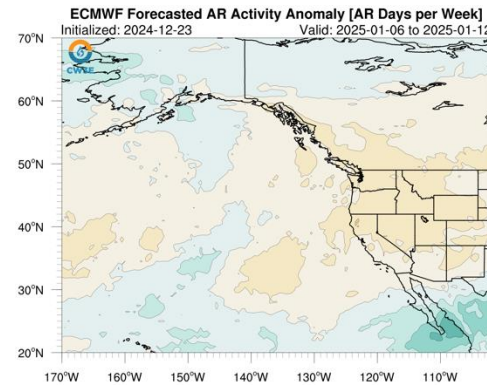
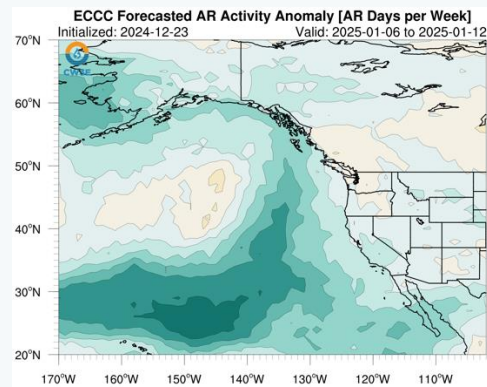
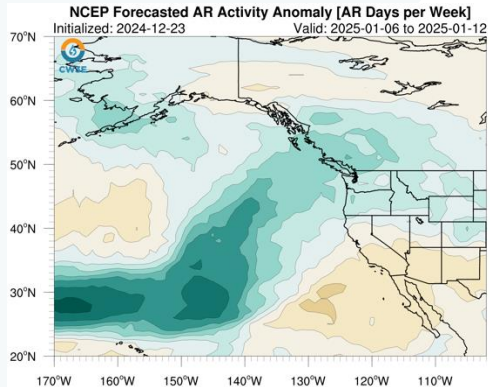
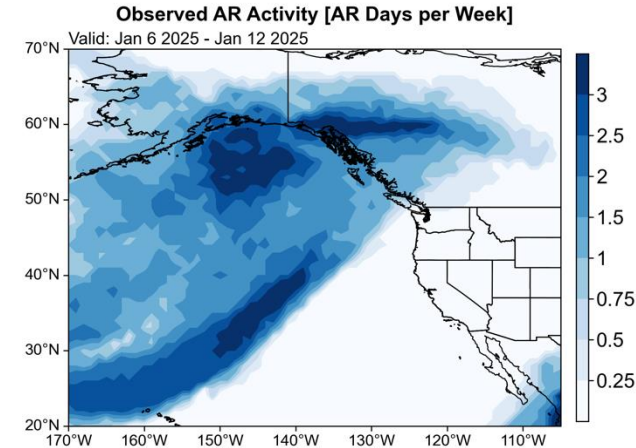
ECCC



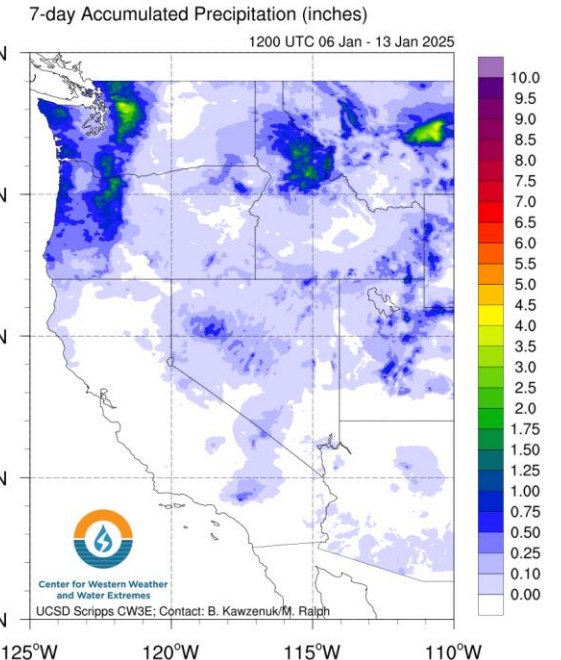
ECMWF



Observed (GFS Analysis)



Observed Precipitation

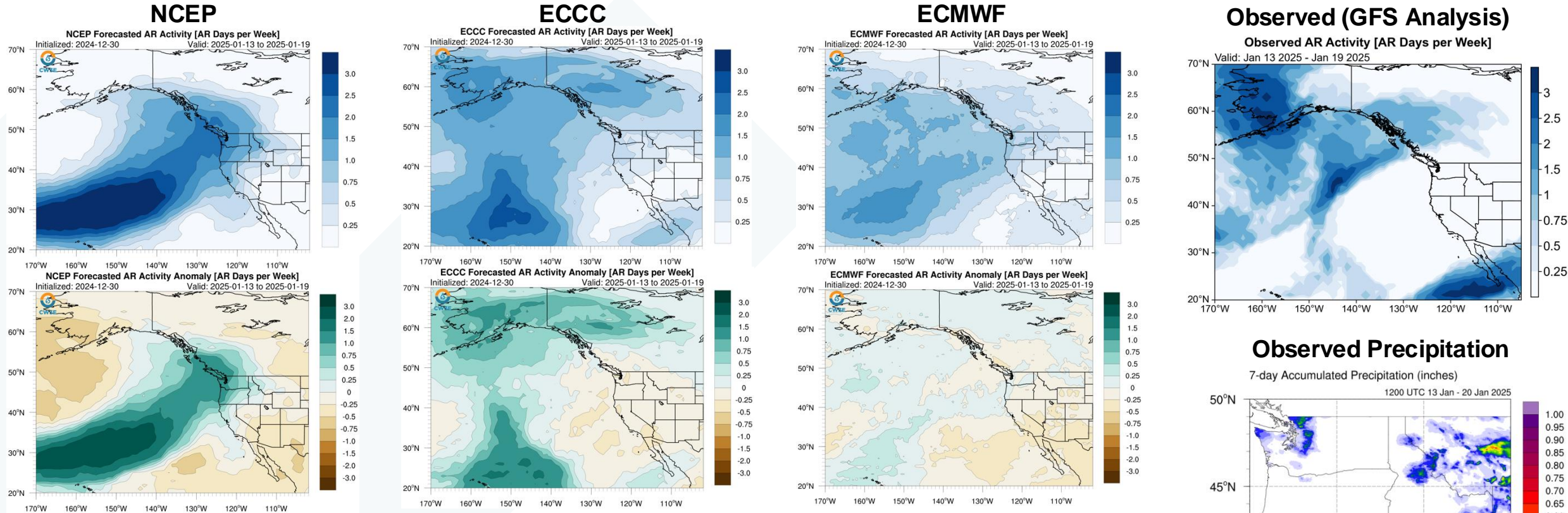


Shading: Fractional # of AR days forecast over a 7-day period (top) and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

