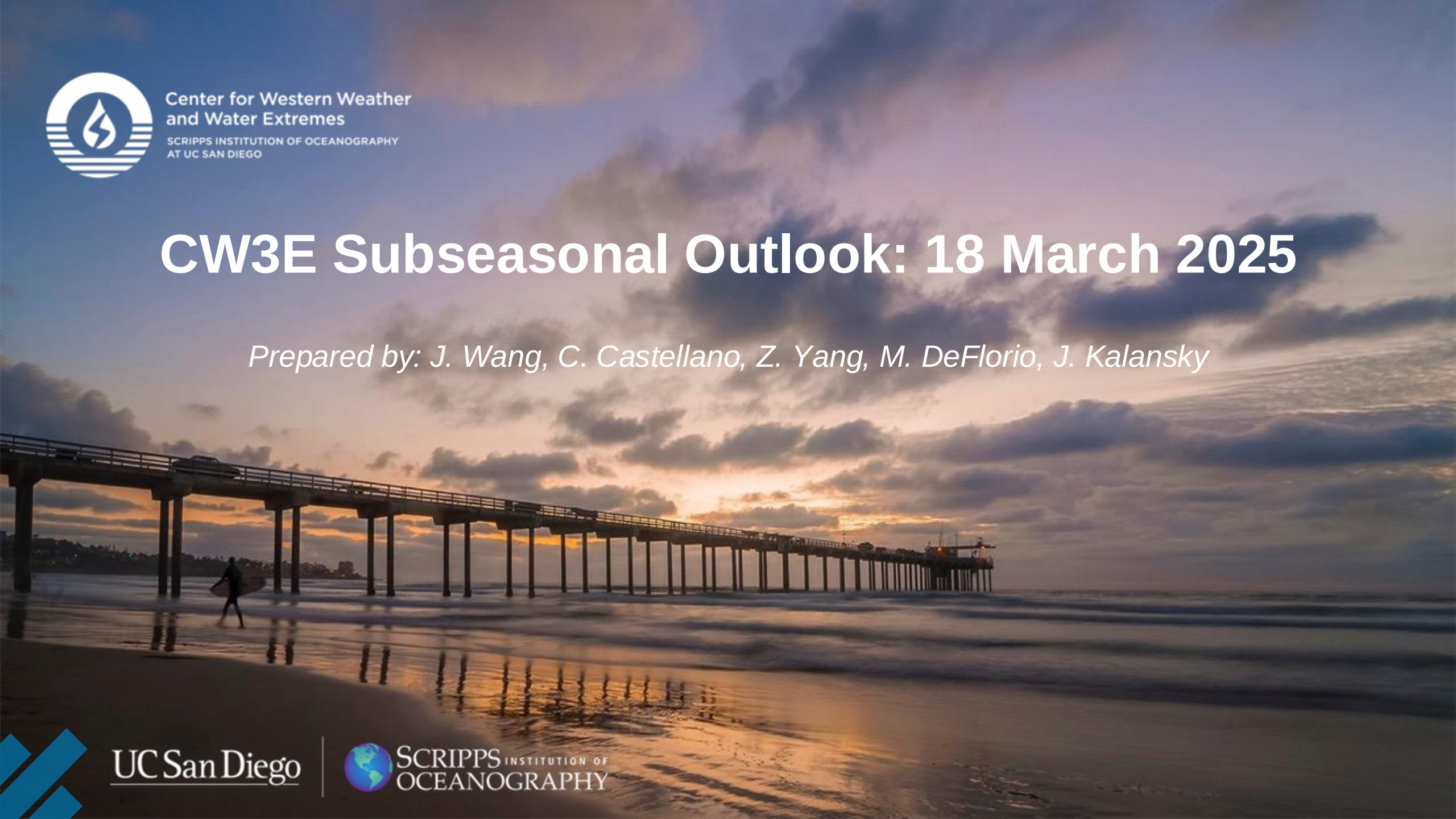

CW3E Subseasonal Outlook: 18 March 2025

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

Summary: Subseasonal Precipitation Outlook by Model

This slide shows the CW3E synthesis of subseasonal products by model

Forecasts Initialized 17 Mar 2025

Region	Week 2 (24–30 Mar)				Week 3 (31 Mar – 6 Apr)				Week 4 (7 – 13 Apr)			
	NCEP[1,2,3]	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												
Northern CA												
Central CA												
Southern CA												

Higher Confidence | Lower Confidence

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

- Models show large uncertainty in precipitation over CA during Weeks 2-4 due to disagreement among models and forecast products

Subseasonal products included in this Outlook:

[1]CW3E/JPL Atmospheric River Activity Forecasts (DeFlorio et al. 2019, Zhang et al. 2023)
[2]CW3E/JPL Ridging Forecasts (Gibson et al. 2020)
[3]IRI North American Weather Regime Forecasts (Robertson et al. 2020)

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Summary

MJO/QBO Conditions

- Strong MJO convection is currently located over the Indian Ocean (Phase 3); QBO is in the westerly phase
- Both models are forecasting MJO convection to propagate eastward across the Maritime Continent (Phases 4&5) and reach the Western Pacific (Phase 6) by the end of Week 1. After that, MJO is predicted to be relatively stationary with slow or no eastward propagation over the Western Pacific 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 (24–30 Mar):

- Models agree on near-normal AR activity over Northern and Central CA, but slightly disagree on AR activity over Southern CA during Week 2
  - ECCC and ECMWF are forecasting near-normal AR activity in Southern CA, whereas NCEP is forecasting near-normal to slightly below-normal AR activity

- Ridging outlooks show moderate-to-high likelihood of above-normal North-ridge activity (dry conditions over all of 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)
  - ECMWF is also forecasting a moderate likelihood of above-normal South-ridge activity (wet conditions in Northern CA and dry conditions in Southern CA)

- 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 (31 Mar – 6 Apr):

- Models disagree somewhat on AR activity over CA during Week 3
  - In Northern CA, NCEP is forecasting above-normal AR activity, ECCC is forecasting near-normal to slightly above-normal AR activity, and ECMWF is forecasting near-normal AR activity
  - In Central CA, NCEP is forecasting near-normal to slightly above-normal AR activity, ECCC is forecasting above-normal AR activity, and ECMWF is forecasting near-normal to slightly below-normal AR activity
  - In Southern CA, NCEP is forecasting near-normal AR activity, ECCC is forecasting slightly above-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 high likelihood of above-normal West-ridge activity
  - ECMWF is also forecasting above-normal West-ridge activity, but with low confidence

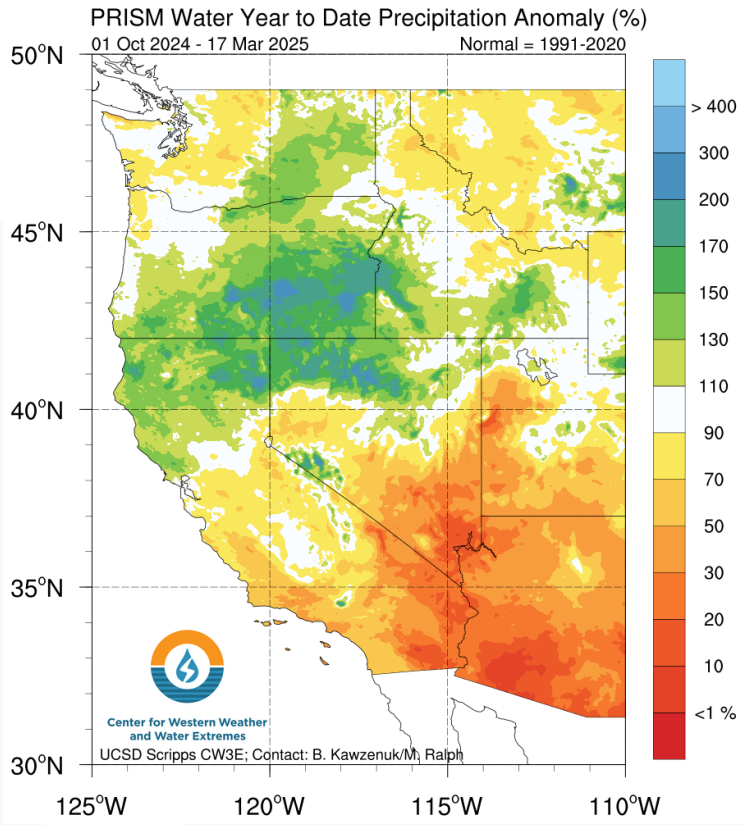
- IRI weather regime tool forecasts are not available for Weeks 3-4

Week 4 Forecasts (7 – 13 Apr):

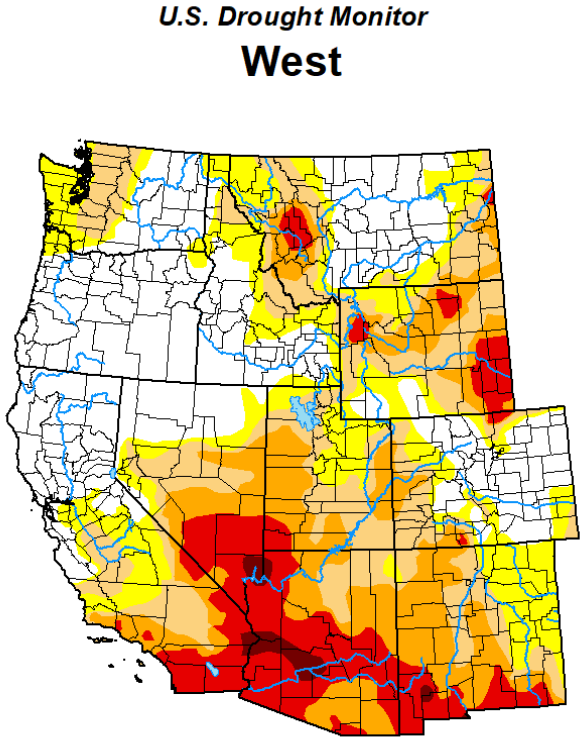
- Models generally agree on near-normal AR activity over Central CA, but disagree somewhat on AR activity over Northern and Southern CA
  - In Northern CA, NCEP and ECCC are forecasting near-normal AR activity, whereas ECMWF is forecasting slightly below-normal AR activity
  - In Southern CA, NCEP is forecasting near-normal to slightly below-normal AR activity, ECCC is forecasting slightly above-normal AR activity, and ECMWF is forecasting near-normal AR activity

