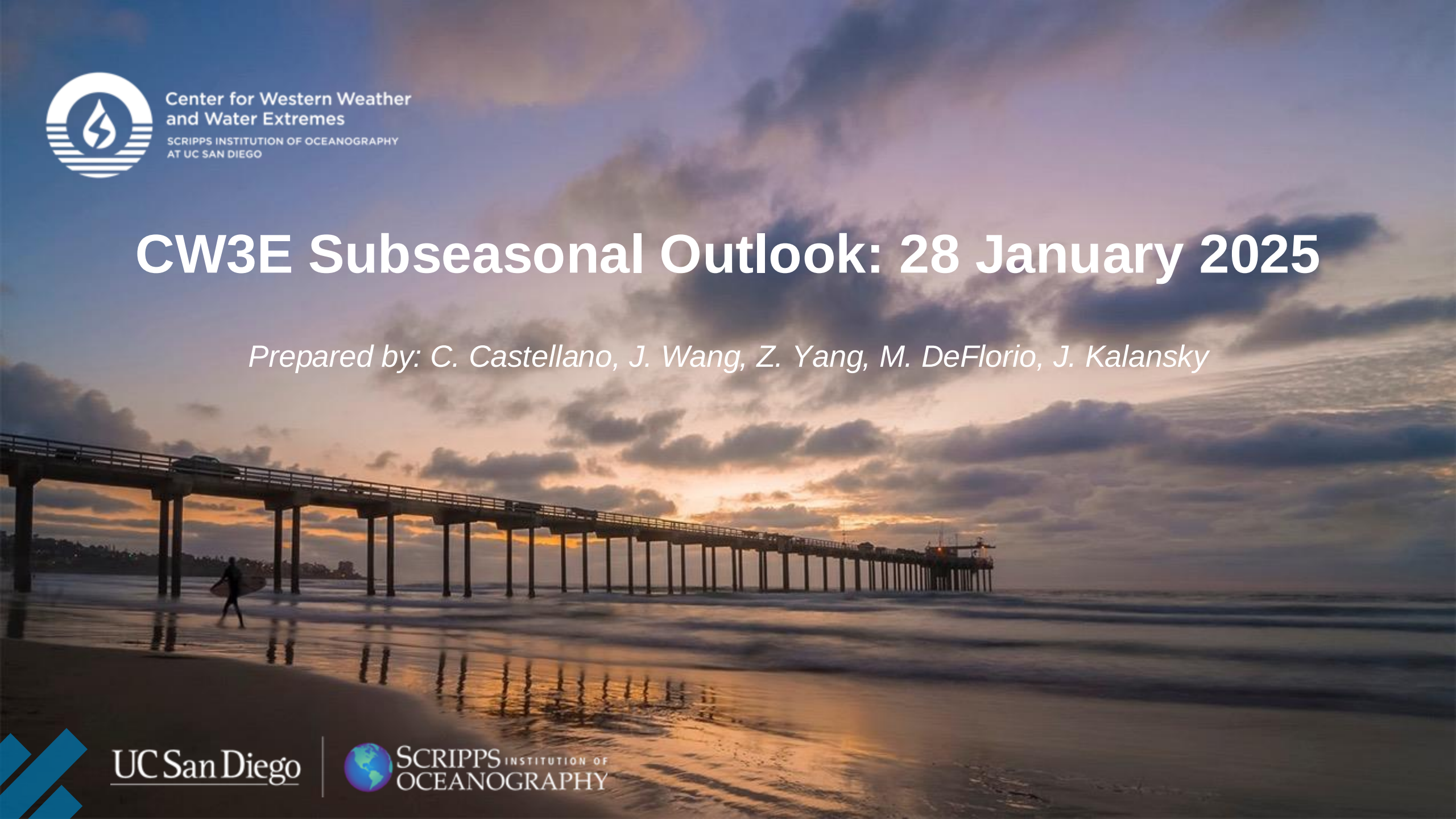

Center for Western Weather
and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO
CW3E Subseasonal Outlook: 28 January 2025
Prepared by: C. Castellano, J. Wang, Z. Yang, M. DeFlorio, J. Kalansky
UC San Diego
SCRIPPS INSTITUTION OF
OCEANOGRAPHY

Summary: Subseasonal Precipitation Outlook by Model

This slide shows the CW3E synthesis of subseasonal products by model

Forecasts Initialized 27 Jan 2025

Region	Week 2 (3–9 Feb)				Week 3 (10–16 Feb)				Week 4 (17–23 Feb)			
	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[1,2,3]	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 above-normal precipitation in Northern CA during Week 2; more uncertainty over Central and Southern CA
- Note that more nuanced aspects of the forecast, such as the timing and exact location of large-scale circulation features, are contributing to inconsistencies in expected precipitation outcomes in the NCEP Week 2 products, despite these products using data from the same model
- High degree of uncertainty in precipitation over all of CA during Weeks 3–4 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)

Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

Summary

MJO/QBO Conditions

- MJO convection is currently located over the Maritime Continent (Phase 4); QBO is in the westerly phase
  - Without considering QBO/ENSO conditions, MJO in Phases 4&5 during JFM is associated with decreases in wet extremes in Central CA at lag times of 2–4 weeks

- Models forecast MJO convection to remain over the Maritime Continent during Week 1 and disagree on evolution of MJO activity in Week 2

Week 2 forecasts (3–9 Feb):

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

- Ridging outlooks show high likelihood of above-normal ridging activity near the US West Coast during Weeks 1–2, but models disagree on location of ridging activity
  - NCEP is forecasting a high likelihood of above-normal North-ridge activity (dry conditions over all of CA) and a moderate likelihood of above-normal South-ridge activity (wet conditions over far Northern CA; dry conditions over Southern CA)
  - ECMWF is forecasting a high likelihood of above-normal South-ridge activity

- IRI weather regime tool shows moderate-to-high likelihood of Pacific Ridge (near-normal precipitation in CA) during first half of Week 2 and low-to-moderate likelihood of a brief regime shift to West Coast Ridge (below-normal precipitation in CA) during second half of Week 2

Summary

Week 3 Forecasts (10–16 Feb):

- NCEP and ECCC generally agree on above-normal activity over all of CA during Week 3, but ECMWF is forecasting near-normal AR activity in CA

- Ridging outlooks show potential for persistent ridging activity west of CA during Weeks 3–4, but disagree on likelihood
  - NCEP is forecasting above-normal West-ridge activity (dry conditions in Central and Southern CA) with high confidence
  - ECMWF is forecasting slightly above-normal West-ridge activity, but with low confidence

- IRI weather regime tool shows low-to-moderate likelihood of Pacific Ridge (near-normal precipitation in CA) during Week 3