- Although models generally predicted the meridional orientation of the AR axis, 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; Light precipitation (< 3 inches) over WA/OR

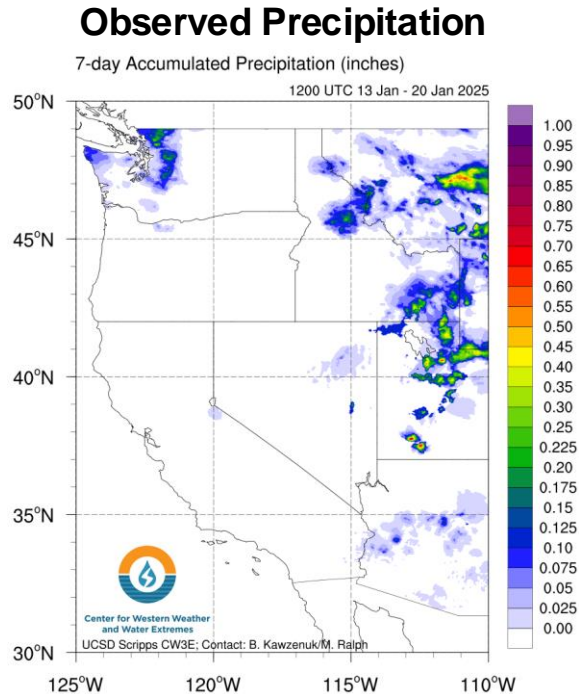
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 30 Dec 2024; Valid: 13–19 Jan 2024

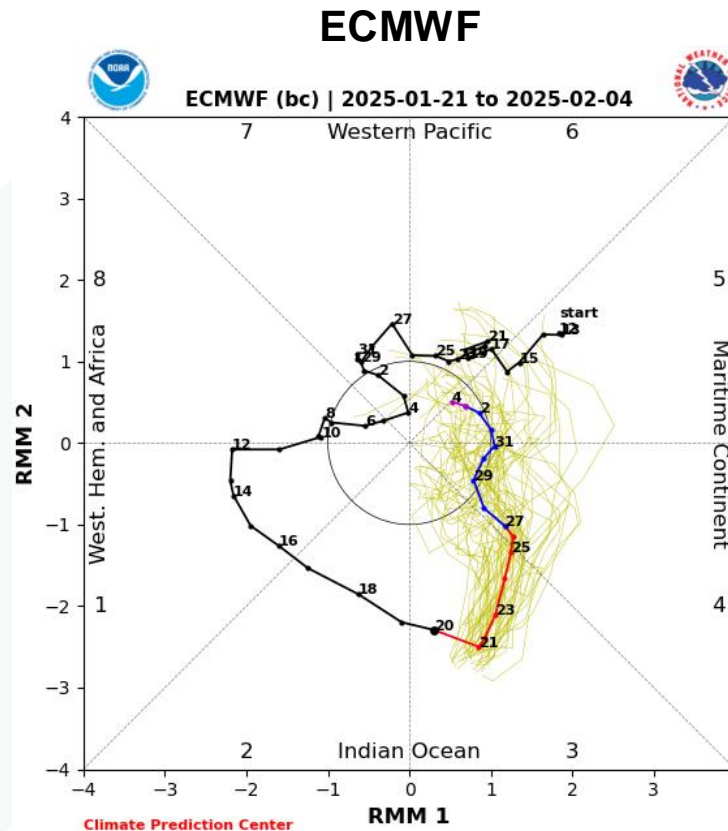
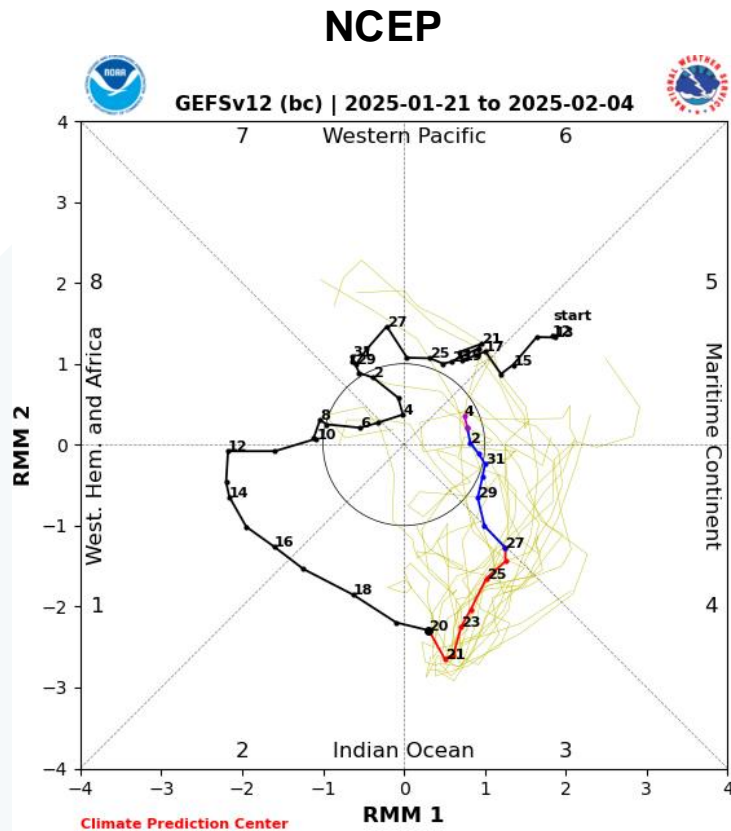


Shading: Fractional # of AR days forecast over a 7-day period (top) and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

- ECCC and ECMWF correctly predicted most of the AR activity to remain offshore, but slightly overestimated AR activity in Northern CA and WA/OR
- NCEP overestimated AR activity over the US West Coast, especially over WA/OR
- Observed AR activity was farther north due to ridging
- No precipitation was observed over CA; Light precipitation (< 1 inch) over the Cascade Range of WA



Dynamical Model MJO Forecasts (NCEP vs. ECMWF)



Black: Last 40 days of observations (12 Dec – 20 Jan); Red: Week 1 (21–27 Jan) ensemble mean; Blue: Week 2 (28 Jan – 3 Feb) ensemble mean; Yellow: Ensemble members

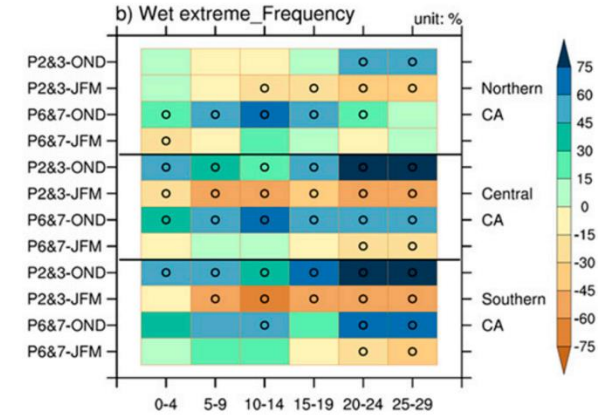


Figure 8 from Wang et al. (2023)

