



Center for Western Weather
and Water Extremes

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AT UC SAN DIEGO

CW3E Subseasonal Outlook: 11 March 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 10 Mar 2025

Region	Week 2 (17–23 Mar)				Week 3 (24–30 Mar)					Week 4 (31 Mar – 6 Apr)			
	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}	ECCC ¹	ECMWF ^{1,2}	Multi-Model Forecast
WA/OR													
Northern CA													
Central CA													
Southern CA													

Higher Confidence | Lower Confidence

Below normal	
Near normal	
Above normal	
? Uncertain/lack of skill	

- Models lean towards below-normal precipitation in Northern CA during Week 2; more uncertainty in Central and Southern CA due to disagreement among models and forecast products
- Models lean towards below-normal precipitation in Central and Southern CA during Week 3; more uncertainty in Northern CA
- Models lean towards near-normal precipitation in all of CA during Week 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

- MJO convection is currently hovering over Africa (Phase 1) and the Indian Ocean (Phase 2); QBO is in the westerly phase
- NCEP and ECMWF are both forecasting MJO convection to propagate eastward through the Indian Ocean (Phases 2&3) during Week 1 and weaken during Week 2
 - Without considering QBO/ENSO conditions, MJO in Phases 2&3 during JFM is associated with decreases in wet extremes over all of CA at lag times of 2–4 weeks

Week 2 Forecasts (17–23 Mar):

- ECCC and ECMWF generally agree on AR activity over CA during Week 2; NCEP differs, particularly over Central and Southern CA
 - ECCC and ECMWF are forecasting slightly below-normal AR activity in Northern CA, near-normal to slightly-above normal AR activity in Central CA, and slightly above-normal to above-normal AR activity in Southern CA
 - NCEP is forecasting below-normal AR activity in Northern CA and slightly below-normal AR activity in Central and Southern CA
- Ridging outlooks show moderate-to-high likelihood of above-normal West-ridge activity (dry conditions over Central and Southern CA) during Weeks 1–2
 - NCEP is forecasting a high likelihood of above-normal West-ridge activity, whereas ECMWF is forecasting a moderate likelihood of above-normal West-ridge activity
- IRI weather regime tool shows moderate-to-high likelihood of West Coast Ridge (below-normal precipitation in CA) during most of Week 2

Summary

Week 3 Forecasts (24–30 Mar):

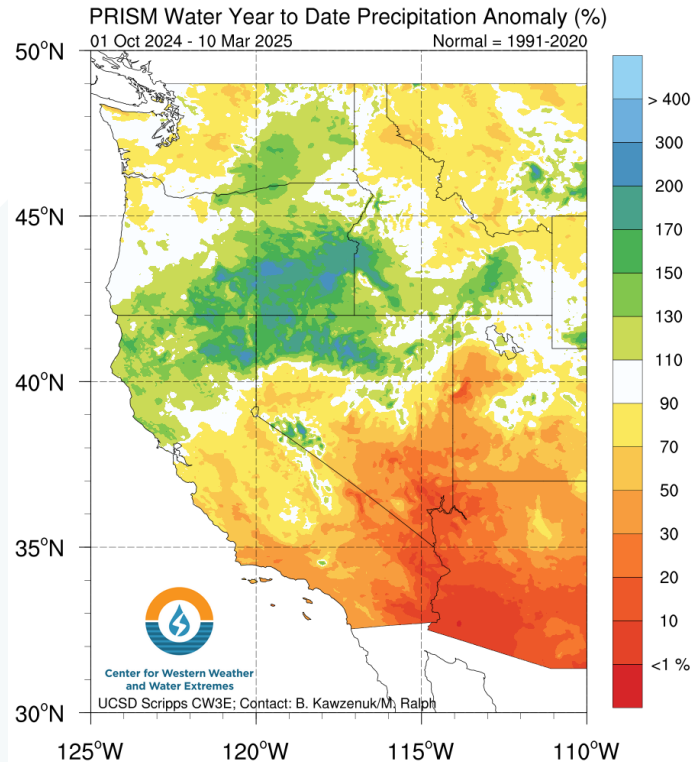
- Models disagree somewhat on AR activity over CA during Week 3
 - In Northern CA, NCEP and ECCO are forecasting near-normal AR activity, whereas ECMWF is forecasting slightly below-normal AR activity
 - In Central CA, NCEP and ECMWF are forecasting slightly below-normal AR activity, whereas ECCO is forecasting near-normal AR activity
 - In Southern CA, NCEP is forecasting below-normal AR activity, ECCO is forecasting near-normal AR activity, and ECMWF is forecasting slightly below-normal AR activity
- Ridging outlooks show potential for above-normal West-ridge activity (dry conditions over Central and Southern CA) during Weeks 3–4
 - NCEP is forecasting a moderate likelihood of above-normal West-ridge activity
 - ECMWF is also forecasting above-normal West-ridge activity, but with low confidence
- IRI weather regime tool shows high degree of uncertainty in regime type with low confidence in West Coast Ridge (dry conditions over all of CA) during most of Week 3

Week 4 Forecasts (31 Mar – 6 Apr):

- Models generally agree on near-normal AR activity over all of CA during Week 4
- IRI weather regime tool forecasts are not available for Week 4

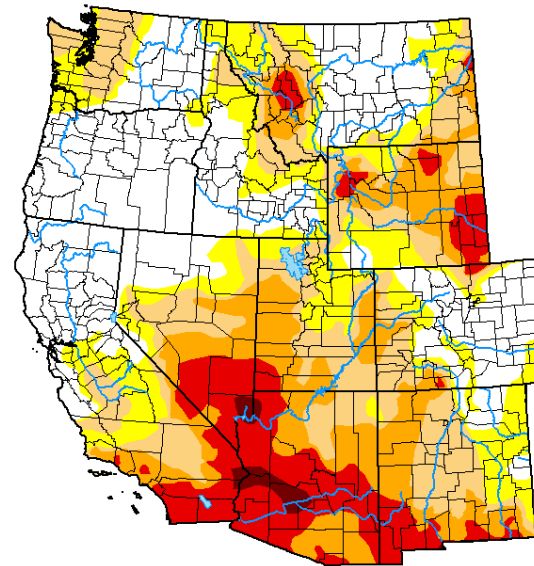
Hydrologic Summary

Precipitation



Drought Conditions

U.S. Drought Monitor Western U.S.



March 4, 2025

(Released Thursday, Mar. 6, 2025)

Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	33.48	66.52	48.82	28.88	12.80	0.96
Last Week 02-25-2025	32.67	67.33	47.97	26.70	12.64	0.28
3 Months Ago 12-03-2024	32.36	67.64	35.00	18.50	6.02	0.10
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 03-05-2024	49.36	50.64	25.82	10.88	2.45	0.36

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:

Curtis Riganti
National Drought Mitigation Center



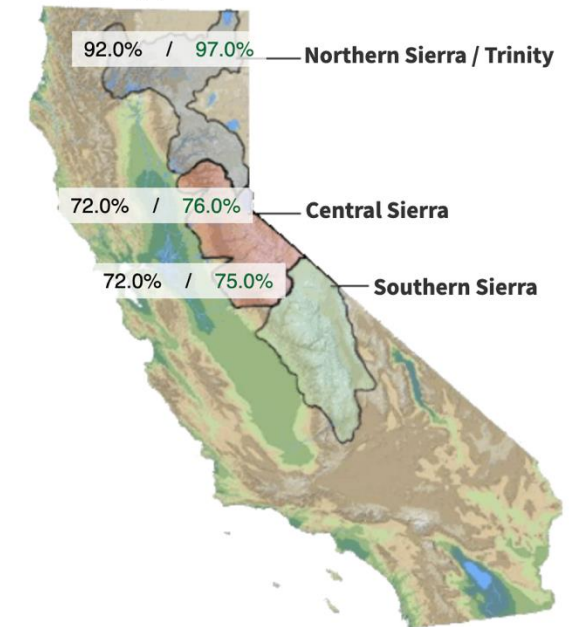
droughtmonitor.unl.edu

Snowpack Conditions

Provided by the California Cooperative Snow Surveys

Data For: 10-Mar-2025

% Apr 1 Avg. / % Normal for this Date



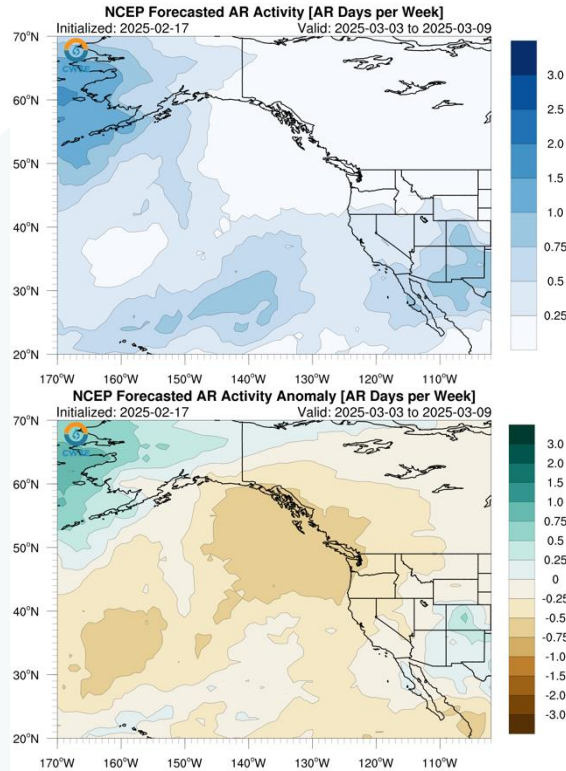
Source: California DWR

- As of 10 Mar, water-year-to-date precipitation is **above normal (> 110% of normal)** in Northern CA, **below-normal (50–90% of normal)** in Central CA, and **well-below normal (<50% of normal)** in Southern CA
- The most recent drought monitor update from 4 Mar is showing a continuation of **severe-to-extreme drought (D2–D3)** in Southern CA and **abnormally dry (D0) to moderate drought (D1)** conditions over much of Central CA
- Current snowpack is **near normal (97% of normal)** in the Northern Sierra Nevada/Trinity region and **below normal** in the Central Sierra Nevada (**76% of normal**) and Southern Sierra Nevada (**75% of normal**)