Hydrologic Summary

Precipitation



Drought Conditions



March 11, 2025
(Released Thursday, Mar. 13, 2025)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	33.53	66.47	48.57	29.43	13.07	1.03
Last Week 03-04-2025	33.48	66.52	48.82	28.88	12.80	0.96
3 Months Ago 12-10-2024	30.41	69.59	34.76	18.15	6.58	0.00
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 03-12-2024	49.88	50.12	25.45	10.53	2.45	0.36

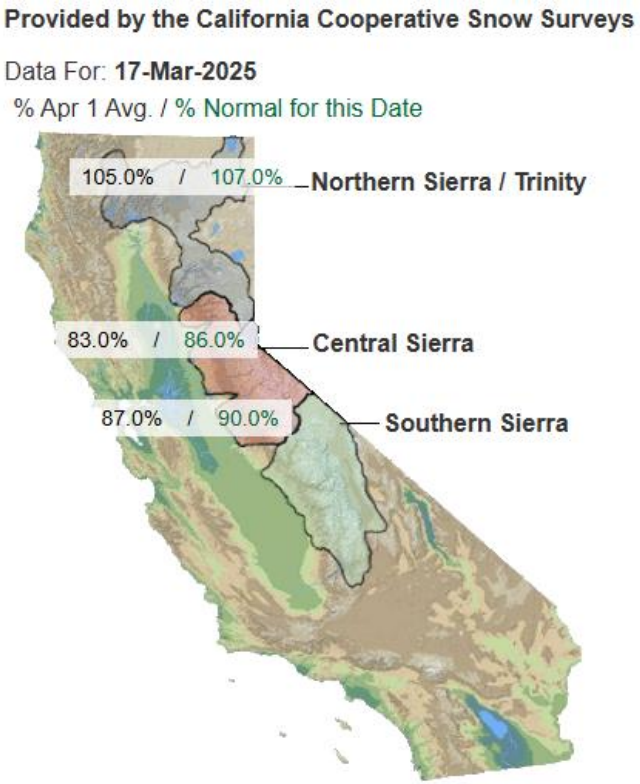
Intensity:
- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

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

Author:
Richard Tinker
CPC/NOAA/NWS/NCEP

droughtmonitor.unl.edu

Snowpack Conditions



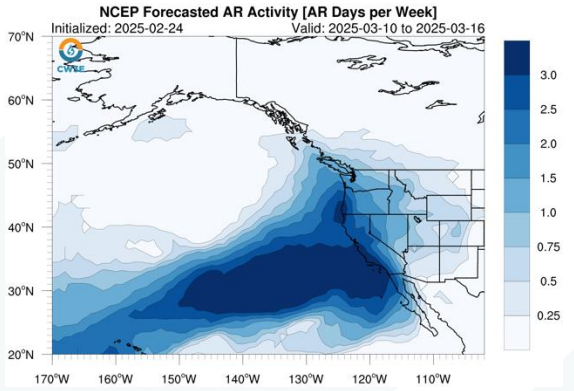
Source: California DWR

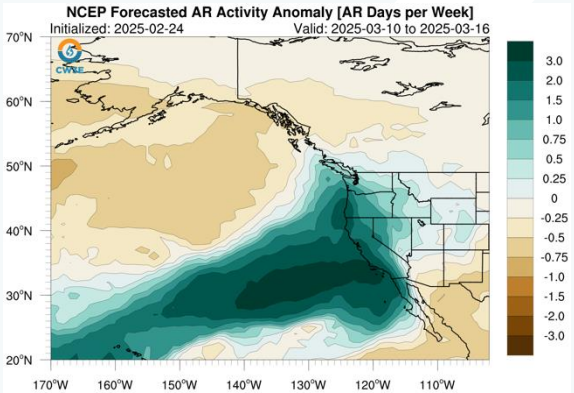
- As of 17 Mar, water-year-to-date precipitation is **above-normal (> 110% of normal)** in Northern CA, **slightly below-normal (70–90% of normal)** in Central CA, and **below-normal (<70% of normal)** in Southern CA
- The most recent drought monitor update from 11 Mar is showing a continuation of **moderate-to-extreme drought (D1–D3)** in Southern CA and **abnormally dry (D0) to moderate drought (D1)** conditions over much of Central CA
- Current snowpack is **near-normal (107% of normal)** in the Northern Sierra Nevada/Trinity region, **slightly below-normal** in the Central Sierra Nevada **(86% of normal)**, and **near-normal** in the Southern Sierra Nevada **(90% of normal)**

Looking Back: Week 3 AR Activity Forecasts

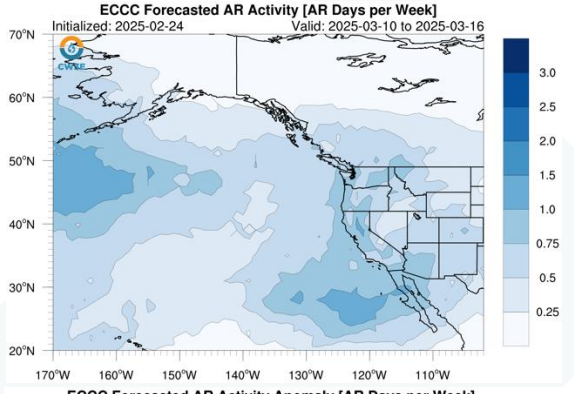
Forecasts Initialized 24 Feb 2025; Valid: 10–16 Mar 2025

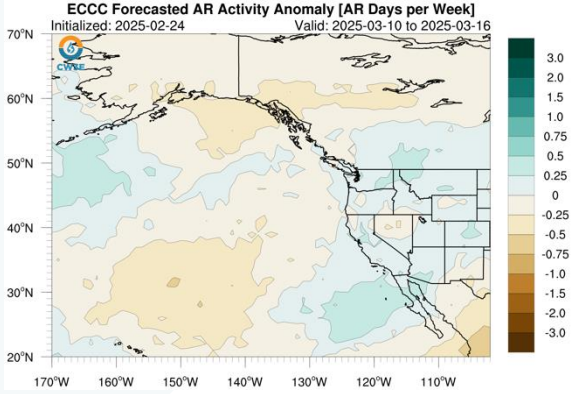
NCEP



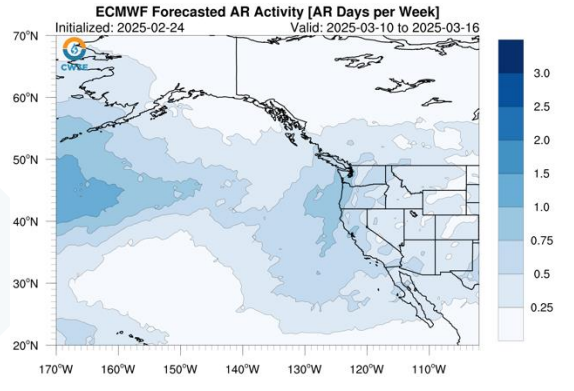


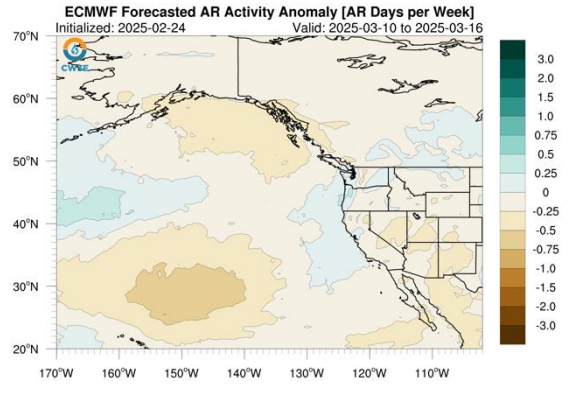
ECCC



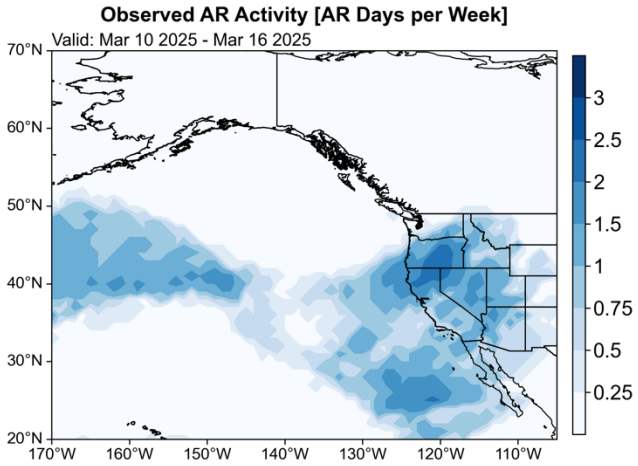


ECMWF

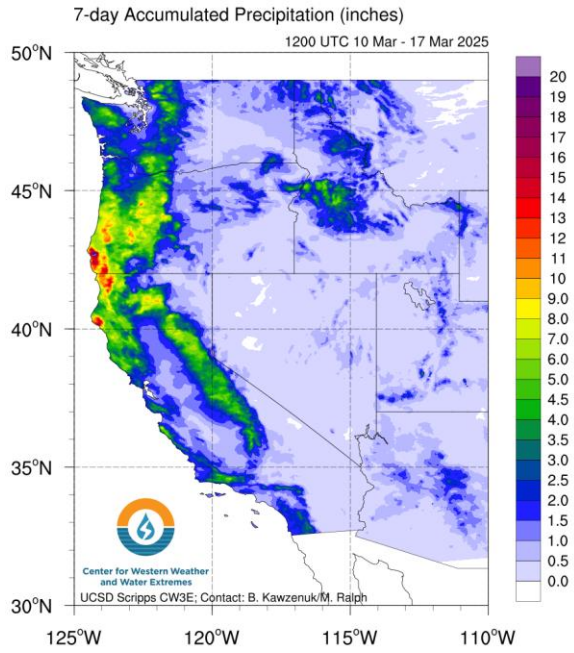




Observed (GFS Analysis)



