



Center for Western Weather  
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY  
AT UC SAN DIEGO

# CW3E Subseasonal Outlook: 17 March 2026

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UC San Diego



# 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/](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 2–4
  - ECCO (Canadian Model): Weeks 2–4
  - ECMWF (European model): Weeks 2–4
- *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*

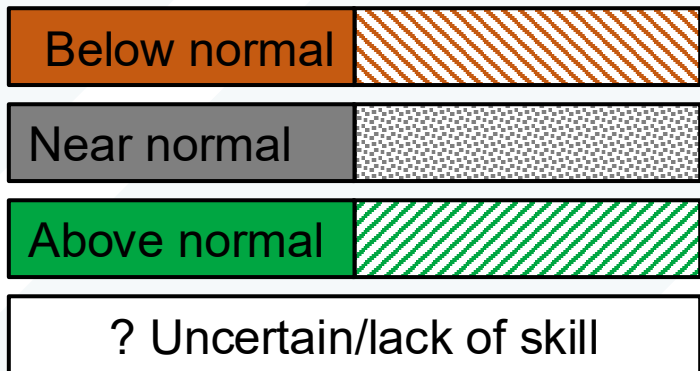
# Summary: Subseasonal Precipitation Outlook by Model

This slide shows the CW3E synthesis of subseasonal products by model

## Forecasts Initialized 16 Mar 2026

Region	Week 2 (23–29 Mar)				Week 3 (30 Mar – 5 Apr)				Week 4 (6–12 Apr)			
	NCEP <sup>1,2,4</sup>	ECMWF <sup>1,2</sup>	ECMWF <sup>1,2</sup>	Multi-Model Forecast	NCEP <sup>1,2</sup>	ECMWF <sup>1,2</sup>	ECMWF <sup>1,2</sup>	Multi-Model Forecast	NCEP <sup>1,2</sup>	ECMWF <sup>1,2</sup>	ECMWF <sup>1,2</sup>	Multi-Model Forecast
WA/OR		Below normal			Below normal	Near normal	Below normal	Below normal	Below normal	Near normal	Below normal	Below normal
Northern CA	Above normal	Below normal	Above normal	Above normal	Below normal	Below normal	Below normal	Below normal	Below normal	Near normal	Below normal	Below normal
Central CA		Near normal			Below normal	Below normal	Below normal	Below normal	Below normal	Near normal		
Southern CA		Near normal				Below normal	Below normal			Near normal		

Higher Confidence | Lower Confidence



- Forecasts lean toward above-normal precipitation in Northern during Week 2; more uncertainty over Central and Southern CA
- Forecasts lean toward below-normal precipitation in Northern and Central CA during Week 3, with higher confidence over Northern CA; more uncertainty over Southern CA
- Forecasts lean toward below-normal precipitation in Northern CA during Week 4; more uncertainty over Central and Southern CA

### Subseasonal products included in this Outlook:

<sup>1</sup>CW3E/JPL Atmospheric River Activity Forecasts ([DeFlorio et al. 2019](#), [Zhang et al. 2023](#))

<sup>2</sup>CW3E/JPL Ridging Forecasts ([Gibson et al. 2020](#))

<sup>3</sup>IRI North American Weather Regime Forecasts ([Robertson et al. 2020](#))

<sup>4</sup>CW3E West Coast Weather Regime Forecasts (Guirguis et al. [2023a](#) and [2023b](#))

# Summary

## **MJO/QBO Conditions**

- Strong MJO convection is currently located over the Western Hemisphere and Africa (Phases 8&1); QBO is in the easterly phase
  - Without considering QBO/ENSO conditions, MJO convection over the Western Hemisphere and Africa is associated with increased extreme precipitation over California at lag times of 1–2 weeks
- NCEP is forecasting MJO convection to remain strong over the Western Hemisphere and Africa during Weeks 1–2
  - The statistical relationship between the MJO and extreme precipitation is consistent with the NCEP Week 2 AR activity forecasts

## **Week 2 Forecasts (23–29 Mar):**

- Models disagree somewhat on AR activity over CA
  - NCEP is forecasting above-normal AR activity in CA, with high confidence over Northern CA
  - ECCO is forecasting high confidence in slightly below-normal AR activity over Northern CA, while forecasting near-normal conditions across Central and Southern CA
  - ECMWF is forecasting near-normal to slightly above-normal AR activity over CA
- Ridging outlooks show high likelihood of persistent South-ridge activity (wet conditions in Northern CA and dry conditions in Southern CA) during Weeks 1–2
- IRI North American weather regime forecasts are unavailable
- CW3E West Coast weather regime tool shows patterns associated with above-normal precipitation in Northern CA early in Week 2

# Summary

## Week 3 Forecasts (30 Mar – 5 Apr):

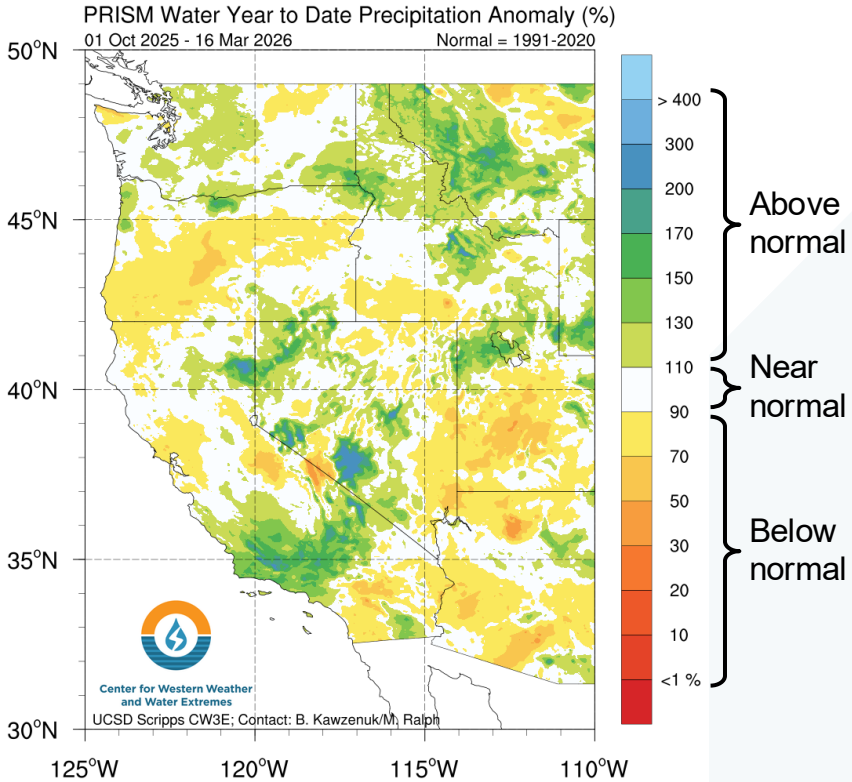
- Models generally agree on slightly below-normal AR activity over Northern CA
  - In Central CA, ECCO and ECMWF are forecasting slightly below-normal AR activity with high confidence, whereas NCEP is forecasting near-normal AR activity
  - In Southern CA, ECCO and ECMWF are forecasting near-normal to slightly below-normal AR activity, whereas NCEP is forecasting near-normal AR activity
- Ridging outlooks show some uncertainty in ridging activity near the US West Coast during Weeks 3–4
  - NCEP is forecasting above-normal North-ridge activity (dry conditions over all of CA) with moderate confidence, whereas ECMWF is forecasting near-normal North-ridge activity
- CW3E West Coast weather regime tool does not extend to Weeks 3–4

## Week 4 Forecasts (6–12 Apr):

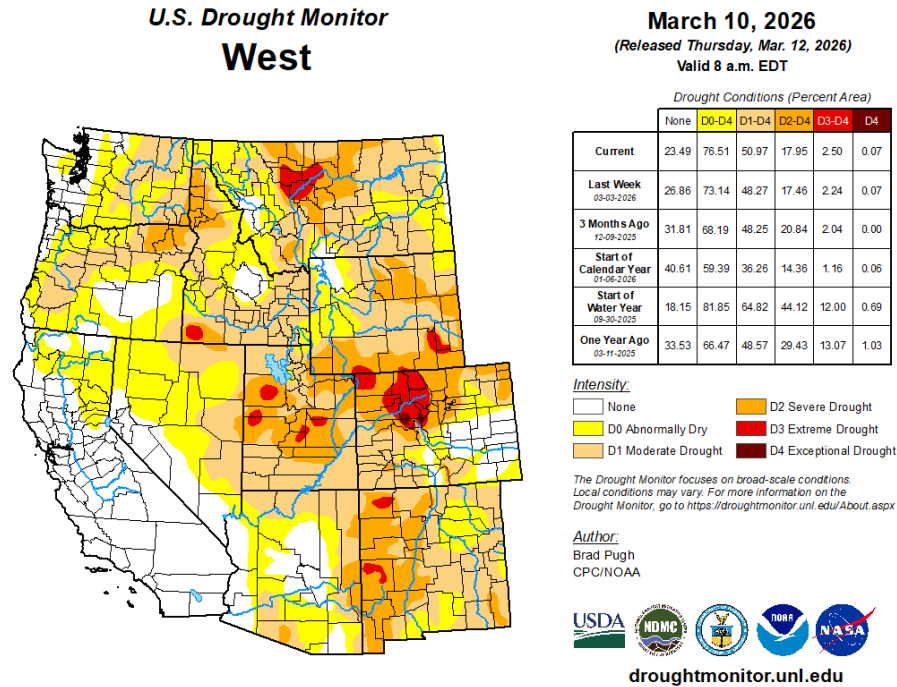
- Models generally agree on near-normal AR activity over Southern CA during Week 4
  - In Northern CA, NCEP and ECMWF are forecasting slightly below-normal AR activity with high confidence, whereas ECCO is forecasting near-normal AR activity
  - In Central CA, NCEP is forecasting slightly below-normal to slightly above-normal AR activity, whereas ECCO and ECMWF are forecasting near-normal AR activity