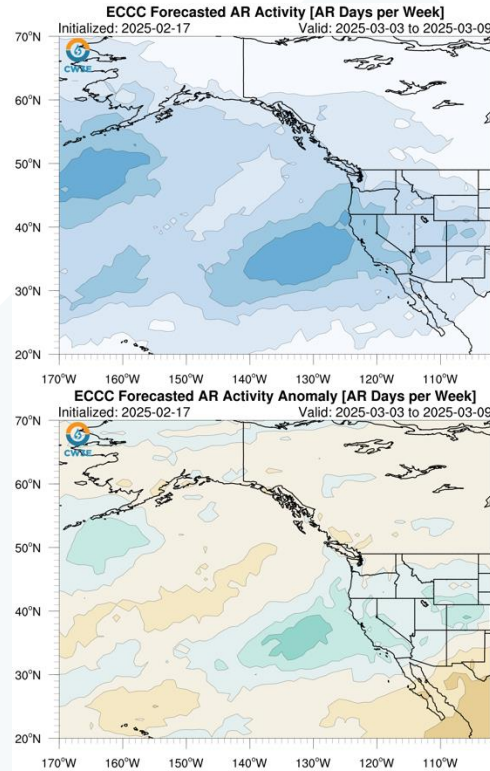
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 17 Feb 2025; Valid: 3–9 Mar 2025

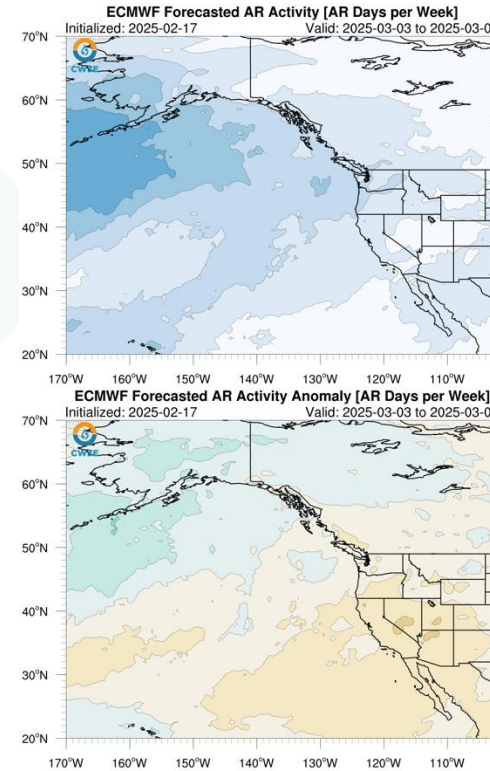
NCEP



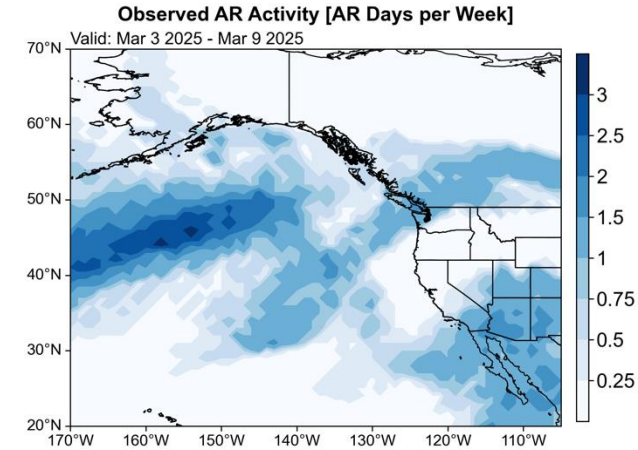
ECNC



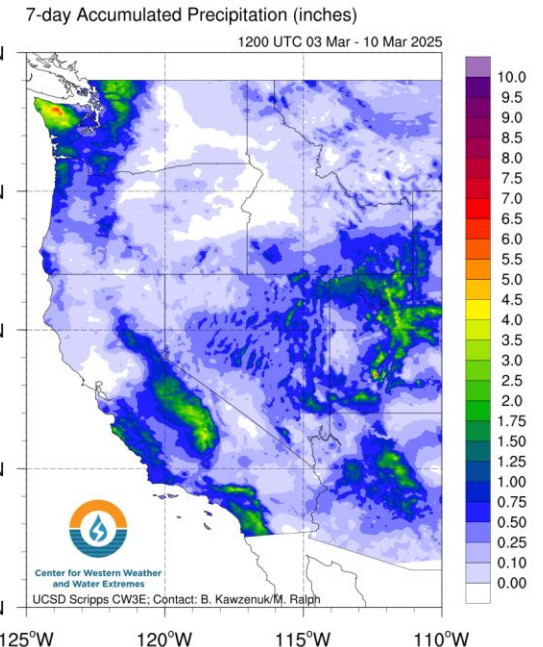
ECMWF



Observed (GFS Analysis)



Observed Precipitation

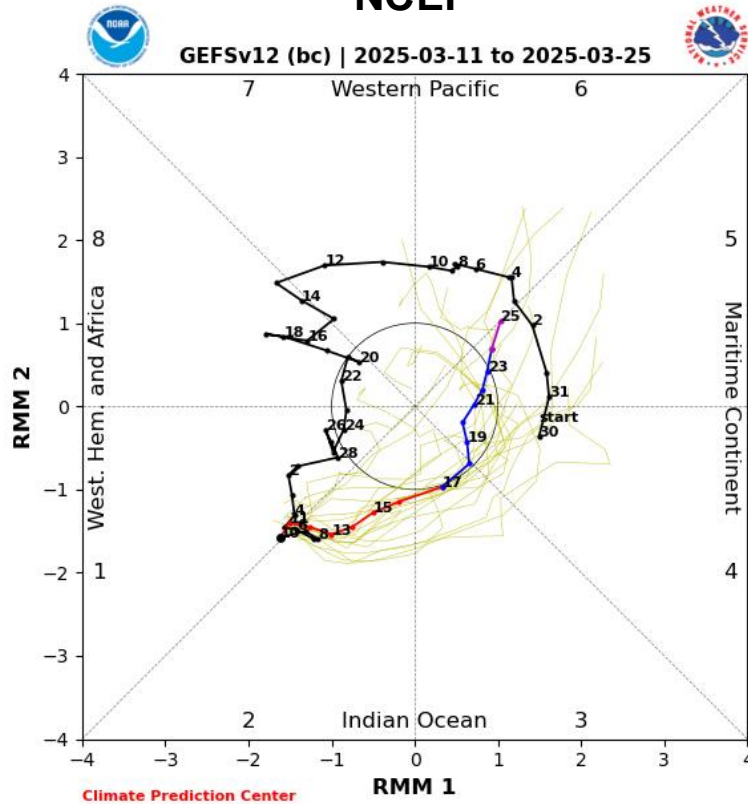


Shading: Fractional # of AR days forecast over a 7-day period (top) and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

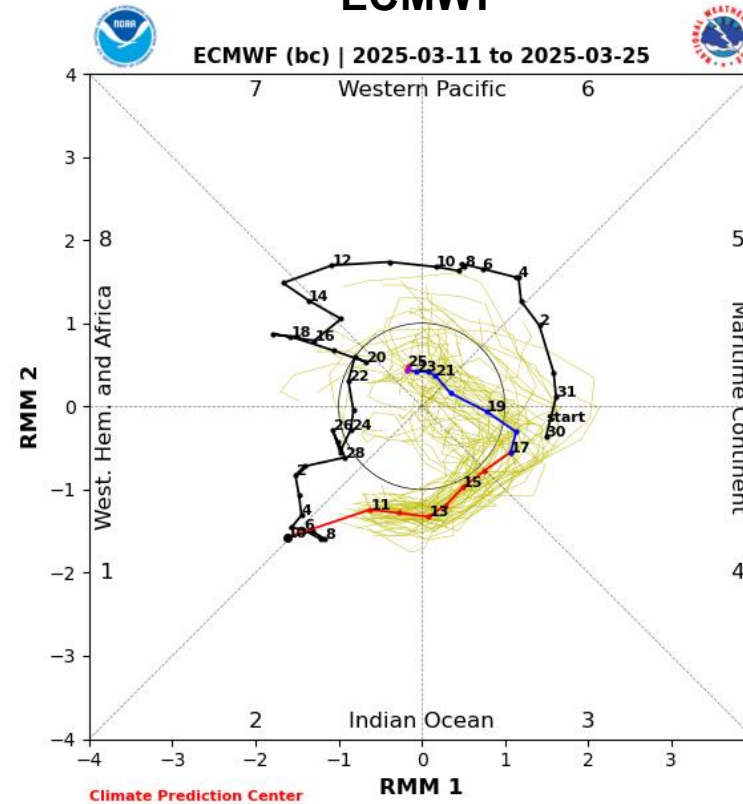
- NCEP correctly predicted a maximum in AR activity over the southwestern US but still underestimated the amount of AR activity
- ECNC predicted the center of AR activity too far north over Northern and Central CA
- ECMWF significantly underestimated AR activity over Southern CA and the interior southwestern US
- A weak AR and a shortwave trough produced 1–3 inches of precipitation in coastal Southern CA and 1–2 feet of snow in the Central and Southern Sierra Nevada on 5–6 Mar
- Another AR produced 2–5 inches of precipitation over the Olympic Peninsula on 8–9 Mar

Dynamical Model MJO Forecasts (NCEP vs. ECMWF)

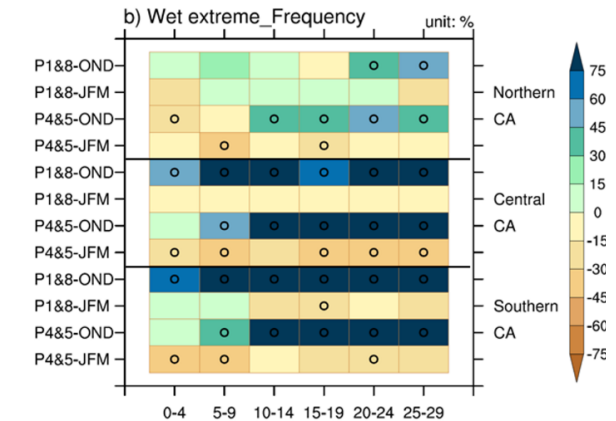
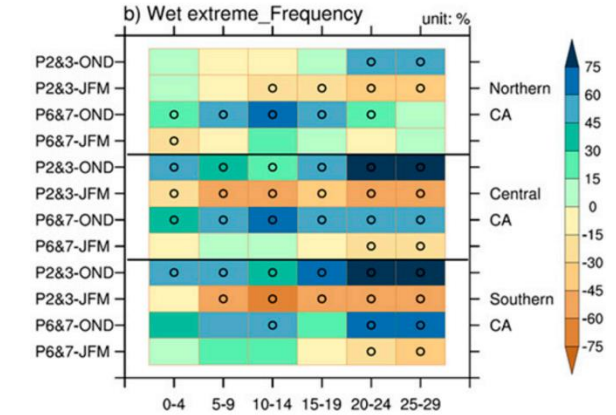
NCEP