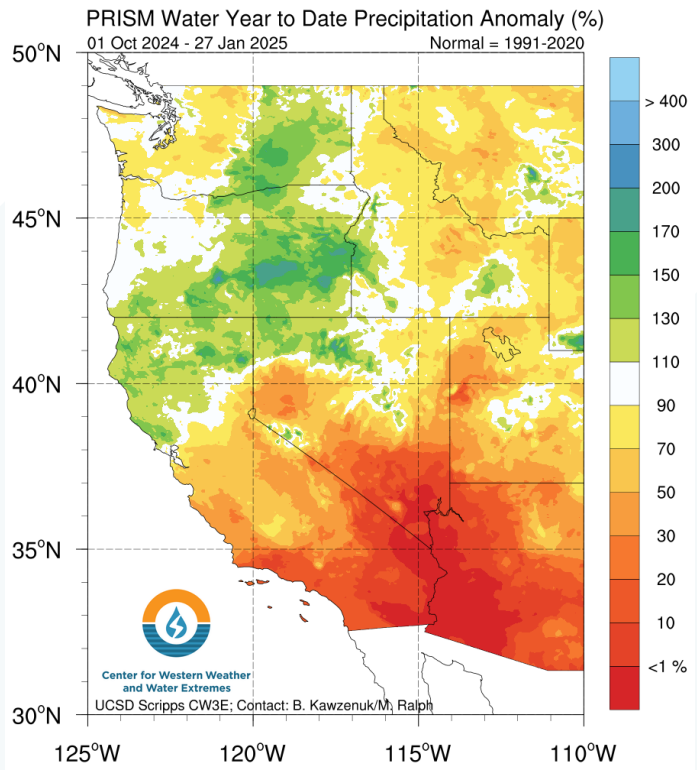
Week 4 Forecasts (17–23 Feb):

- Models disagree somewhat on AR activity in CA during Week 4
  - In Northern CA, NCEP and ECCC are both forecasting slightly above-normal AR activity, and ECMWF is forecasting near-normal AR activity
  - In Central CA, ECCC and ECMWF are both forecasting slightly above-normal AR activity, and NCEP is forecasting near-normal AR activity
  - In Southern CA, NCEP and ECCC are both forecasting near-normal AR activity, and ECMWF is forecasting slightly above-normal AR activity

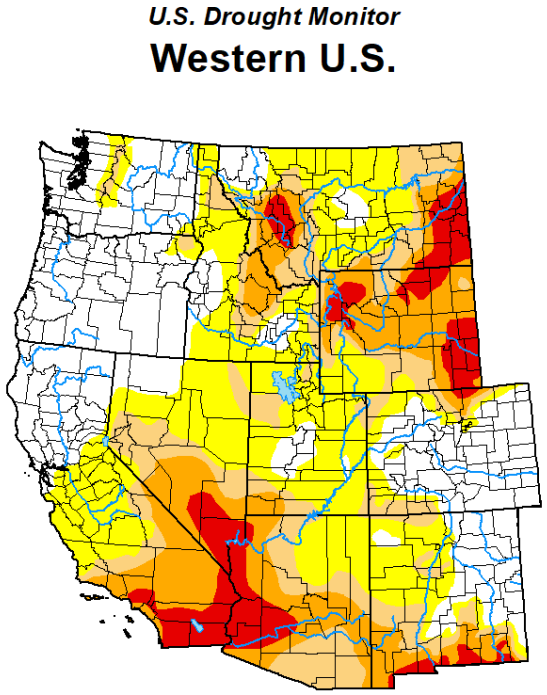
- IRI weather regime tool shows high degree of uncertainty in regime type during Week 4

Hydrologic Summary

Precipitation



Drought Conditions



January 21, 2025
(Released Thursday, Jan. 23, 2025)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	31.69	68.31	39.66	23.93	8.50	0.00
Last Week 01-14-2025	32.97	67.03	39.27	23.21	6.87	0.00
3 Months Ago 10-22-2024	15.06	84.94	45.12	17.87	4.67	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 01-23-2024	48.32	51.68	28.73	13.79	4.31	0.57

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:
Brian Fuchs
National Drought Mitigation Center

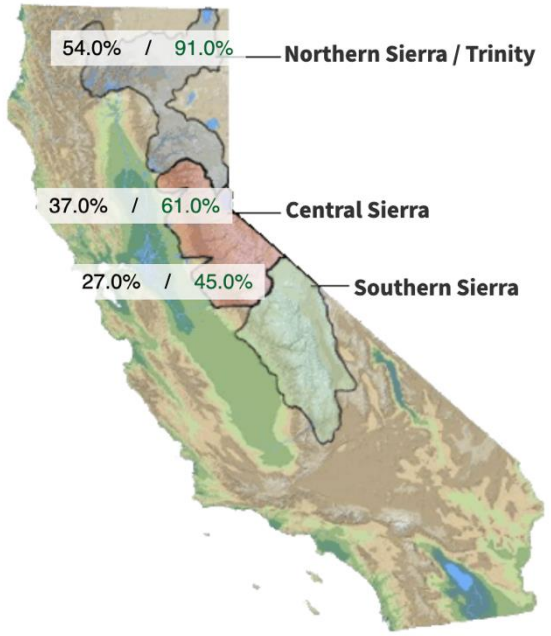
droughtmonitor.unl.edu

Snowpack Conditions

Provided by the California Cooperative Snow Surveys

Data For: **27-Jan-2025**

% Apr 1 Avg. / % Normal for this Date



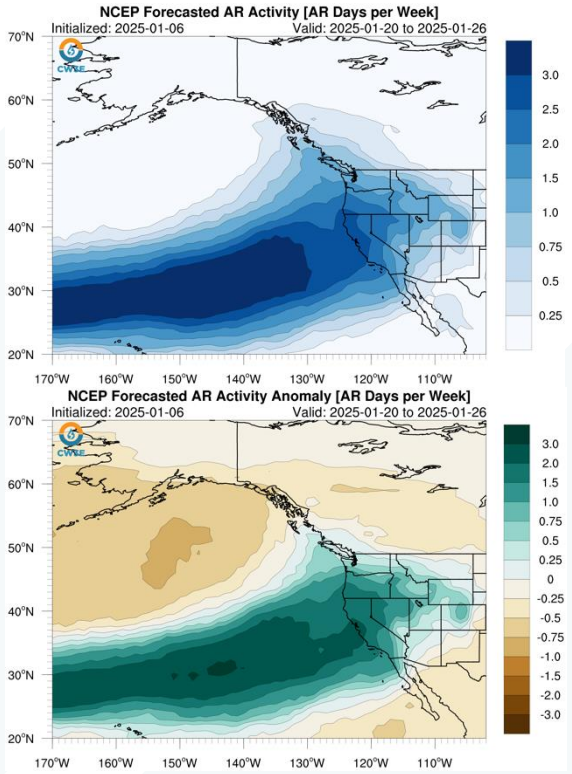
Source: California DWR

- As of 27 Jan, water-year-to-date precipitation is **near-to-slightly above normal (90–130% 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 now showing **severe-to-extreme drought (D2–D3)** in Southern CA and **moderate drought (D1)** beginning to expand northward into Central CA (where **abnormally dry (D0)** conditions have been present since Sep 2024)
- Current snowpack is <65% of normal for this time of year in the Southern and Central Sierra Nevada
- After a strong start to the water year, snowpack is now only 91% of normal in the Northern Sierra/Trinity region