# Hydrologic Summary

## Precipitation

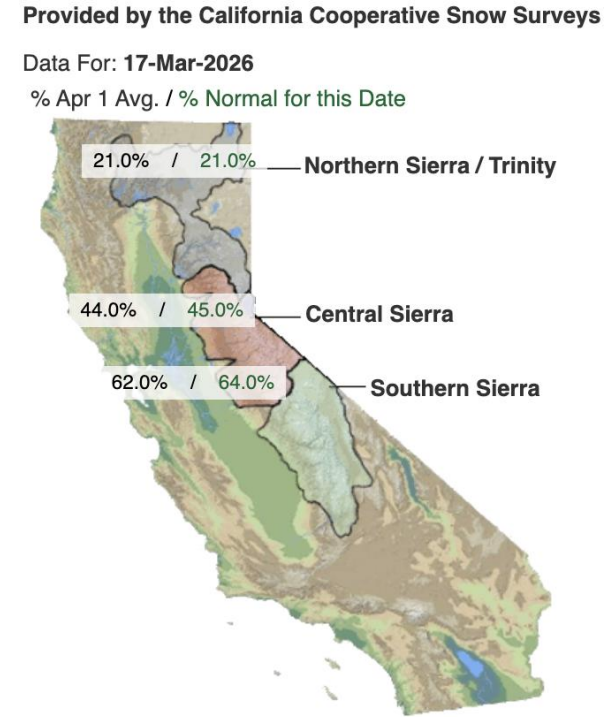


## Drought Conditions



Disclaimer: In addition to climate indicators, the U.S. Drought Monitor also uses impact reports from local observers about crop failures or water restrictions to quantify drought.

## Snowpack Conditions



- As of 16 Mar, water-year-to-date precipitation is still running **above normal (>130% of normal)** in portions of Central and Southern CA and **slightly below normal to slightly above normal (70–130% of normal)** across most of the rest of the state
- The most recent drought monitor update is showing **Abnormally Dry (D0)** conditions across portions of Northern CA, while Central and Southern CA remain drought-free
- As of 17 Mar, estimated snowpack is well-below normal in the Northern Sierra Nevada/Trinity region (**21% of normal**) and the Central Sierra Nevada (**45% of normal**), and below normal in the Southern Sierra Nevada (**64% of normal**)

# Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 23 Feb 2026; Valid: 9–15 Mar 2026

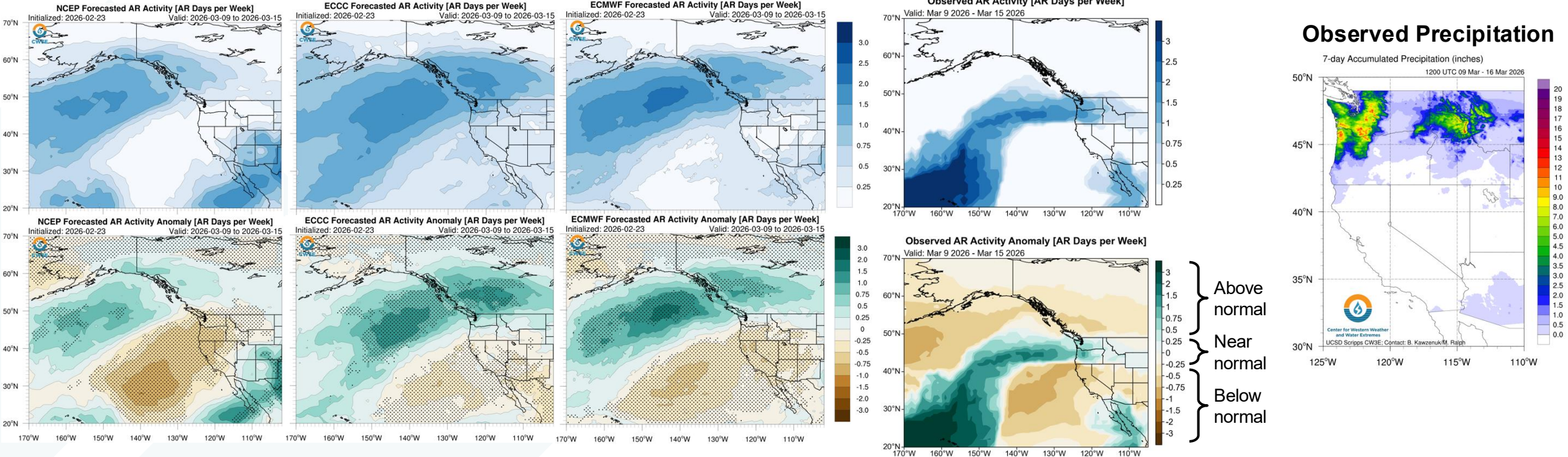
NCEP

ECCC

ECMWF

Observed (CFSv2 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)

- At 3-week lead times, all models generally captured the ridging west of CA, which was largely responsible for the lack of AR activity over CA
- All models incorrectly shifted the AR axis too far north and underestimated AR activity over the Pacific Northwest
- A few ARs produced 5–9 inches of precipitation over the Pacific Northwest during 9–15 Mar

# Looking Back: Week 2 AR Activity Forecasts

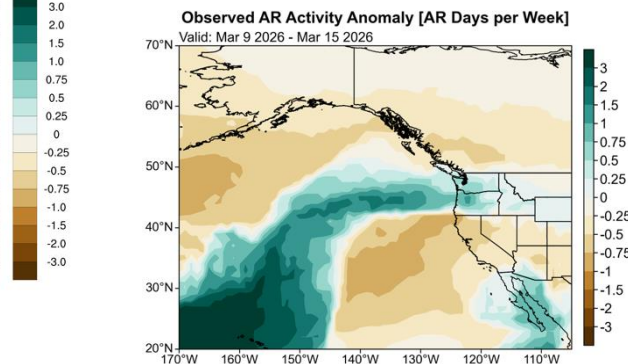
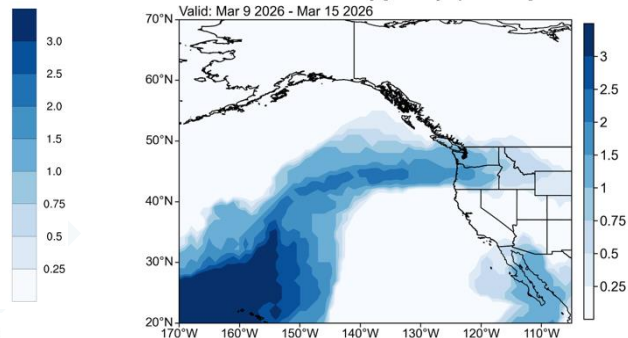
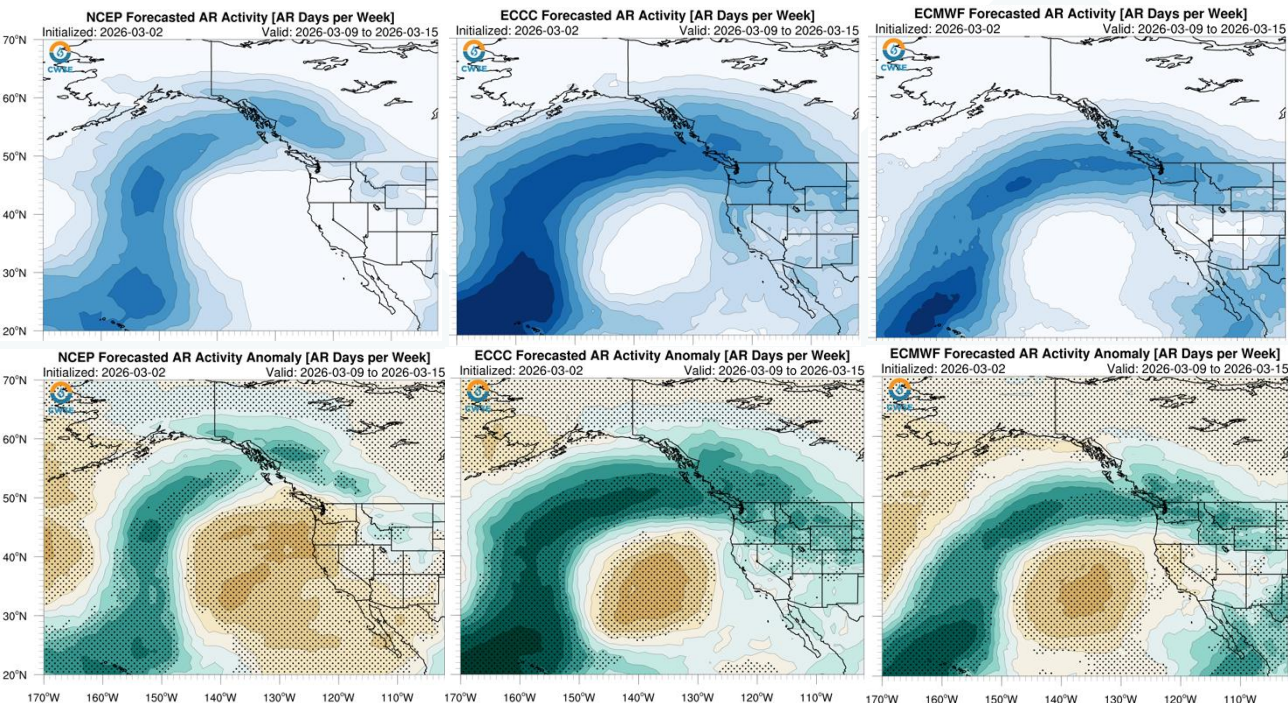
Forecasts Initialized 2 Mar 2026; Valid: 9–15 Mar 2026