ECMWF



Black: Last 40 days of observations (30 Jan – 10 Mar); Red: Week 1 (11–17 Mar) ensemble mean; Blue: Week 2 (18–24 Mar) ensemble mean; Yellow: Ensemble members

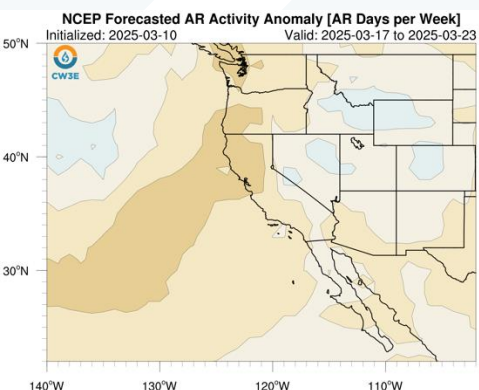
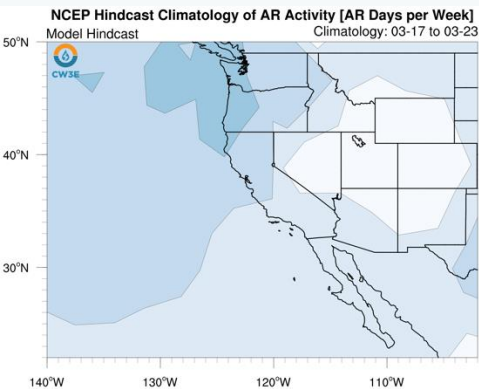
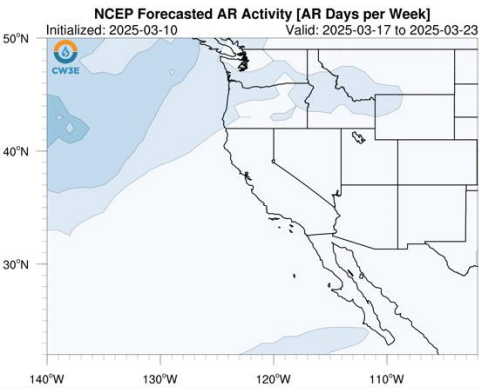


- Strong MJO convection is currently hovering over Africa (Phase 1) and the Indian Ocean (Phase 2)
- Both models are forecasting MJO convection to propagate eastward through the Indian Ocean (Phases 2&3) during Week 1 and weaken during Week 2
- ECMWF is forecasting MJO convection to propagate eastward more rapidly and reach the Maritime Continent (Phase 4) before weakening; NCEP is forecasting the MJO to weaken before reaching the Maritime Continent
- Without considering QBO/ENSO conditions, MJO activity in Phases 2&3 during JFM is associated with a statistically significant decrease in wet extremes in all of CA at lag times of 2–4 weeks

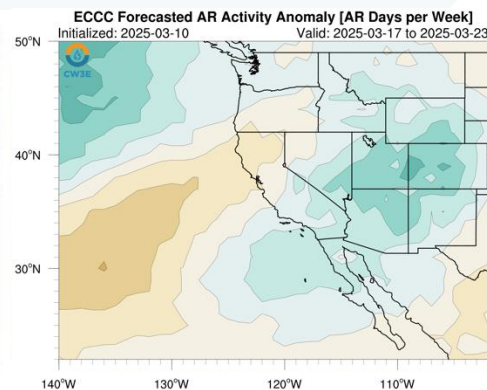
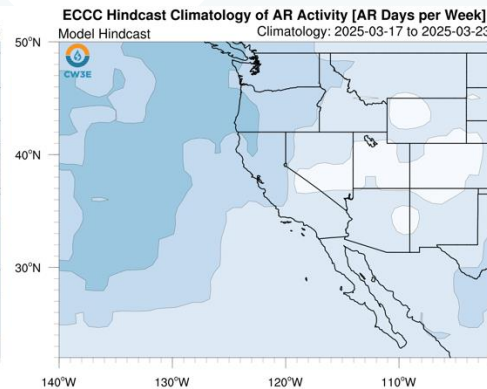
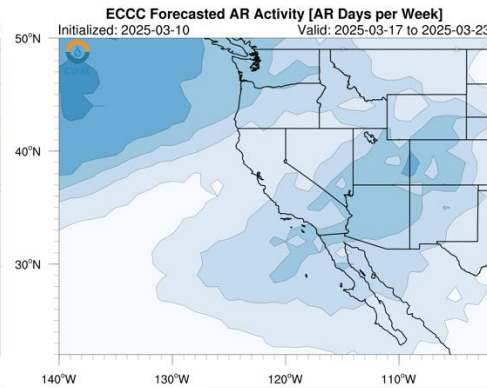
AR Activity Forecasts: Week 2 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 10 Mar 2025

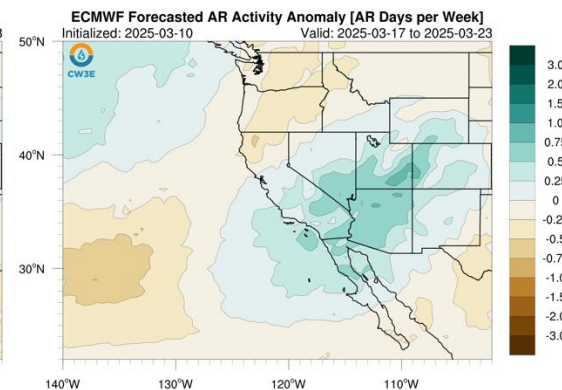
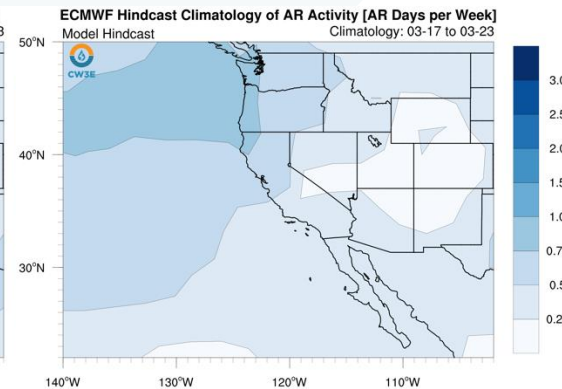
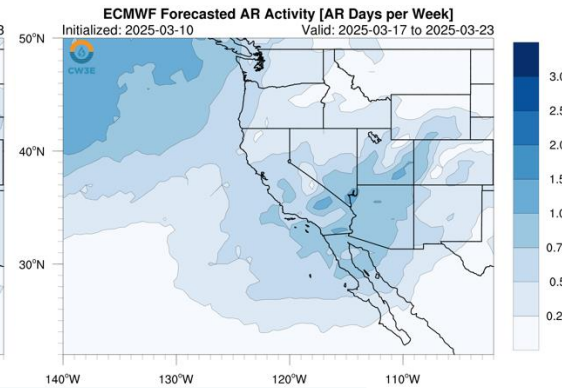
NCEP



ECCC



ECMWF



- ECCC and ECMWF generally agree on slightly below-normal AR activity in Northern CA, near-normal to slightly above-normal AR activity in Central CA, and slightly above-normal to above-normal AR activity in Southern CA during Week 2 (17–23 Mar)
- NCEP is forecasting below-normal AR activity in Northern CA and slightly below-normal AR activity in Central and Southern CA

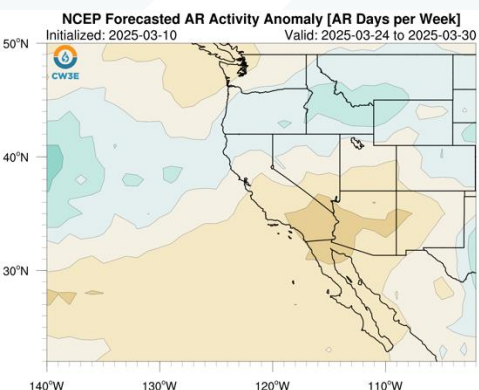
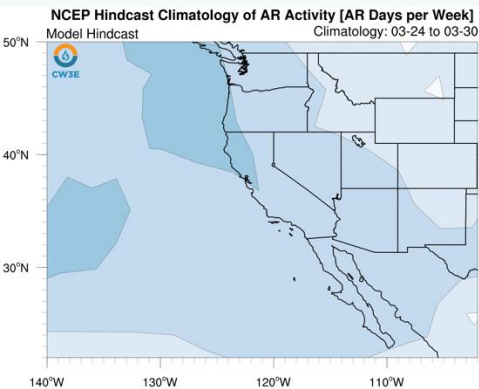
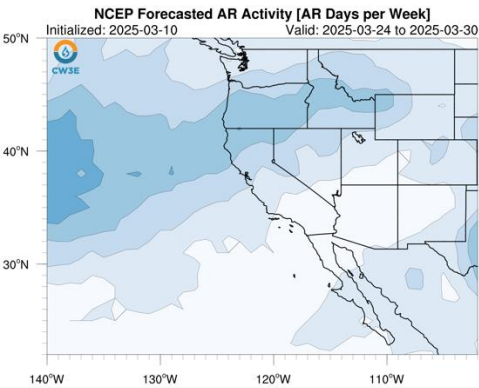
ECCC and ECMWF generally agree on AR activity over all of CA during Week 2 (17–23 Mar); NCEP differs, particularly over Central and Southern CA

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)