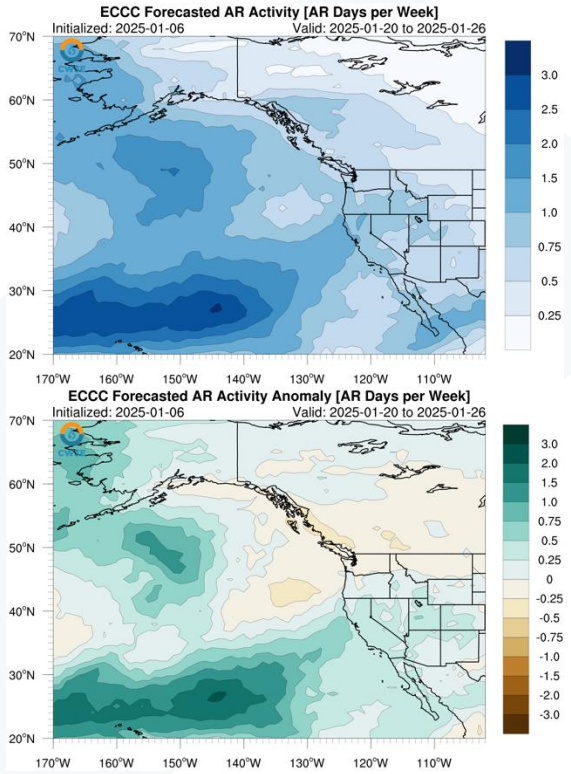
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 6 Jan 2025; Valid: 20–26 Jan 2025

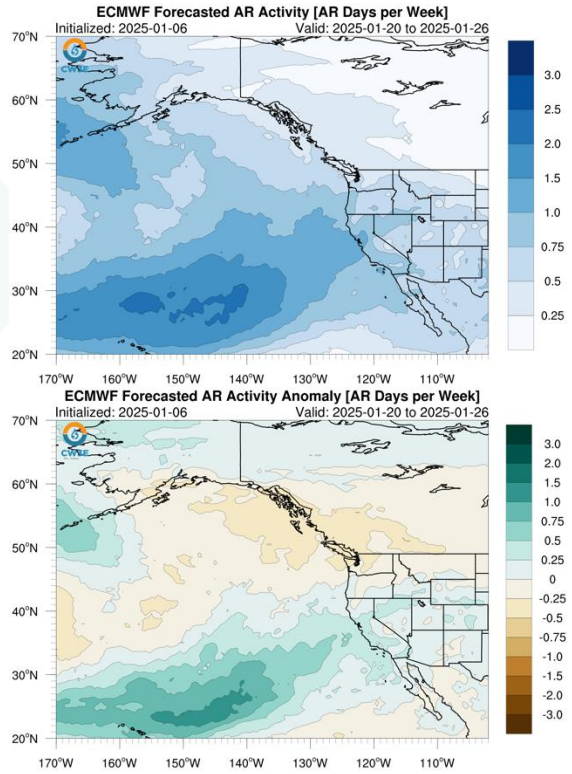
NCEP



ECCC

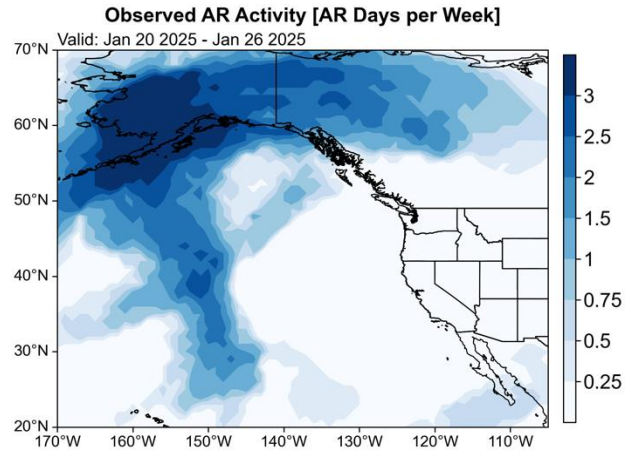


ECCC

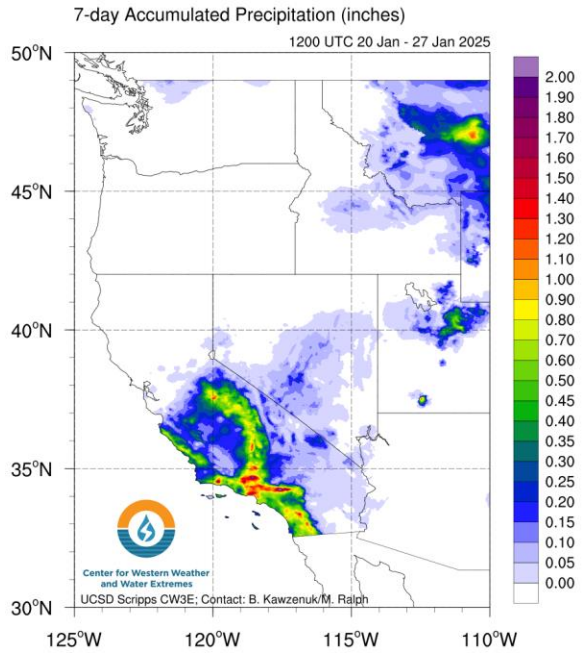


Shading: Fractional # of AR days forecast over a 7-day period (top) and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

Observed (GFS Analysis)



