



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E Subseasonal Outlook: 4 February 2025

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UC San Diego



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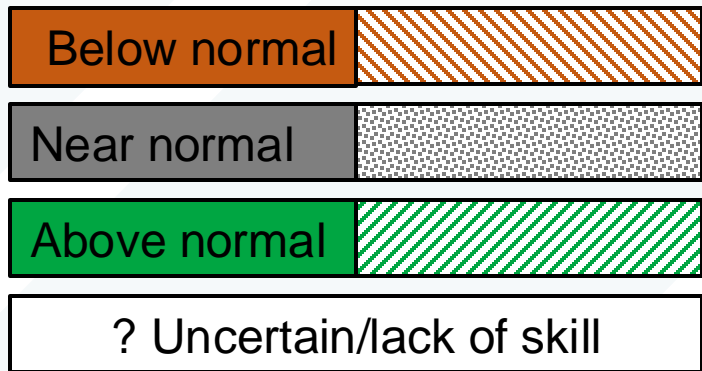
Summary: Subseasonal Precipitation Outlook by Model

This slide shows the CW3E synthesis of subseasonal products by model

Forecasts Initialized 3 Feb 2025

Region	Week 2 (10–16 Feb)				Week 3 (17–23 Feb)				Week 4 (24 Feb–2 Mar)			
	NCEP ^{1,2,3}	ECMWF ^{1,2}	ECMWF ^{1,2}	Multi-Model Forecast	NCEP ^{1,2,3}	ECMWF ^{1,2}	ECMWF ^{1,2}	Multi-Model Forecast	NCEP ^{1,2,3}	ECMWF ^{1,2}	ECMWF ^{1,2}	Multi-Model Forecast
WA/OR	Diagonal Green	Diagonal Orange				Diagonal Green				Solid Green		
Northern CA		Diagonal Orange				Diagonal Green				Solid Green		
Central CA		Stippled				Diagonal Green				Diagonal Green		
Southern CA		Diagonal Green	Solid Orange		Diagonal Orange	Diagonal Green			Diagonal Orange	Diagonal Green		

Higher Confidence | Lower Confidence



- High degree of uncertainty in precipitation over all of CA during Weeks 2–4 due to disagreement among models and forecast products

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 Western Pacific (Phase 6); QBO is in the westerly phase
 - Without considering QBO/ENSO conditions, MJO activity over the Western Pacific during JFM is associated with statistically significant decreases in wet extremes over Central and Southern CA at lag times of 3–4 weeks
- Models disagree on the propagation and amplitude of MJO forecasts in Weeks 1-2
 - NCEP is forecasting MJO convection to remain strong over the Western Pacific during Week 1, while ECMWF suggests some westward retreatment to the Maritime Continent (Phase 5)
 - NCEP forecasts strong MJO convection to propagate eastward across the Western Pacific in Week 2, while ECMWF suggests the MJO will weaken

Week 2 Forecasts (10–16 Feb):

- Models disagree on AR activity in CA during Week 2
 - NCEP is forecasting slightly above-normal AR activity over Northern and Southern CA and above-normal AR activity over Central CA
 - ECCO is forecasting slightly below-normal AR activity over Northern CA, near-normal AR activity over Central CA, and slightly above-normal AR activity over Southern CA
 - ECMWF is forecasting near-normal AR activity over Northern and Central CA, and slightly below-normal AR activity over Southern CA
- Ridging outlooks show very high likelihood of above-normal South-ridge activity (dry conditions over Southern CA) during Weeks 1–2
 - NCEP is also forecasting a high likelihood of above-normal West-ridge activity (dry conditions over Central and Southern CA)
- IRI weather regime tool shows high likelihood of Pacific Ridge (near-normal precipitation in CA) during Week 2

Summary

Week 3 Forecasts (17–23 Feb):

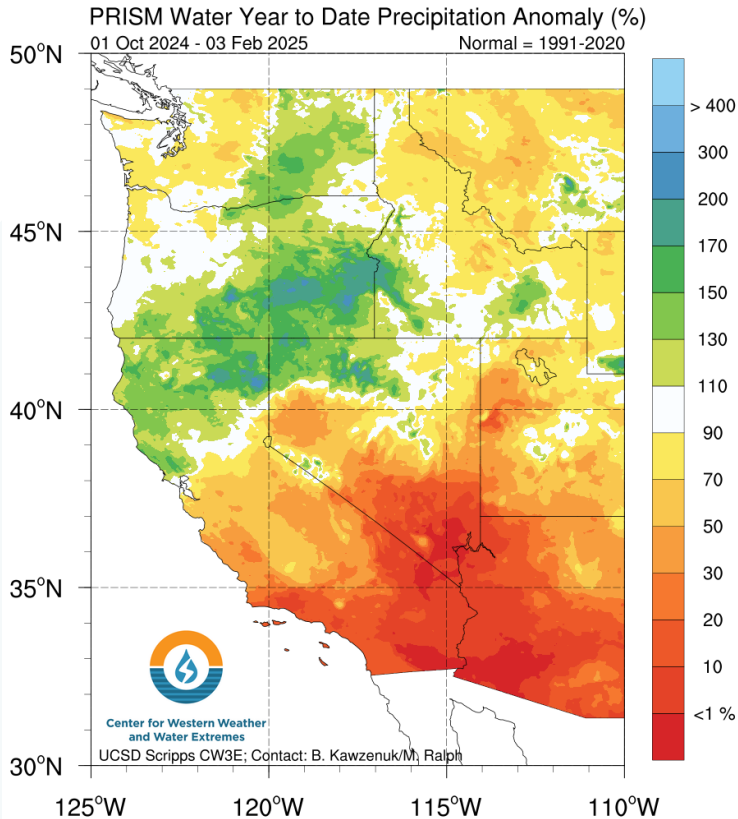
- NCEP and ECMWF agree on near-normal AR activity over all of CA during Week 3, but ECCC is forecasting above-normal AR activity in CA
- Ridging outlooks show moderate likelihood of above-normal South-ridge activity (dry conditions over Southern CA) during Weeks 3–4
 - NCEP is also forecasting a high likelihood of above-normal West-ridge activity (dry conditions over Central and Southern CA)
- IRI weather regime tool shows low-to-moderate likelihood of West Coast Ridge (below-normal precipitation in CA) during most of Weeks 3-4

Week 4 Forecasts (24 Feb–2 Mar):

- NCEP and ECMWF agree on near-normal AR activity over all of CA during Week 4, but ECCC is forecasting above-normal AR activity over Northern and Central CA, and slightly above-normal AR activity over Southern CA

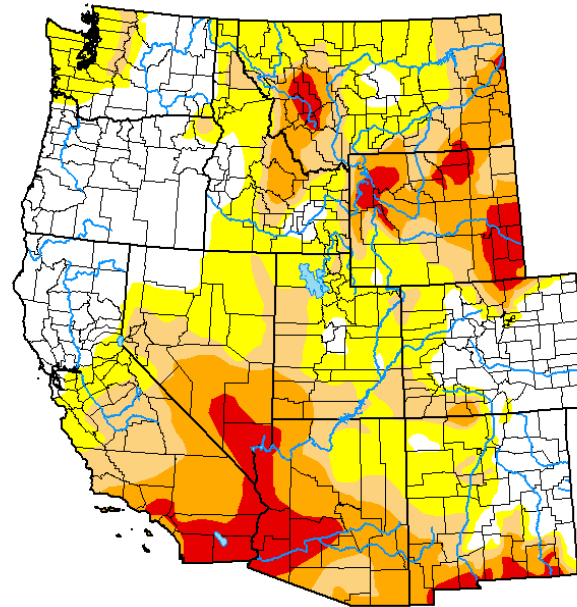
Hydrologic Summary

Precipitation



Drought Conditions

U.S. Drought Monitor West



January 28, 2025

(Released Thursday, Jan. 30, 2025)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	27.83	72.17	44.16	25.13	7.66	0.00
Last Week 01-21-2025	31.69	68.31	39.66	23.93	8.50	0.00
3 Months Ago 10-29-2024	15.18	84.82	44.14	18.52	5.01	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 01-30-2024	48.00	52.00	29.27	13.77	3.31	0.57

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:

Brian Fuchs
National Drought Mitigation Center



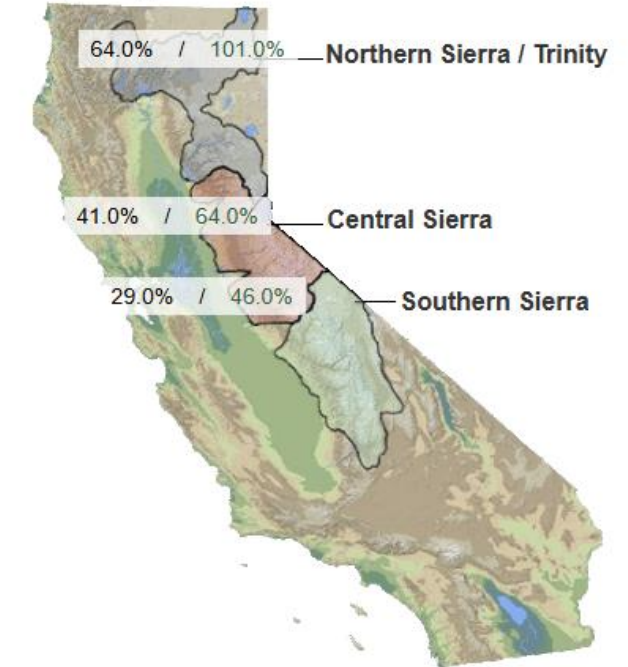
droughtmonitor.unl.edu

Snowpack Conditions

Provided by the California Cooperative Snow Surveys

Data For: 03-Feb-2025

% Apr 1 Avg. / % Normal for this Date

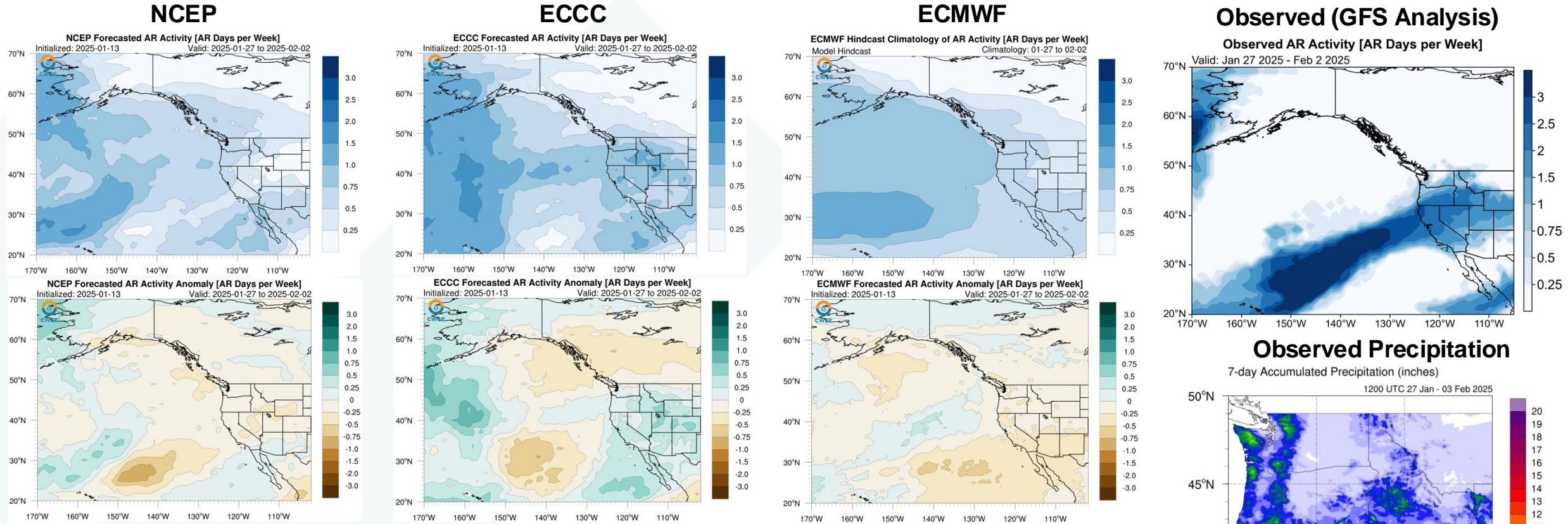


Source: California DWR

- As of 3 Feb, water-year-to-date precipitation is **near-to-above normal (>90% of normal)** in Northern CA, **below-normal (30–70% of normal)** in Central CA, and **well-below normal (<20% of normal)** in Southern CA
- The most recent drought monitor update is showing **severe-to-extreme drought (D2–D3)** in Southern CA and **abnormally dry (D0)-to-moderate drought (D1)** in Central CA
- Current snowpack is **<65% of normal** for this time of year in the Southern and Central Sierra Nevada and **near normal (101% of normal)** in the Northern Sierra/Trinity region

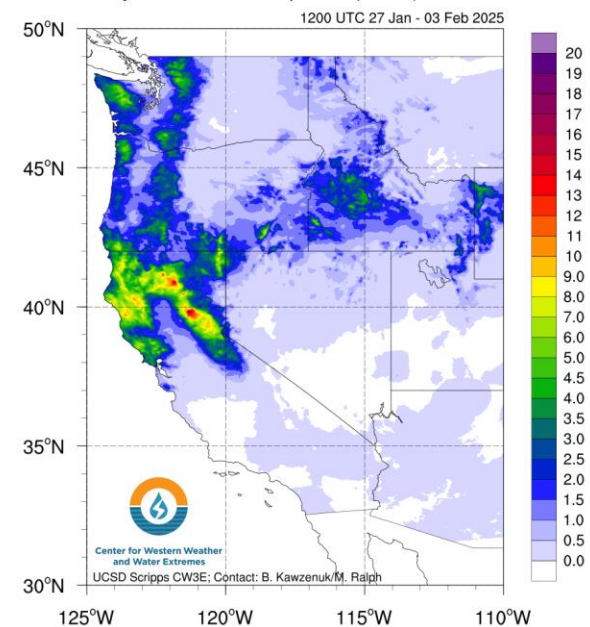
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 13 Jan 2025; Valid: 27 Jan–2 Feb 2025



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 correctly predicted the AR activity over CA and OR, although with underestimation of the magnitude
- All models predicted main AR activity too offshore, especially in NCEP and ECMWF
- The wet conditions over the US West Coast during this period was suggested in [early January forecasts](#)
- Two ARs produced heavy precipitation (>7 inches) over Northern CA and moderate precipitation (3-7 inches) over coastal WA/OR during 31 Jan–3 Feb



Dynamical Model MJO Forecasts (NCEP vs. ECMWF)

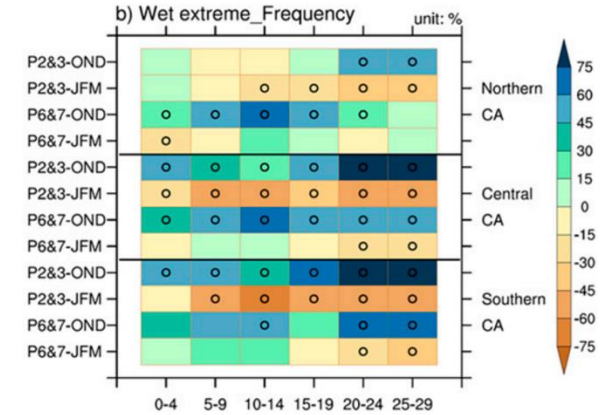
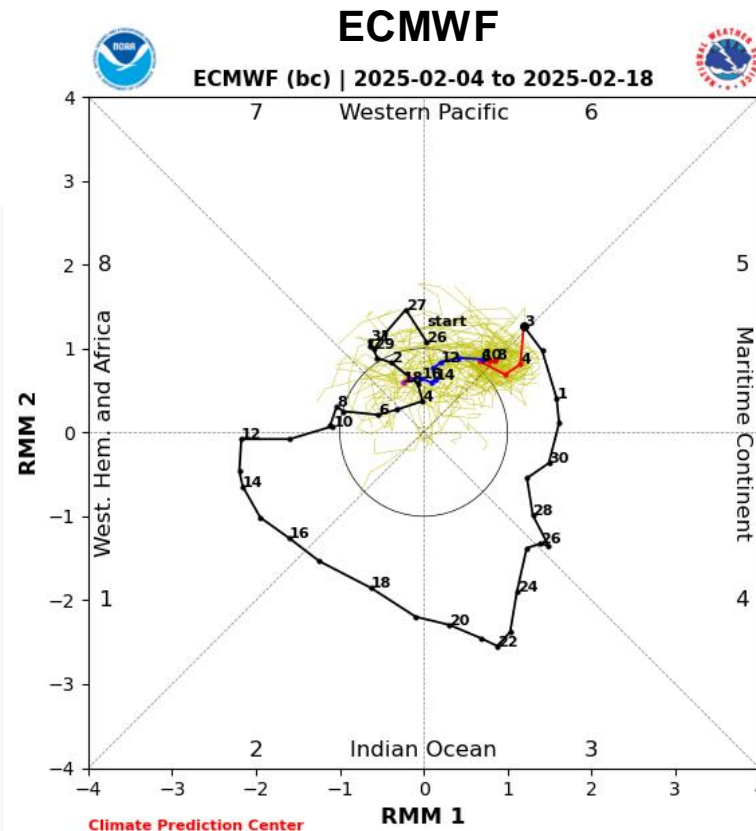
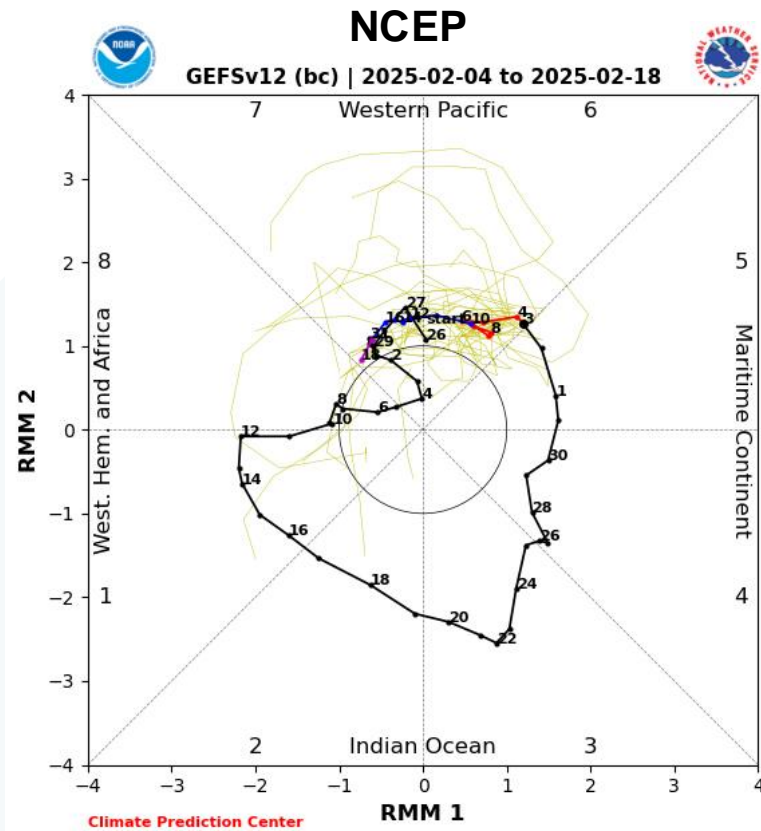