NCEP

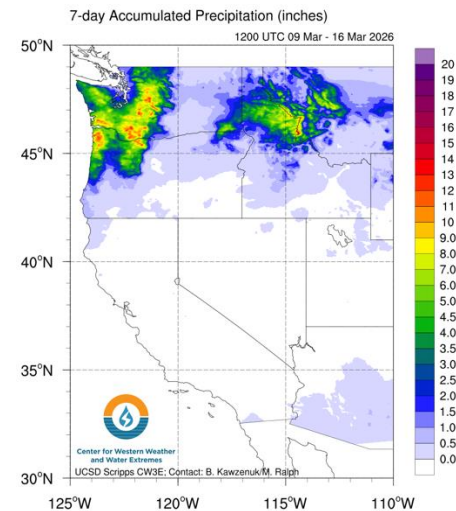
ECCC

ECMWF

Observed (CFSv2 Analysis)



Observed Precipitation



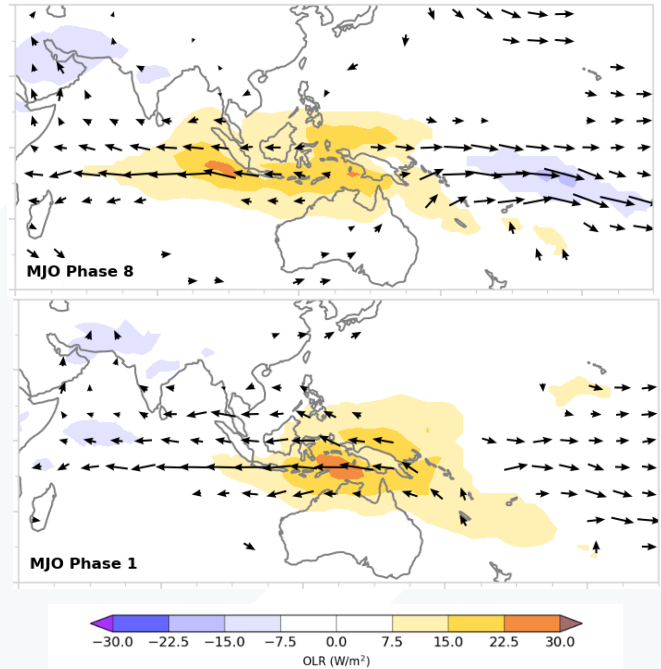
Shading: Fractional # of AR days forecast over a 7-day period (top) and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

- At 2-week lead times, ECCC and ECMWF captured the large-scale pattern and AR activity over the Pacific Northwest, while NCEP shifted the AR axis too far north; both ECCC and ECMWF placed the ridging too far offshore
- NCEP and ECMWF successfully captured negative AR activity anomalies over CA
- A few ARs produced 5–9 inches of precipitation over the Pacific Northwest during 9–15 Mar

# Dynamical Model MJO Forecasts (NCEP)

## Observed MJO

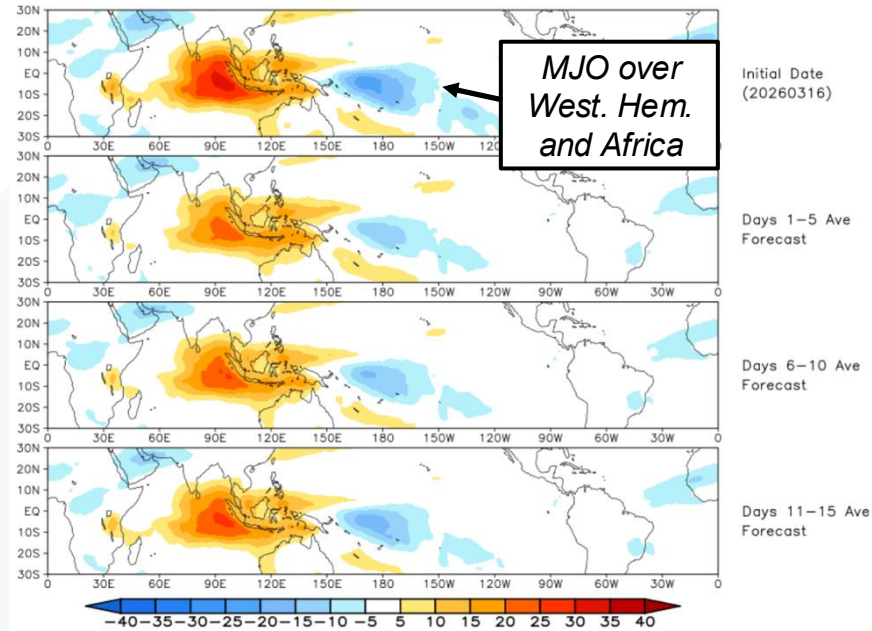
Phases 8&1 (West. Hem. and Africa)



OLR = Outgoing longwave radiation

## Weeks 1–2 MJO Prediction

OLR prediction of MJO-related anomalies using GFS model reconstruction by RMM1 & RMM2 (20260316)



## Circulation and Moisture Transport Anomalies

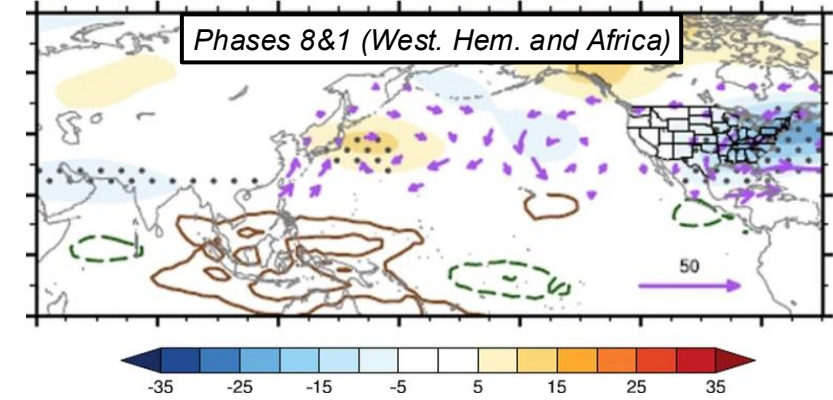


Figure 5 from Wang et al. (2024)

Composite Z500 anomalies (shading; orange = positive; blue = negative), IVT anomalies (vectors); and OLR anomalies (brown = suppressed convection; green = enhanced convection)

## Extreme Precipitation Frequency

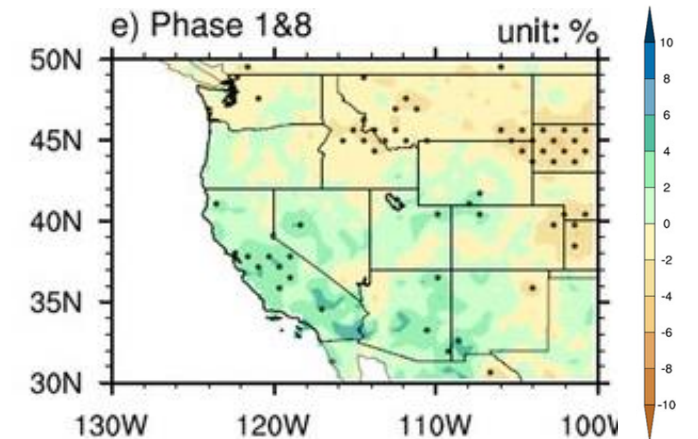


Figure 3 from Wang et al. (2023)

Percent Change in frequency of extreme precipitation (brown = decreased frequency; green/blue = increased frequency)

- As of 16 Mar, strong MJO convection is currently located over the Western Hemisphere and Africa (Phases 8&1)
- NCEP is forecasting MJO convection to remain strong over the Western Hemisphere and Africa during Weeks 1-2
- MJO convection over the Western Hemisphere and Africa is associated with an anomalous trough off the U.S. West Coast at lag times of 1–2 weeks, leading to slightly increased moisture transport and an increase in extreme precipitation frequency over CA

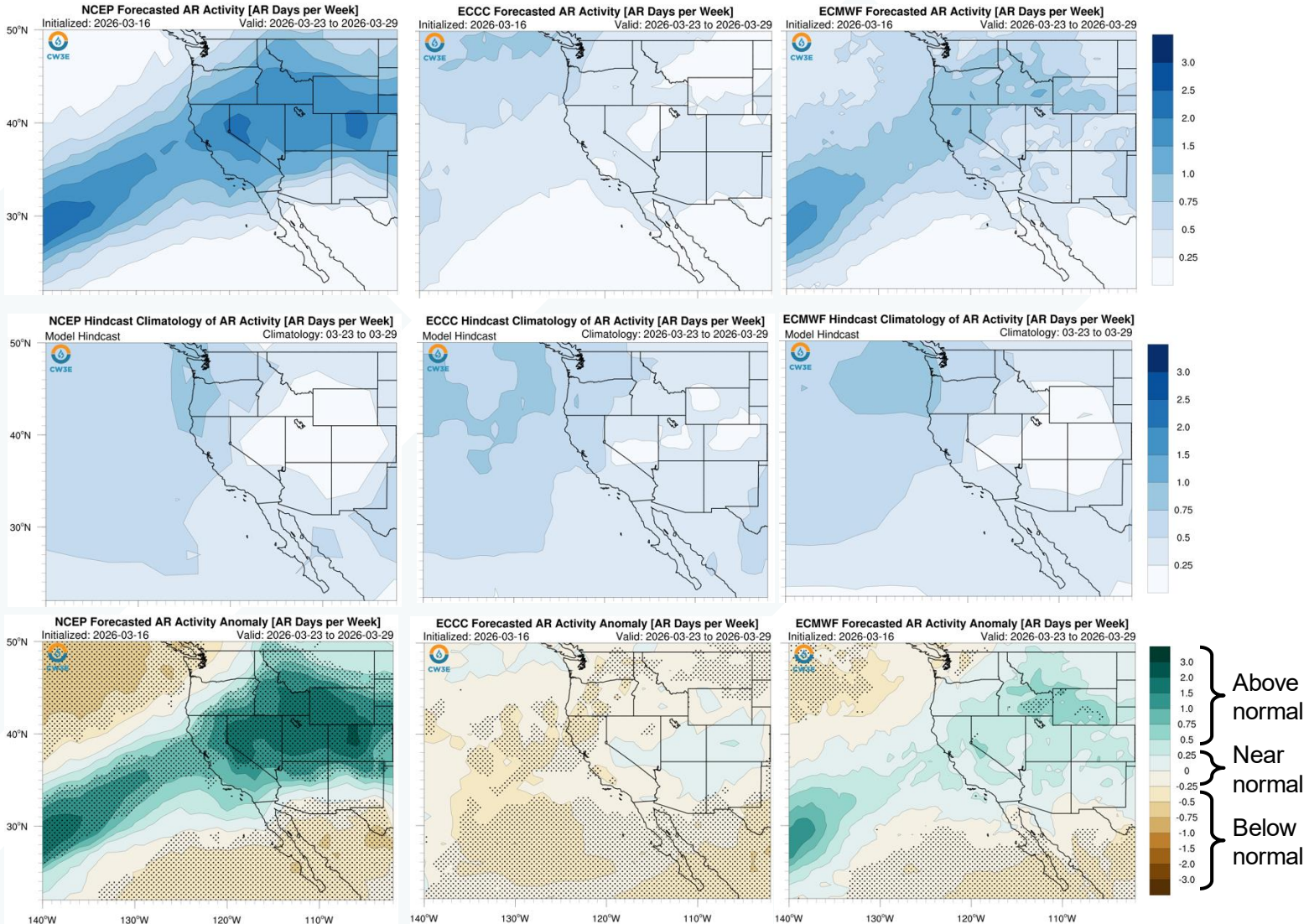
# AR Activity Forecasts: Week 2 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 16 Mar 2026