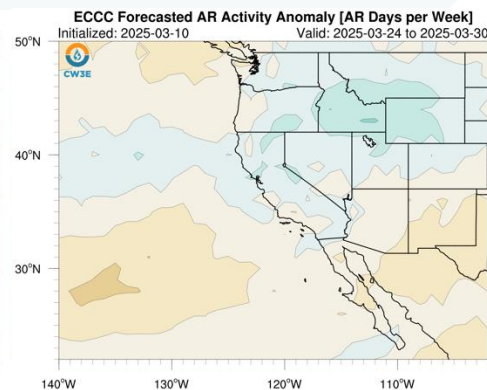
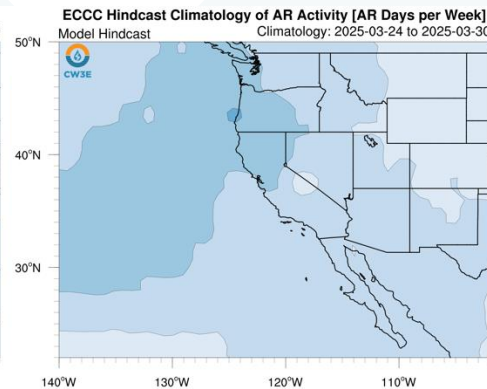
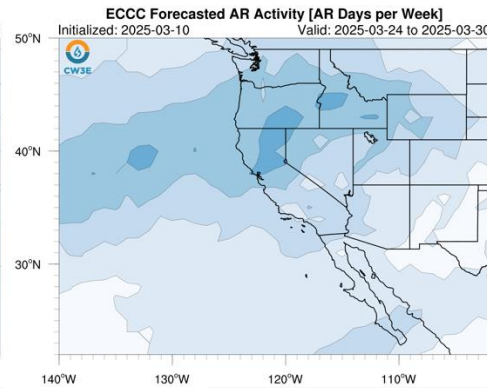
AR Activity Forecasts: Week 3 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 10 Mar 2025

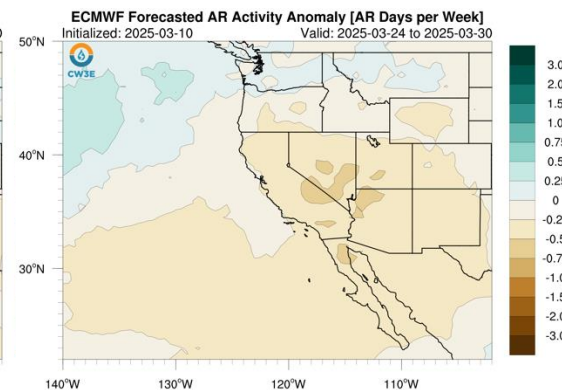
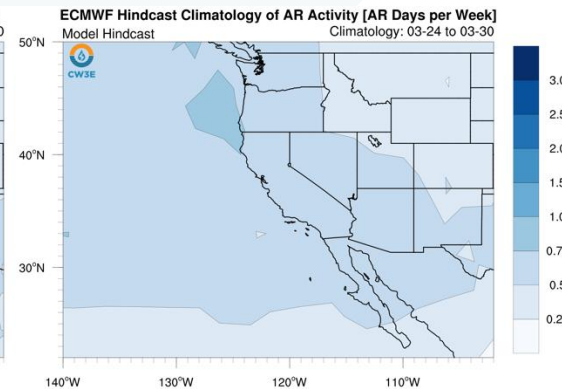
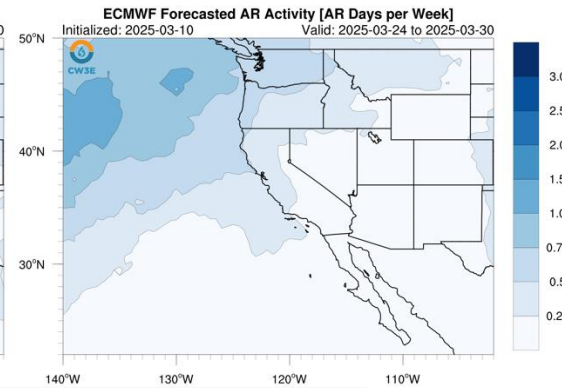
NCEP



ECCC



ECMWF



- In Northern CA, NCEP and ECCC are forecasting near-normal AR activity during Week 3 (24–30 Mar), whereas ECMWF is forecasting slightly below-normal AR activity
- In Central CA, NCEP and ECMWF are forecasting slightly below-normal AR activity, whereas ECCC is forecasting near-normal AR activity
- In Southern CA, NCEP is forecasting below-normal AR activity, ECCC is forecasting near-normal AR activity, and ECMWF is forecasting slightly below-normal AR activity

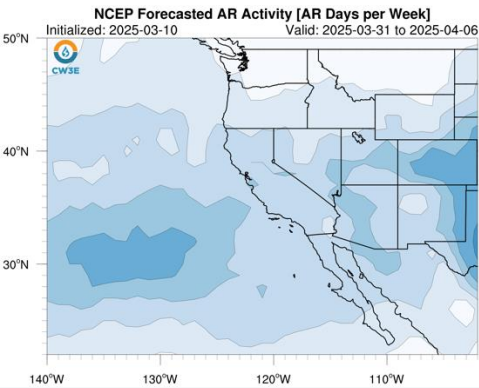
NCEP and ECCC agree on AR activity over Northern CA during Week 3 (24–30 Mar); NCEP and ECMWF generally agree on AR activity over Central and Southern CA

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)

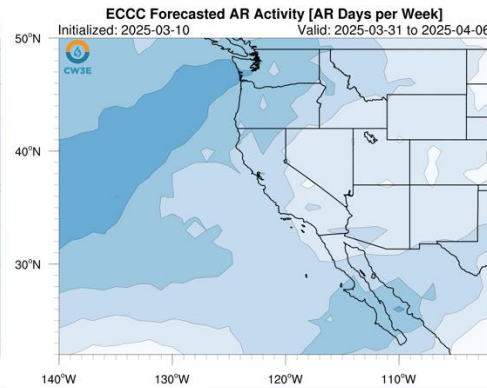
AR Activity Forecasts: Week 4 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 10 Mar 2025

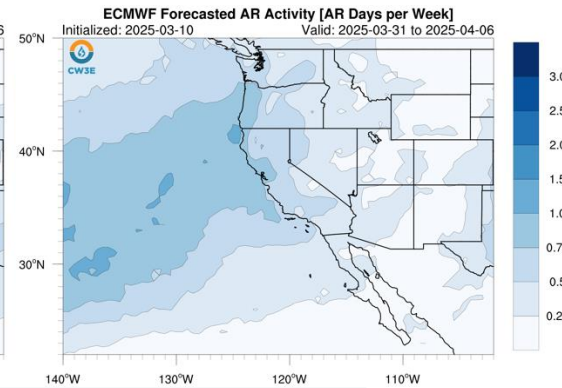
NCEP



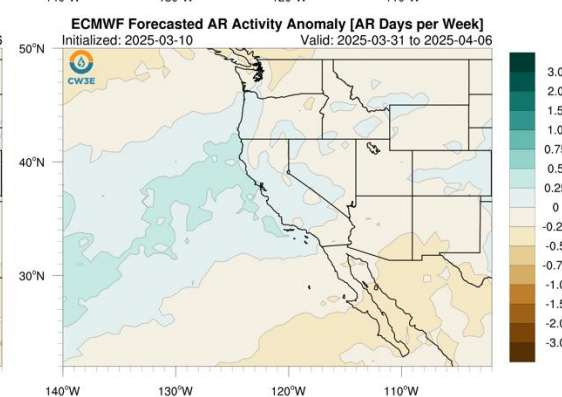
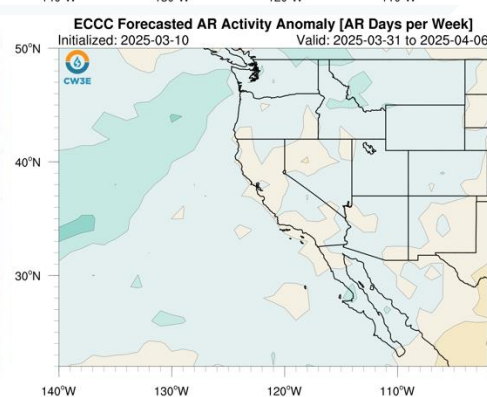
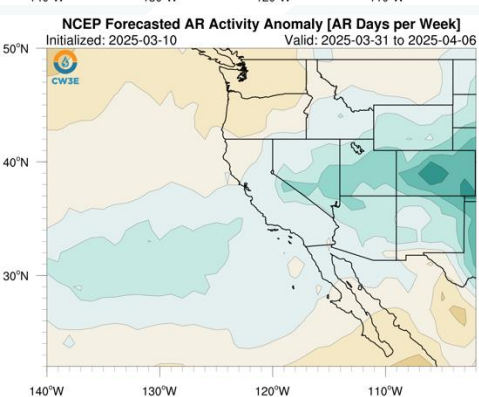
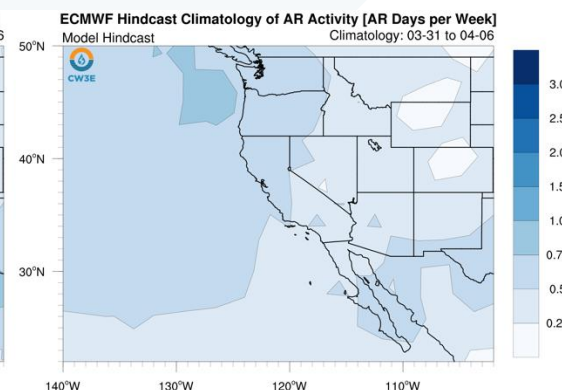
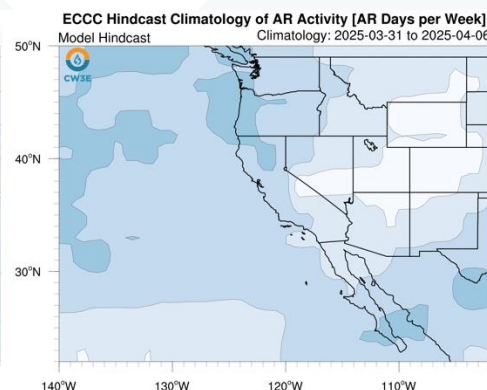
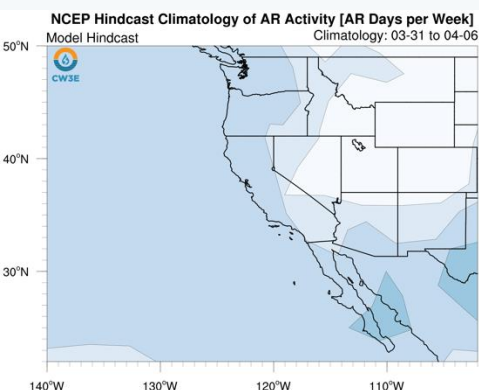
ECCC