Figure 8 from Wang et al. (2023)

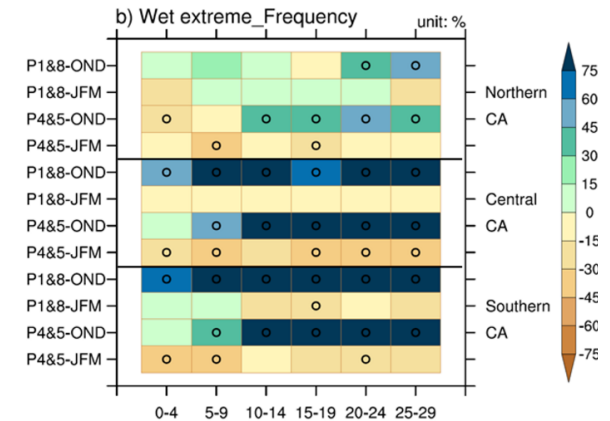


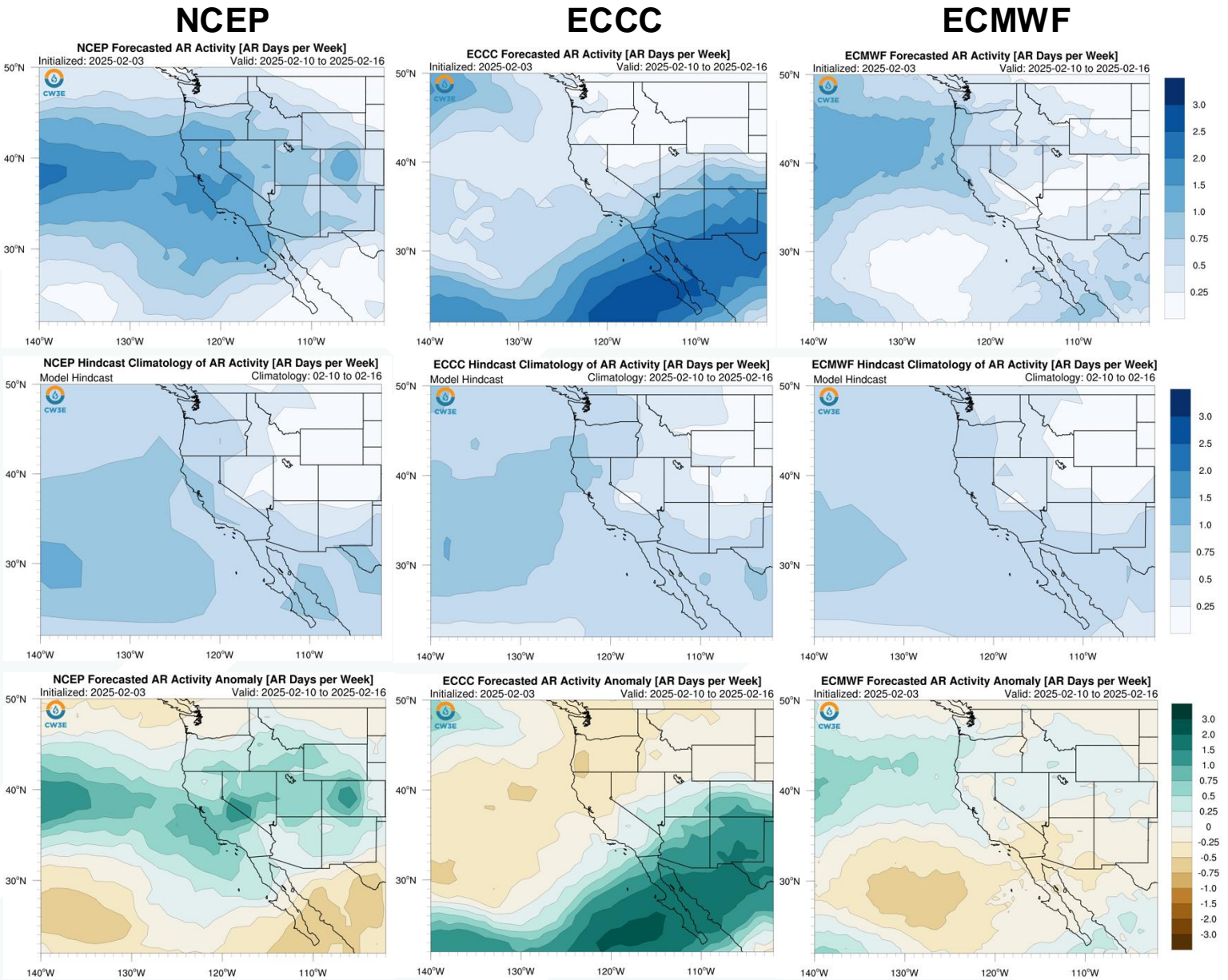
Figure S6 from Wang et al. (2023)

Black: Last 40 days of observations (26 Dec – 3 Feb); Red: Week 1 (4–10 Feb) ensemble mean; Blue: Week 2 (11–17 Feb) ensemble mean; Yellow: Ensemble members

- Strong MJO convection is currently located over the Western Pacific (Phase 6)
- There is large uncertainty in Weeks 1-2 MJO forecasts
- NCEP is forecasting MJO convection to remain strong over the Western Pacific during Week 1, while ECMWF suggests some westward retreatment to the Maritime Continent (Phase 5)
- NCEP forecasts strong MJO convection to propagate eastward across the Western Pacific in Week 2, while ECMWF suggests the MJO will weaken
- Without considering QBO/ENSO conditions, MJO activity over the Western Pacific during JFM is associated with statistically significant decreases in wet extremes over Central and Southern CA at lag times of 3–4 weeks

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

Forecasts Initialized 3 Feb 2025



- NCEP is forecasting slightly above-normal AR activity over Northern and Southern CA and above-normal AR activity over Central CA during Week 2 (10-16 Feb)
- ECCC is forecasting slightly below-normal AR activity over Northern CA, near-normal AR activity over Central CA, and slightly above-normal AR activity over Southern CA
- ECMWF is forecasting near-normal AR activity over Northern and Central CA, and slightly below-normal AR activity over Southern CA

Models disagree on Week 2 (10–16 Feb) AR activity forecasts over 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)