Observed Precipitation

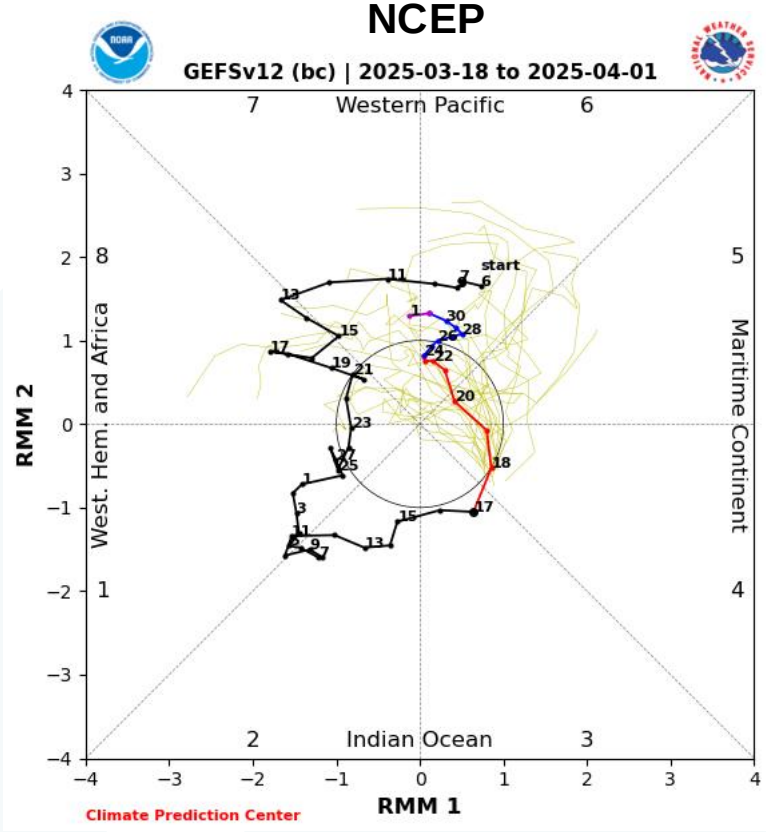


Shading: Fractional # of AR days forecast over a 7-day period (top) and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

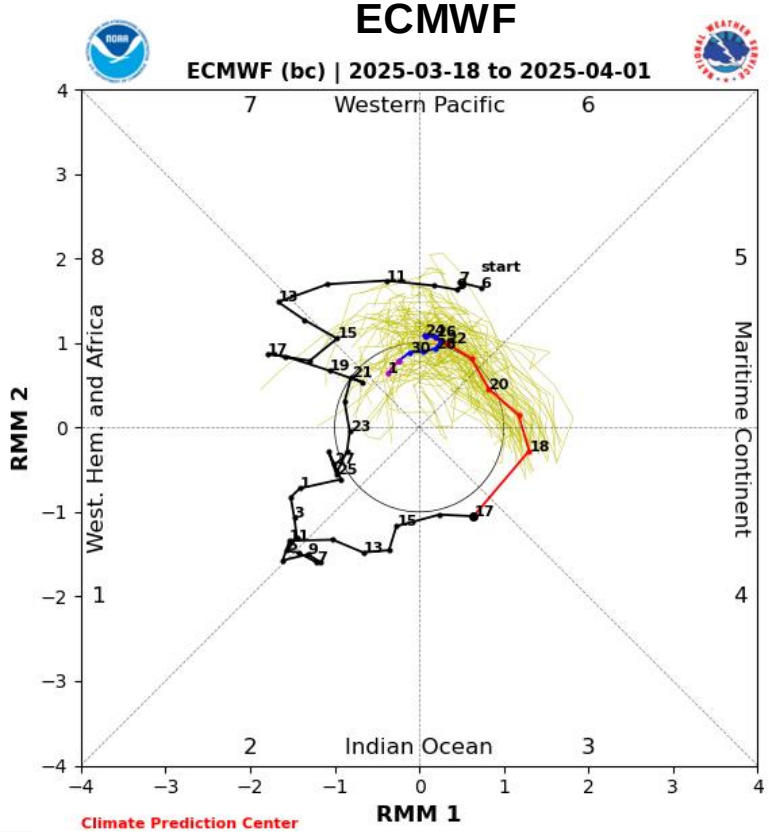
- All models captured some AR activity over the western US
- ECCC and ECMWF better predicted the large-scale circulation pattern and AR axis
- ECCC better predicted the amount of AR activity over CA; NCEP better predicted the amount of AR activity over Oregon; ECMWF significantly underestimated AR activity
- An AR produced 2–4 inches of precipitation in coastal Southern CA and >3 feet of snow across the Sierra Nevada on 13–14 Mar
- Another AR produced heavy precipitation (> 7 inches) over Western OR and Northern CA on 15–17 Mar

Dynamical Model MJO Forecasts (NCEP vs. ECMWF)

NCEP



ECMWF



Black: Last 40 days of observations (6 Feb – 17 Mar); Red: Week 1 (18–24 Mar) ensemble mean; Blue: Week 2 (25–31 Mar) ensemble mean; Yellow: Ensemble members

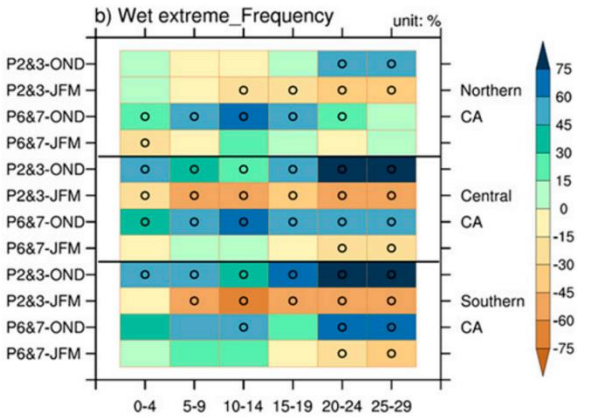


Figure 8 from Wang et al. (2023)

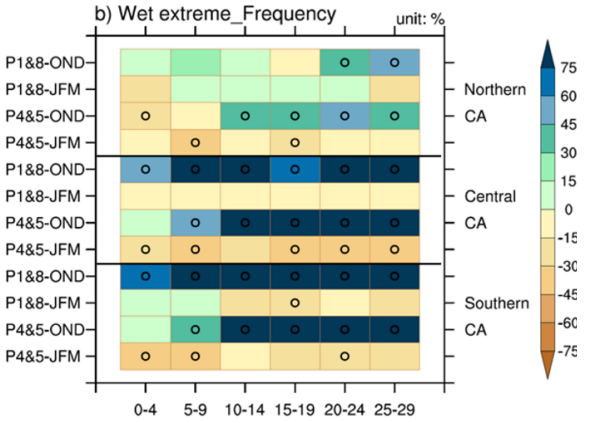


Figure S6 from Wang et al. (2023)

- Strong MJO convection is currently located over the Indian Ocean (Phase 3)
- Both models are forecasting MJO convection to propagate eastward across the Maritime Continent (Phases 4&5) and reach the Western Pacific (Phase 6) by the end of Week 1, and then being relatively stationary with slow or no eastward propagation over the Western Pacific during Week 2
- NCEP is forecasting MJO to weaken during Week 1 and re-strengthen during Week 2, whereas ECMWF is forecasting MJO to remain moderately strong during most of Week 1 and weaken afterwards
- 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

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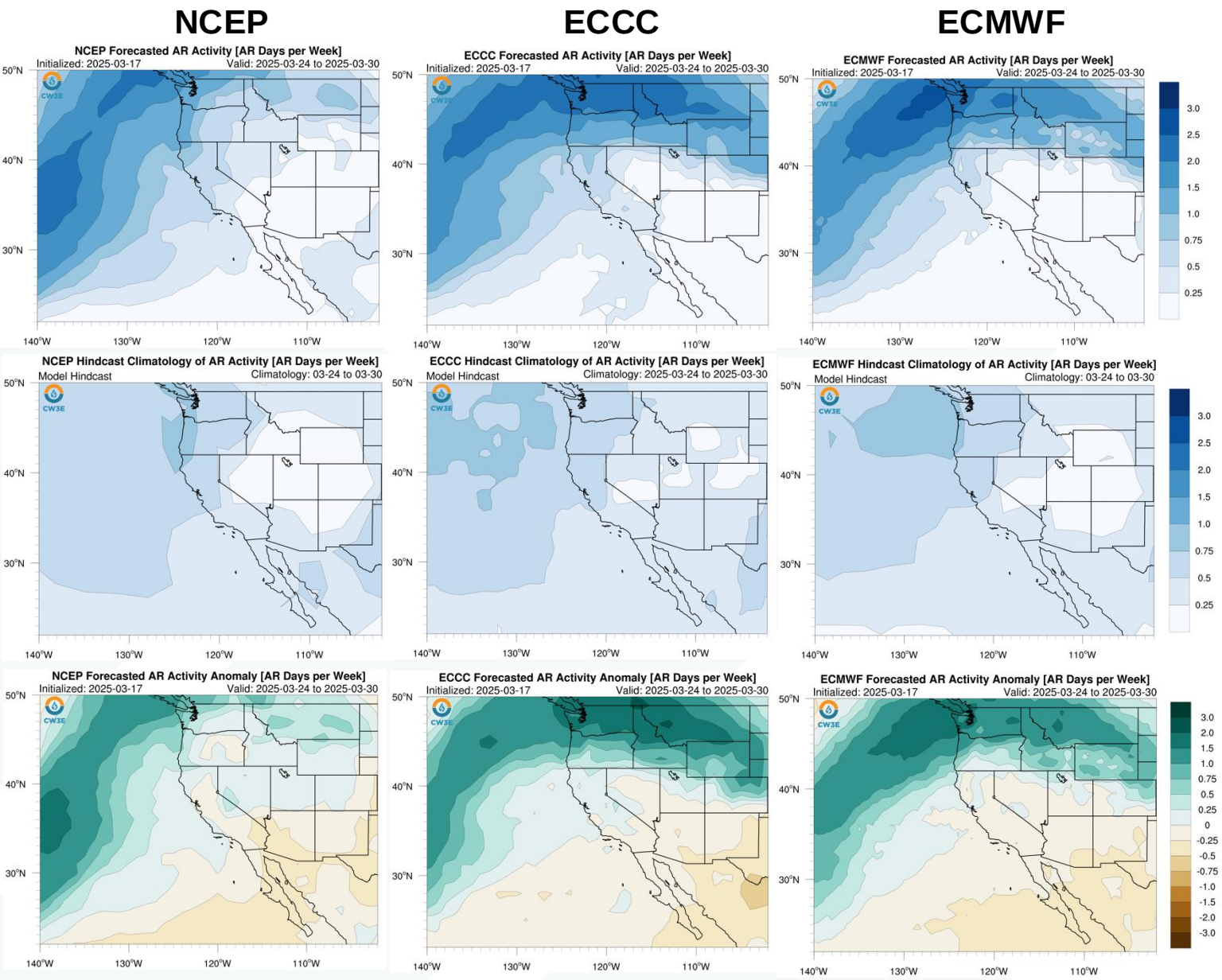
AR Activity Forecasts: Week 2 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 17 Mar 2025