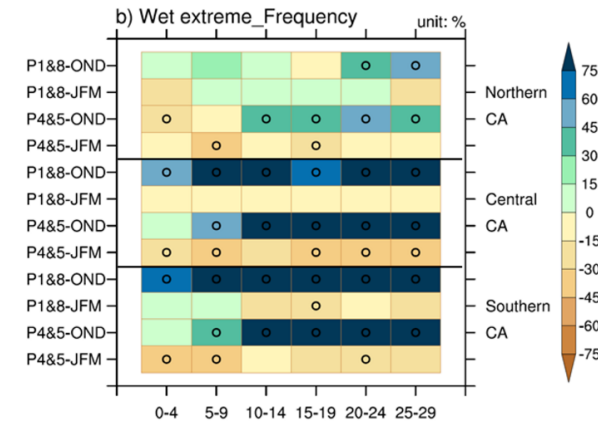


Figure S6 from Wang et al. (2023)

- As of 20 Jan 2025, strong MJO convection was located over the Indian Ocean (Phase 3)
- Models agree on the predicted MJO activity in Weeks 1–2: MJO is forecasted to remain strong and in the Indian Ocean (phases 3) in Week 1 (21–27 Jan) and propagate eastward to the Maritime Continent (phase 4) with weakening amplitude in Week 2 (28 Jan – 3 Feb)
- Without considering QBO/ENSO conditions, MJO activity over the Indian Ocean during JFM is associated with a statistically significant decrease in wet extremes in CA at lag times of 2–4 weeks

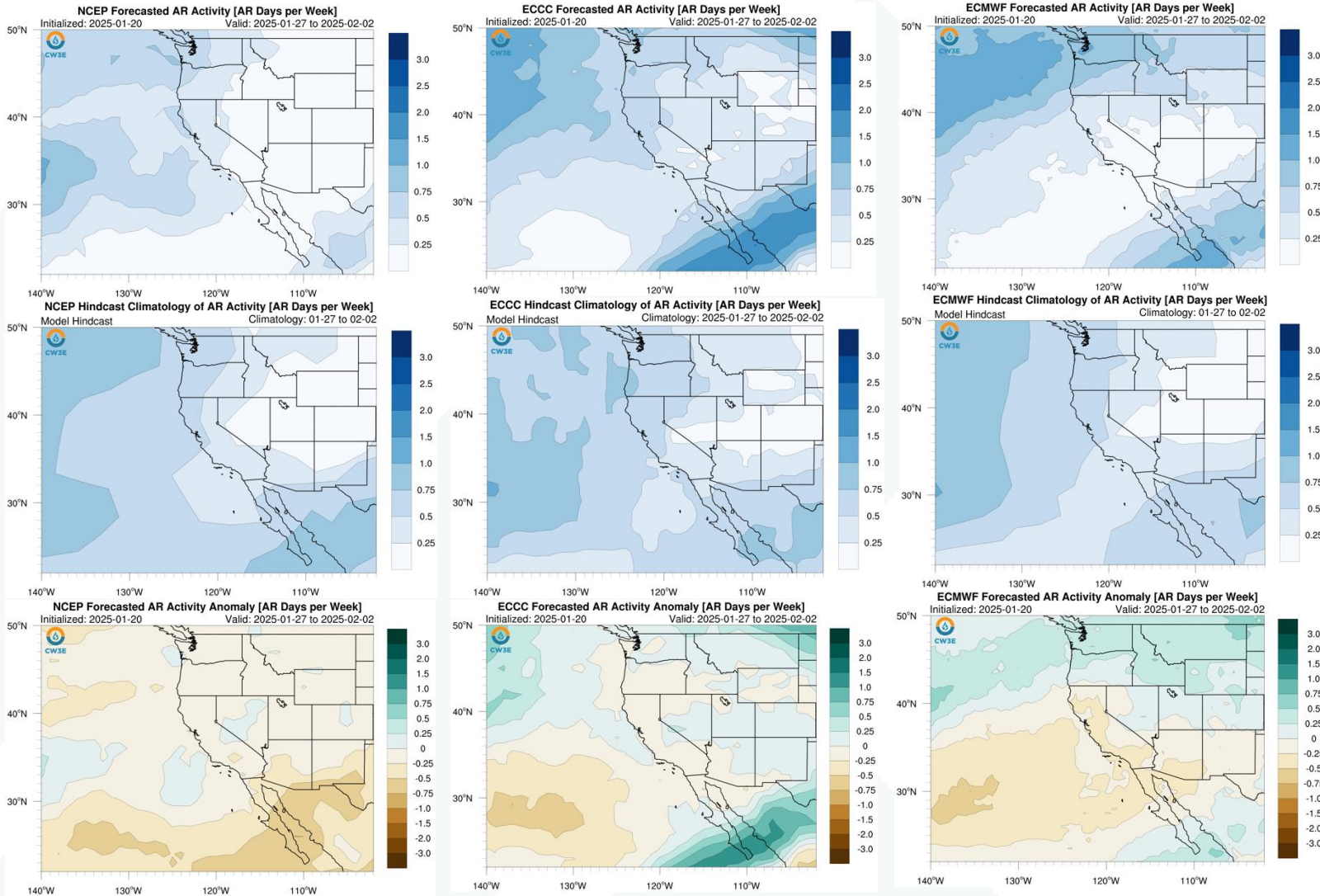
AR Activity Forecasts: Week 2 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 20 Jan 2025