ECMWF



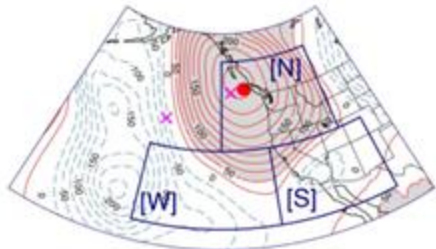
- Models generally agree on near-normal AR activity over all of CA during Week 4 (31 Mar – 6 Apr)
- NCEP is also forecasting above-normal AR activity over the interior southwestern US



Models generally agree on near-normal AR activity over CA during Week 4 (31 Mar – 6 Apr)

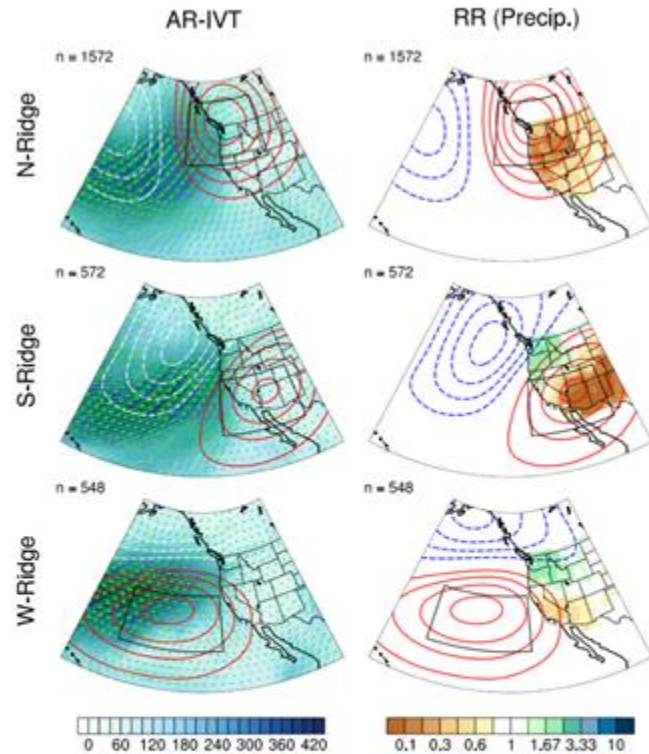
Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

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



Jet Propulsion Laboratory
California Institute of Technology



Center for Western Weather
and Water Extremes
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AT UC SAN DIEGO

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

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

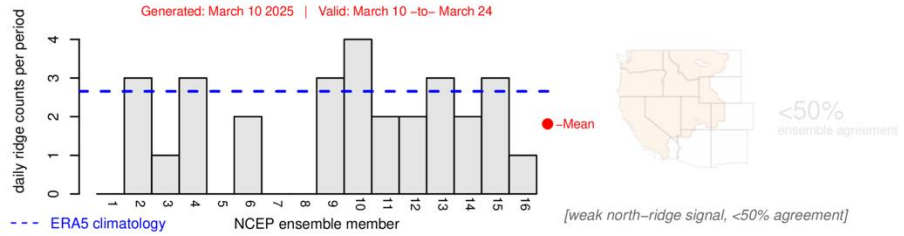
Forecasts Initialized 10 Mar 2025

NCEP

CW3E Subseasonal Ridging Forecast (Uses NCEP CFSv2 model)

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

Generated: March 10 2025 | Valid: March 10 –to– March 24

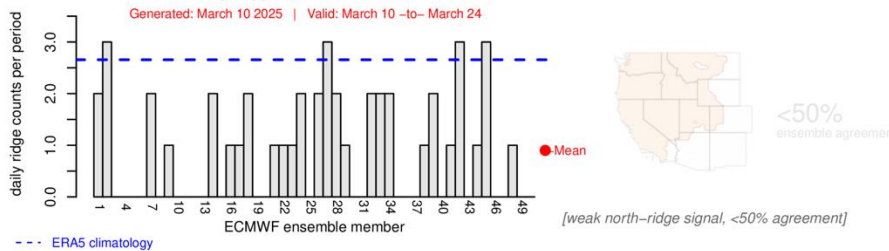


ECMWF

CW3E Subseasonal Ridging Forecast (Uses ECMWF model)

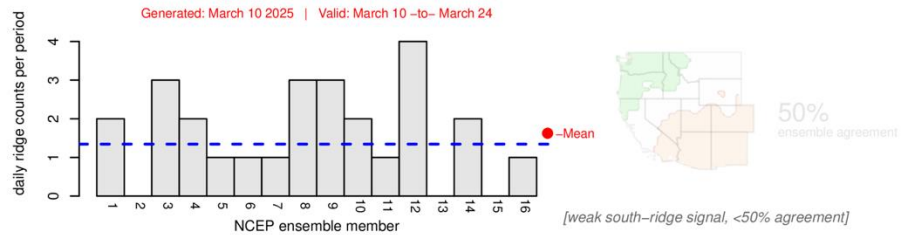
North-ridge type (lead time: weeks 1 & 2)

Generated: March 10 2025 | Valid: March 10 –to– March 24



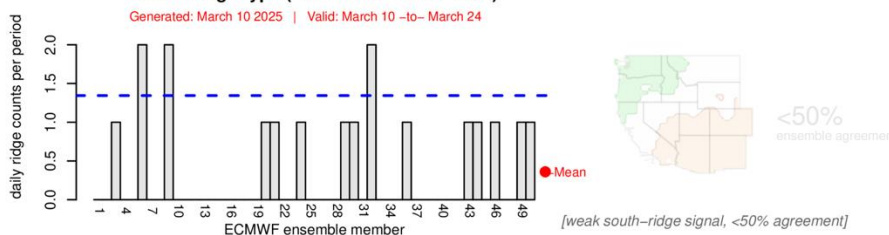
South-ridge type (Lead time: weeks 1 & 2)

Generated: March 10 2025 | Valid: March 10 –to– March 24



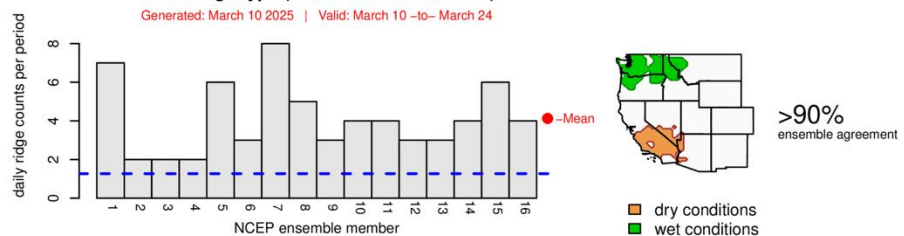
South-ridge type (Lead time: weeks 1 & 2)

Generated: March 10 2025 | Valid: March 10 –to– March 24



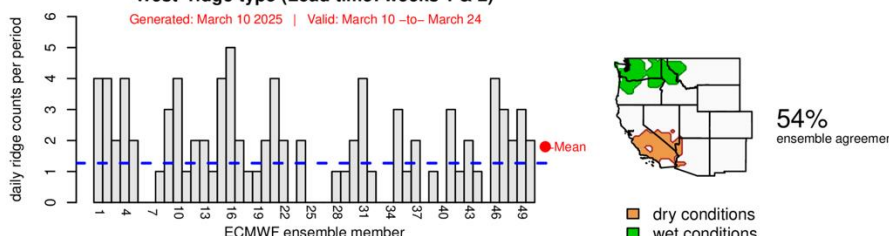
West-ridge type (Lead time: weeks 1 & 2)

Generated: March 10 2025 | Valid: March 10 –to– March 24



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

Generated: March 10 2025 | Valid: March 10 –to– March 24



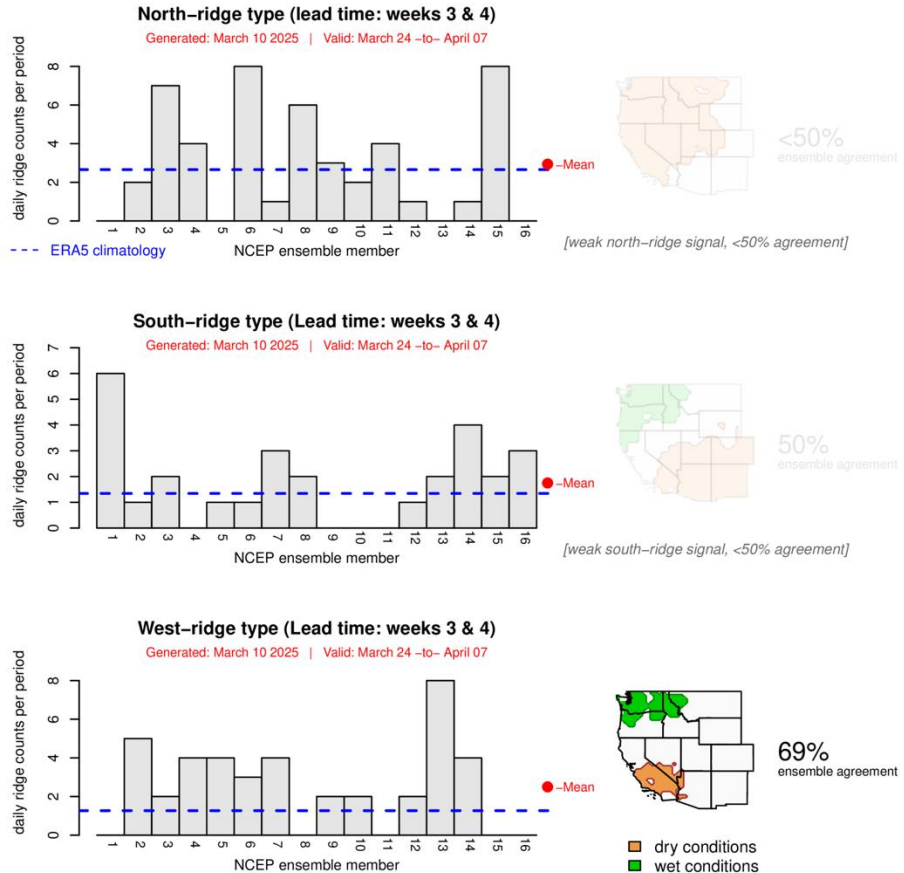
- NCEP is forecasting a high likelihood (>90% ensemble agreement) of above-normal West-ridge activity during Weeks 1–2 (10–24 Mar)
- ECMWF is forecasting a moderate likelihood (54% ensemble agreement) of above-normal West-ridge activity
- NCEP is also forecasting near-normal South-ridge activity