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)

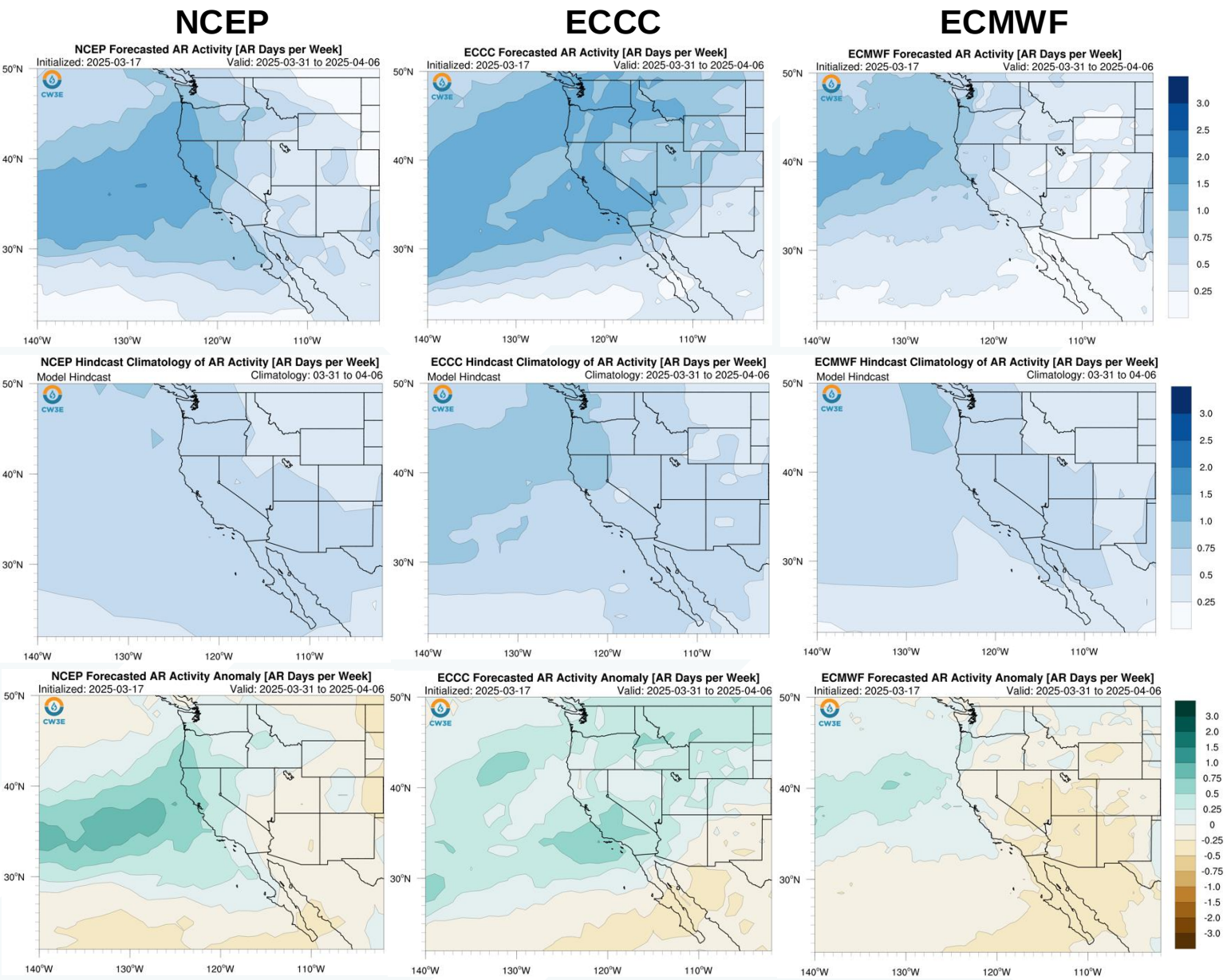
- Models agree on near-normal AR activity in Northern and Central CA and generally agree on near-normal to slightly below-normal AR activity over Southern CA during Week 2 (24-30 Mar)

Models agree on near-normal AR activity over Northern and Central CA and near-normal to slightly below-normal AR activity over Southern CA during Week 2 (24–30 Mar)

Center for Western Weather and Water Extremes

AMBASSADOR WRN WEATHER-READY NATION

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



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)

Forecasts Initialized 17 Mar 2025

- In Northern CA, NCEP is forecasting above-normal AR activity, ECCC is forecasting near-normal to slightly above-normal AR activity, and ECMWF is forecasting near-normal AR activity during Week 3 (31 Mar – 6 Apr)
- In Central CA, NCEP is forecasting near-normal to slightly above-normal AR activity, ECCC is forecasting above-normal AR activity, and ECMWF is forecasting near-normal to slightly below-normal AR activity
- In Southern CA, NCEP is forecasting near-normal AR activity, ECCC is forecasting slightly above-normal AR activity, and ECMWF is forecasting slightly below-normal AR activity

Models disagree on AR activity over CA during Week 3 (31 Mar – 6 Apr)

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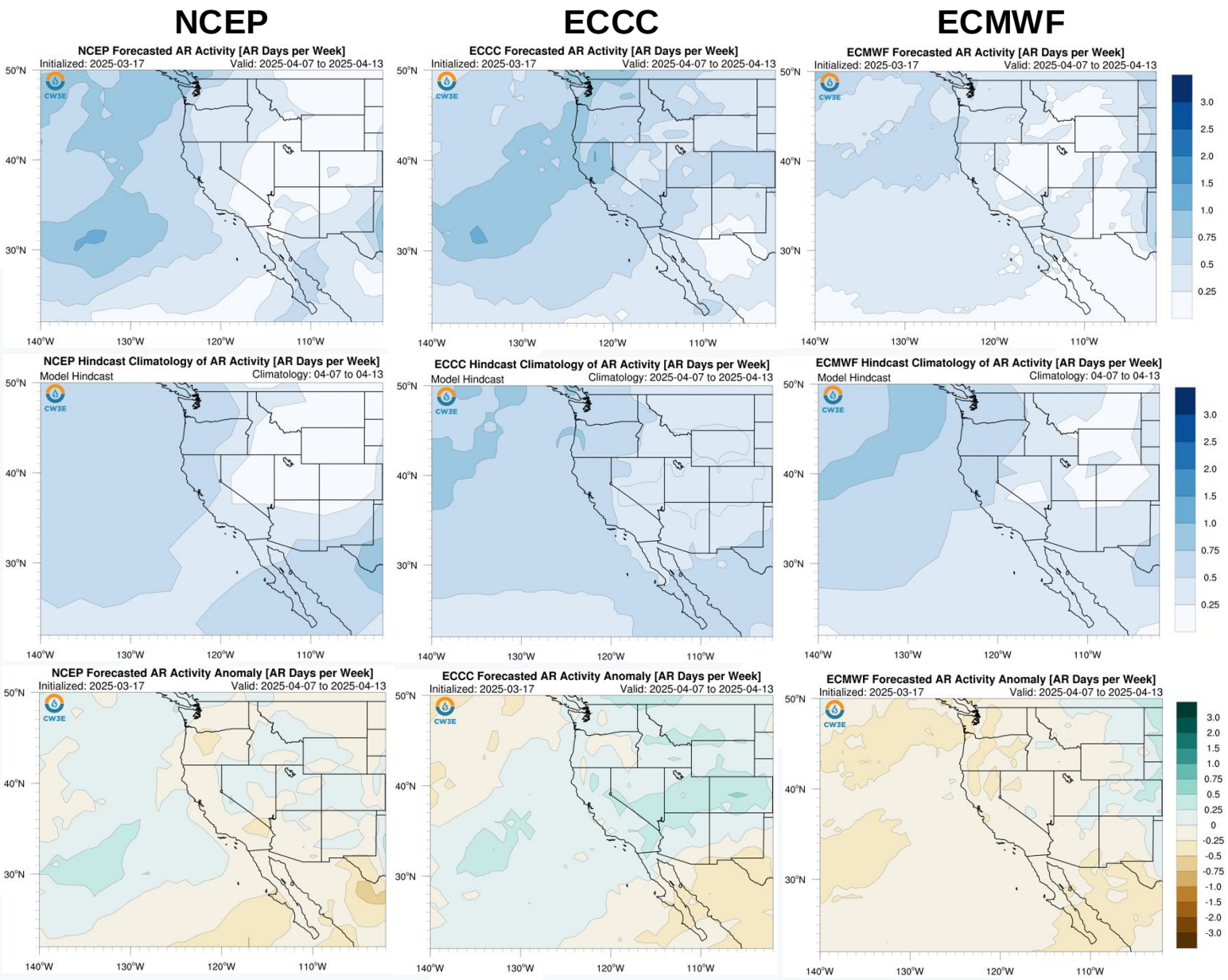
AR Activity Forecasts: Week 4 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 17 Mar 2025



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)

- In Northern CA, NCEP and ECCC are also forecasting near-normal AR activity, whereas ECMWF is forecasting slightly below-normal AR activity during Week 4 (7 – 13 Apr)
- In Central CA, models generally agree on near-normal AR activity
- In Southern CA, NCEP is forecasting near-normal to slightly below-normal AR activity, ECCC is forecasting slightly above-normal AR activity, and ECMWF is forecasting near-normal AR activity

Models generally agree on near-normal AR activity over Central CA during Week 4 (7 – 13 Apr)