NCEP

ECCC

ECMWF



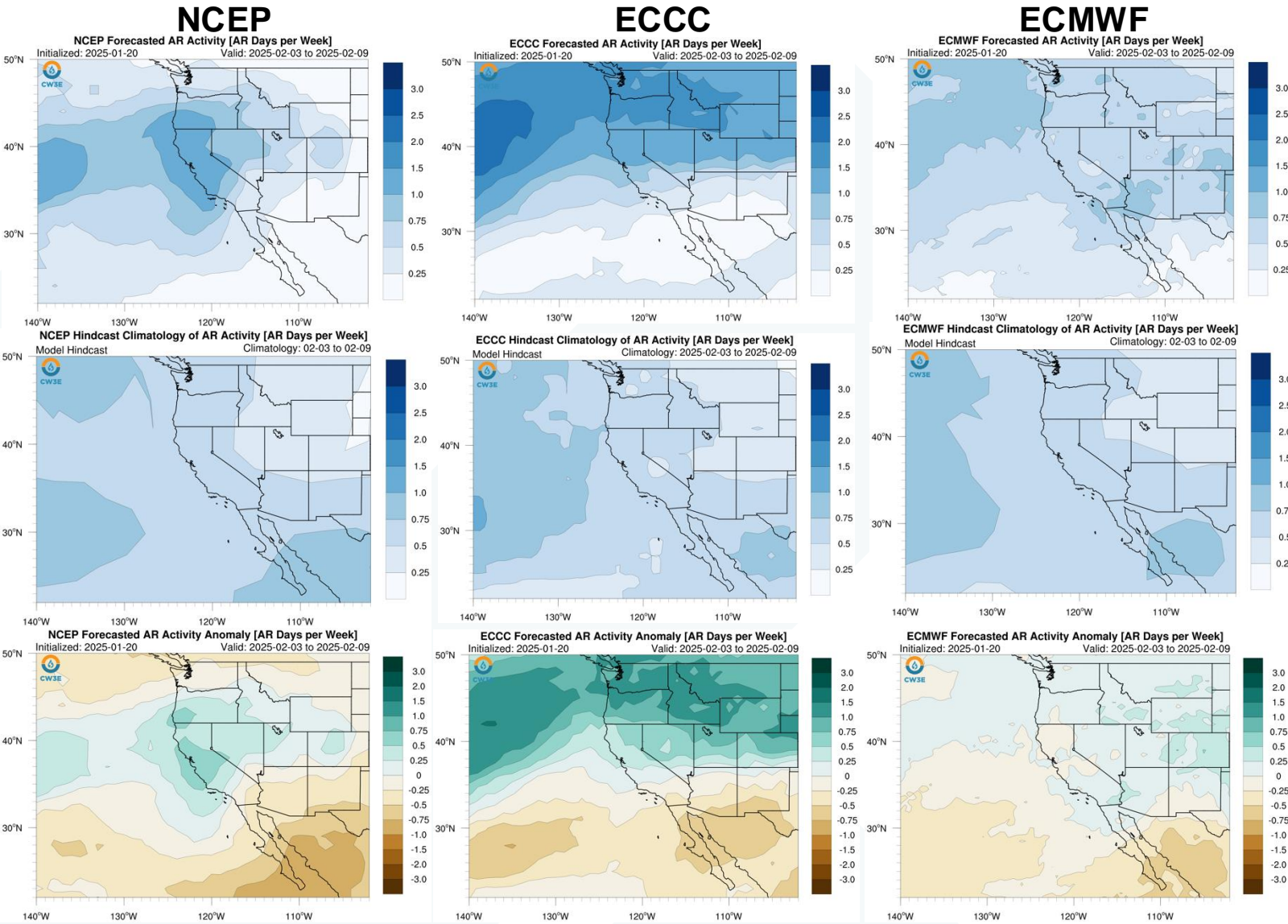
- NCEP and ECCC generally forecast near-normal AR activity over all of CA, while ECMWF is forecasting slightly below-normal AR activity during Week 2 (27 Jan – 2 Feb)

Models generally agree on near-normal to slightly below-normal AR activity over CA during Week 2 (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 3 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 20 Jan 2025



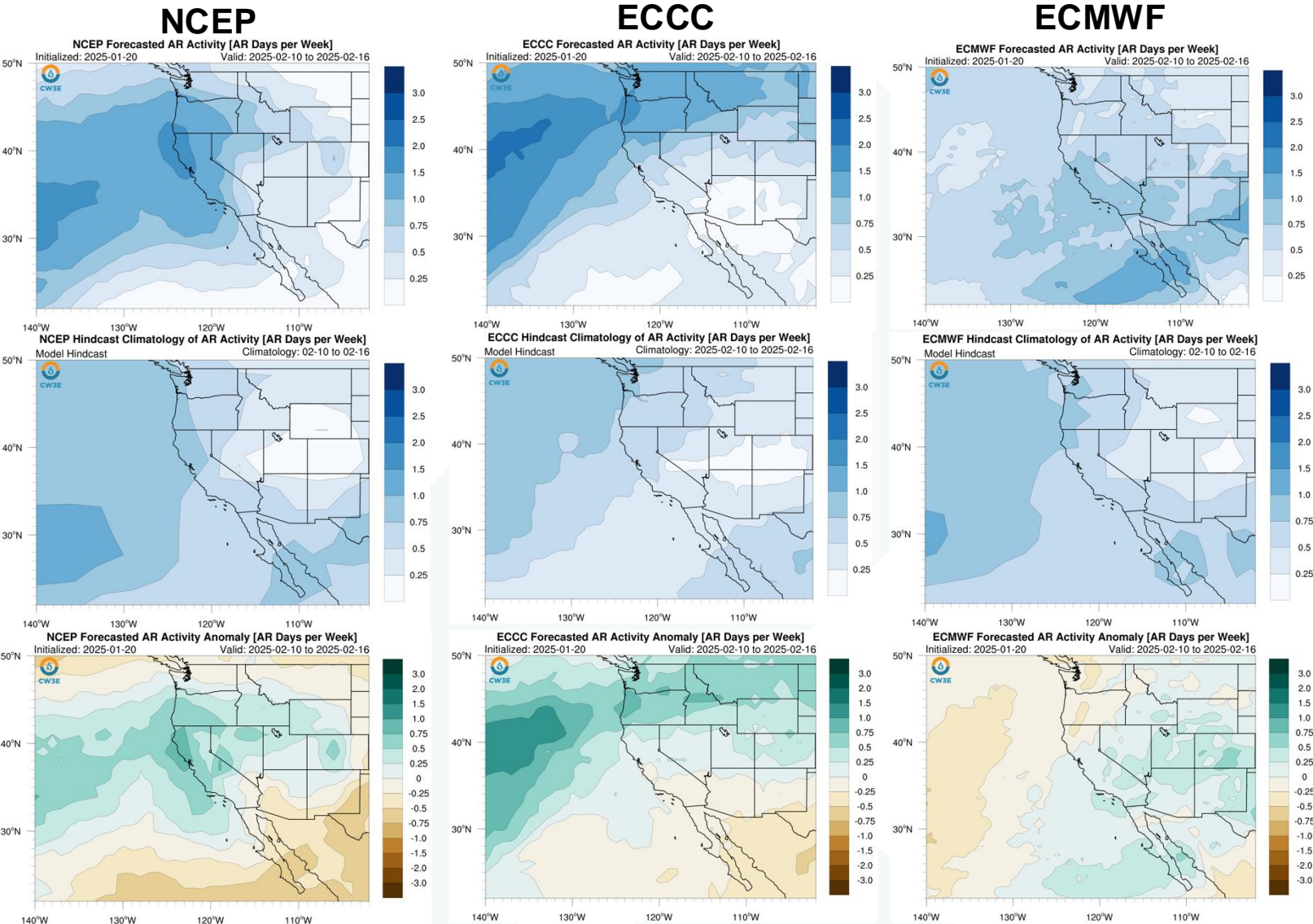
- All models agree on near-normal AR activity over Southern CA during Week 3 (3–9 Feb)
- NCEP and ECCC are forecasting slightly above-normal AR activity, while ECMWF is forecasting near-normal AR activity over Northern CA
- Over Central CA, NCEP is forecasting above-normal AR activity, while ECCC and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