Models show moderate-to-high likelihood of above-normal ridging activity west of California during Weeks 1–2 (10–24 Mar)

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

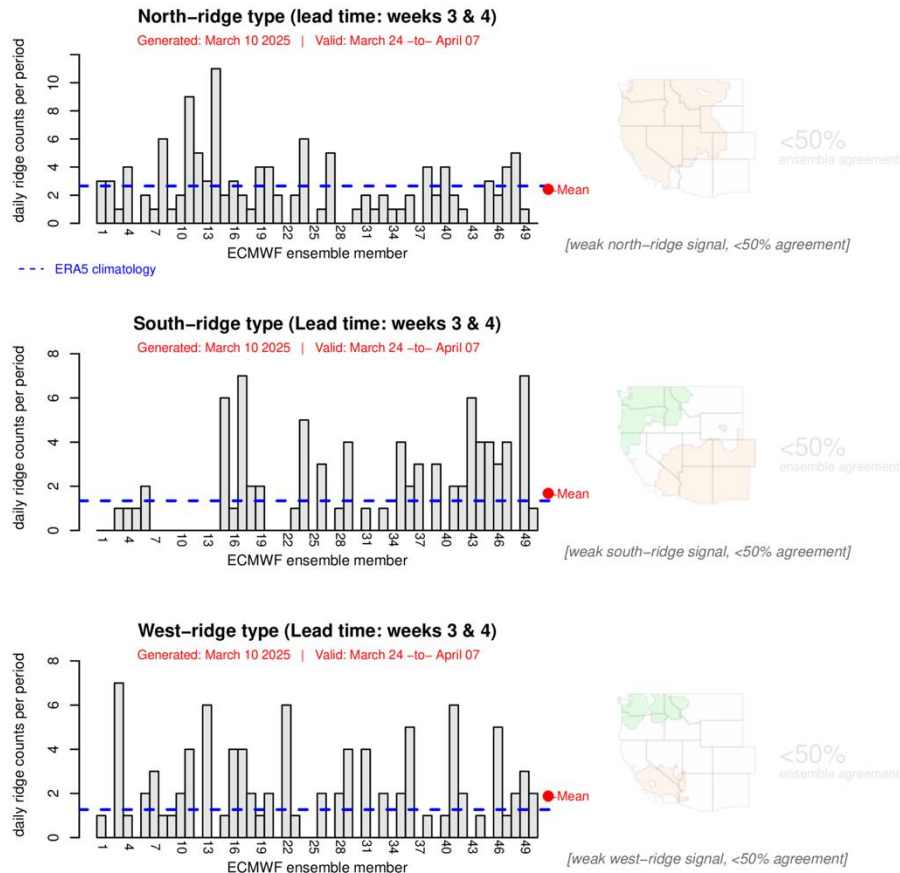
NCEP

CW3E Subseasonal Ridging Forecast (Uses NCEP CFSv2 model)



ECMWF

CW3E Subseasonal Ridging Forecast (Uses ECMWF model)



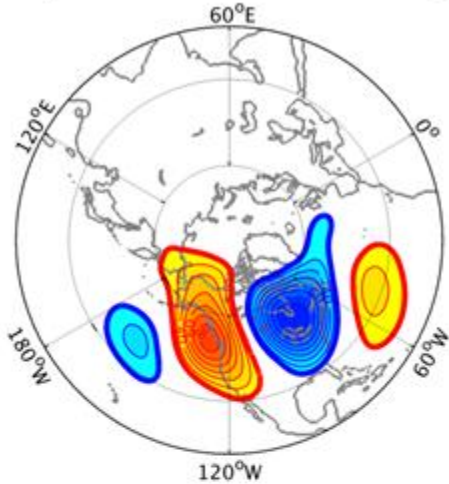
Forecasts Initialized 10 Mar 2025

- NCEP is forecasting a moderate likelihood (69% ensemble agreement) of above-normal West-ridge activity during Weeks 3–4 (24 Mar – 7 Apr)
- ECMWF is also forecasting above-normal West-ridge activity, but with low confidence (<50% ensemble agreement)
- Both models are also forecasting near-normal North-ridge and South-ridge activity

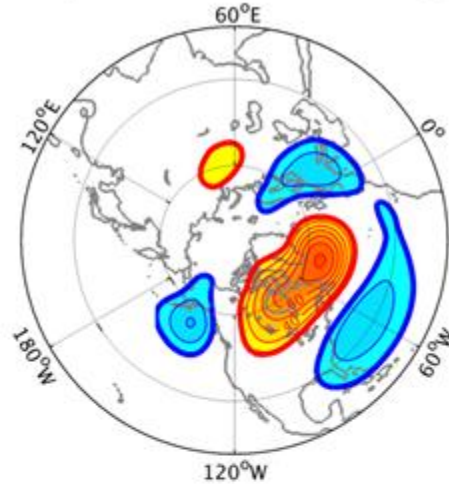
Models show potential for above-normal ridging activity west of California during Weeks 3–4 (24 Mar – 7 Apr), but disagree on likelihood

Background Info: IRI Subseasonal Weather Regime Forecasts

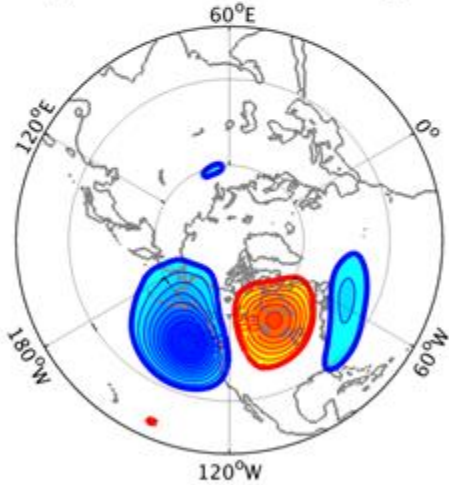
a) WR 1: West Coast Ridge



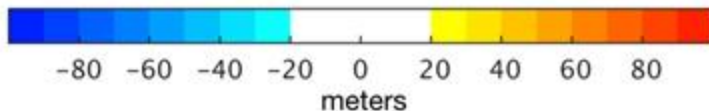
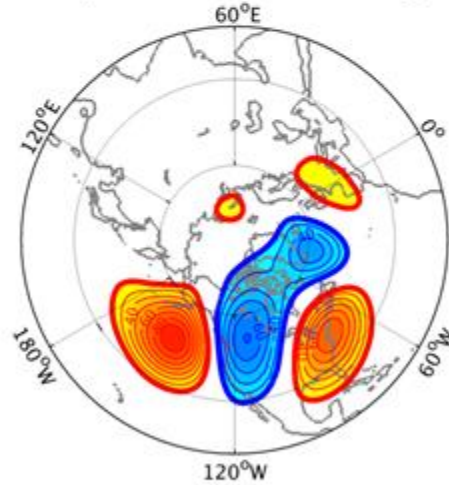
b) WR 2: Greenland High



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)

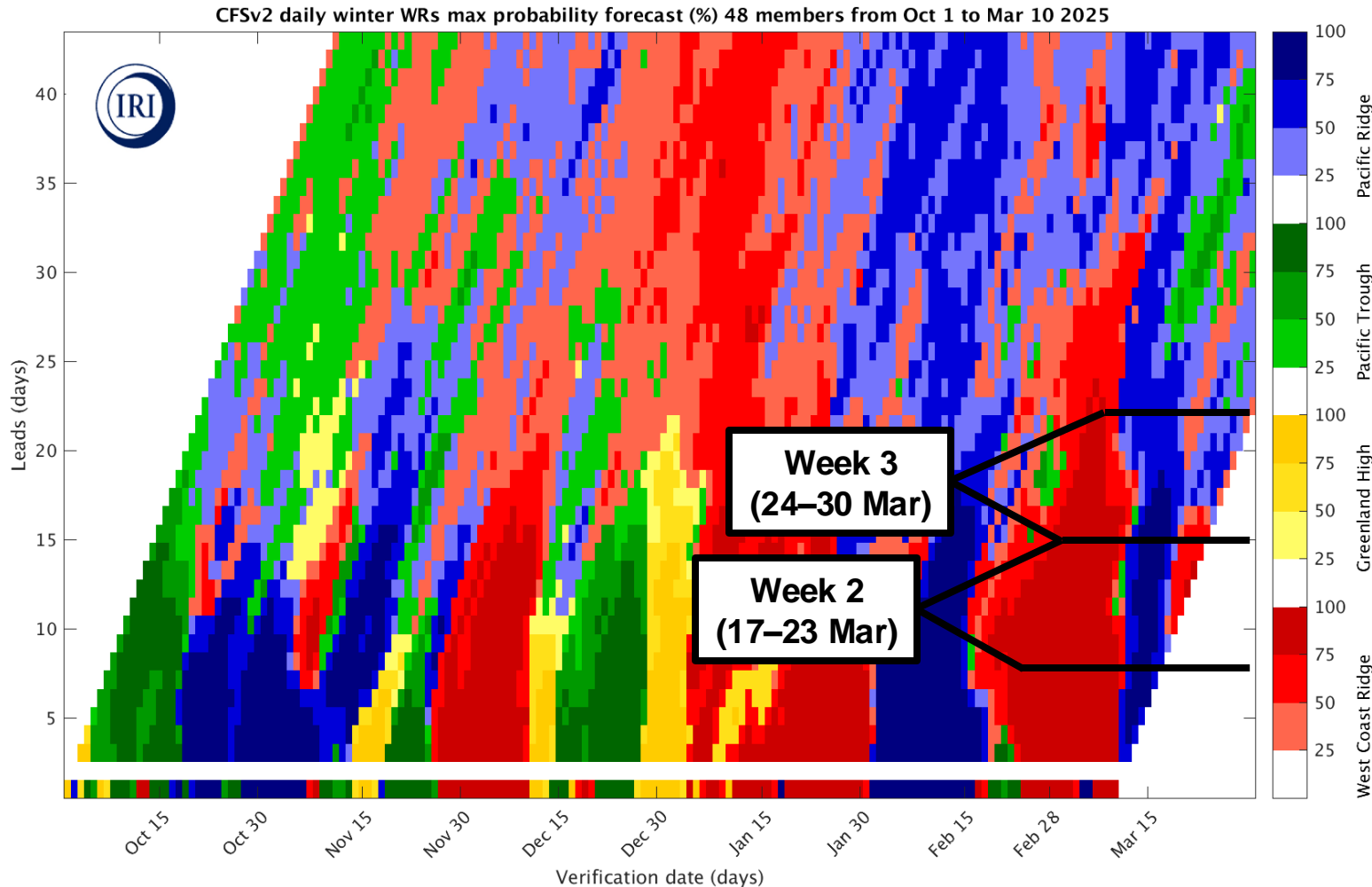
Reference: [Robertson et al. \(2020\)](#)