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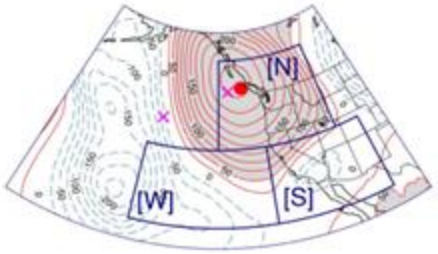
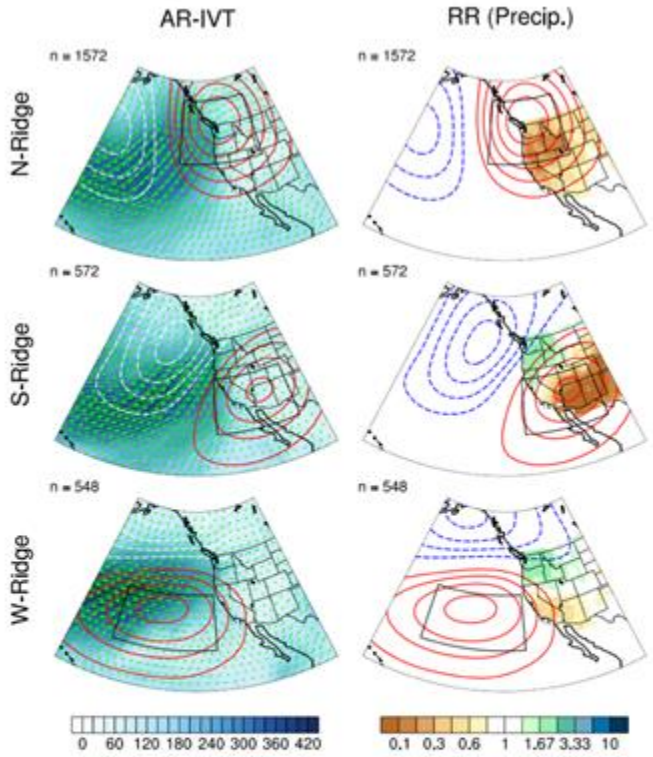
Background Info: Subseasonal Ridging Outlooks



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

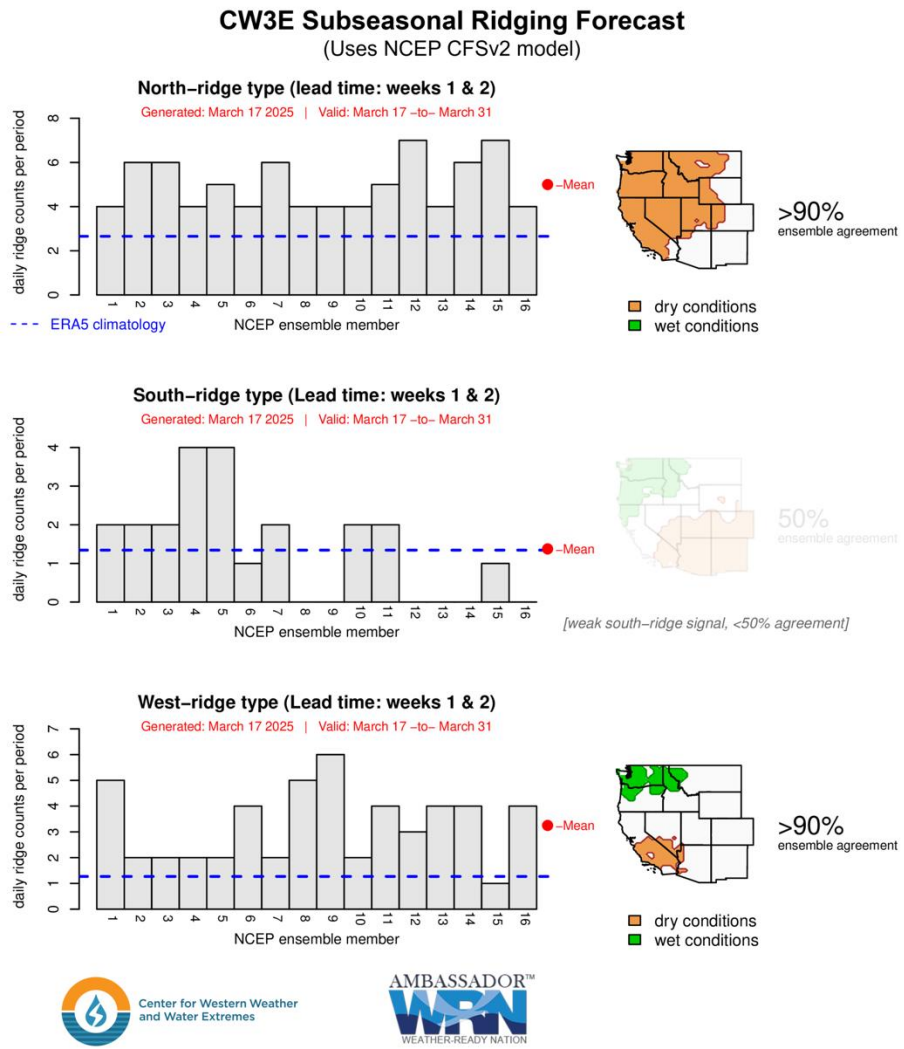
Jet Propulsion Laboratory
California Institute of Technology

Center for Western Weather and Water Extremes
Scripps Institution of Oceanography at UC San Diego

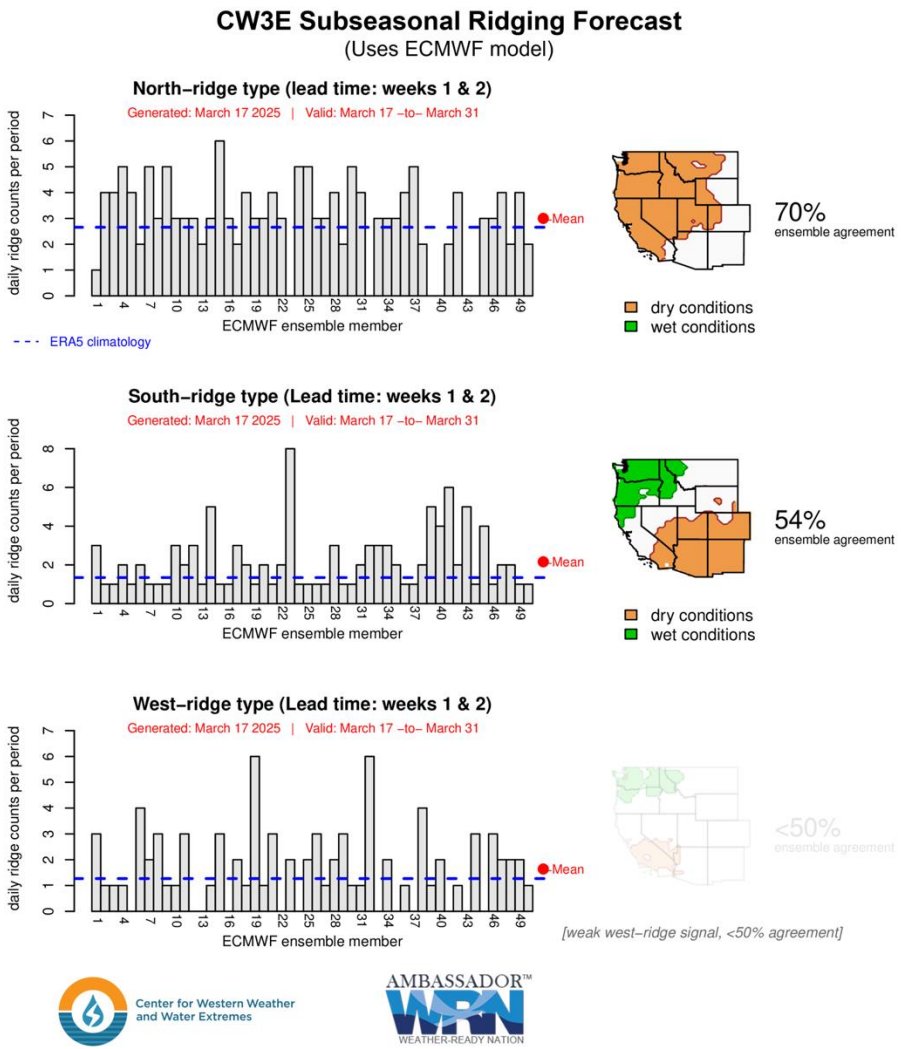
Contact: pgibson@ucsd.edu
Reference: Gibson et al. (2020) Journal of Climate

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

NCEP



ECMWF



Forecasts Initialized 17 Mar 2025

- NCEP and ECMWF are forecasting moderate-to-high likelihood (>70% ensemble agreement) of above-normal North-ridge activity during Weeks 1–2 (17–31 Mar)
- NCEP is also forecasting a high likelihood (>90% ensemble agreement) of above-normal West-ridge activity
- ECMWF is also forecasting a moderate likelihood (54% ensemble agreement) of above-normal South-ridge activity

Models agree on above-normal ridging activity near the Pacific Northwest during Weeks 1–2 (17–31 Mar) and show potential for persistent ridging activity to the southeast or west of CA

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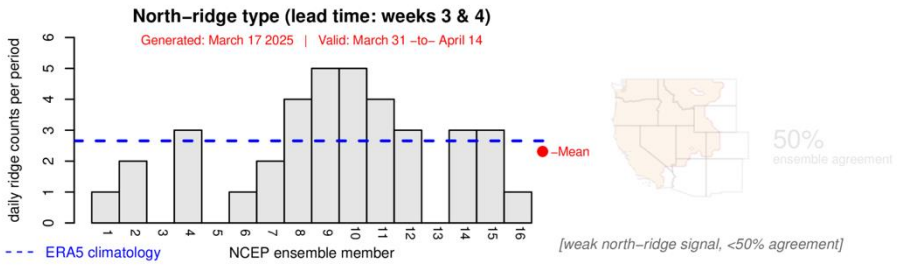
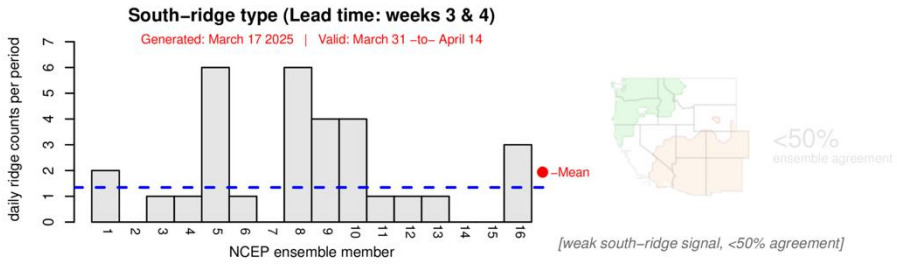
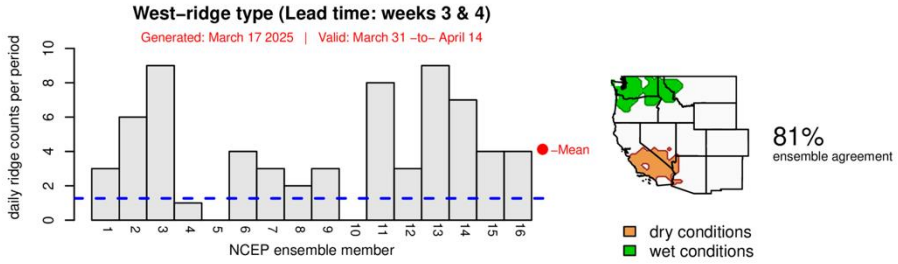
Ridging Forecasts: Weeks 3–4 (NCEP vs. ECMWF)