Models agree on near-normal AR activity over Southern CA during Week 3 (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)

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

Forecasts Initialized 20 Jan 2025

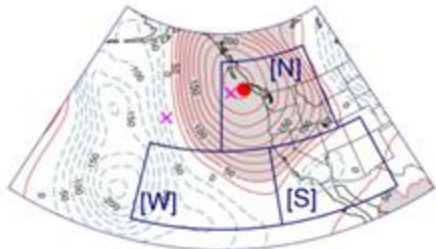


- All models agree on near-normal AR activity over Southern CA during Week 4 (10–16 Feb)
- ECCC and ECMWF agree on near-normal AR activity over Northern and Central CA, while NCEP is forecasting slightly above-normal AR activity

Models agree on near-normal AR activity over Southern CA during Week 4 (10–16 Feb)

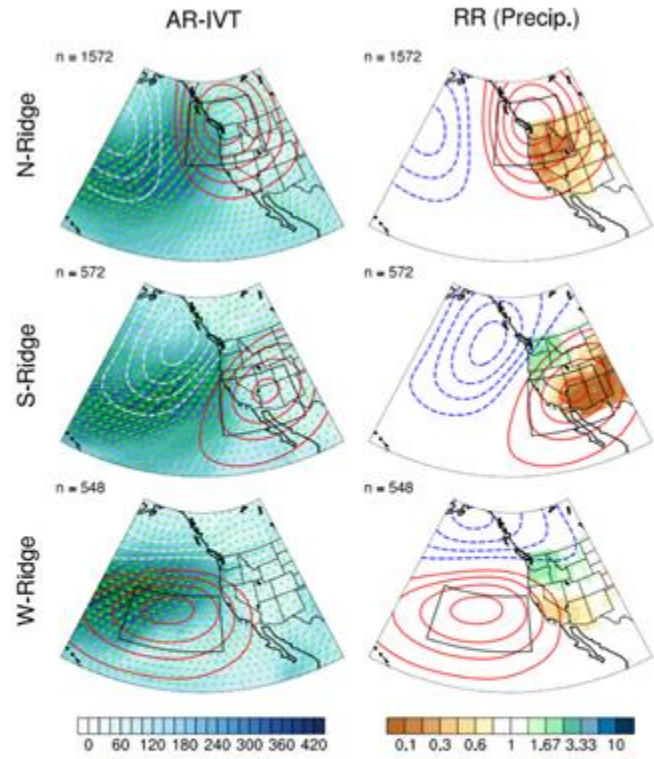
Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

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



- 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



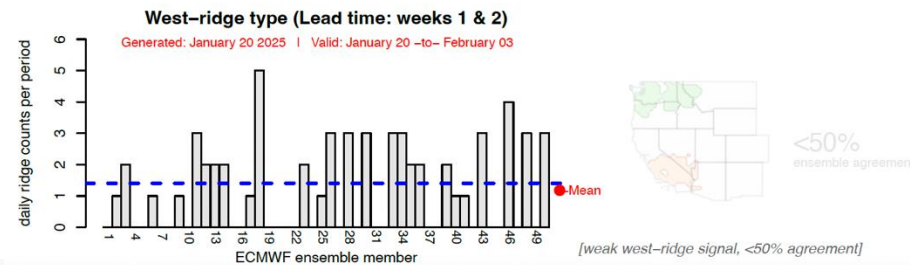
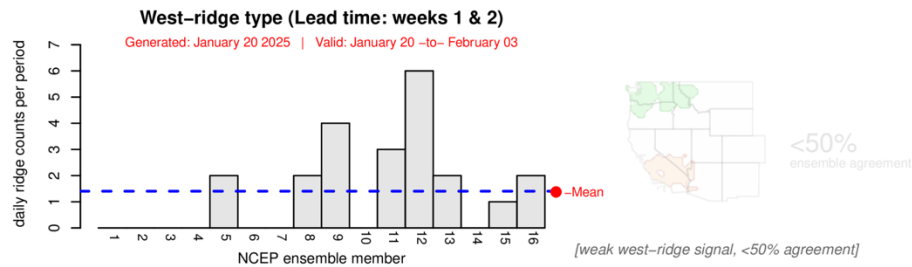
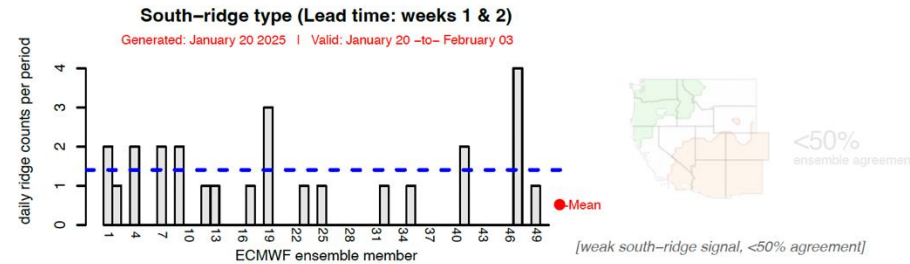
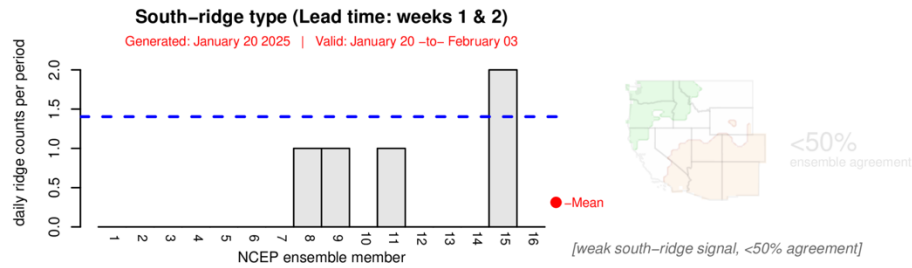
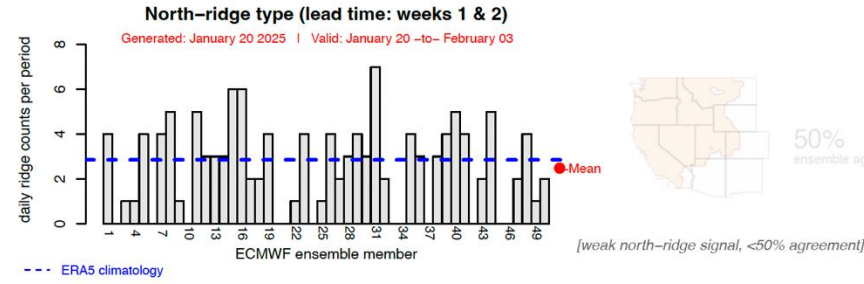
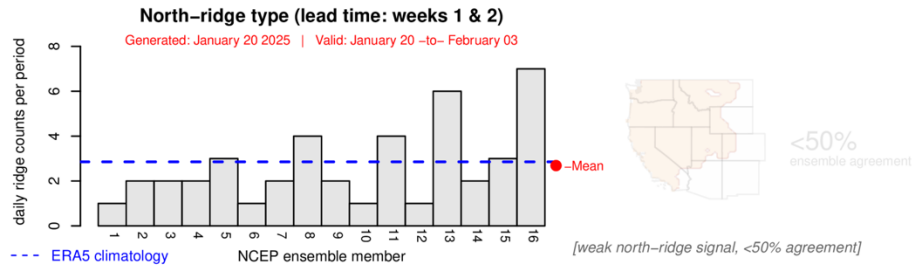
Contact: pgibson@ucsd.edu
Reference: Gibson et al. (2020) Journal of Climate