NCEP

ECCC

ECMWF



- NCEP is forecasting above-normal AR activity in CA, with high confidence over Northern CA during Week 2 (23–29 Mar)
- ECCC is forecasting high confidence in slightly below-normal AR activity over Northern CA, while forecasting near-normal conditions across Central and Southern CA
- ECMWF is forecasting near-normal to slightly above-normal AR activity over CA

Models disagree somewhat on AR activity over CA during Week 2 (23–29 Mar)

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)

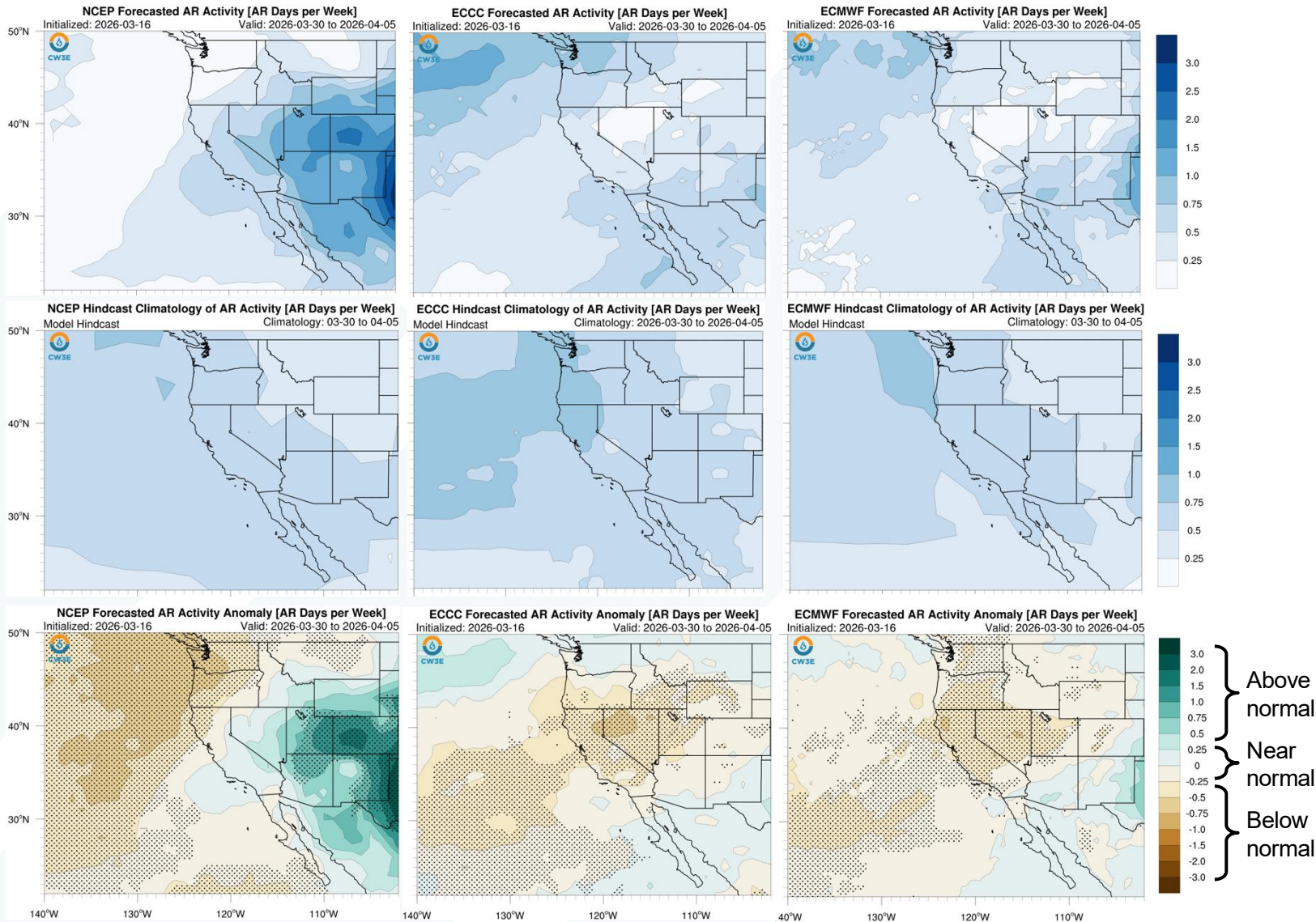
# AR Activity Forecasts: Week 3 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 16 Mar 2026

NCEP

ECCC

ECMWF



- Models are forecasting slightly below-normal AR activity with high confidence in Northern CA during Week 3 (30 Mar–5 Apr)
- In Central CA, ECCC and ECMWF are forecasting slightly below-normal AR activity with high confidence, whereas NCEP is forecasting near-normal AR activity
- In Southern CA, ECCC and ECMWF are forecasting near-normal to slightly below-normal AR activity, whereas NCEP is forecasting near-normal AR activity

Models generally agree on slightly below-normal AR activity over Northern CA during Week 3 (30 Mar – 5 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)

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

Forecasts Initialized 16 Mar 2026

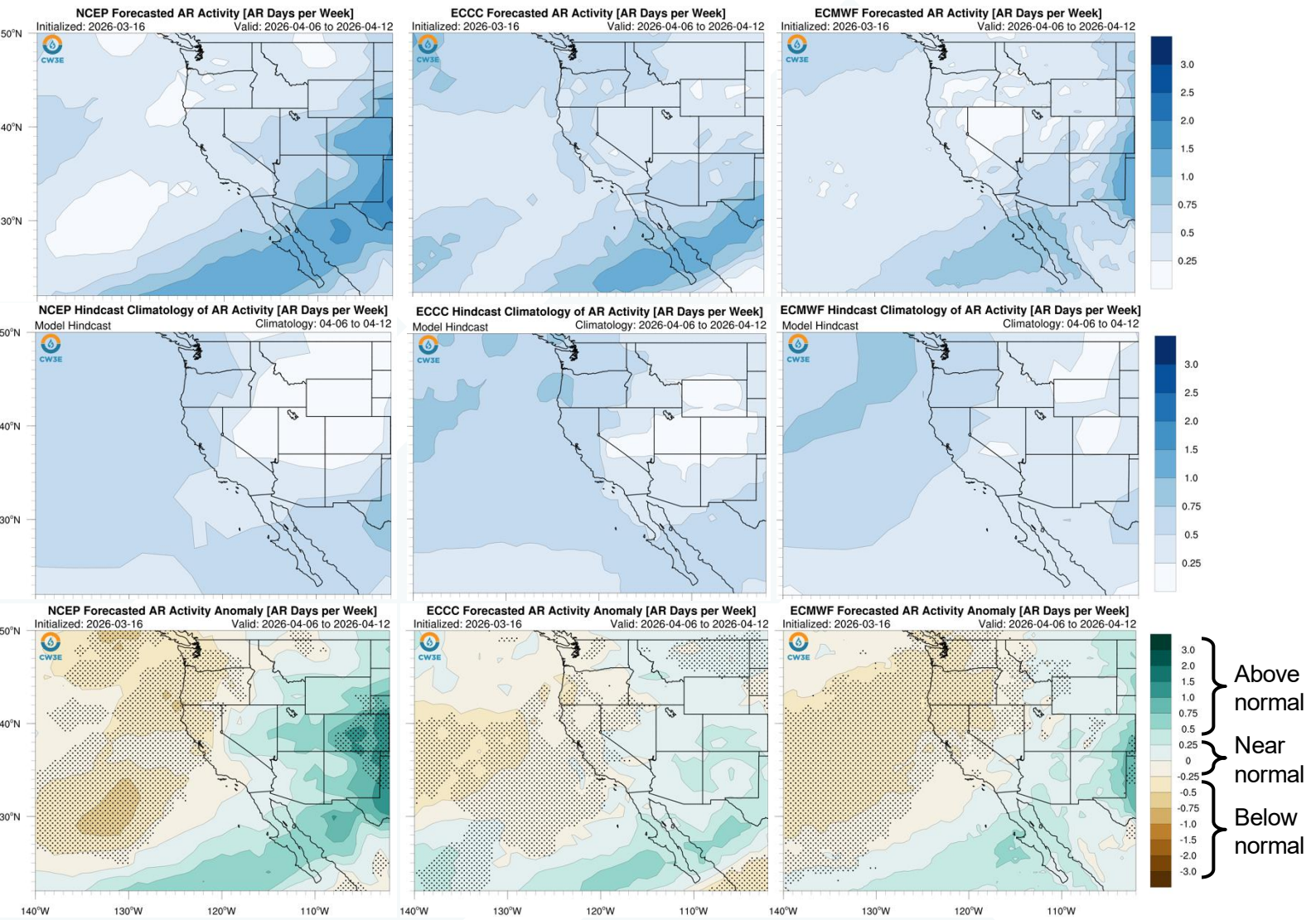
NCEP

ECCC

ECMWF

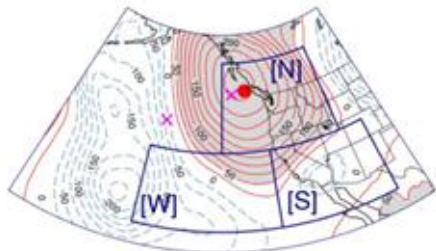
- All models are forecasting near-normal AR activity over Southern CA during Week 4 (6–12 Apr)
- In Northern CA, NCEP and ECMWF are forecasting slightly below-normal AR activity with high confidence, whereas ECCC is forecasting near-normal AR activity
- In Central CA, NCEP is forecasting slightly below-normal to slightly above-normal AR activity, whereas ECCC and ECMWF are forecasting near-normal AR activity