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 10 Mar 2025



- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- Moderate-to-high likelihood ($\geq 50\%$ ensemble agreement) of transition from Pacific Ridge to West Coast Ridge early in Week 2 (17–23 Mar)
- High degree of uncertainty in regime type during Week 3 (24–30 Mar), with a plurality of ensemble members predicting West Coast Ridge on most days

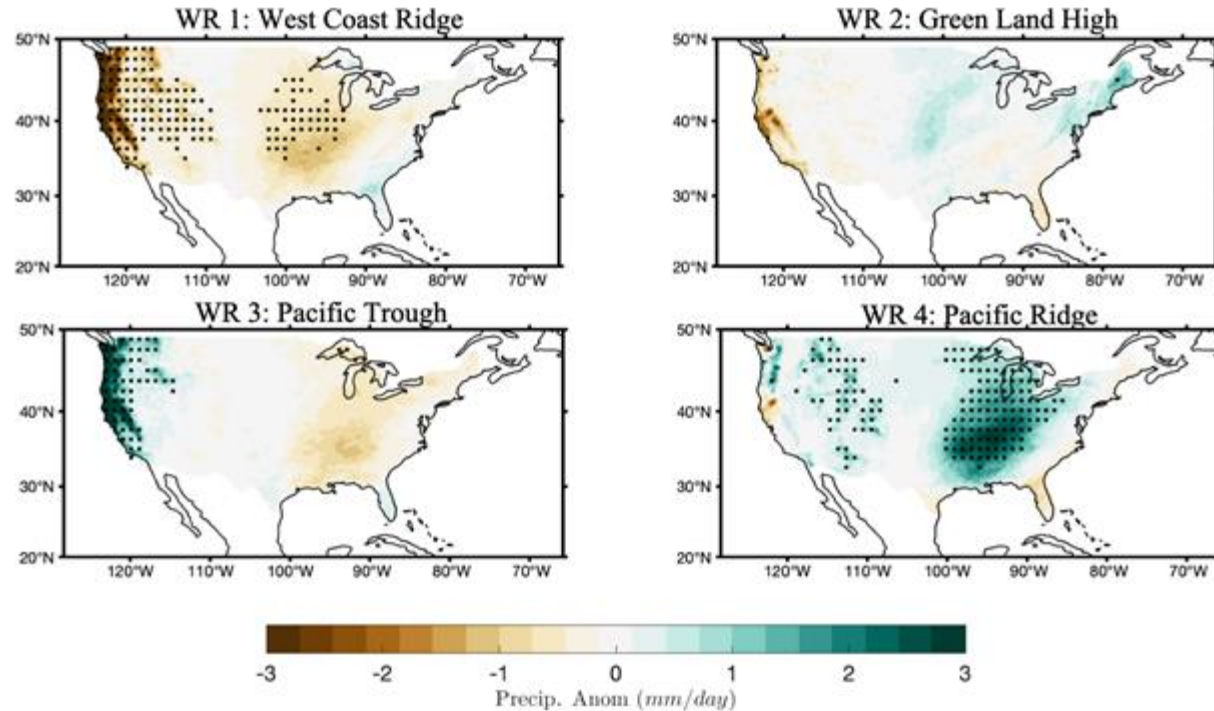
* Note that this product only shows forecasts out to 31 Mar (beginning of Week 4)

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.

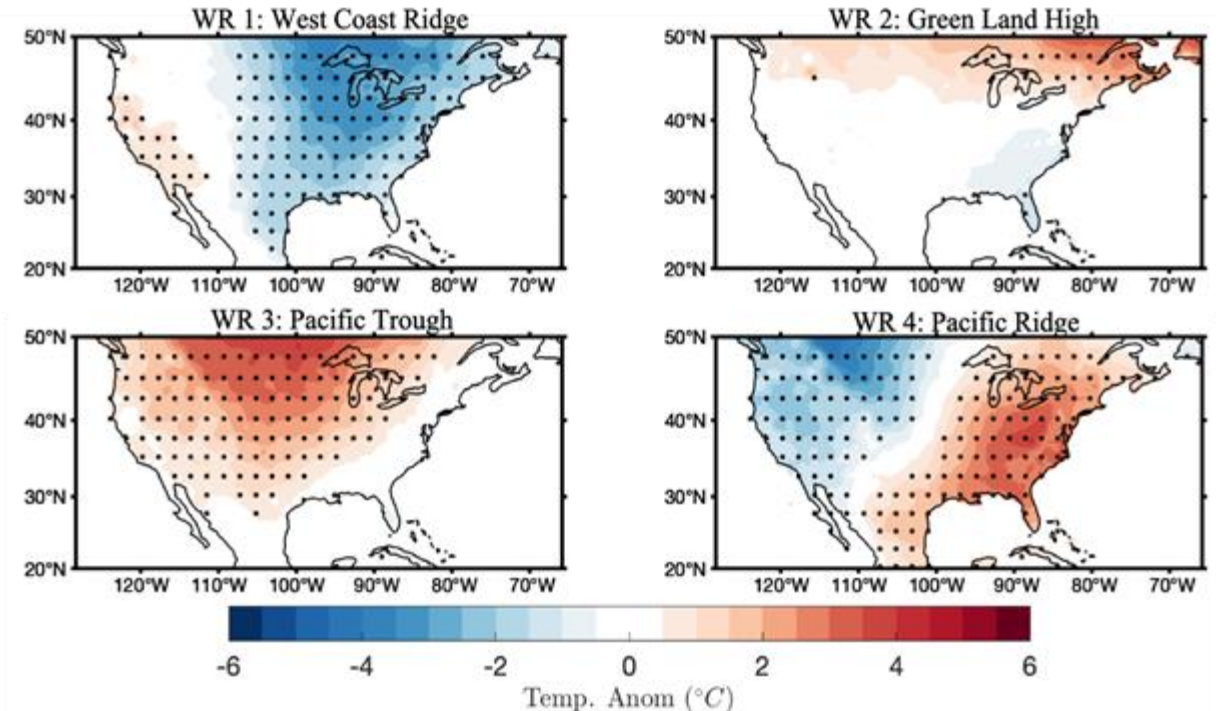
For more information about the forecast product: <https://wiki.iri.columbia.edu/index.php?n=Climate.S2S-WRs>

IRI North American Weather Regime Forecasts

Precipitation



Temperature

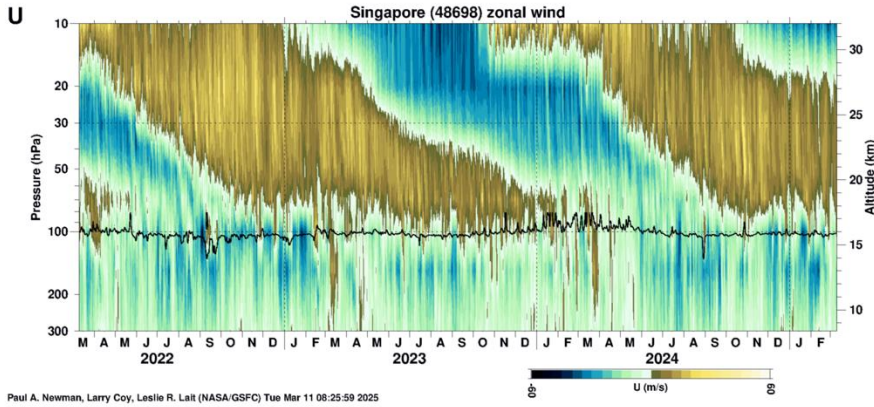


This graphic shows composite mean precipitation (left) and temperature (right) anomalies associated with each weather regime. Stippling (black dots) indicate statistically significant anomalies.

- Below-normal precipitation and above-normal temperature predicted over CA during most of Week 2 (17–23 Mar) with moderate-to-high confidence in regime shift from Pacific Ridge to West Coast Ridge
- Below-normal precipitation and above-normal temperature predicted over CA during most of Week 3 (24–30 Mar) with low confidence in West Coast Ridge regime

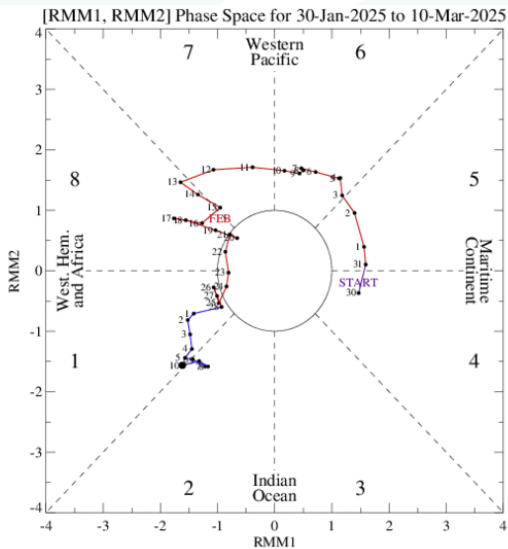
Background Info: AR Activity and Precipitation Based on MJO and QBO