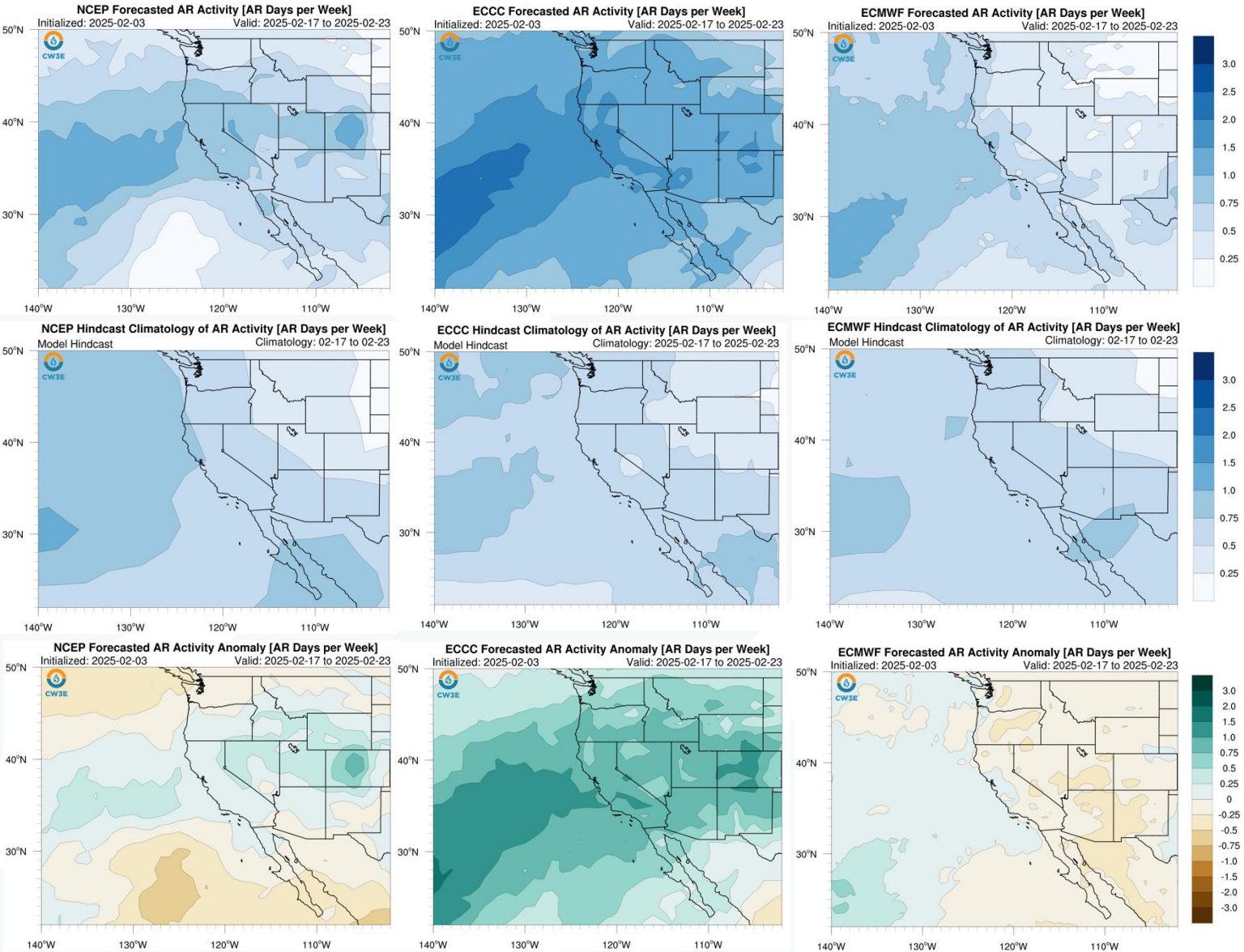
AR Activity Forecasts: Week 3 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 3 Feb 2025

NCEP

ECCC

ECMWF



- NCEP and ECMWF are forecasting near-normal AR activity over all of CA during Week 3 (17–23 Feb)
- ECCC is forecasting above-normal AR activity over all of CA

NCEP and ECMWF agree on near-normal activity in CA during Week 3 (17–23 Feb); ECCC differs

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)

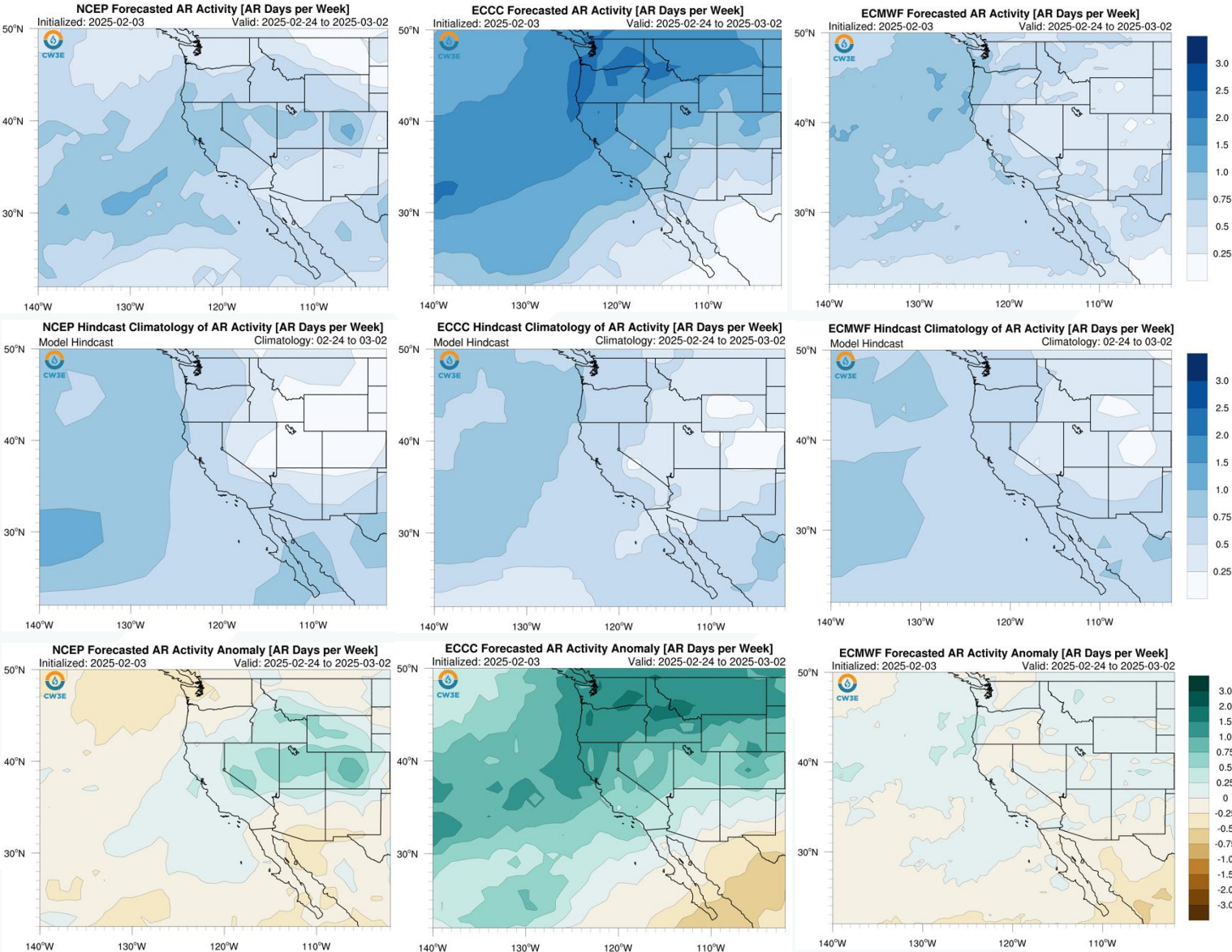
AR Activity Forecasts: Week 4 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 3 Feb 2025

NCEP

ECCC

ECMWF

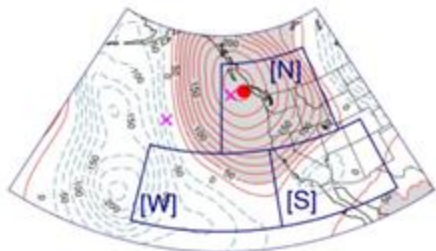


- NCEP and ECMWF are forecasting near-normal AR activity over all of CA during Week 4 (24 Feb–2 Mar)
- ECCC is forecasting above-normal AR activity over Northern and Central CA, and slightly above-normal AR activity over Southern CA

NCEP and ECMWF generally agree on near-normal activity in CA during Week 4 (24 Feb–2 Mar); ECCC differs

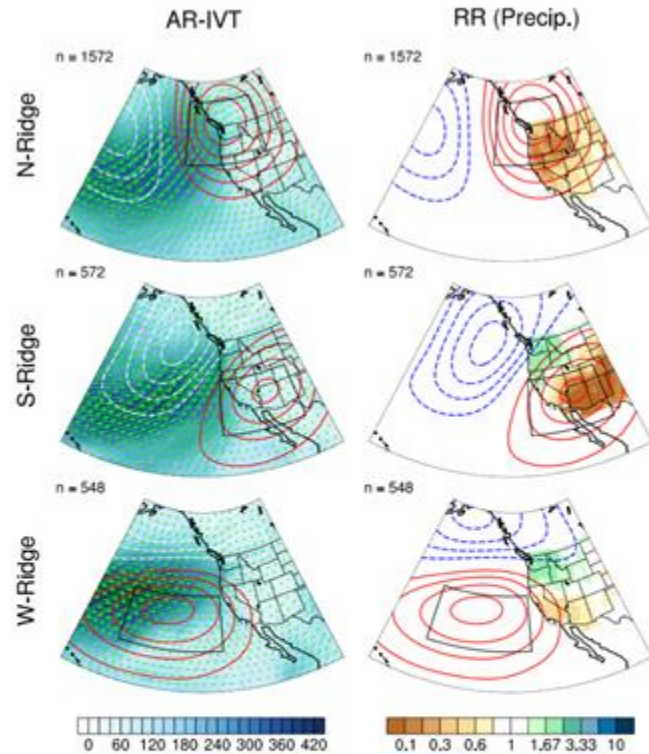
Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