Models generally agree on near-normal AR activity over Southern CA during Week 4 (6–12 Apr)



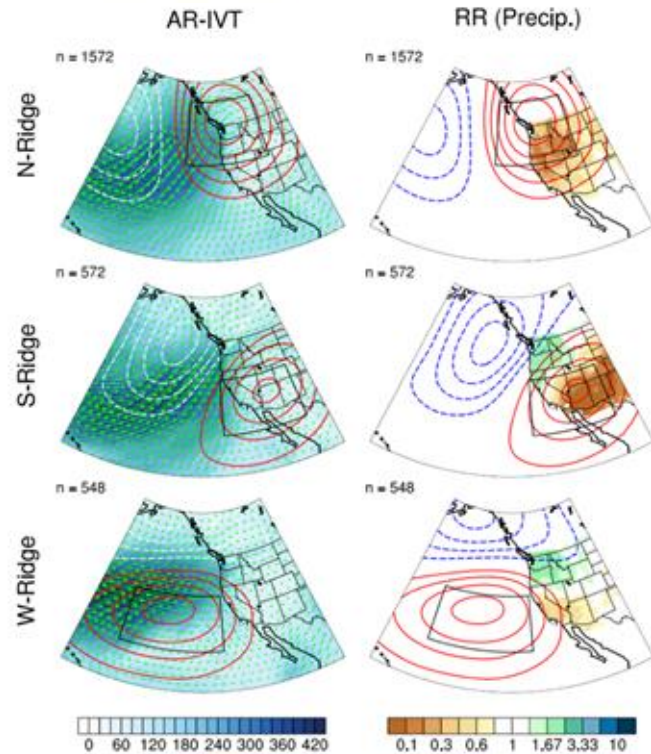
Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

# 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



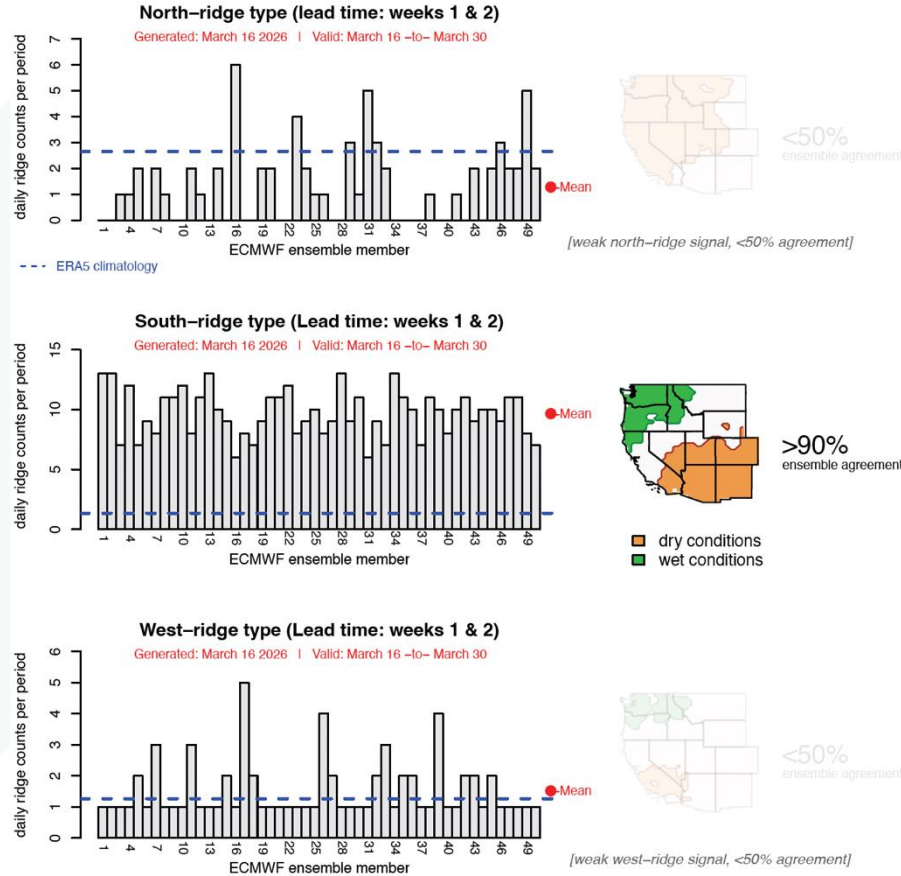
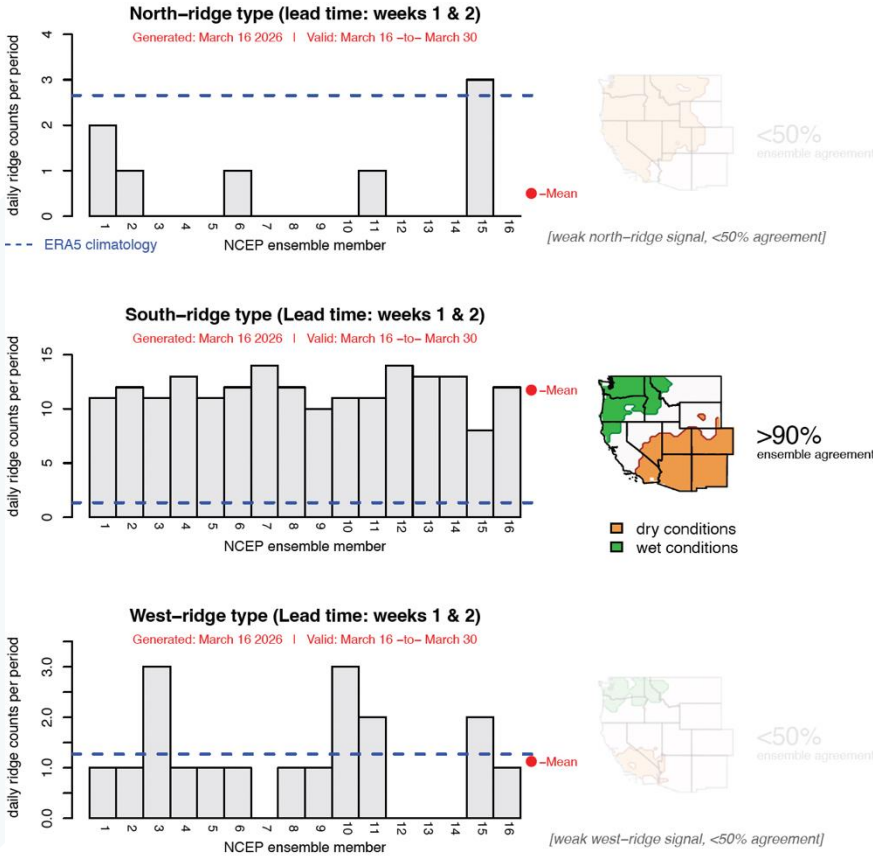
Contact: [pgibson@ucsd.edu](mailto:pgibson@ucsd.edu)  
Reference: Gibson et al. (2020)  
Journal of Climate

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

Forecasts Initialized 16 Mar 2026

## NCEP

## ECMWF



- Both models are forecasting above-normal South-ridge activity with high confidence (>90% ensemble agreement) during Weeks 1–2 (16–30 Mar)
- Both models are forecasting near-normal West-ridge activity and below-normal North-ridge activity