QBO Conditions



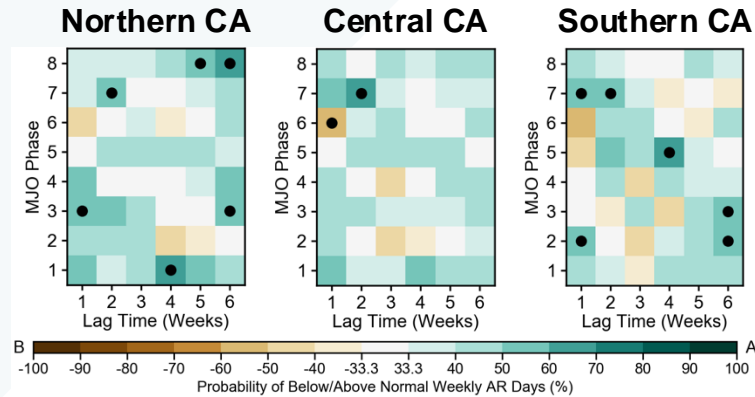
QBO is in the westerly phase at 50-hPa

MJO Conditions

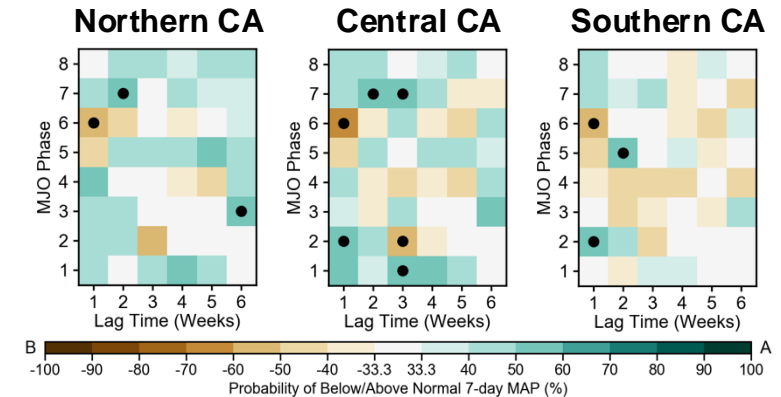


MJO convection is currently hovering over Africa (Phase 1) and the Indian Ocean (Phase 2)

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



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



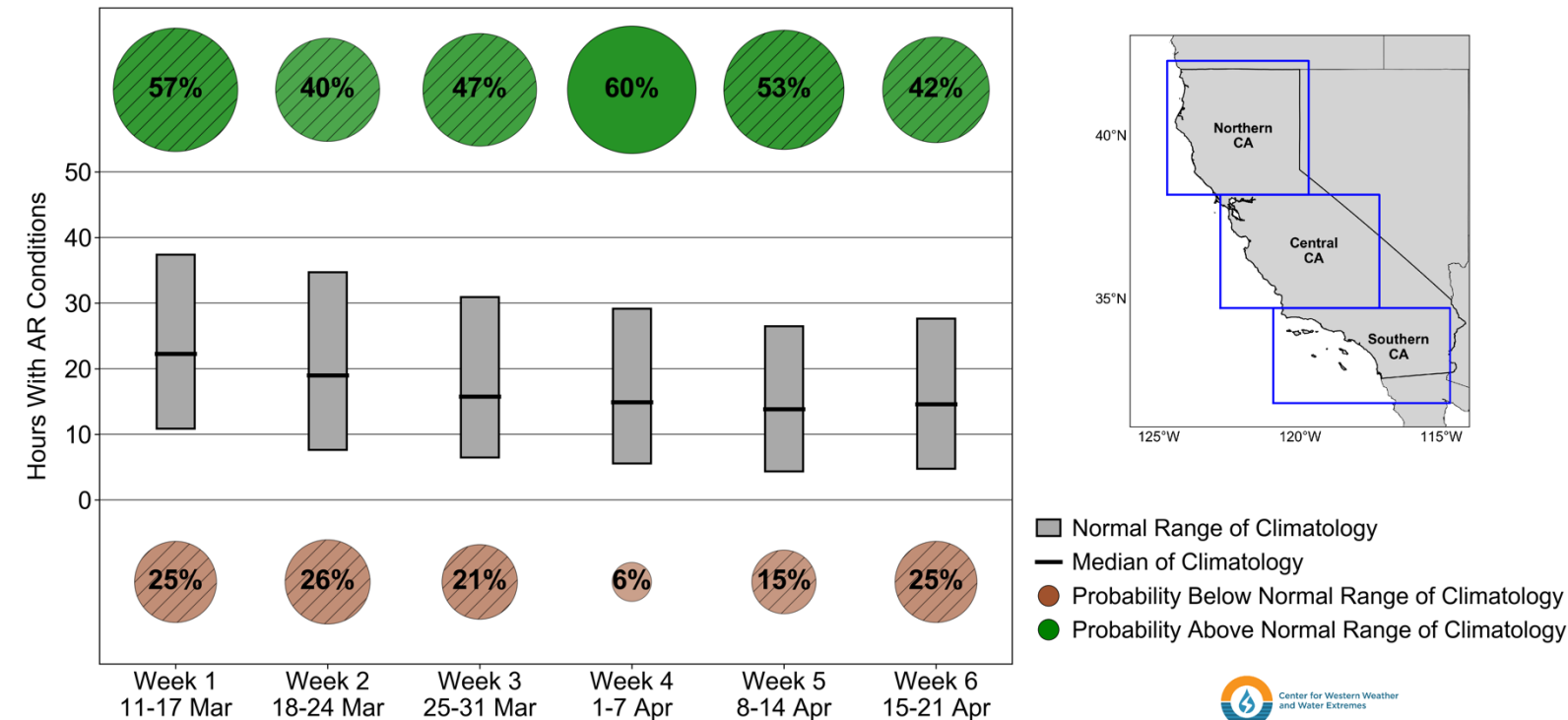
Probability matrices illustrating the weeks 1–6 lagged probability of below-normal (brown shading) or above-normal (green shading) AR occurrence and precipitation for all MJO phases when the QBO is in the westerly phase during JFM in Northern CA (left), Central CA (middle), and Southern CA (right). White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

Forecasts Initialized 10 Mar 2025

AR Occurrence: Northern CA

Northern CA Subseasonal AR Occurrence Outlook
Issued: 10 Mar 2025 MJO Phase 1 WQBO



- CW3E's probabilistic AR occurrence forecast based on current MJO and QBO conditions (see forecast for all regions [here](#))
- **Moderate likelihood ($\geq 40\%$ probability) of above-normal AR occurrence during Weeks 2–3 (18–31 Mar) and high likelihood ($\geq 60\%$ probability) of above-normal AR occurrence during Week 4 (1–7 Apr) in Northern CA**
- Moderate likelihood of above-normal AR occurrence in Central CA during Weeks 2–4 (18 Mar – 7 Apr)
- Moderate likelihood of above-normal AR occurrence in Southern CA during Week 4

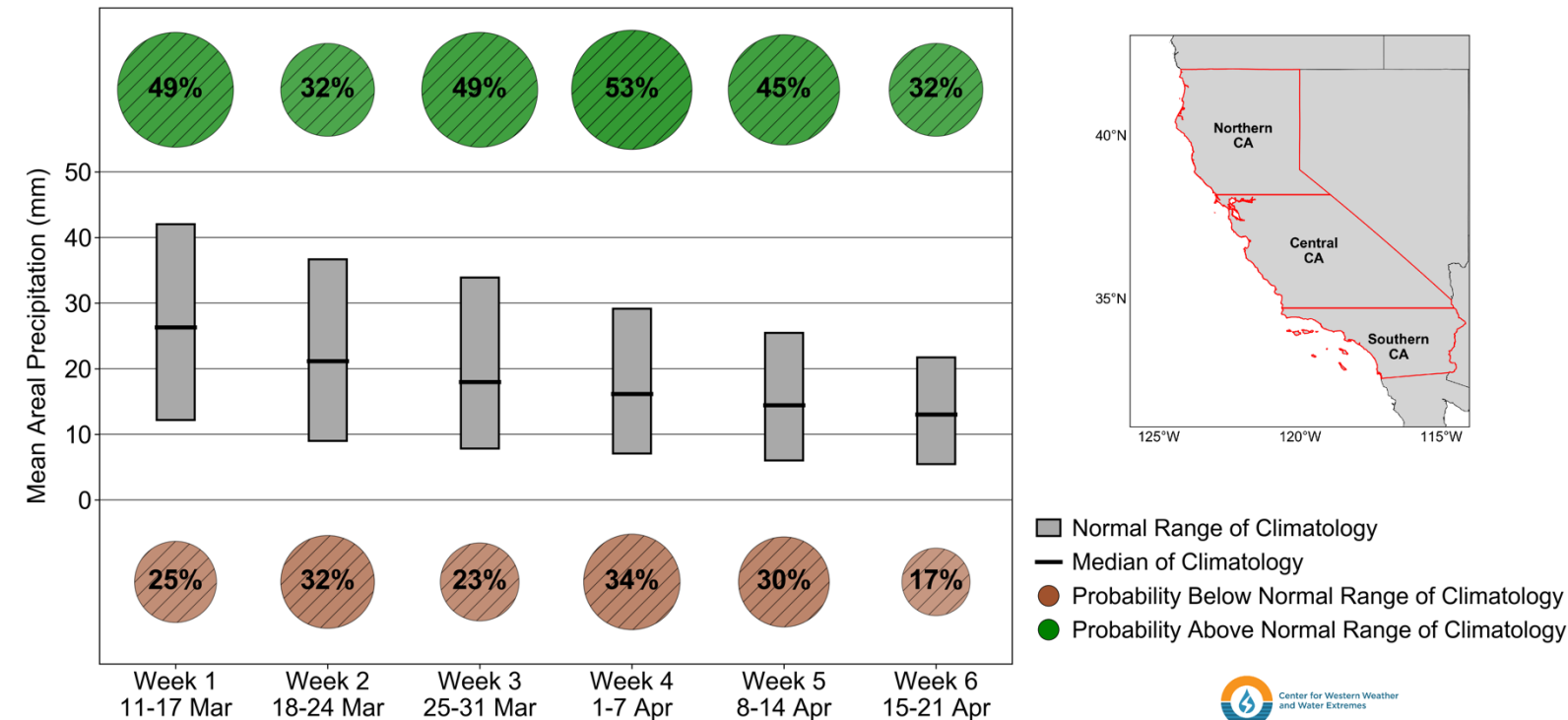
This product shows weekly probabilities of above-normal and below-normal AR occurrence in California. These probabilities are calculated for lead times of 1–6 weeks based on the current season (i.e., OND or JFM) and phases of the Madden-Julian Oscillation (MJO) and Quasi-biennial Oscillation (QBO). If 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 10 Mar 2025

Precipitation: Northern CA

Northern CA Subseasonal Precipitation Outlook
Issued: 10 Mar 2025 MJO Phase 1 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 of above-normal precipitation in Northern CA during Weeks 3–4 (25 Mar – 7 Apr)**
- Moderate likelihood of above-normal precipitation in Central CA during Weeks 2–4
- Moderate likelihood of above-normal precipitation in Southern CA during Week 4

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
 - ECCC (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*