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



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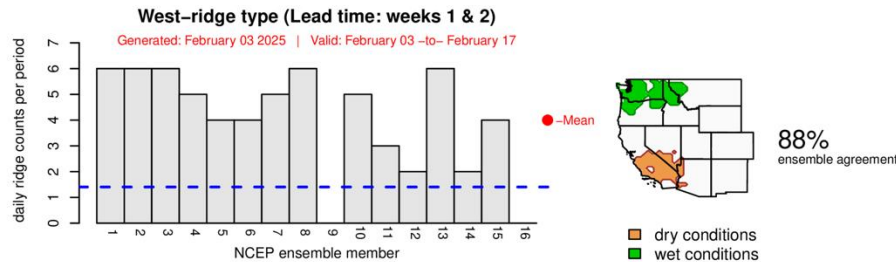
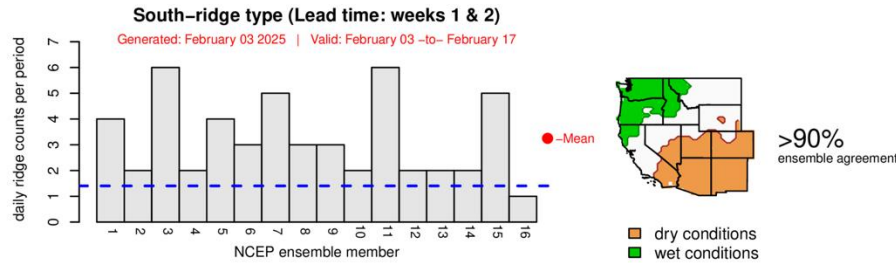
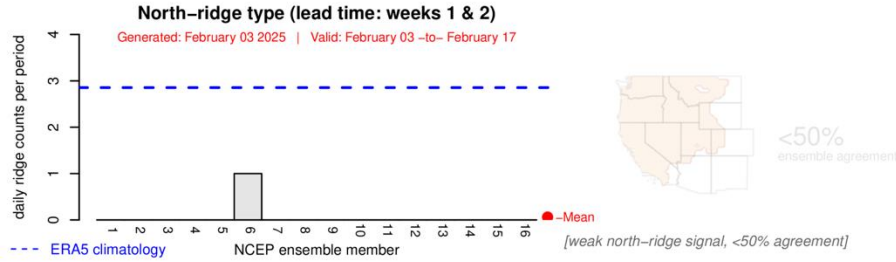
Contact: pgibson@ucsd.edu
Reference: Gibson et al. (2020)
Journal of Climate

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

Forecasts Initialized 3 Feb 2025

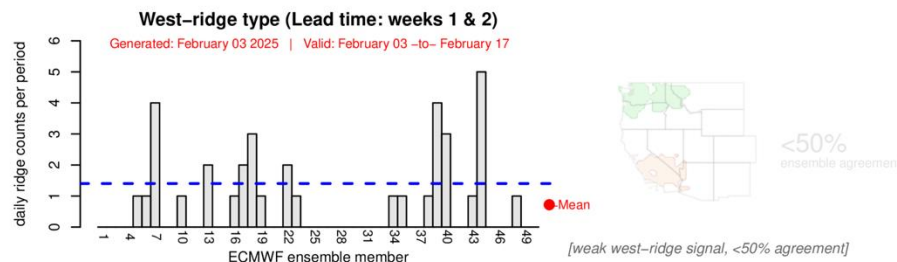
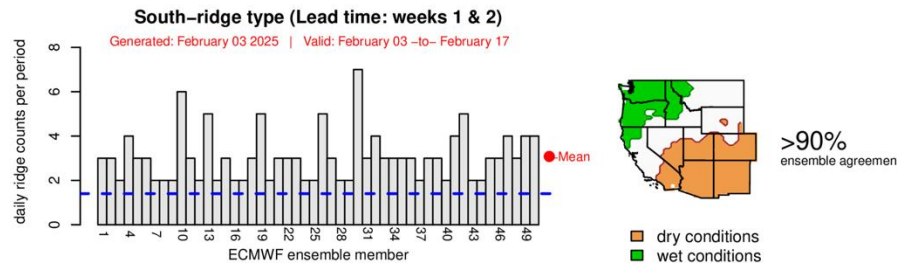
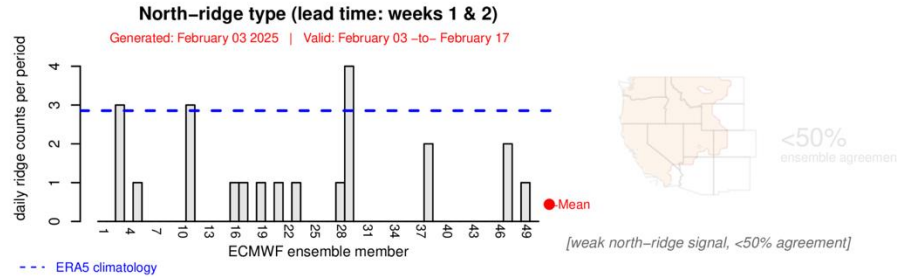
NCEP

CW3E Subseasonal Ridging Forecast (Uses NCEP CFSv2 model)



ECMWF

CW3E Subseasonal Ridging Forecast (Uses ECMWF model)



- Both NCEP and ECMWF are forecasting a very high likelihood (>90% ensemble agreement) of above-normal South-ridge activity during Weeks 1–2 (3 – 17 Feb)
- NCEP is also forecasting a high likelihood (88% ensemble agreement) of above-normal West-ridge type
- Both models are forecasting below-normal North-ridge activity

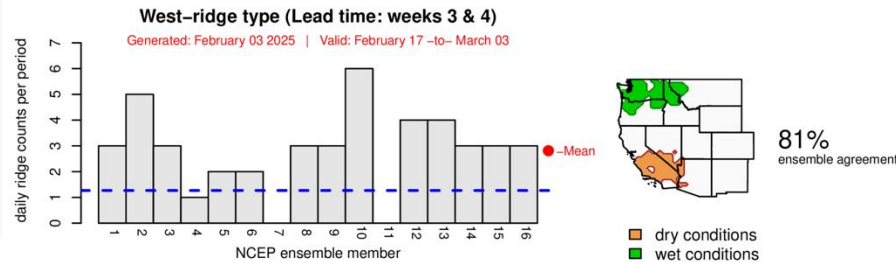
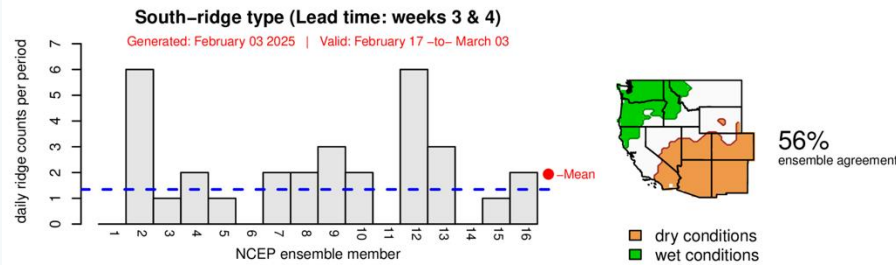
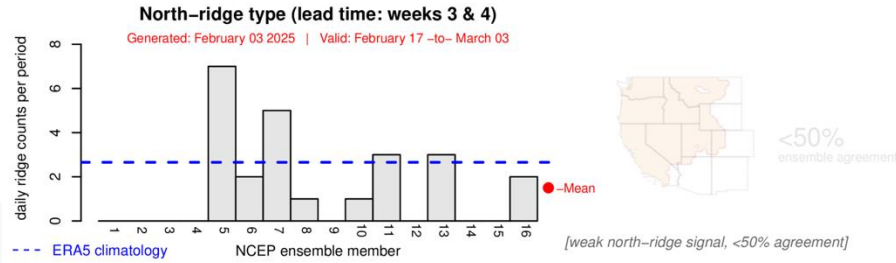
Models agree on the very high likelihood of above-normal ridging activity over the Southwestern US during Weeks 1-2 (3 – 17 Feb); NCEP also predicts high likelihood of above-normal ridging activity to the west of CA