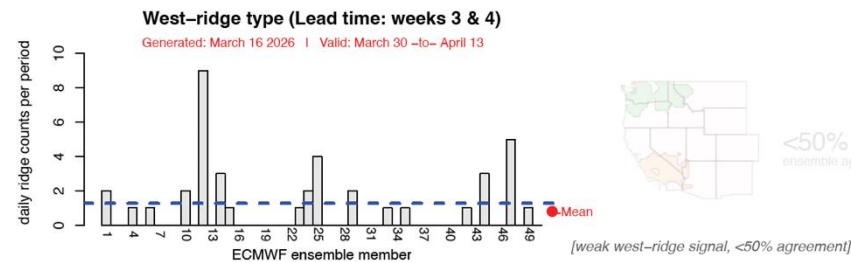
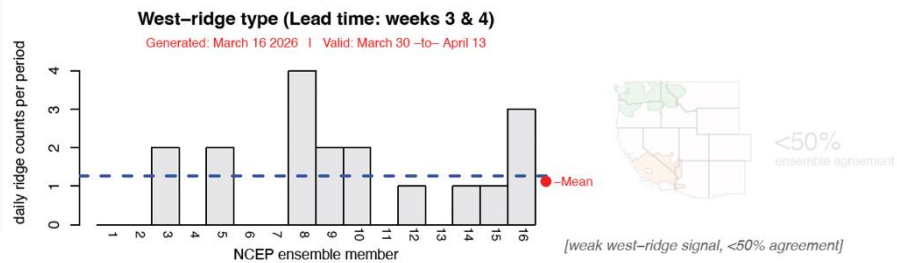
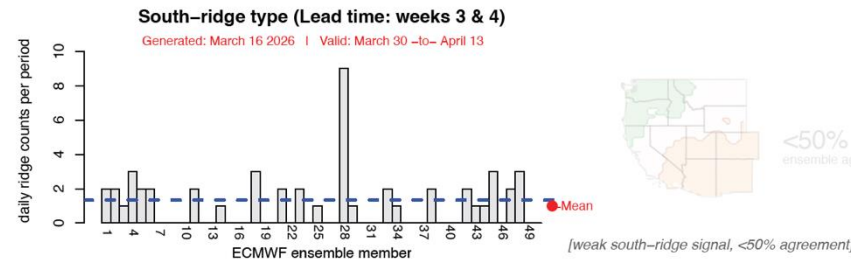
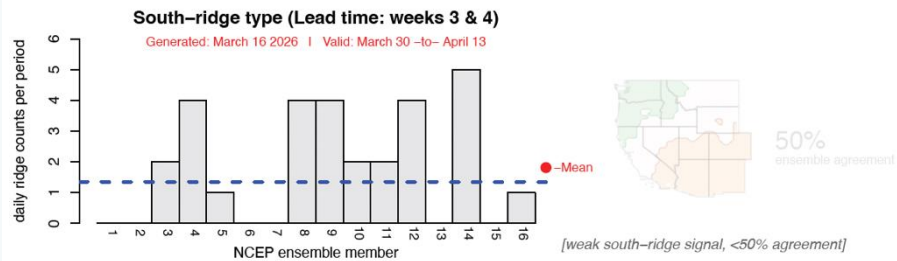
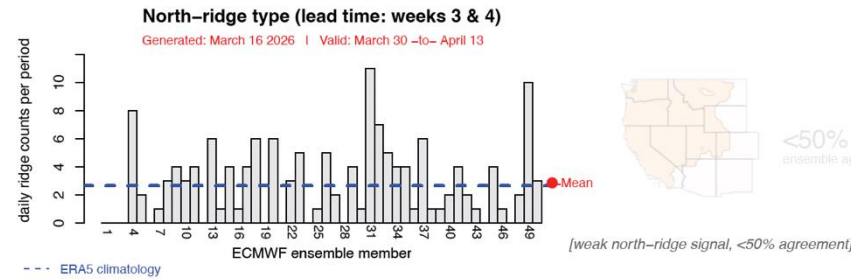
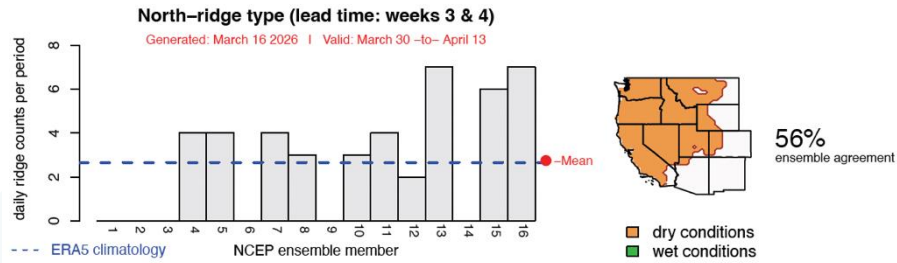
Models show high likelihood of persistent ridging activity over the southwestern US during Weeks 1–2 (16–30 Mar)

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

Forecasts Initialized 16 Mar 2026

## NCEP

## ECMWF



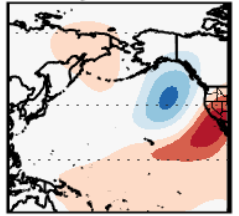
- NCEP is forecasting above-normal North-ridge activity with moderate confidence (56% ensemble agreement), whereas ECMWF is forecasting near-normal North-ridge activity during Weeks 3–4 (30 Mar – 13 Apr)
- NCEP is also forecasting slightly above-normal South-ridge activity with low confidence, and ECMWF is forecasting near-normal South-ridge activity
- Both models are forecasting near-normal West-ridge activity

Models show some uncertainty in ridging activity near the US West Coast during Weeks 3–4 (30 Mar – 13 Apr)

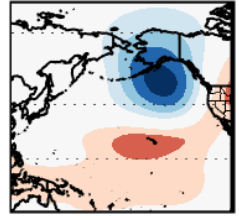
# Background Info: Hybrid Weather Regime Impacts Forecast

## a) NP4 Mode

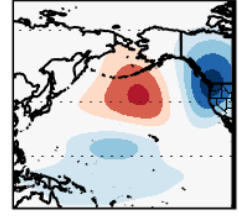
### Patterns



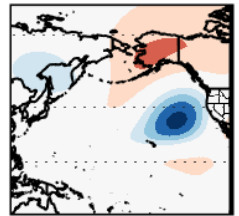
### Alaskan-Pacific



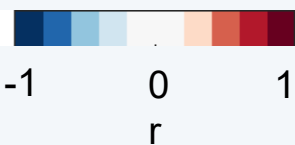
### Canadian-Pacific



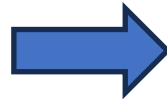
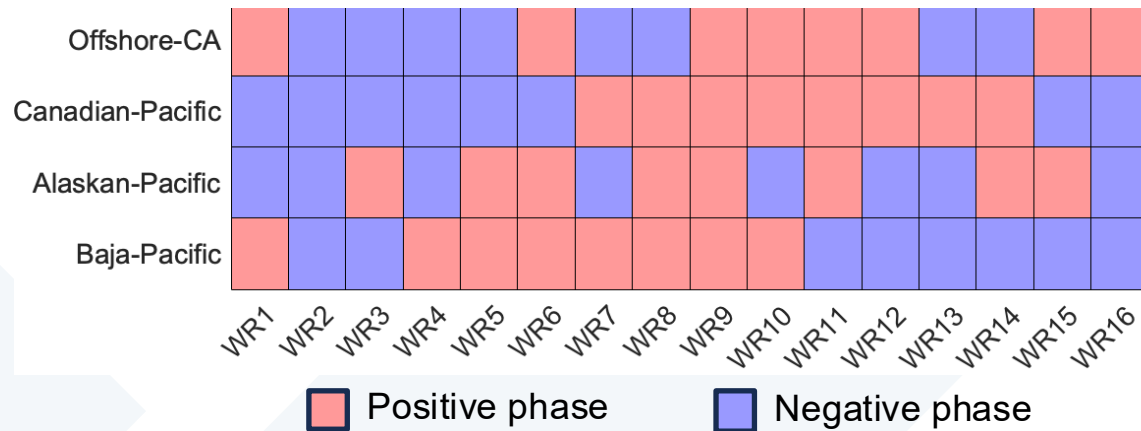
### Offshore-CA



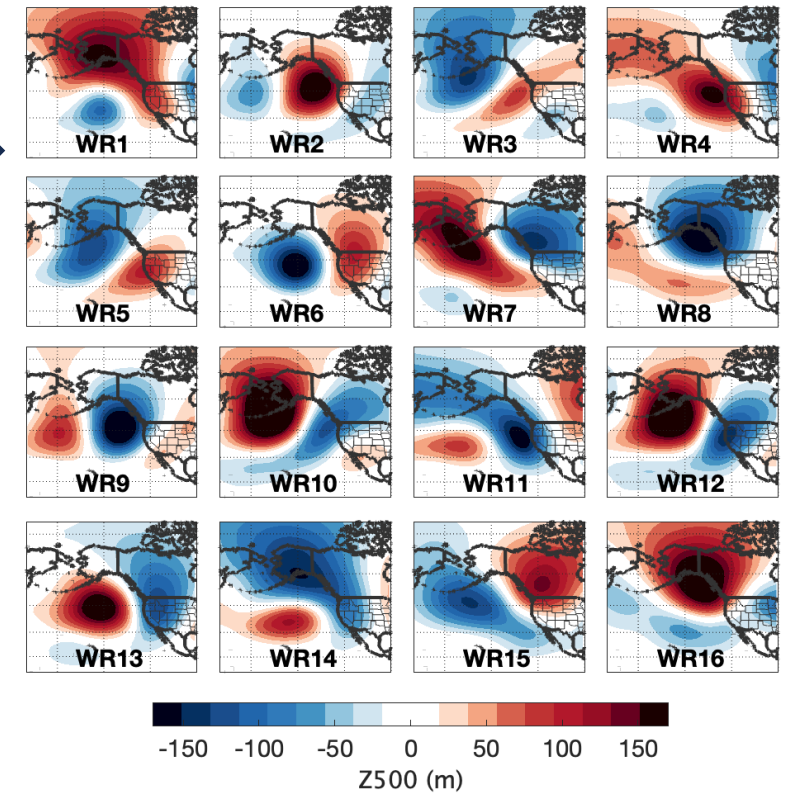
Z500 rEOFs



## b) NP4 Mode Phase Combinations



## c) Daily Weather Regimes



### a) NP4 Mode Patterns

Four key modes of atmospheric variability over the North Pacific (called the “NP4 Modes”, shown in the positive phase) capture most of the variance in atmospheric circulation in this region.

### b) NP4 Mode Phase Combinations

The day-to-day changes in the amplitude and phase of the NP4 modes control ridge-trough positioning over the West Coast.

### c) Daily Weather Regimes

Sixteen daily weather regimes are defined by the joint phase state of the four NP4 modes. These represent short-duration daily weather patterns.

### Relevance to West Coast Weather

These regimes are historically linked to impactful West Coast weather, including AR landfalls, precipitation and flooding, temperature extremes, Santa Ana winds, and wildfire conditions.