NCEP

CW3E Subseasonal Ridging Forecast
(Uses NCEP CFSv2 model)

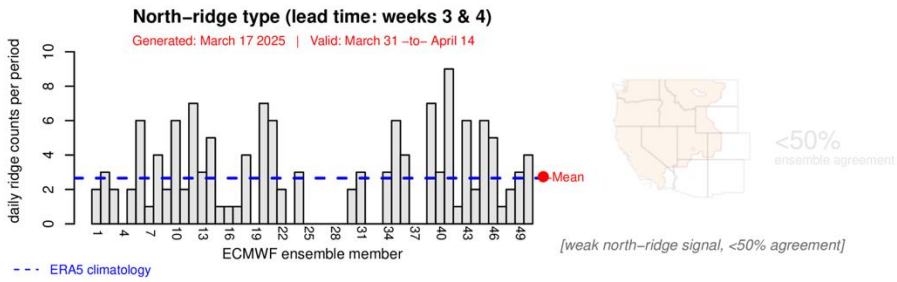


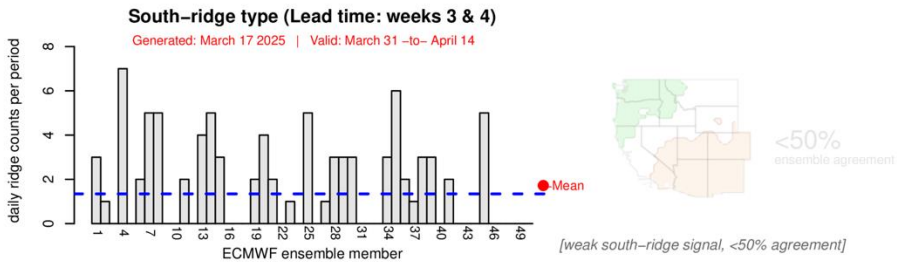


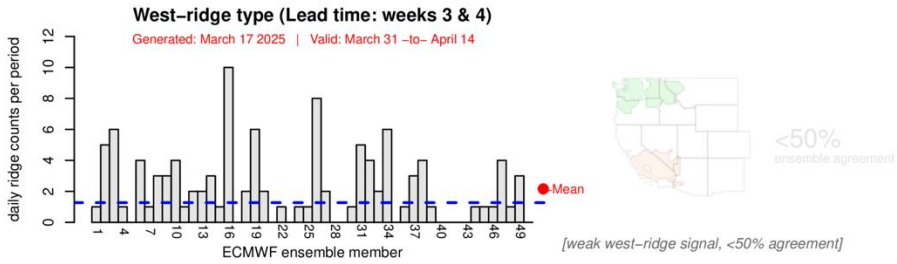


ECMWF

CW3E Subseasonal Ridging Forecast
(Uses ECMWF model)







Forecasts Initialized 17 Mar 2025

- NCEP is forecasting a high likelihood (81% ensemble agreement) of above-normal West-ridge activity during Weeks 3–4 (31 Mar– 14 Apr)
- ECMWF is also forecasting slightly 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 CA during Weeks 3–4 (31 Mar – 14 Apr), but disagree on likelihood

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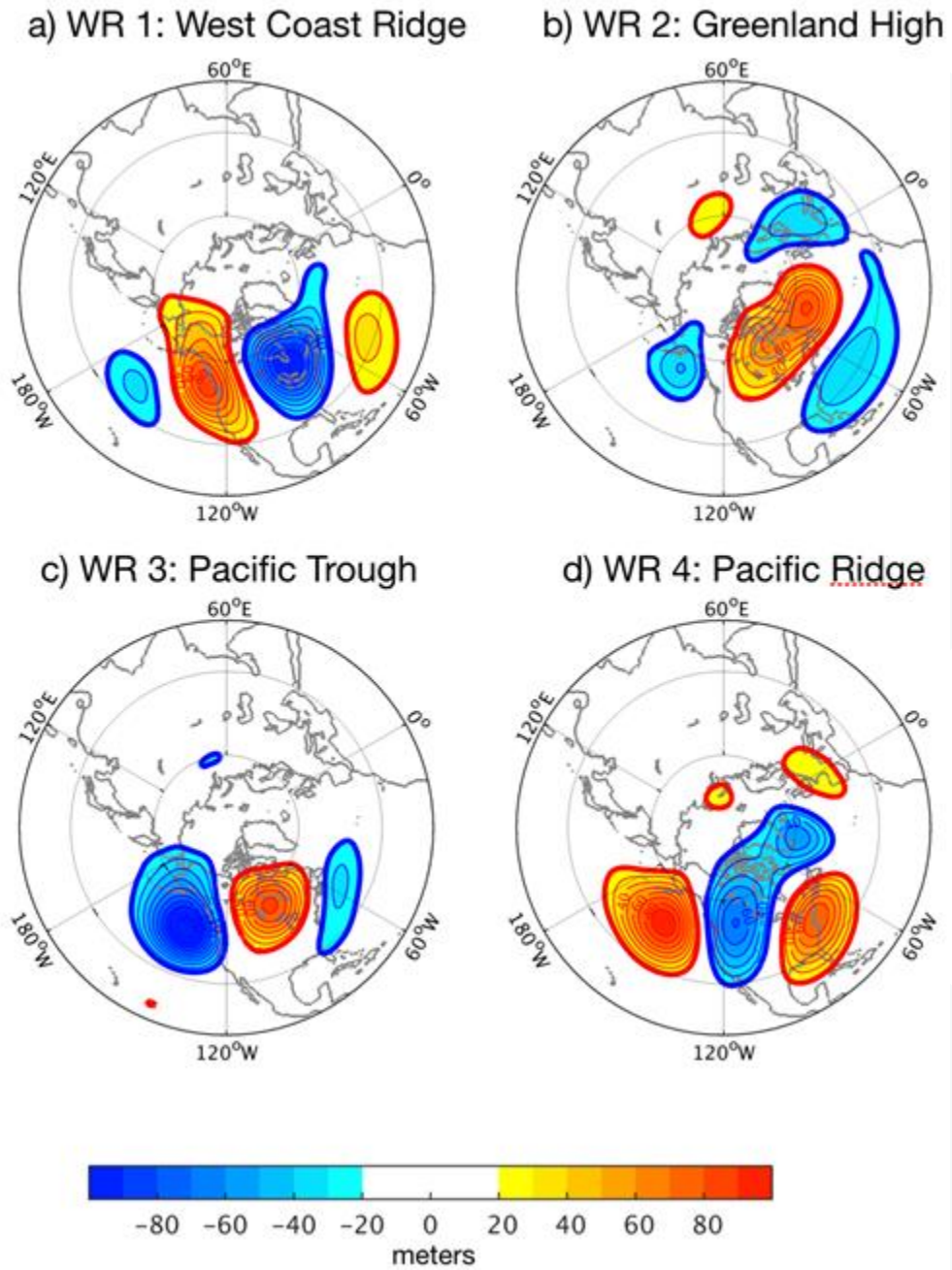
Background Info: IRI Subseasonal Weather Regime Forecasts

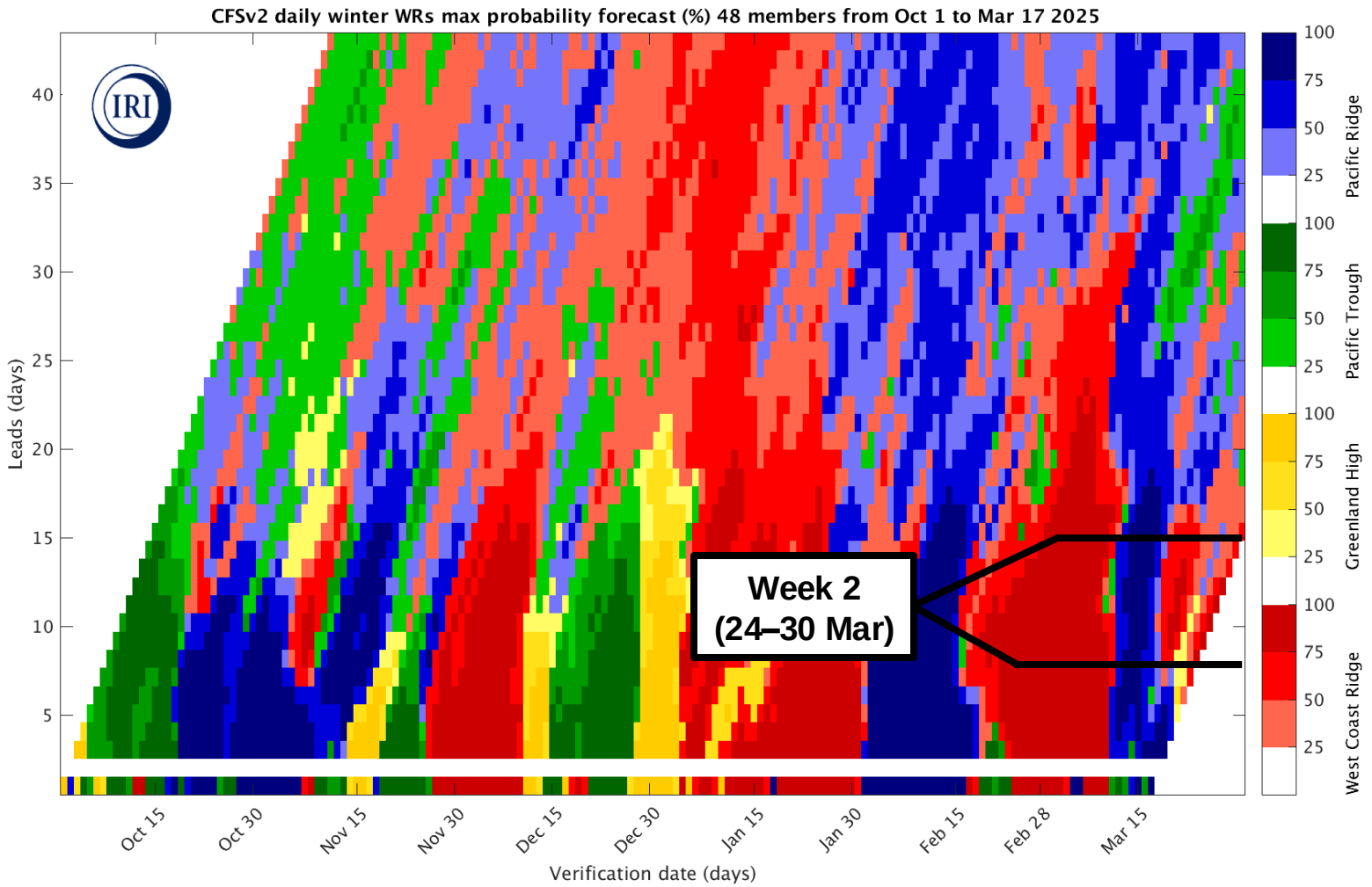


This slide contains background information about IRI's North American weather regime forecast product