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

Forecasts Initialized 3 Feb 2025

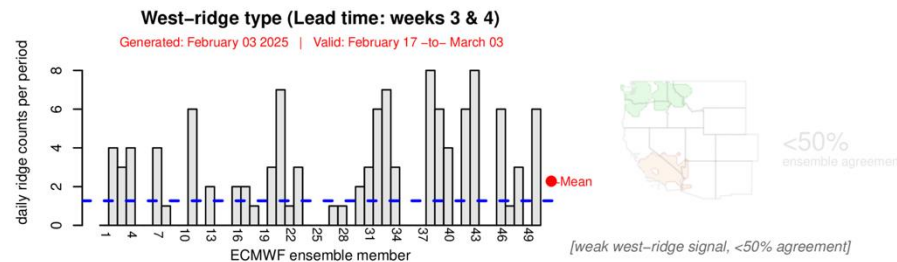
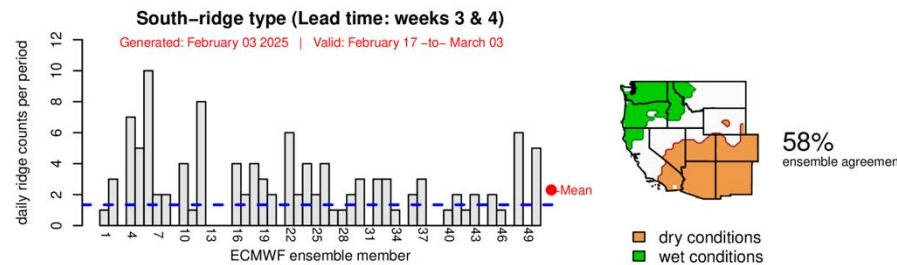
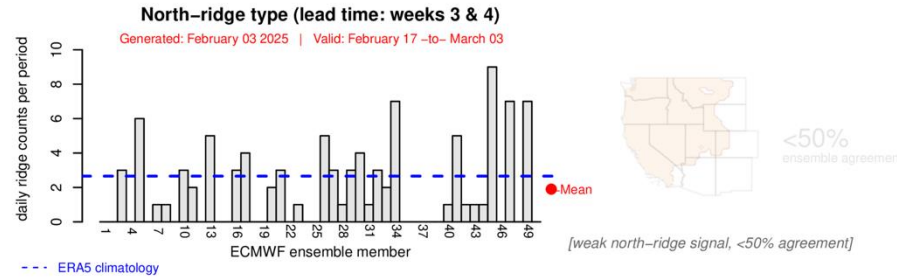
NCEP

CW3E Subseasonal Ridging Forecast (Uses NCEP CFSv2 model)



ECMWF

CW3E Subseasonal Ridging Forecast (Uses ECMWF model)



- Both NCEP and ECMWF are forecasting a moderate likelihood (55-60 % ensemble agreement) of above-normal South-ridge activity during Weeks 3–4 (17 Feb–3 Mar)

- NCEP is also forecasting a high likelihood (81% ensemble agreement) of above-normal West-ridge activity, which is predicted by ECMWF with low confidence (< 50% ensemble agreement)

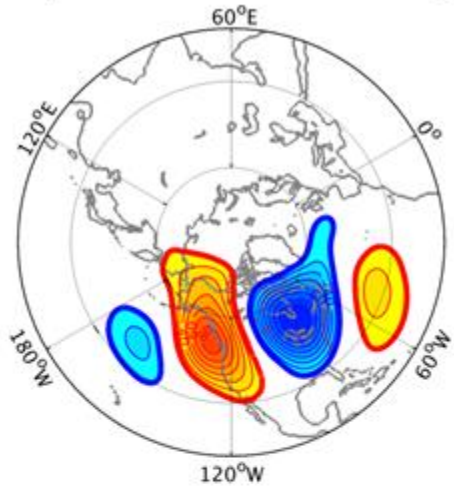
- Both models are forecasting slightly below-normal North-ridge activity

Models agree on the moderate likelihood of above-normal ridging activity over the Southwestern US during Weeks 3-4 (17 Feb – 3 Mar); NCEP also predicts high likelihood of above-normal ridging activity to the west of CA

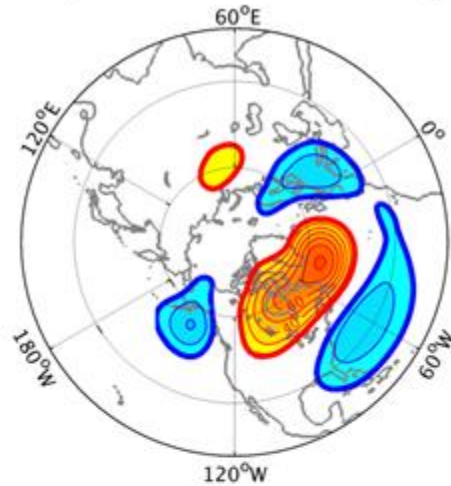


Background Info: IRI Subseasonal Weather Regime Forecasts

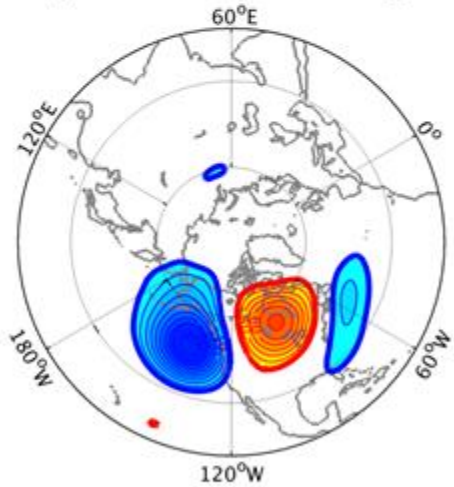
a) WR 1: West Coast Ridge



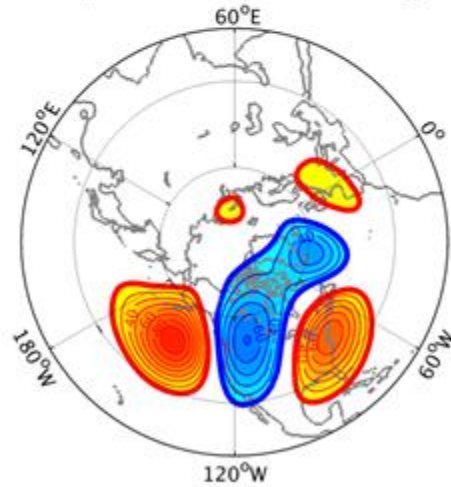
b) WR 2: Greenland High



c) WR 3: Pacific Trough



d) WR 4: Pacific Ridge



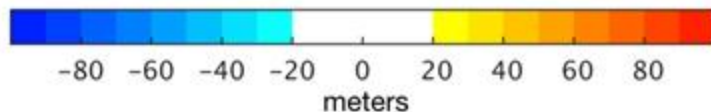
This slide contains background information about IRI's North American weather regime forecast product

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

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

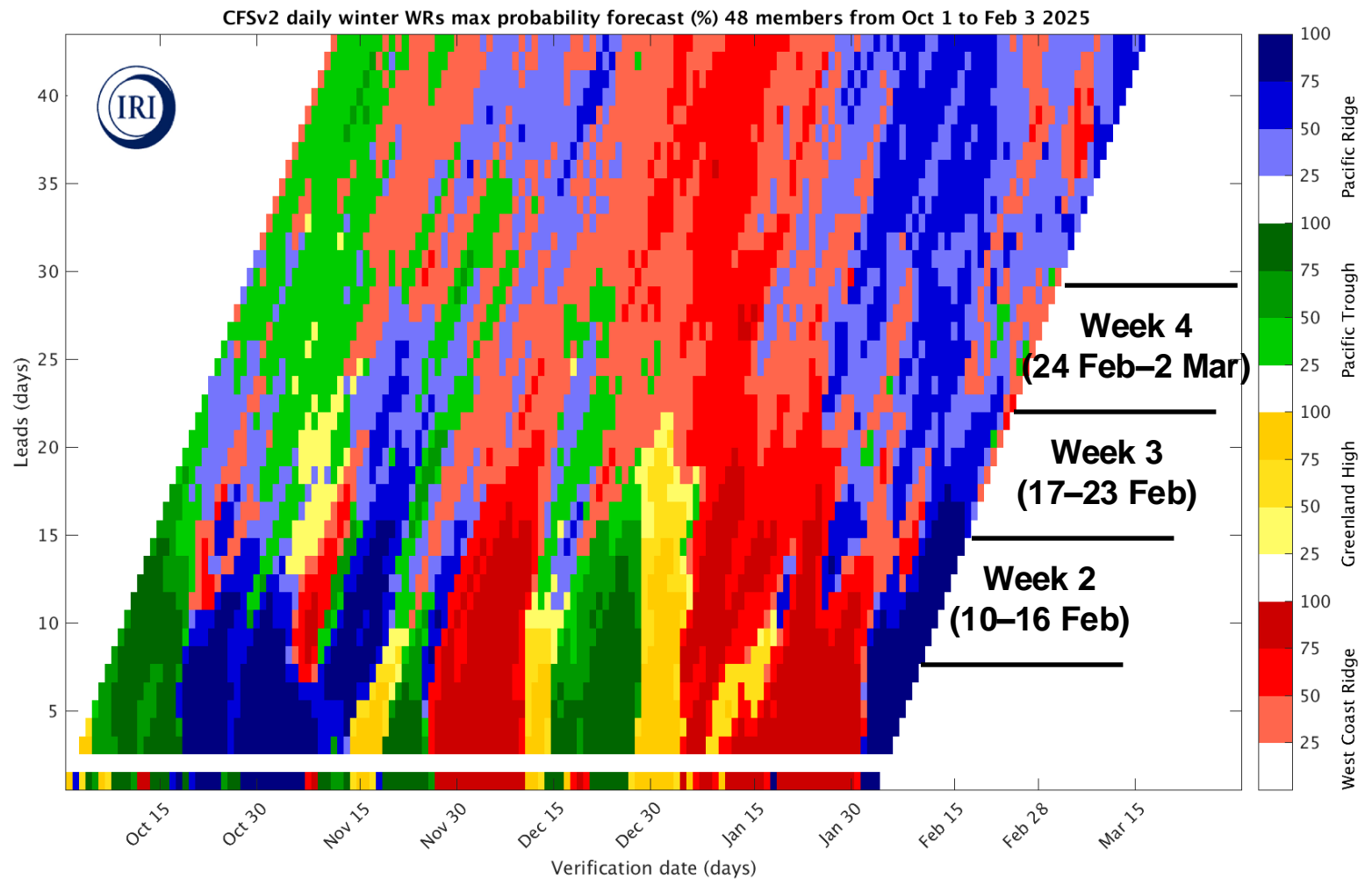
For more information about the forecast product:

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



IRI North American Weather Regime Forecasts

Forecast Initialized 3 Feb 2025



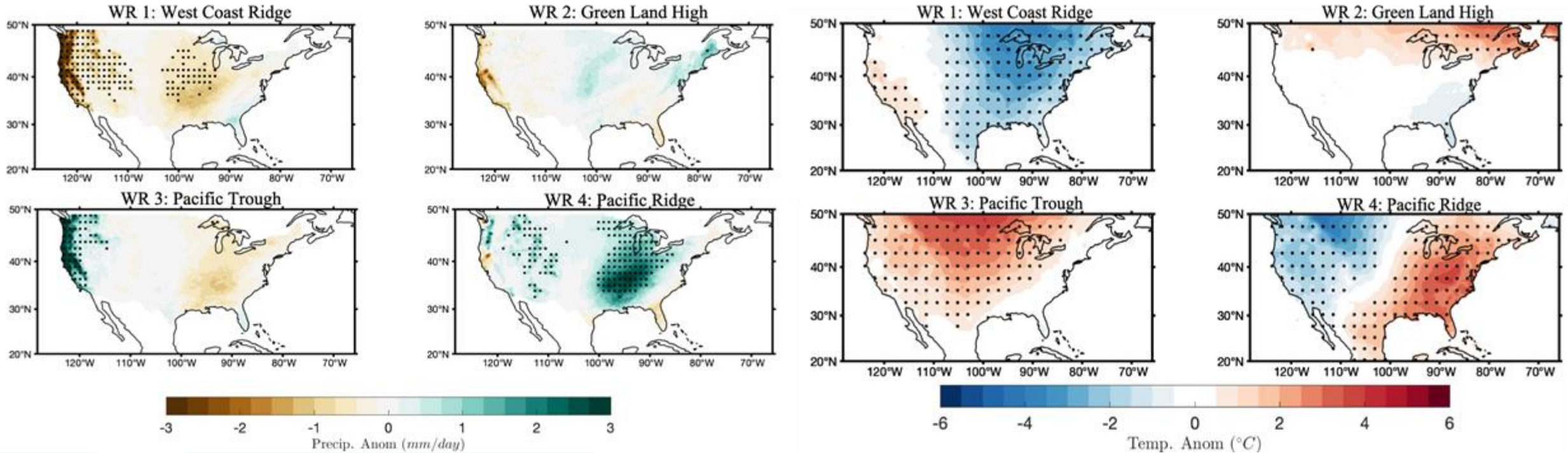
- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- High likelihood (>75 % ensemble agreement) of Pacific Ridge during Week 2 (10–16 Feb)
- Possible regime shift to West Coast Ridge with low-to-moderate likelihood (25–75% ensemble agreement) during Week 3 (17–23 Feb)
- Low likelihood (25-50% ensemble agreement) of West Coast Ridge persisting out to Week 4 (24 Feb–2 Mar)

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

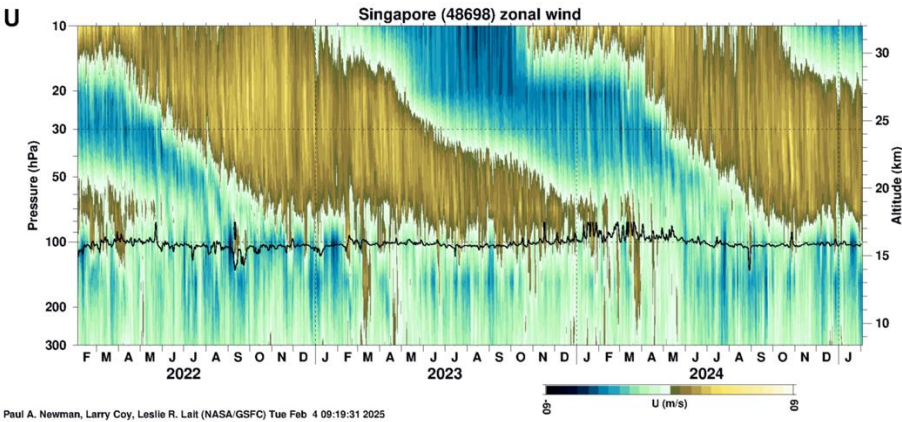


This graphic shows composite mean precipitation (left) and temperature (right) anomalies associated with each weather regime. Stippling (black dots) indicate statistically significant anomalies.

- Near-normal precipitation and below-normal temperature predicted over CA during Week 2 (10–16 Feb) with high confidence in Pacific Ridge regime
- Below-normal precipitation and above-normal temperature predicted over CA during much of Weeks 3-4 (17 Feb–2 Mar) with low-to-moderate confidence in West Coast Ridge regime

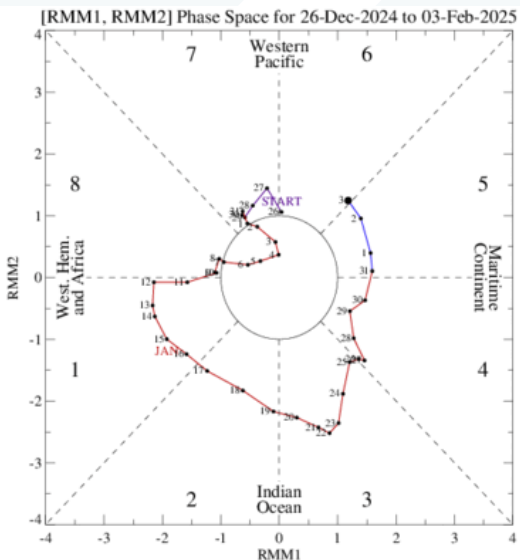
Background Info: AR Activity and Precipitation Based on MJO and QBO

QBO Conditions



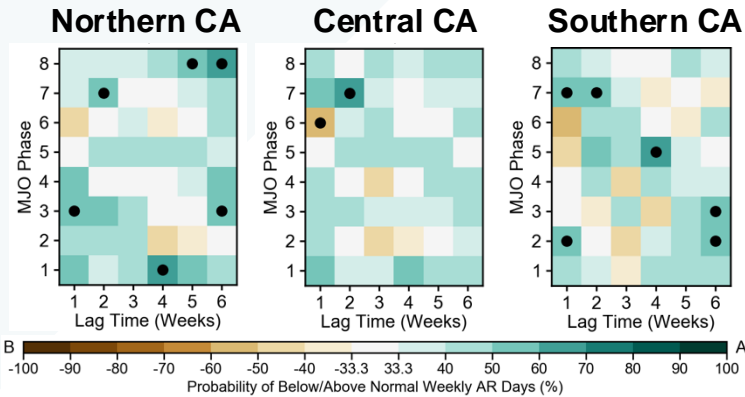
QBO is in the westerly phase at 50-hPa

MJO Conditions

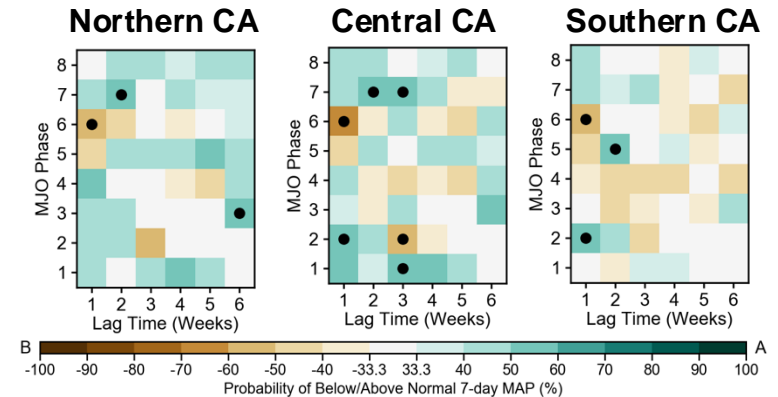


MJO convection is currently located over the Western Pacific (Phase 6)