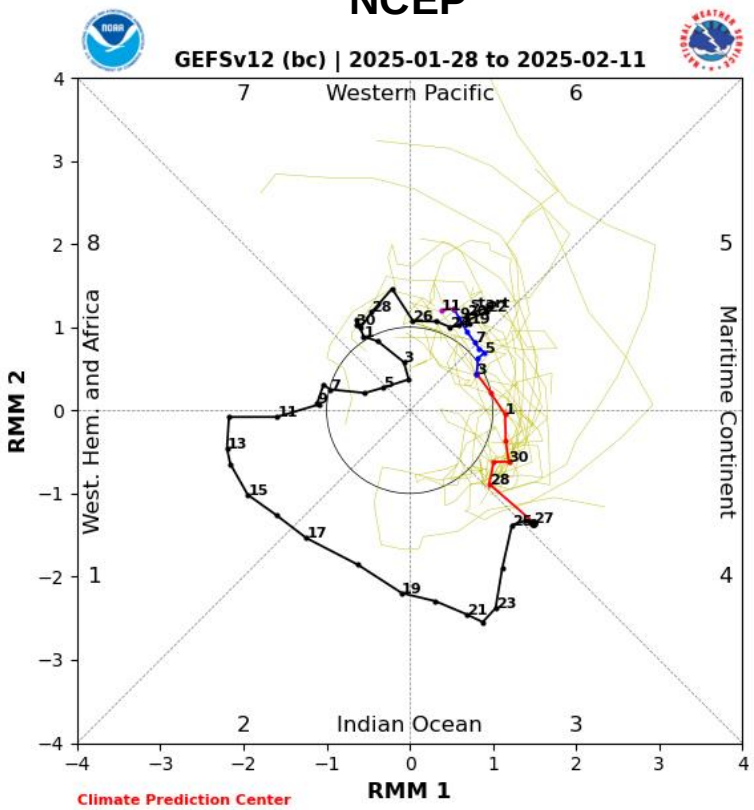
Observed Precipitation



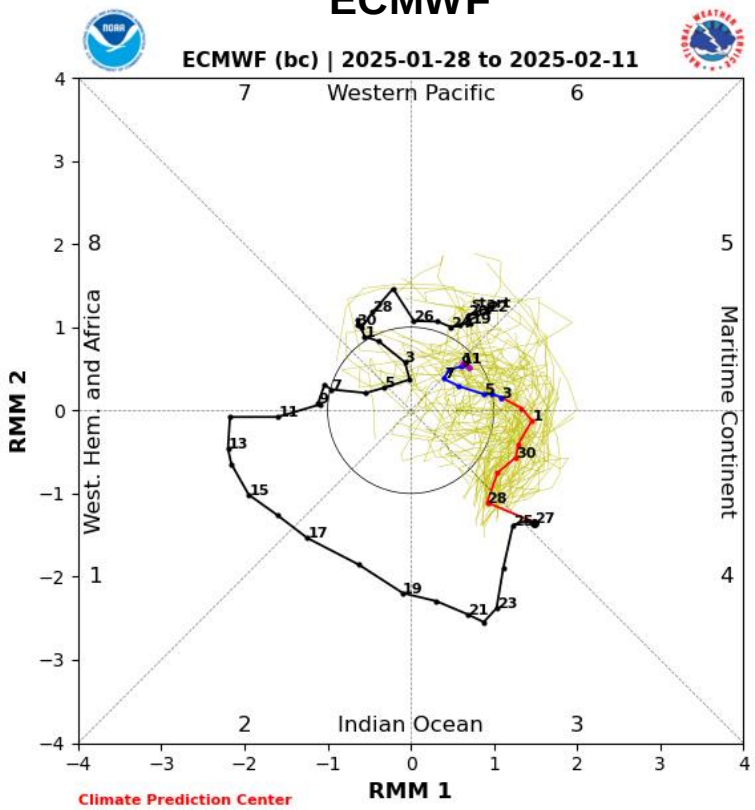
- All models struggled to predict the large-scale circulation pattern over the Northeast Pacific and forecasted too much AR activity over the western US, especially CA
- Models were suggesting the possibility of a regime change in mid-to-late Jan, but observed activity remained far offshore due to continued ridging along the US West Coast
- A weak low-pressure system produced light precipitation (< 2 inches) over coastal Southern CA and the Central and Southern Sierra Nevada during 25–26 Jan

Dynamical Model MJO Forecasts (NCEP vs. ECMWF)

NCEP



ECMWF



Black: Last 40 days of observations (19 Dec – 27 Jan); Red: Week 1 (28 Jan – 3 Feb) ensemble mean; Blue: Week 2 (4–10 Feb) ensemble mean; Yellow: Ensemble members

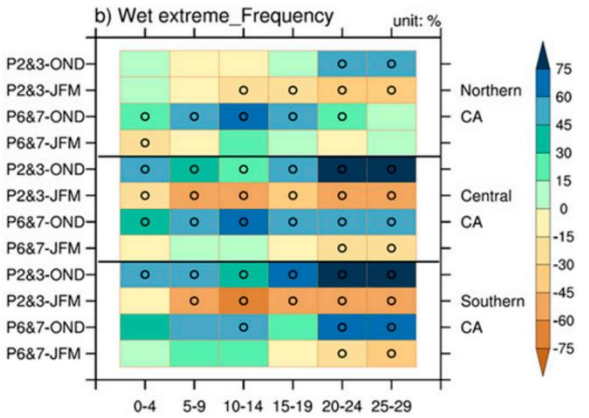


Figure 8 from Wang et al. (2023)

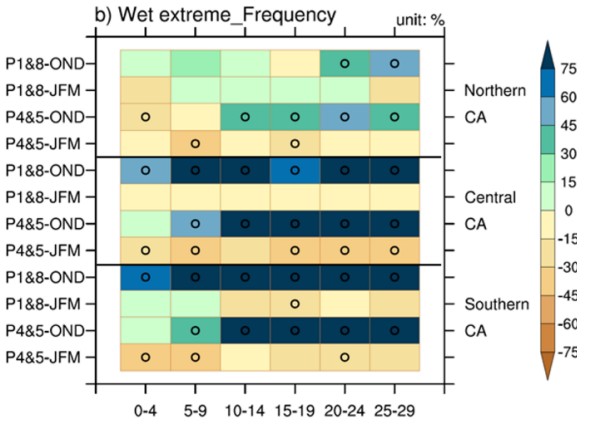
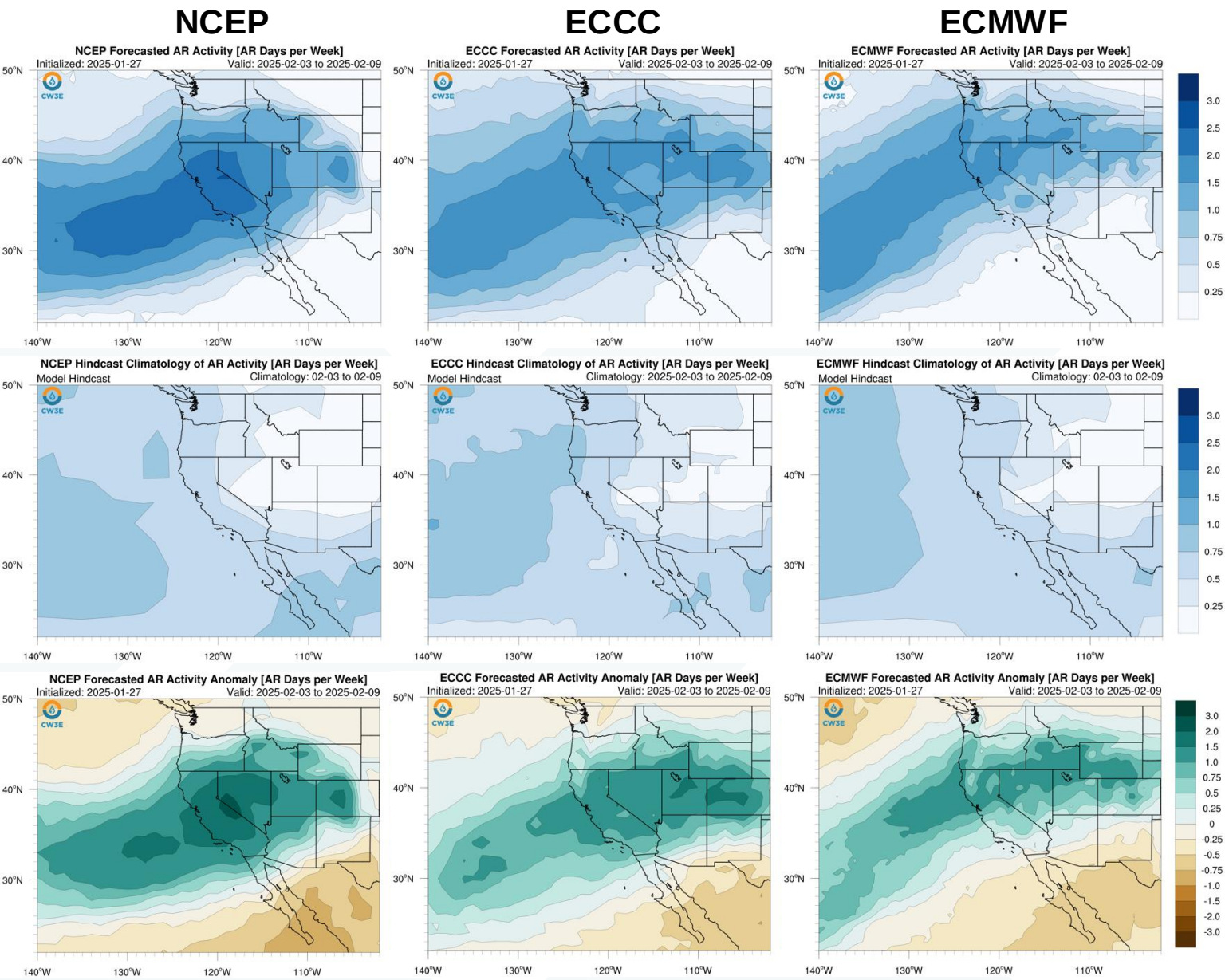