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

Forecasts Initialized 20 Jan 2025

NCEP

ECMWF



- NCEP and ECMWF are forecasting below-normal activity for South-ridge during Weeks 1–2 (20 Jan – 3 Feb)

- NCEP and ECMWF are forecasting near-normal activity for North- and West-ridge

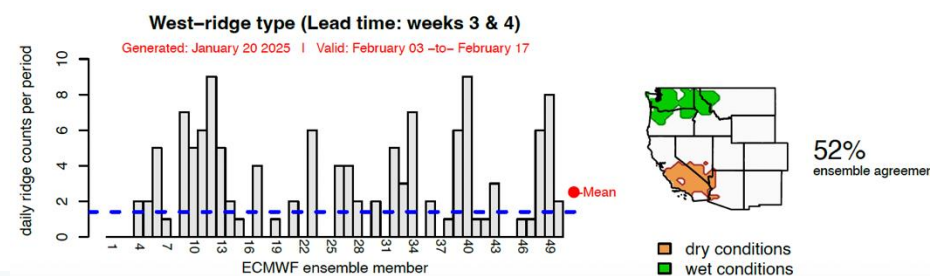
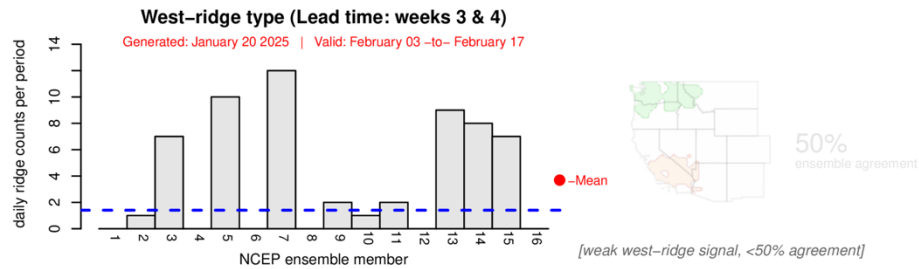
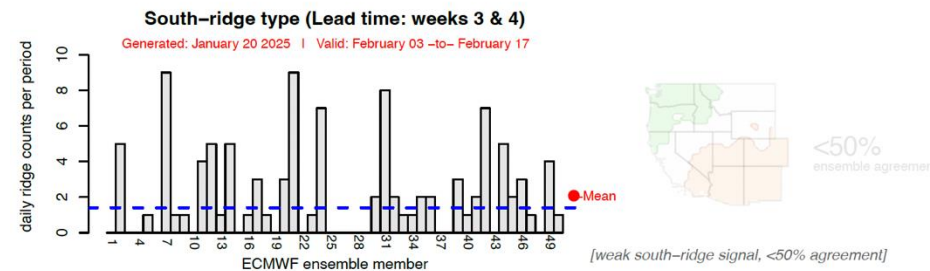
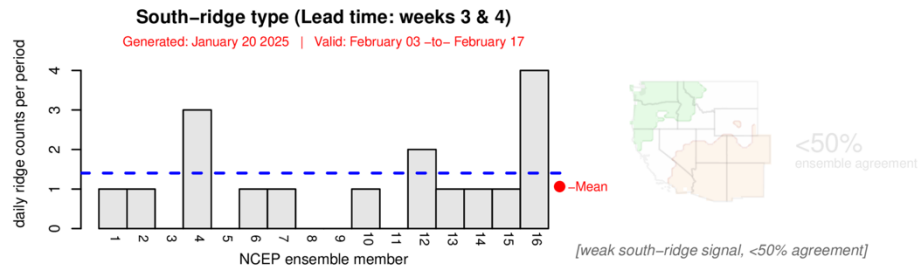
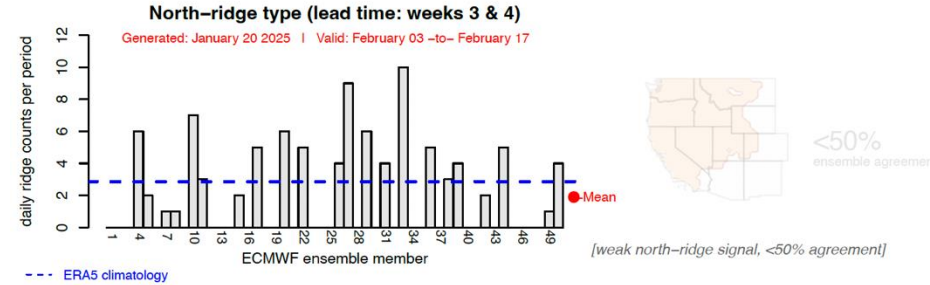
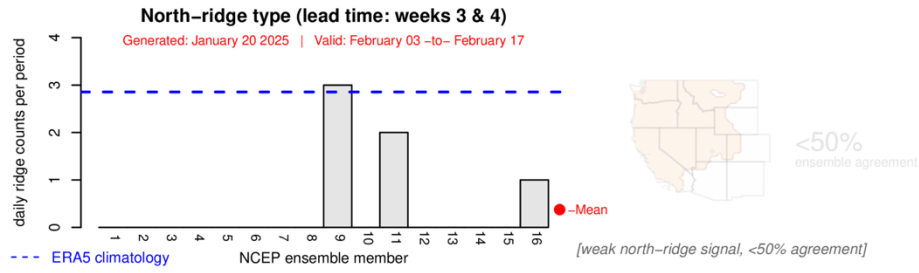
Models show uncertainty on the location of ridging activity near the US West Coast during Weeks 1–2 (20 Jan – 3 Feb)