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



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

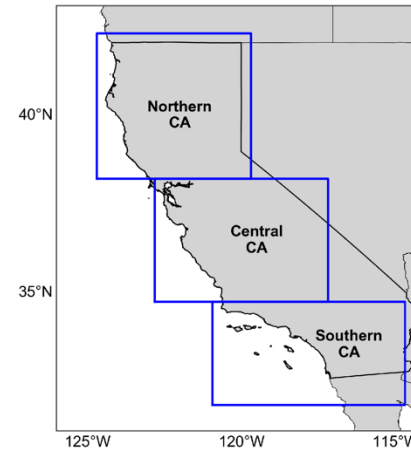
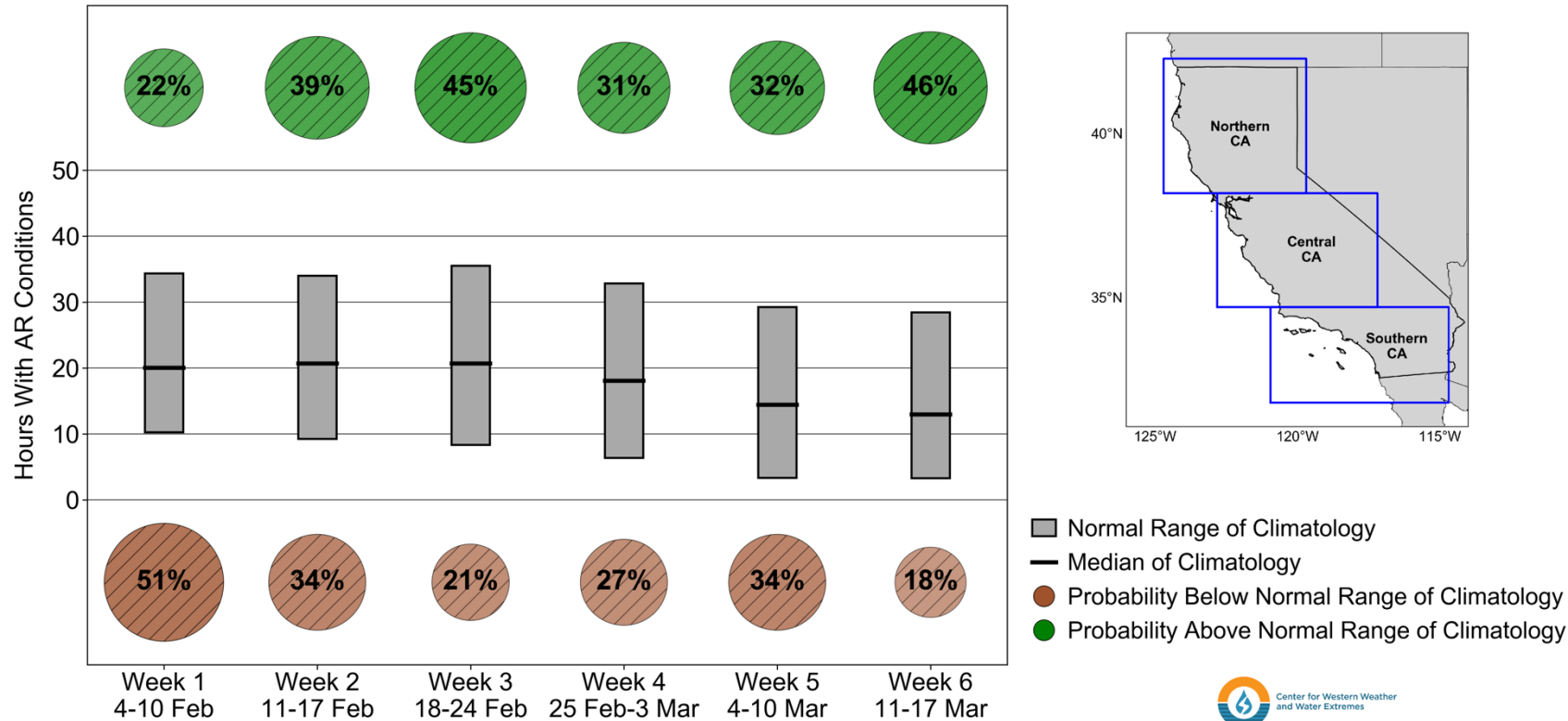


Probability matrices illustrating the weeks 1–6 lagged probability of below-normal (brown shading) or above-normal (green shading) AR occurrence and precipitation for all MJO phases when the QBO is in the westerly phase during JFM in Northern CA (left), Central CA (middle), and Southern CA (right). White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

Central CA Subseasonal AR Occurrence Outlook
 Issued: 3 Feb 2025 MJO Phase 6 WQBO



Forecasts Initialized 3 Feb 2025

- 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 during Week 3 (18-24 Feb) and Week 6 (11-17 Mar) in Central CA**
- Moderate likelihood of above-normal AR occurrence in Northern CA during Week 3 and Week 6
- Moderate likelihood of above-normal AR occurrence in Southern CA during Weeks 2-3 (11-24 Feb) and Week 6



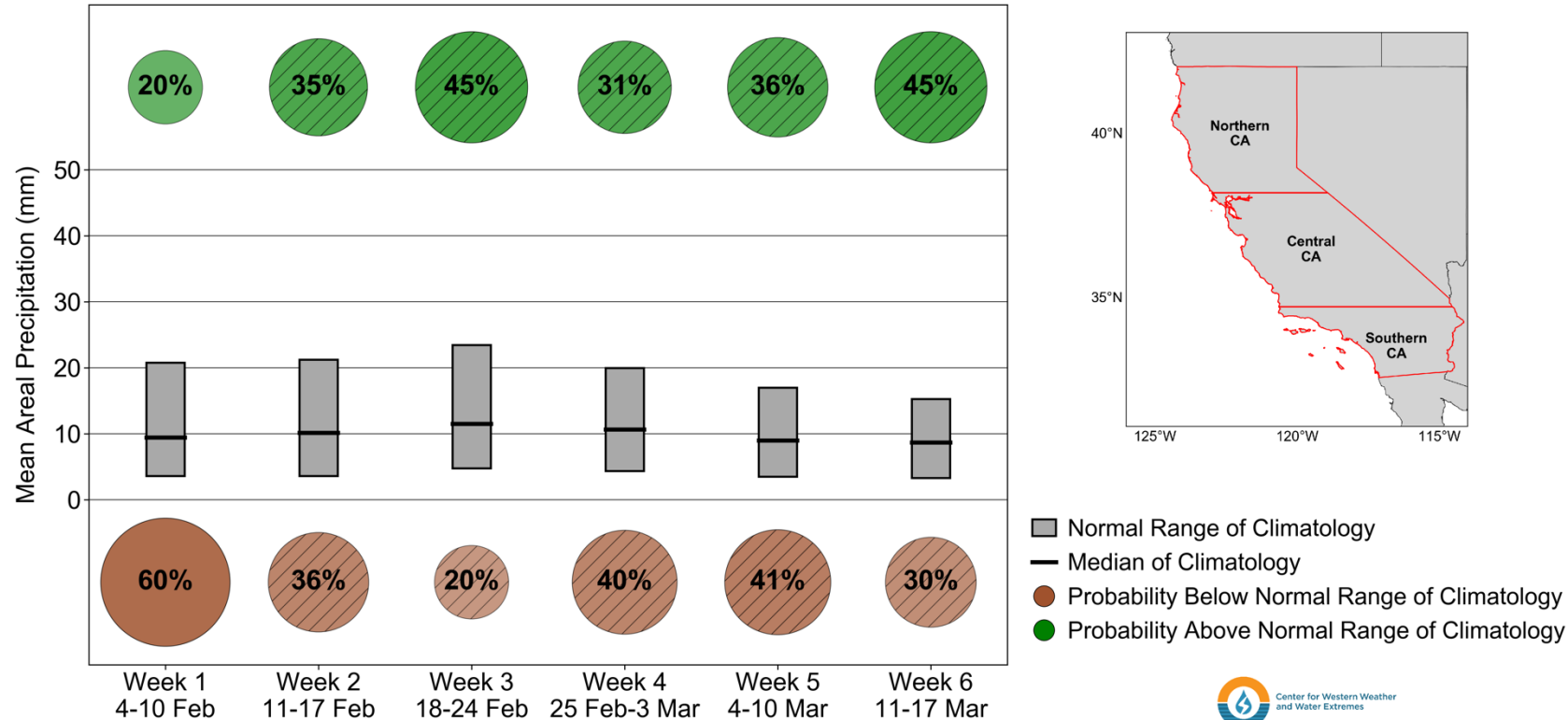
This product shows weekly probabilities of above-normal and below-normal AR occurrence in California. These probabilities are calculated for lead times of 1–6 weeks based on the current season (i.e., OND or JFM) and phases of the Madden-Julian Oscillation (MJO) and Quasi-biennial Oscillation (QBO). If 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 3 Feb 2025

Precipitation: Central CA

Central CA Subseasonal Precipitation Outlook
Issued: 3 Feb 2025 MJO Phase 6 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 Central CA during Week 3 (18-24 Feb) and Week 6 (11-17 Mar)**



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*