Figure S6 from Wang et al. (2023)

- Strong MJO convection is currently located over the Maritime Continent (Phase 4)
- Both NCEP and ECMWF are forecasting MJO convection to remain over the Maritime Continent during Week 1
- NCEP is forecasting MJO convection to propagate eastward into the Western Pacific during Week 2, whereas ECMWF is forecasting MJO convection to weaken over the Maritime Continent
- Without considering QBO/ENSO conditions, MJO activity over the Maritime Continent during JFM is associated with a statistically significant decrease in wet extremes in Central CA at lag times of 2–4 weeks

Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

AR Activity Forecasts: Week 2 (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 27 Jan 2025

- NCEP and ECCC agree on above-normal AR activity over all of CA during Week 2 (3–9 Feb)
- ECMWF is also forecasting above-normal AR activity over Northern and Central CA but near-normal AR activity over Southern CA

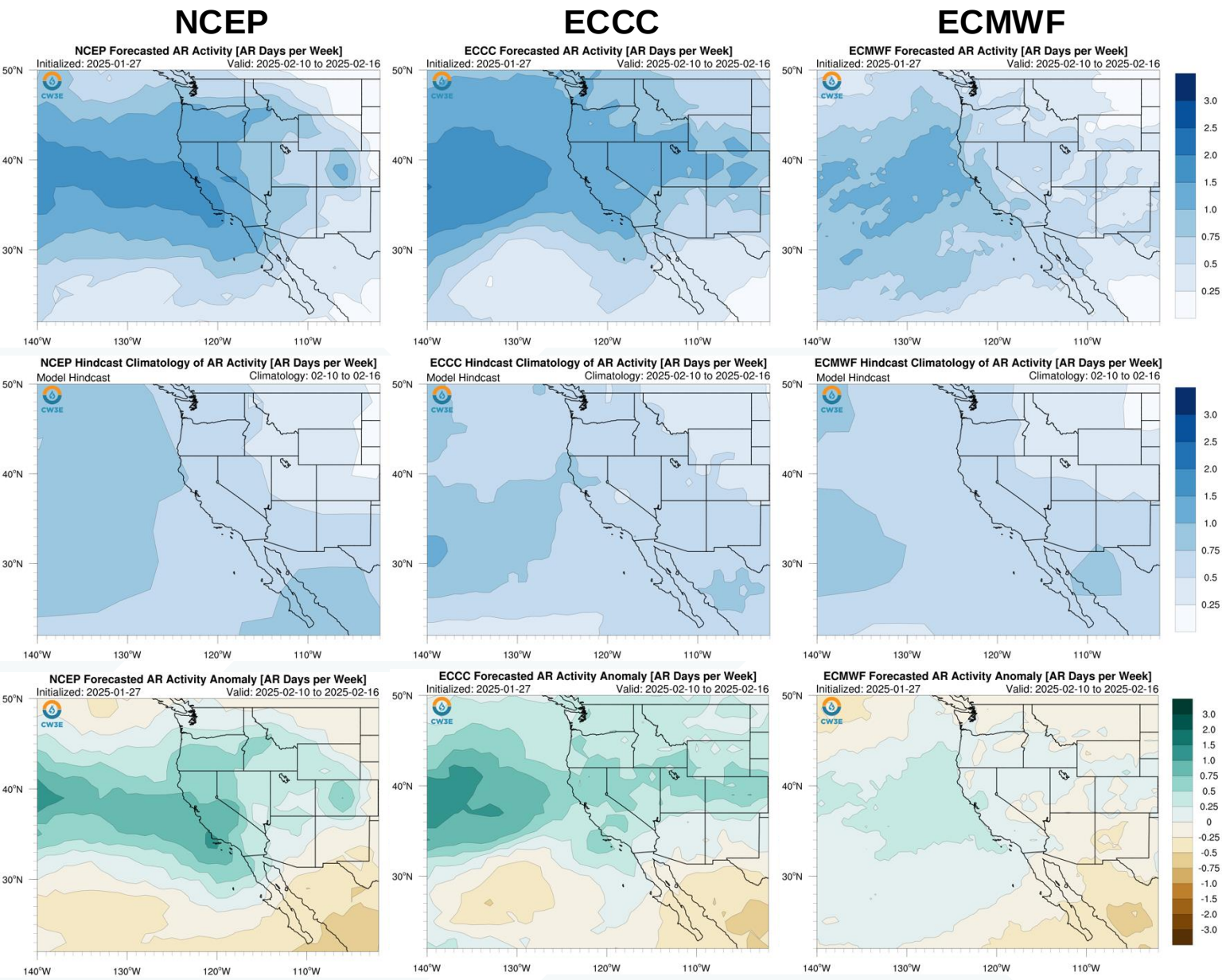
Models agree on above-normal activity over Northern and Central CA during Week 2 (3–9 Feb); some disagreement over Southern CA