- 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 17 Mar 2025

- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- Moderate-to-high likelihood (≥50% ensemble agreement) of West Coast Ridge in Week 2 (24–30 Mar)

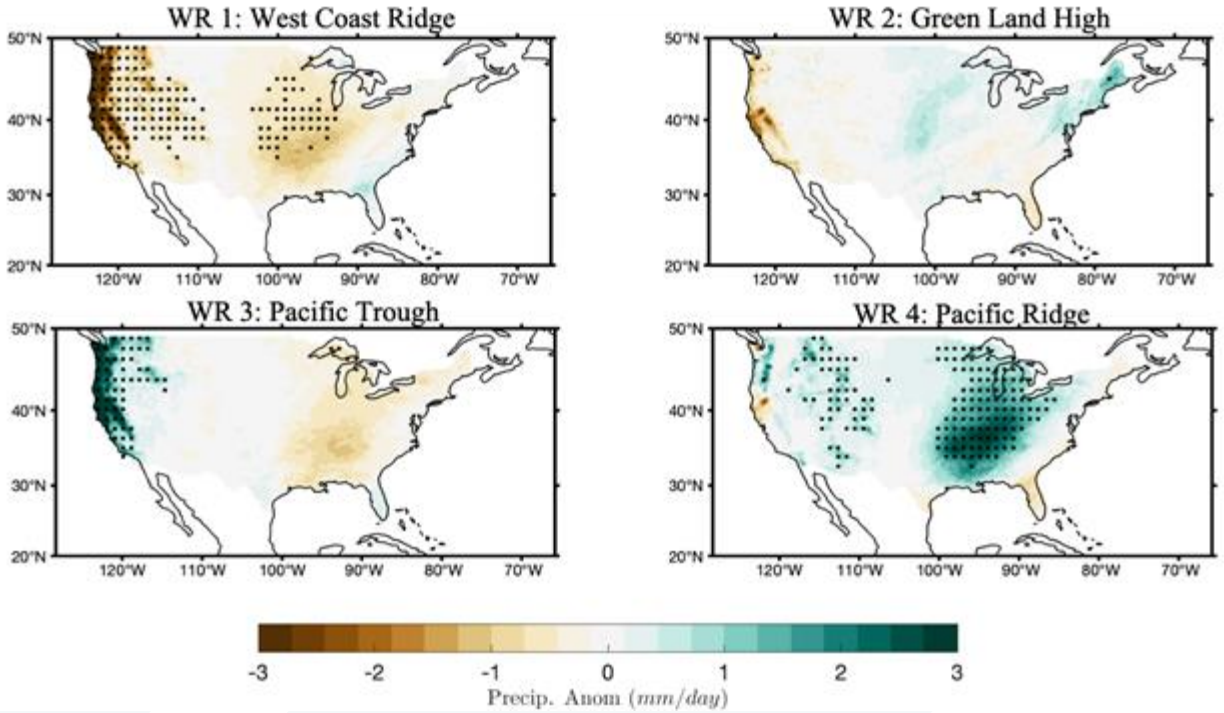
∗Note that this product only shows forecasts out to 31 Mar, so the forecasts are made out to Week 2

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.

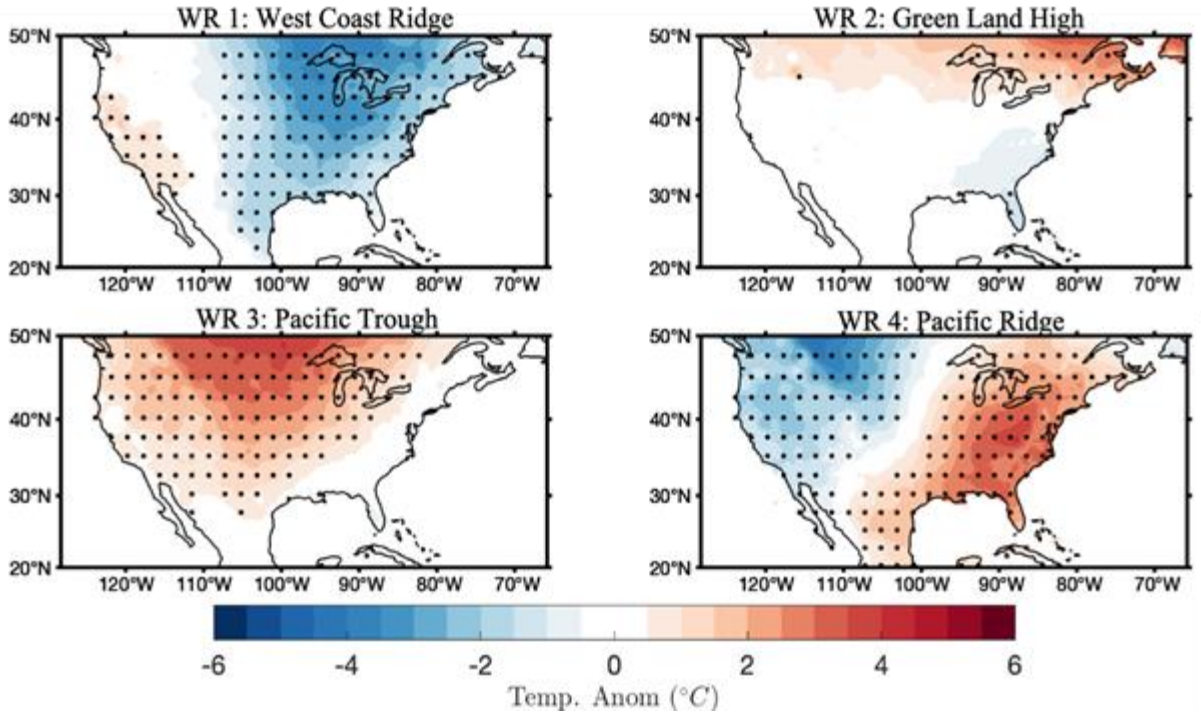
For more information about the forecast product: https://wiki.iri.columbia.edu/index.php?n=Climate.S2S-WRs

IRI North American Weather Regime Forecasts

Precipitation



Temperature

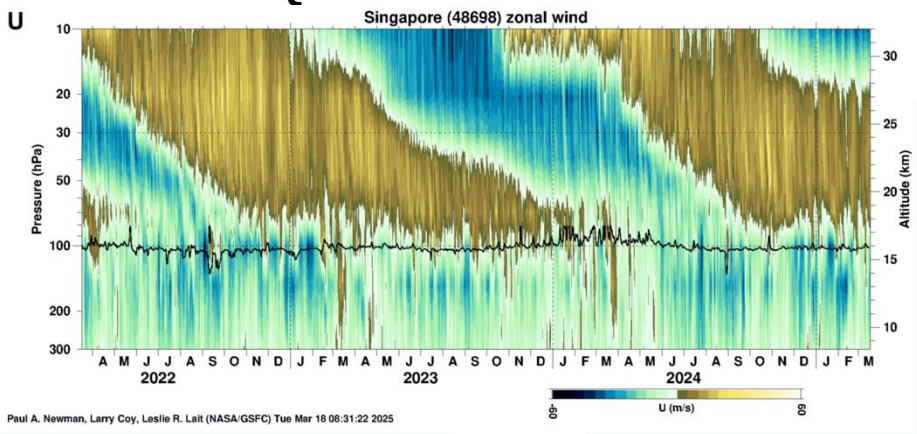


This graphic shows composite mean precipitation (left) and temperature (right) anomalies associated with each weather regime. Stippling (black dots) indicate statistically significant anomalies.

- Below-normal precipitation and above-normal temperature predicted over CA during Week 2 (24– 30 Mar) with moderate-to-high confidence in West Coast Ridge regime

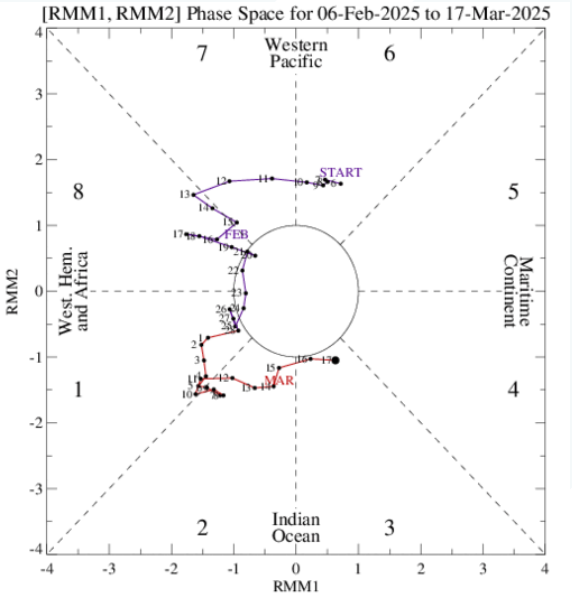
Background Info: AR Activity and Precipitation Based on MJO and QBO