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

Forecasts Initialized 20 Jan 2025

NCEP

ECMWF

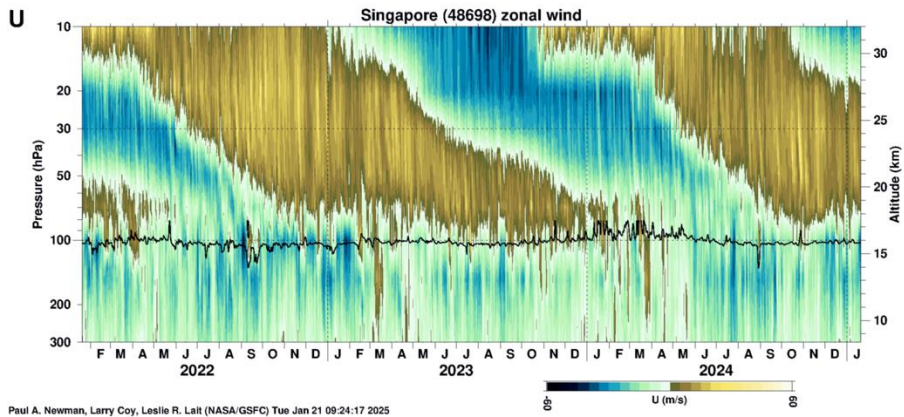


- ECMWF is forecasting a moderate likelihood (52% ensemble agreement) of above-normal West-ridge activity during Weeks 3–4 (3–17 Feb)
- NCEP is also forecasting above-normal West-ridge activity, but with low confidence (< 50% ensemble agreement)
- ECMWF is forecasting near-normal North- and South-ridge activity, while NCEP is forecasting very low North-ridge activity and near-normal South-ridge activity

Models disagree on the location of ridging activity near the US West Coast during Weeks 3–4 (3–17 Feb)

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

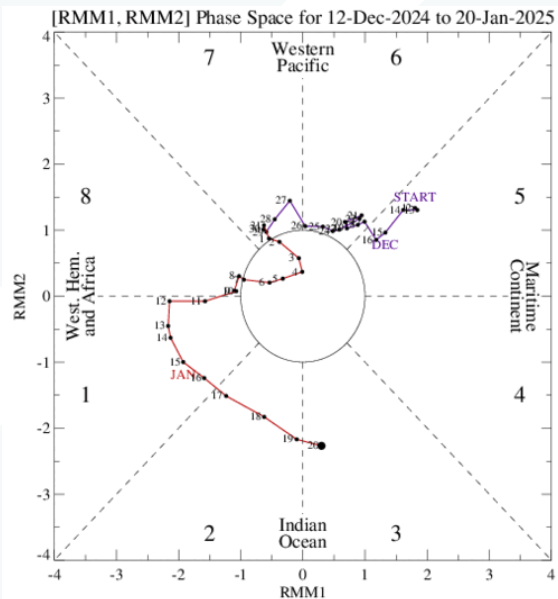
QBO Conditions



Paul A. Newman, Larry Coy, Leslie R. Lait (NASA/GSFC) Tue Jan 21 09:24:17 2025

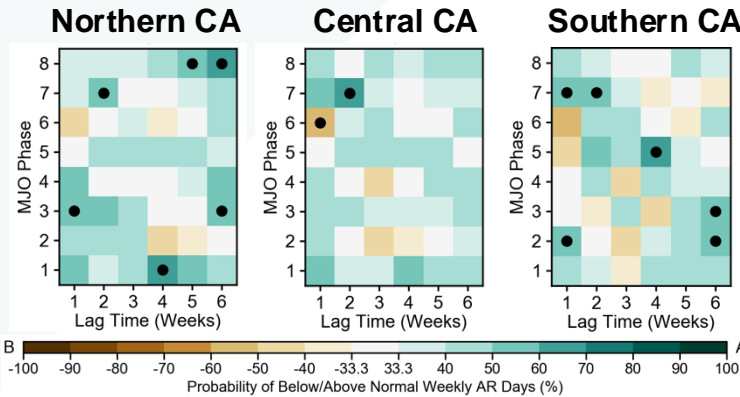
QBO is in the westerly phase at 50-hPa

MJO Conditions

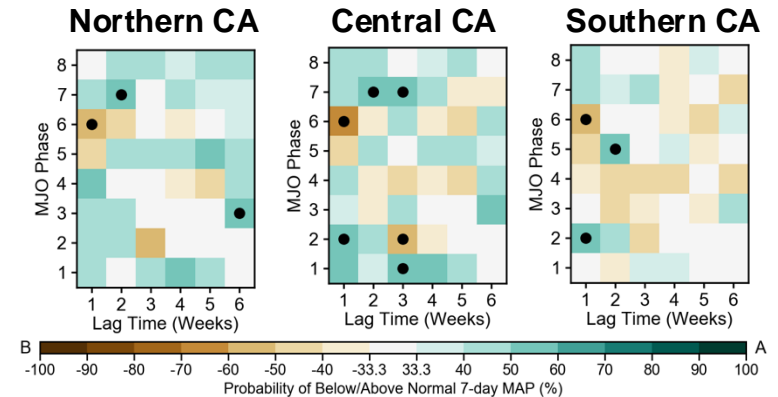


MJO convection is currently located over the Indian Ocean (Phase 3)