Center for Western Weather and Water Extremes

AMBASSADOR™ WRN WEATHER-READY NATION

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

Forecasts Initialized 27 Jan 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 and Central CA, NCEP and ECCC are both forecasting above-normal AR activity, but ECMWF is forecasting near-normal AR activity during Week 3 (10–16 Feb)
- In Southern CA, NCEP is forecasting above-normal AR activity, ECCC is forecasting slightly above-normal AR activity, and ECMWF is forecasting near-normal AR activity

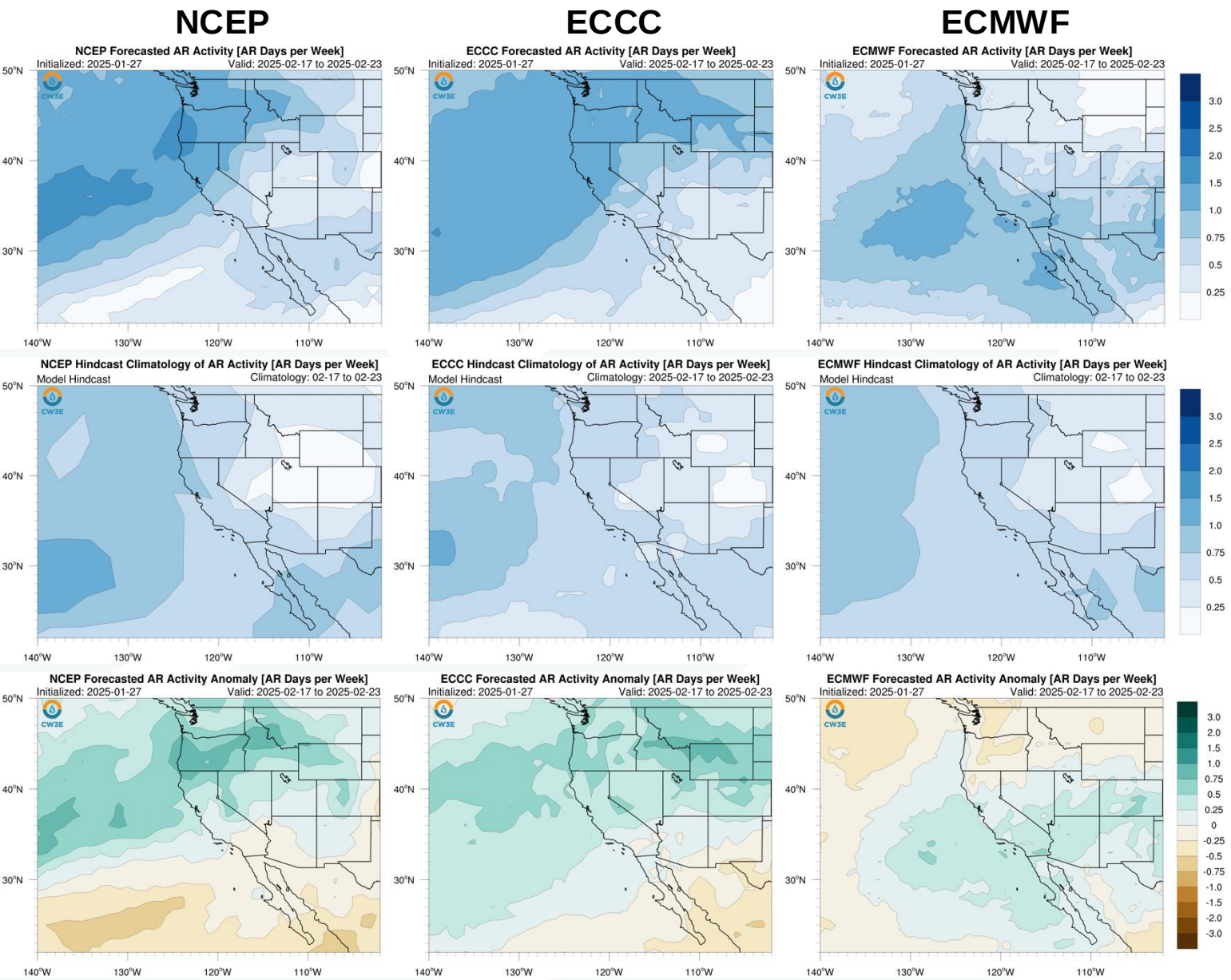
NCEP and ECCC generally agree on above-normal activity in CA during Week 3 (10–16 Feb); ECMWF differs

Center for Western Weather and Water Extremes

AMBASSADOR™ WRN WEATHER-READY NATION

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

Forecasts Initialized 27 Jan 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)

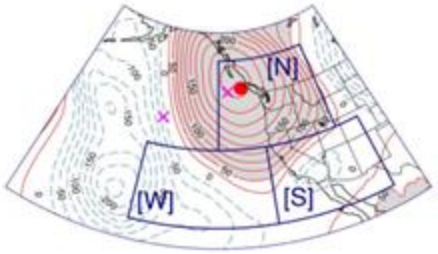
- In Northern CA, NCEP and ECCC are both forecasting slightly above-normal AR activity, and ECMWF is forecasting near-normal AR activity during Week 4 (17–23 Feb)
- In Central CA, ECCC and ECMWF are both forecasting slightly above-normal AR activity, and NCEP is forecasting near-normal AR activity
- In Southern CA, NCEP and ECCC are both forecasting near-normal AR activity, and ECMWF is forecasting slightly above-normal AR activity

Models disagree somewhat on AR activity in CA during Week 4 (17–23 Feb)