QBO Conditions



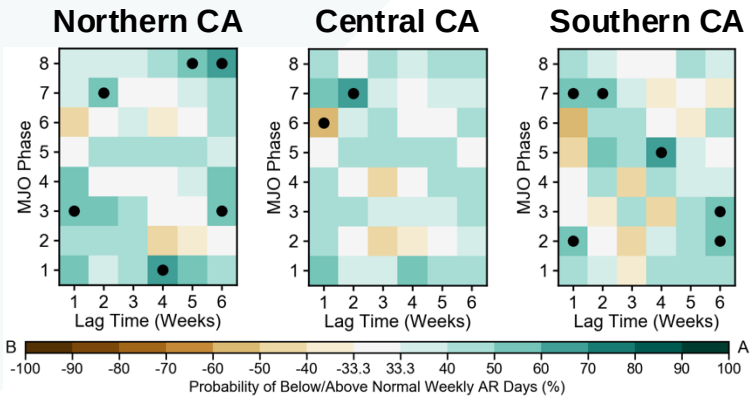
QBO is in the westerly phase at 50-hPa

MJO Conditions

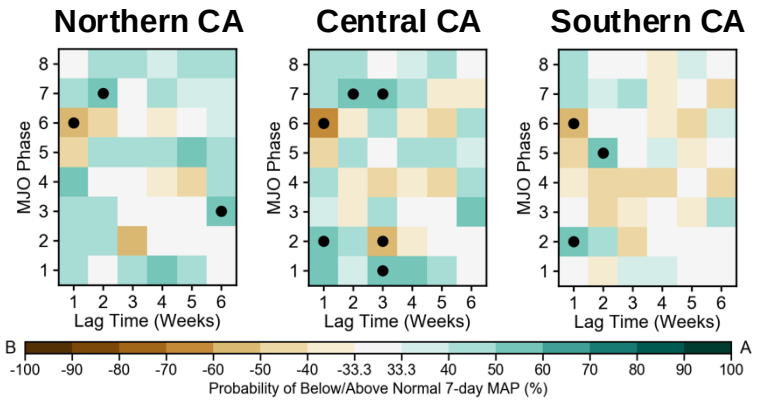


MJO convection is currently located over the Indian Ocean (Phase 3)

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



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

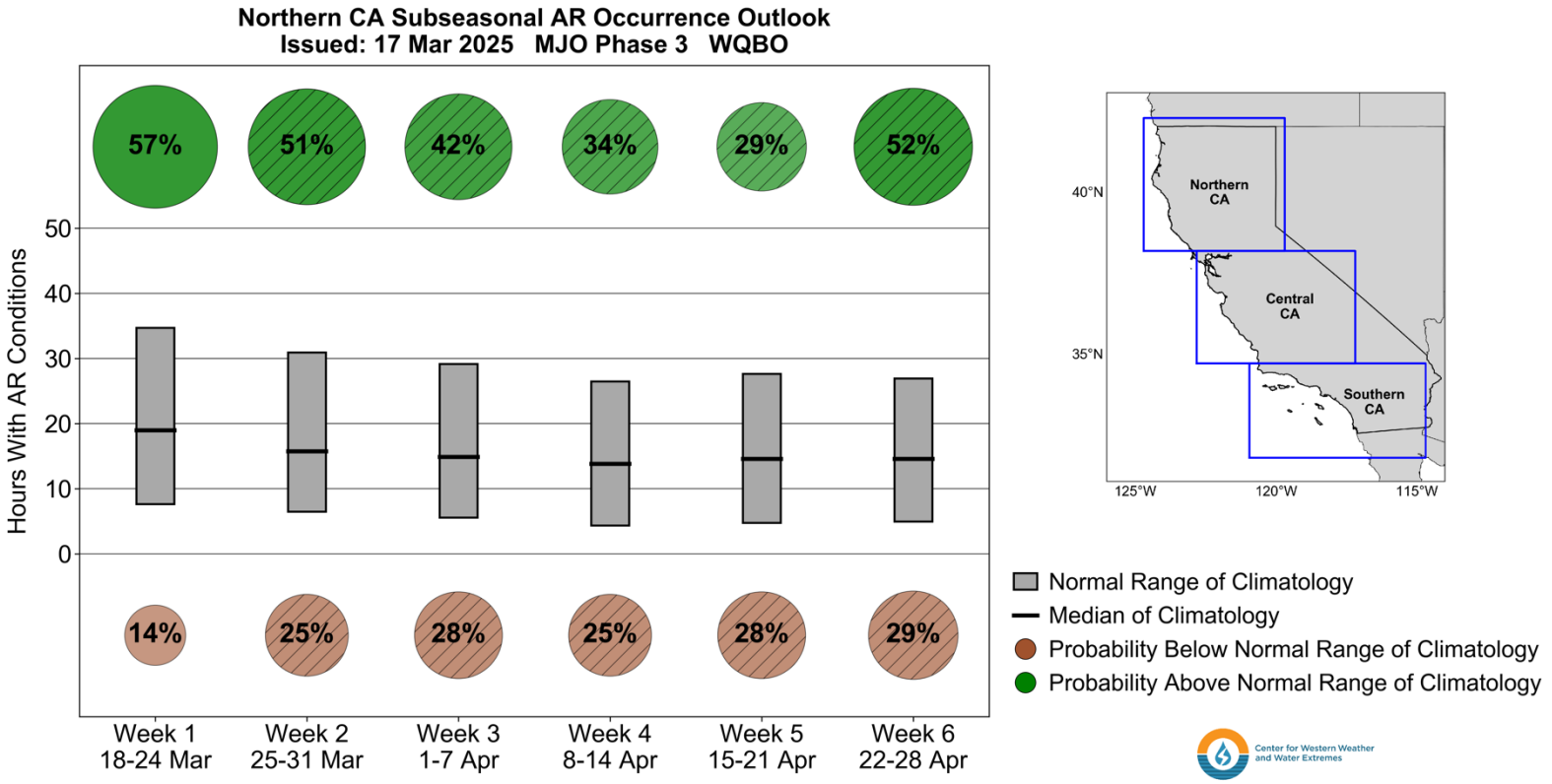


Probability matrices illustrating the weeks 1–6 lagged probability of below-normal (brown shading) or above-normal (green shading) AR occurrence and precipitation for all MJO phases when the QBO is in the westerly phase during JFM in Northern CA (left), Central CA (middle), and Southern CA (right). White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

Forecasts Initialized 17 Mar 2025

AR Occurrence: Northern CA



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

Center for Western Weather and Water Extremes

- 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 Weeks 2–3 (25 Mar – 7 Apr) and Week 6 (22 – 28 Apr) in Northern CA**
- Moderate likelihood of above-normal AR occurrence in Central CA during Week 2 (25 – 31 Mar)
- Moderate likelihood of above-normal AR occurrence in Southern CA during Week 3 (1 – 7 Apr)

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)

Center for Western Weather and Water Extremes
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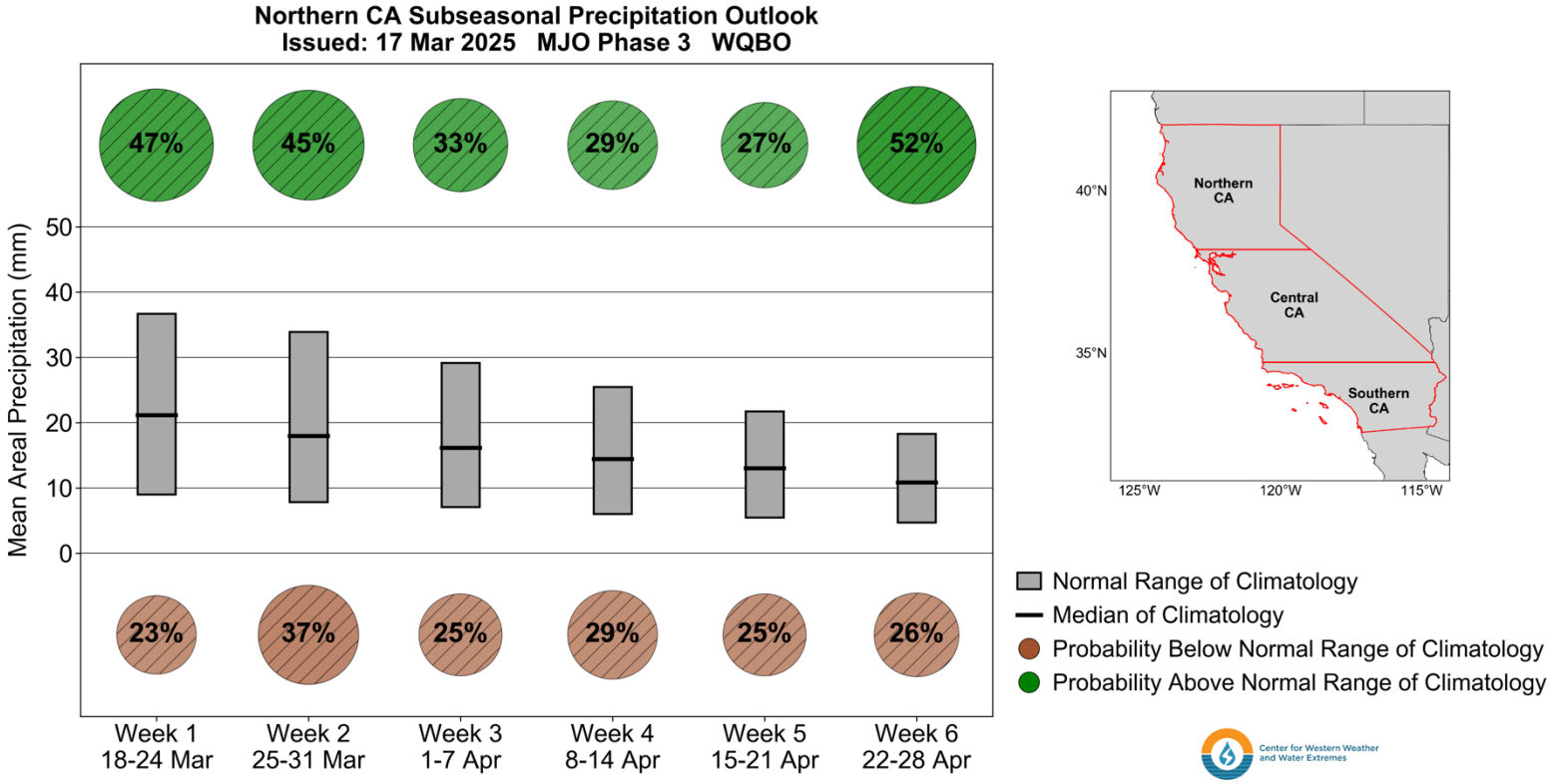
AR Activity and Precipitation Based on MJO and QBO

Forecasts Initialized 17 Mar 2025

Precipitation: Northern CA



- 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 Week 2 (25 – 31 Mar) and Week 6 (22 – 28 Apr)**
- Moderate likelihood of above-normal precipitation in Central CA during Week 3 (1 – 7 Apr)

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)

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CW3E Subseasonal Outlooks: Glossary & Context

- **The outlooks are based on CW3E subseasonal forecast products that can be found here:**
  https://cw3e.ucsd.edu/s_and_s_forecasts/

- **CW3E subseasonal (2–6 weeks lead time) atmospheric river, ridging, and circulation regime products use three different global ensemble prediction systems to create these products:**
  - NCEP CFSv2 (US Model): Weeks 2–6
  - 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***