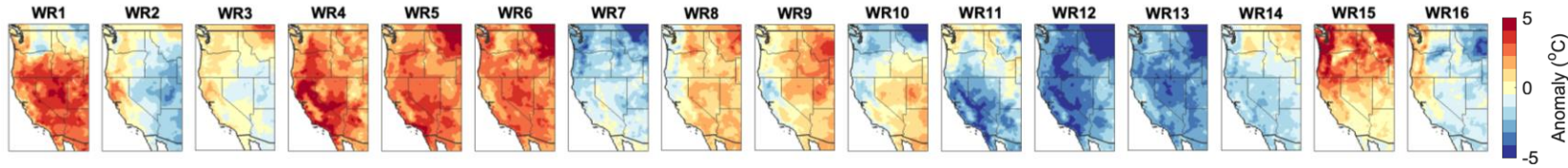
This slide contains background information about CW3E’s hybrid weather regimes forecast product.

#### Reference:

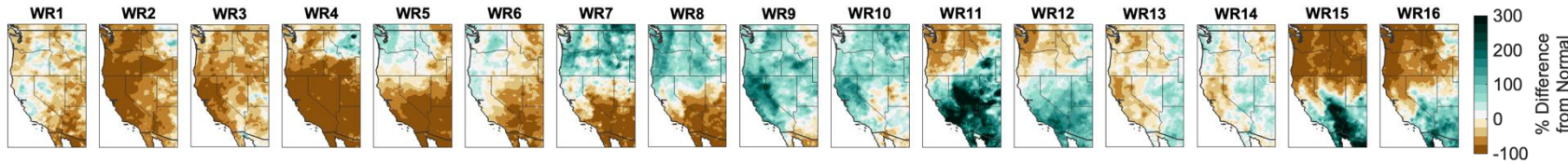
Guirguis et al. [2023a](#) and [2023b](#)

# Hybrid Weather Regime Impacts Forecast

## a) Temperature Anomaly Associated With Each Weather Regime

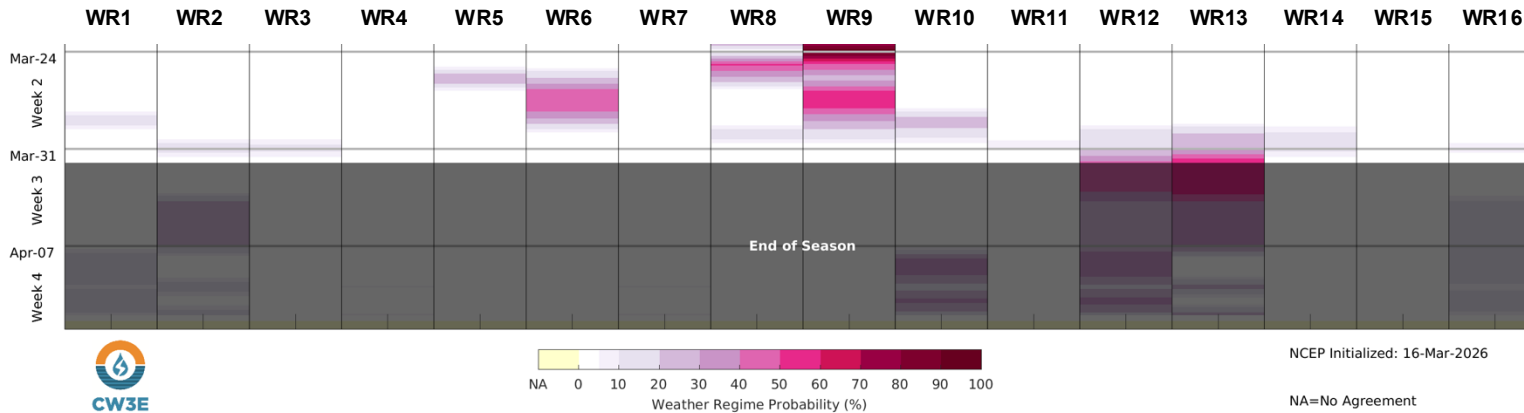


## b) Precipitation Anomaly Associated With Each Weather Regime



Valid 24–31 Mar

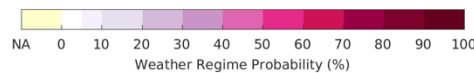
## c) Weather Regime Forecast



## Forecasts Initialized 16 Mar 2026

**Week 2 (24–31 Mar):** Early in the week, conditions are dominated by WRs 8 and 9, which are associated with above-normal precipitation and slightly below-normal temperatures over Northern CA, and slightly above-normal temperatures over Southern CA. For the remainder of the week, WRs 6 and 9 prevail, which are linked to above-normal temperatures in Southern CA.

**Weeks 3-4 (1–13 Apr):** End of the forecast season



NCEP Initialized: 16-Mar-2026

NA=No Agreement

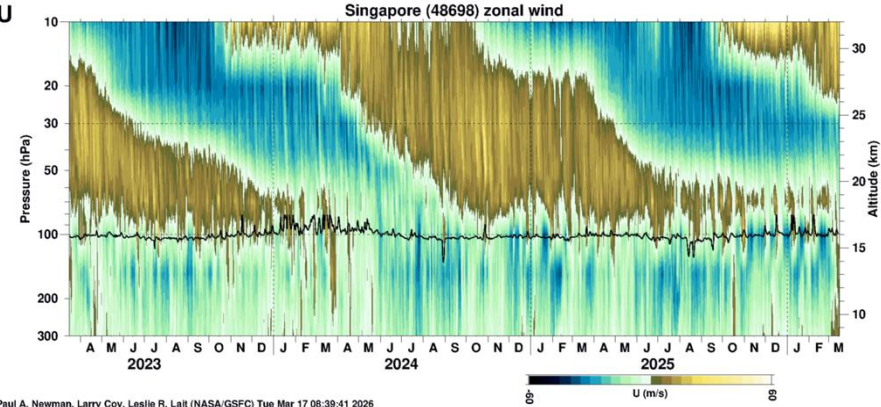
**a-b:** Weather regime impacts based on historical relationships  
**c:** Forecast weather regime probability based on the NCEP dynamical model

NA=No Agreement/Uncertain

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

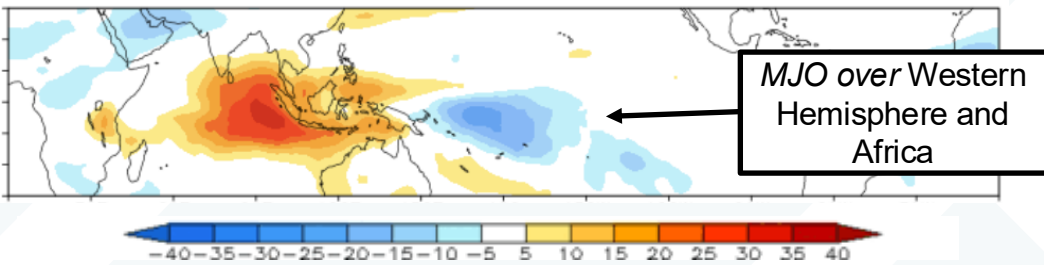
## QBO Conditions

Singapore (48698) zonal wind



**QBO is in the easterly phase at 50-hPa**

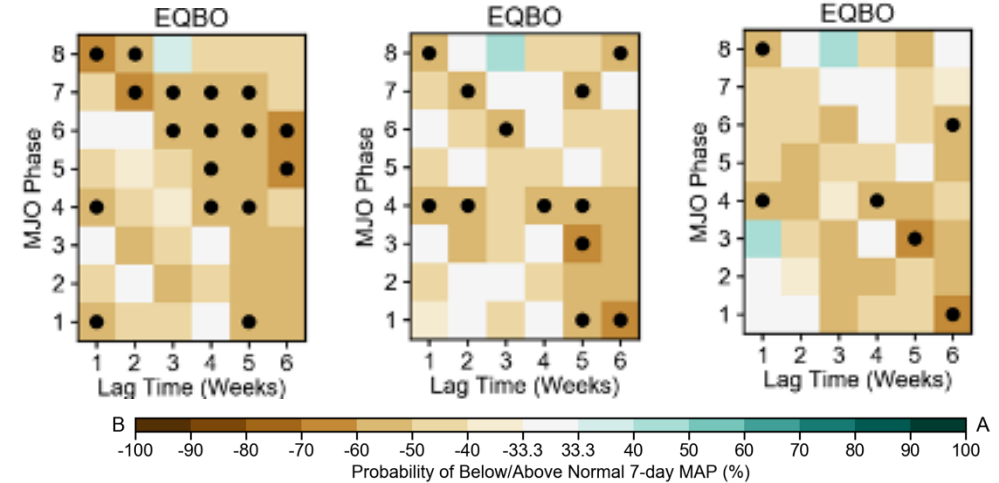
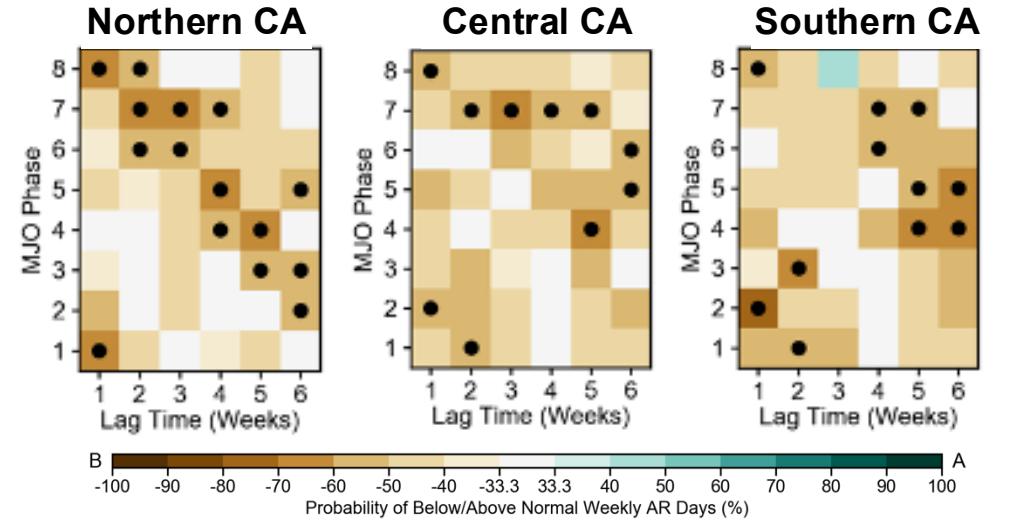
## MJO Conditions