Center for Western Weather and Water Extremes

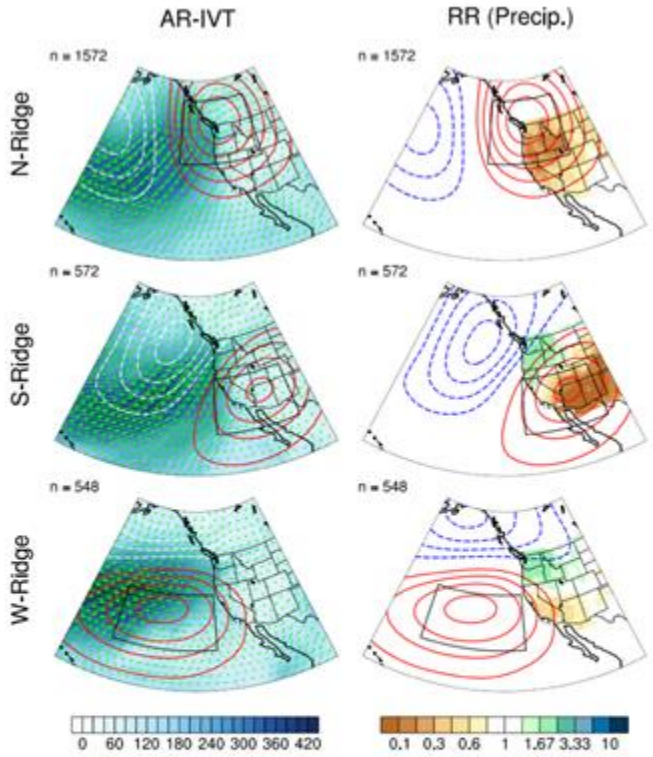
AMBASSADOR™ WRN WEATHER-READY NATION

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

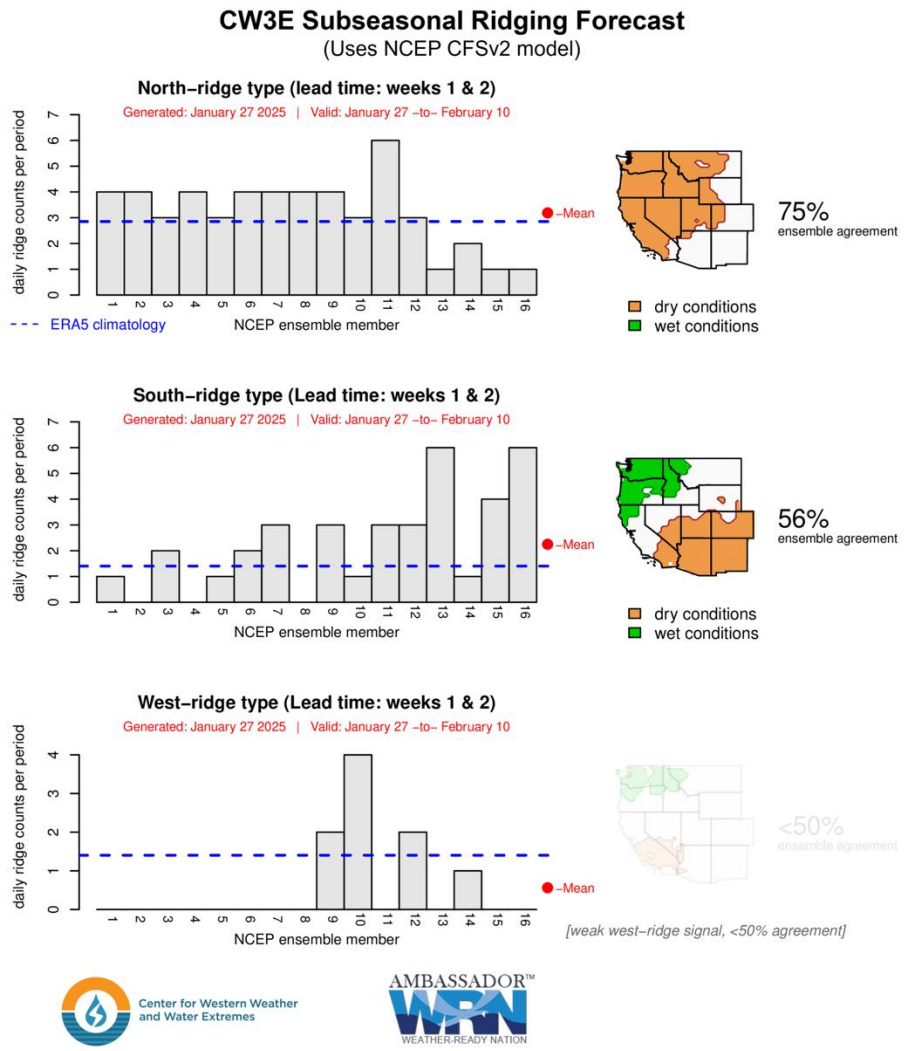
Jet Propulsion Laboratory
California Institute of Technology

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

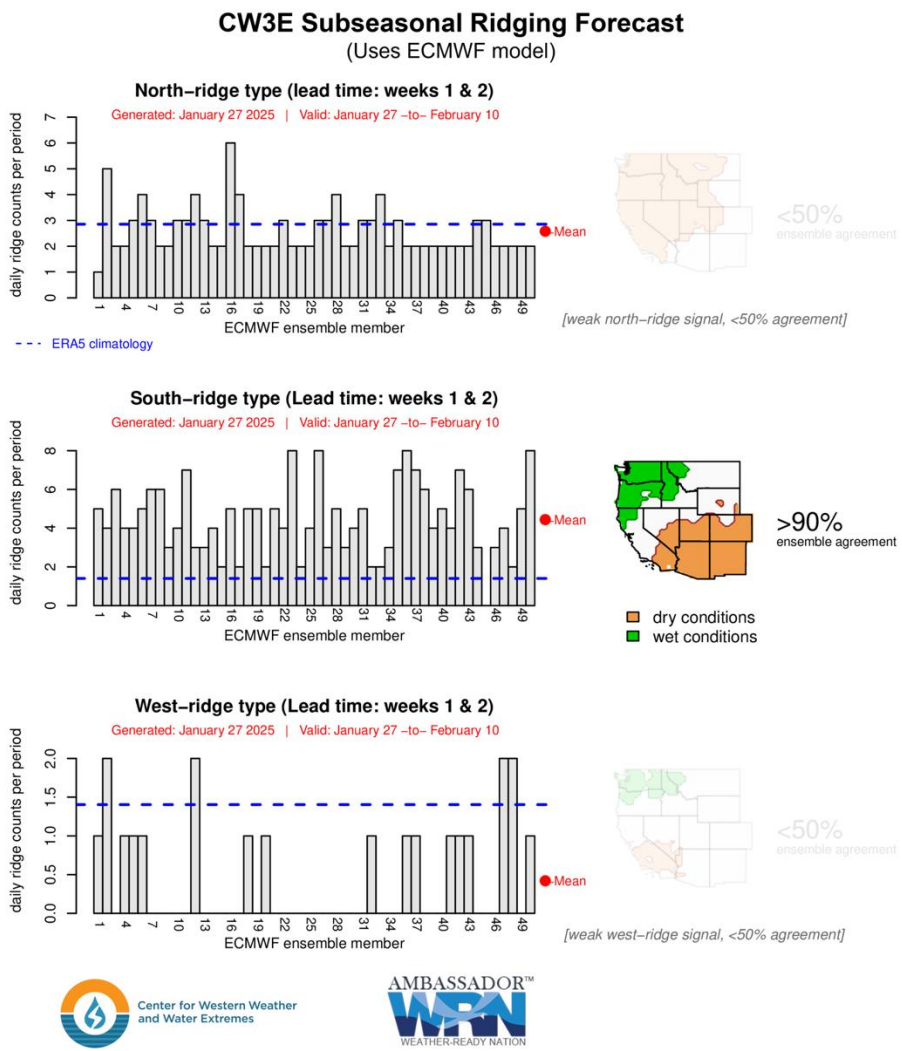
Contact: pgibson@ucsd.edu
Reference: Gibson et al. (2020) Journal of Climate