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



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

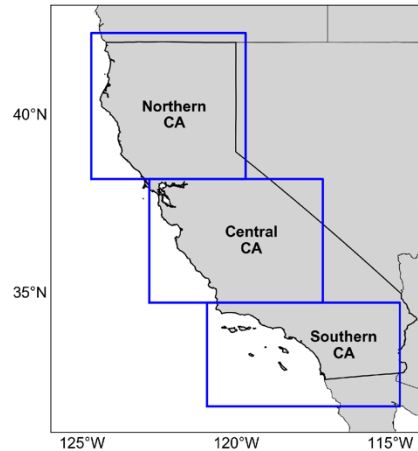
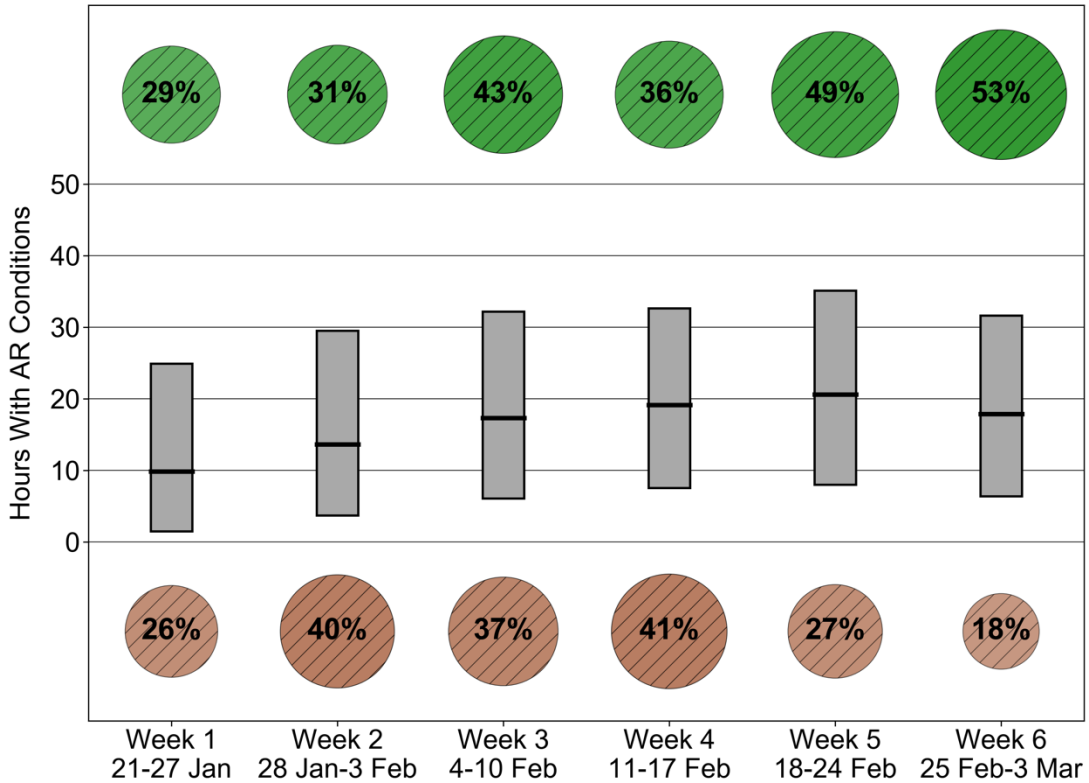


Probability matrices illustrating the weeks 1–6 lagged probability of below-normal (brown shading) or above-normal (green shading) AR occurrence and precipitation for all MJO phases when the QBO is in the westerly phase during JFM in Northern CA (left), Central CA (middle), and Southern CA (right). White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

Southern CA Subseasonal AR Occurrence Outlook
Issued: 20 Jan 2025 MJO Phase 3 WQBO



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



Forecasts Initialized 20 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 2–6 (24 Jan – 27 Feb)
- Moderate likelihood (> 40% probability) of above-normal AR occurrence in Central CA during Weeks 2 and 6
- **Moderate likelihood (> 40% probability) of above-normal AR occurrence in Southern CA during Weeks 3, 5, and 6**

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. \(2023\)](#)

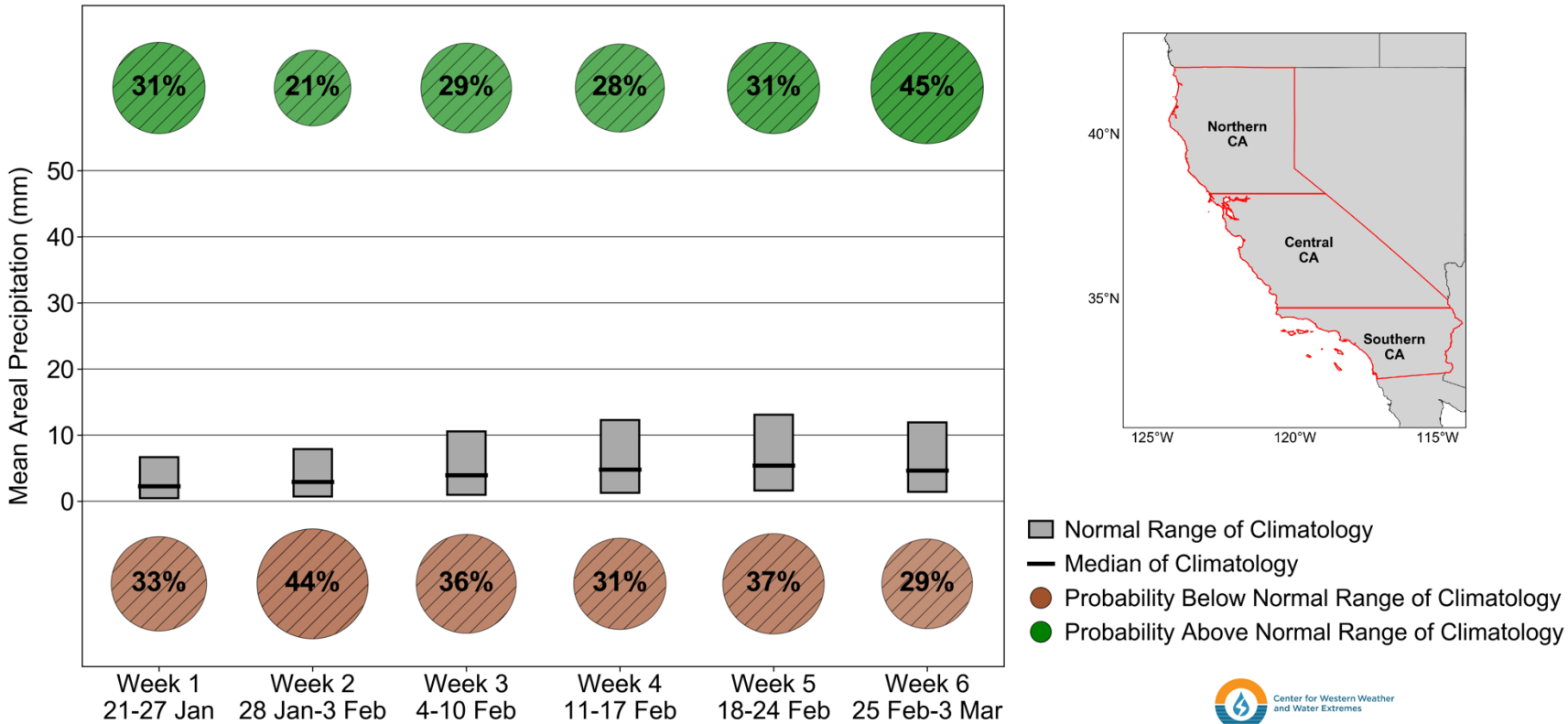


AR Activity and Precipitation Based on MJO and QBO

Forecasts Initialized 20 Jan 2024

Precipitation: Southern CA

Southern CA Subseasonal Precipitation Outlook
Issued: 20 Jan 2025 MJO Phase 3 WQBO



- CW3E's probabilistic precipitation forecast based on current MJO and QBO conditions (see forecast for all regions [here](#))
- Moderate likelihood (> 40% probability) of above-normal precipitation in Northern CA during Weeks 2 and 6
- Moderate likelihood of above-normal precipitation in Central CA during Weeks 3 and 6
- **Moderate likelihood of above-normal precipitation in Southern CA during Week 6**



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*