**MJO convection is currently located over the Western Hemisphere and Africa (Phase 8)**

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

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



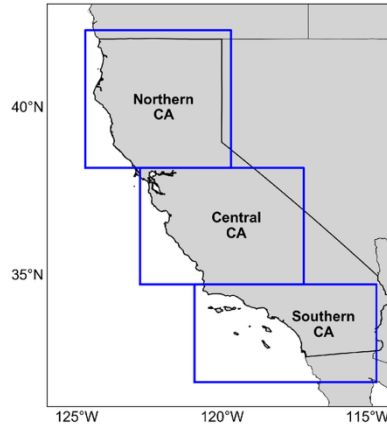
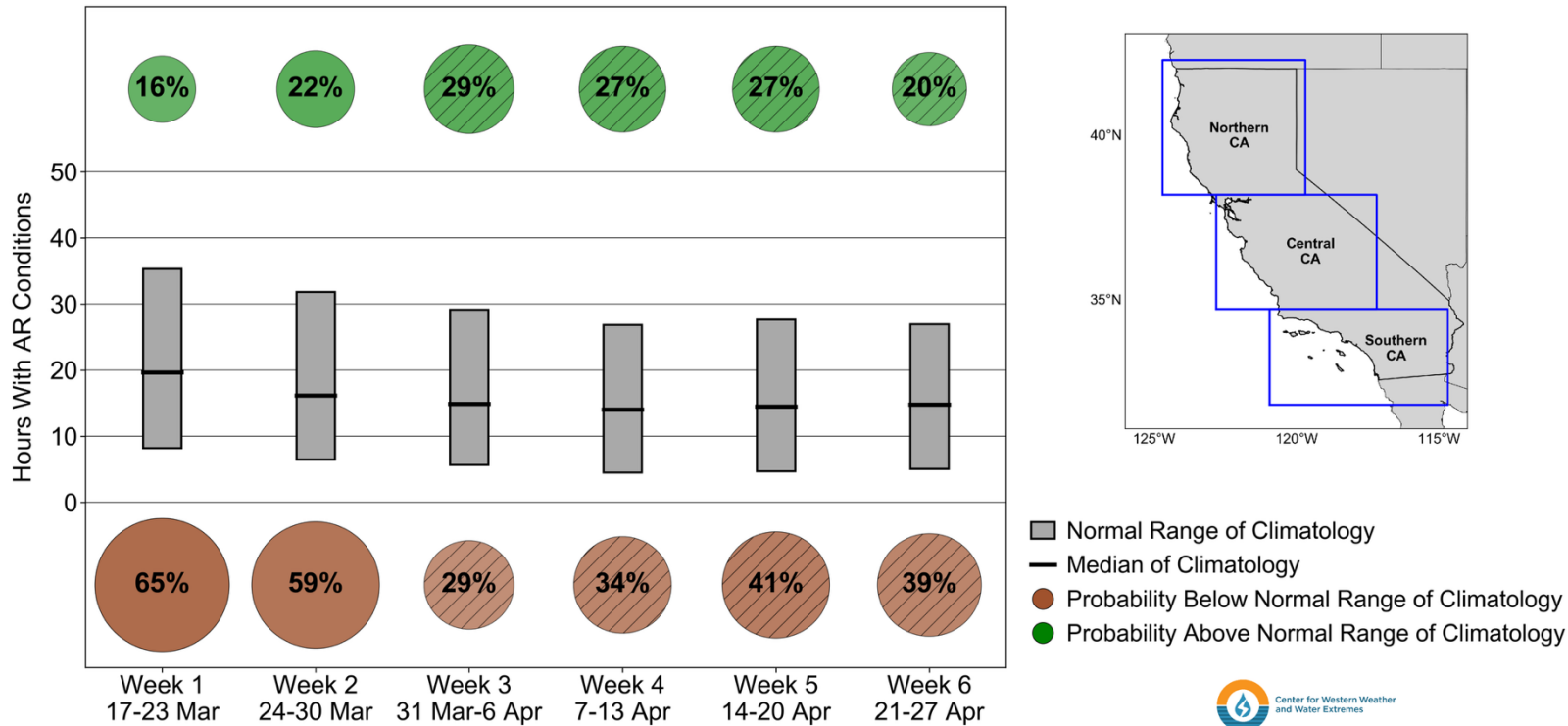
Probability matrices illustrating the weeks 1–6 lagged probability of below-normal (brown shading) or above-normal (green shading) AR occurrence and precipitation for all MJO phases when the QBO is in the westerly phase during JFM in Northern CA (left), Central CA (middle), and Southern CA (right). White 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 16 Mar 2026

## AR Occurrence: Northern CA

Northern CA Subseasonal AR Occurrence Outlook  
Issued: 16 Mar 2026 MJO Phase 8 EQBO



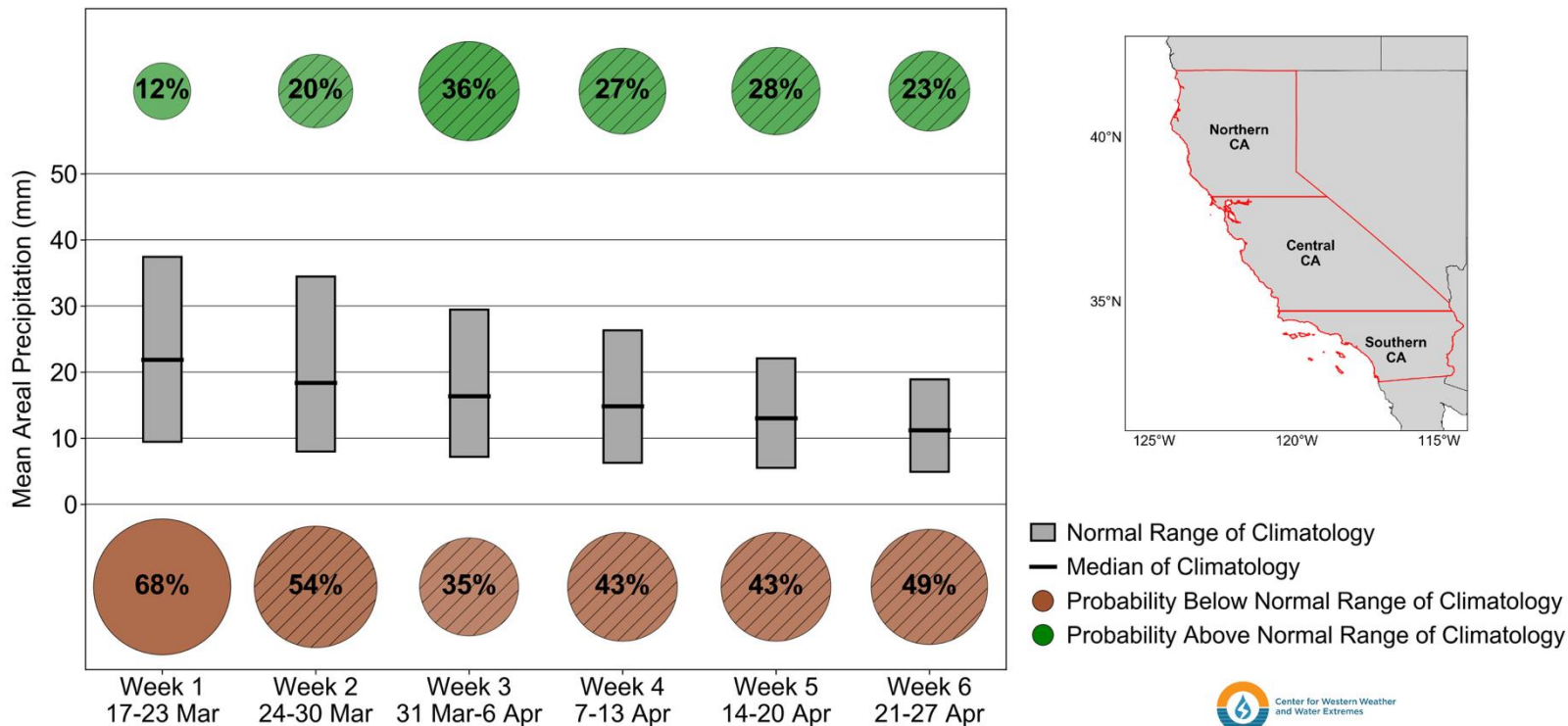
- CW3E’s probabilistic AR occurrence forecast based on current MJO and QBO conditions (see forecast for all regions [here](#))
- **Moderate likelihood (>40% probability) of below-normal AR occurrence during Week 2 (24–30 Mar) in Northern CA, with high confidence**
- Moderate likelihood of below-normal AR occurrence in Central CA during Weeks 2–4 (24 Mar – 13 Apr), and below-normal AR occurrence in Southern CA during Weeks 2 and 4 (7–13 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. \(2023\)](#).

Forecasts Initialized 16 Mar 2026

## Precipitation: Northern CA

Northern CA Subseasonal Precipitation Outlook  
Issued: 16 Mar 2026 MJO Phase 8 EQBO



- CW3E’s probabilistic precipitation forecast based on current MJO and QBO conditions (see forecast for all regions [here](#))
- **Moderate likelihood of below-normal precipitation in Northern CA during Weeks 2 and 4**
- Moderate likelihood of below-normal precipitation in Central and 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. \(2023\)](#)