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

NCEP



ECMWF



Forecasts Initialized 27 Jan 2025

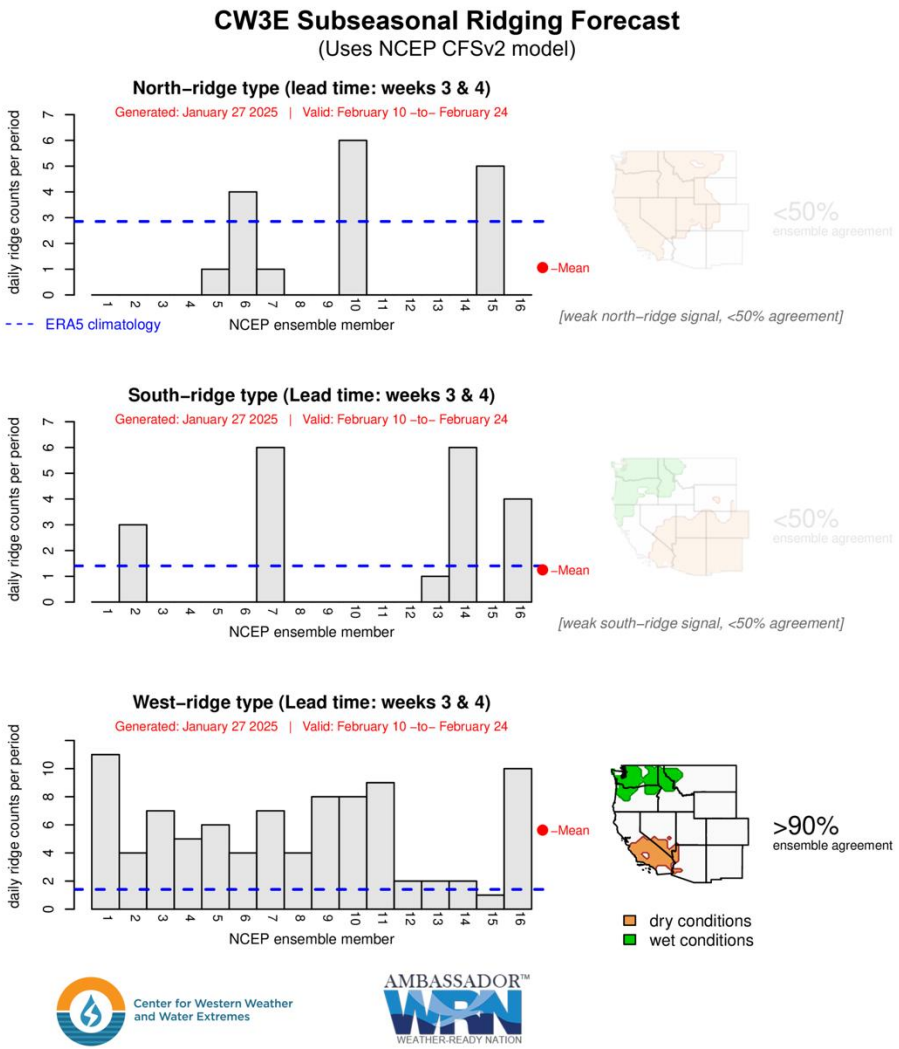
- NCEP is forecasting a high likelihood (75% ensemble agreement) of above-normal North-ridge activity and a moderate likelihood (56% ensemble agreement) of above-normal South-ridge activity during Weeks 1–2 (27 Jan – 10 Feb)
- ECMWF is forecasting near-normal North-ridge activity and a very high likelihood (>90% ensemble agreement) of above-normal South-ridge activity
- Both models are forecasting below-normal West-ridge activity

Models show high likelihood of above-normal ridging activity near the US West Coast, but disagree on center of ridging activity during Weeks 1–2 (27 Jan – 10 Feb)

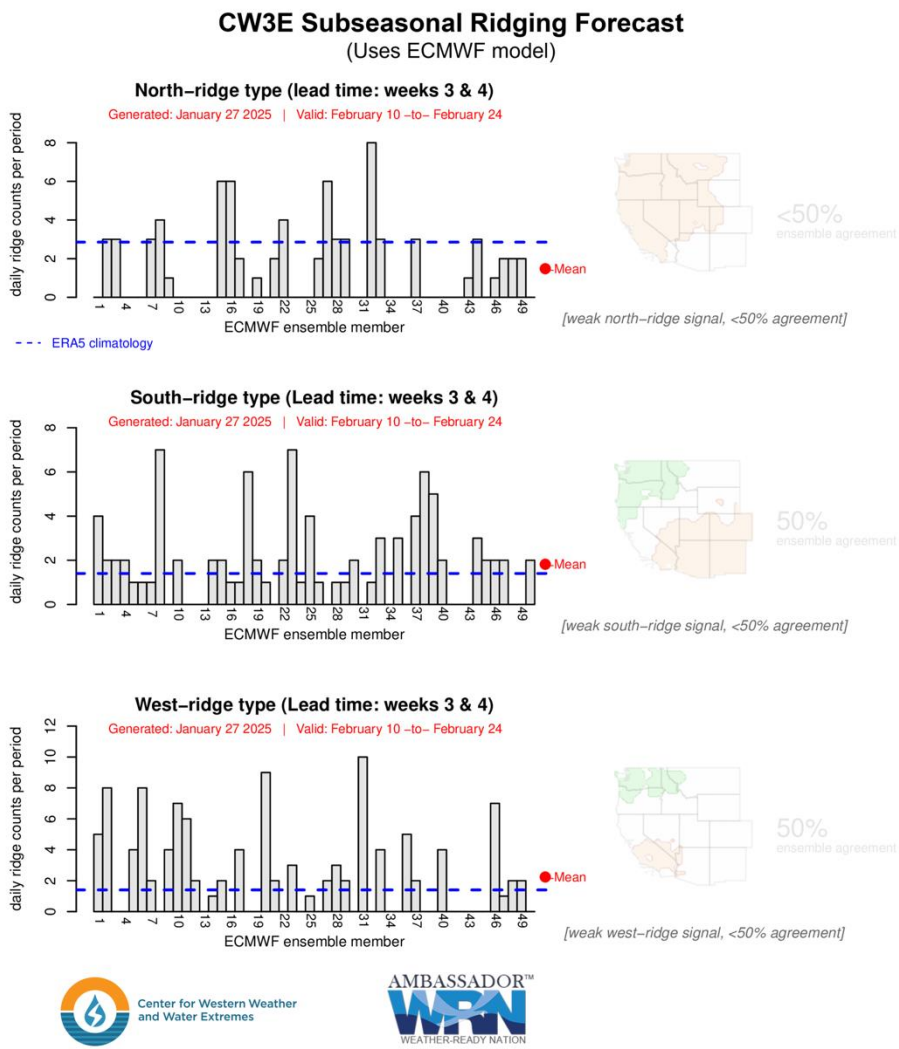
Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

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

NCEP



ECMWF



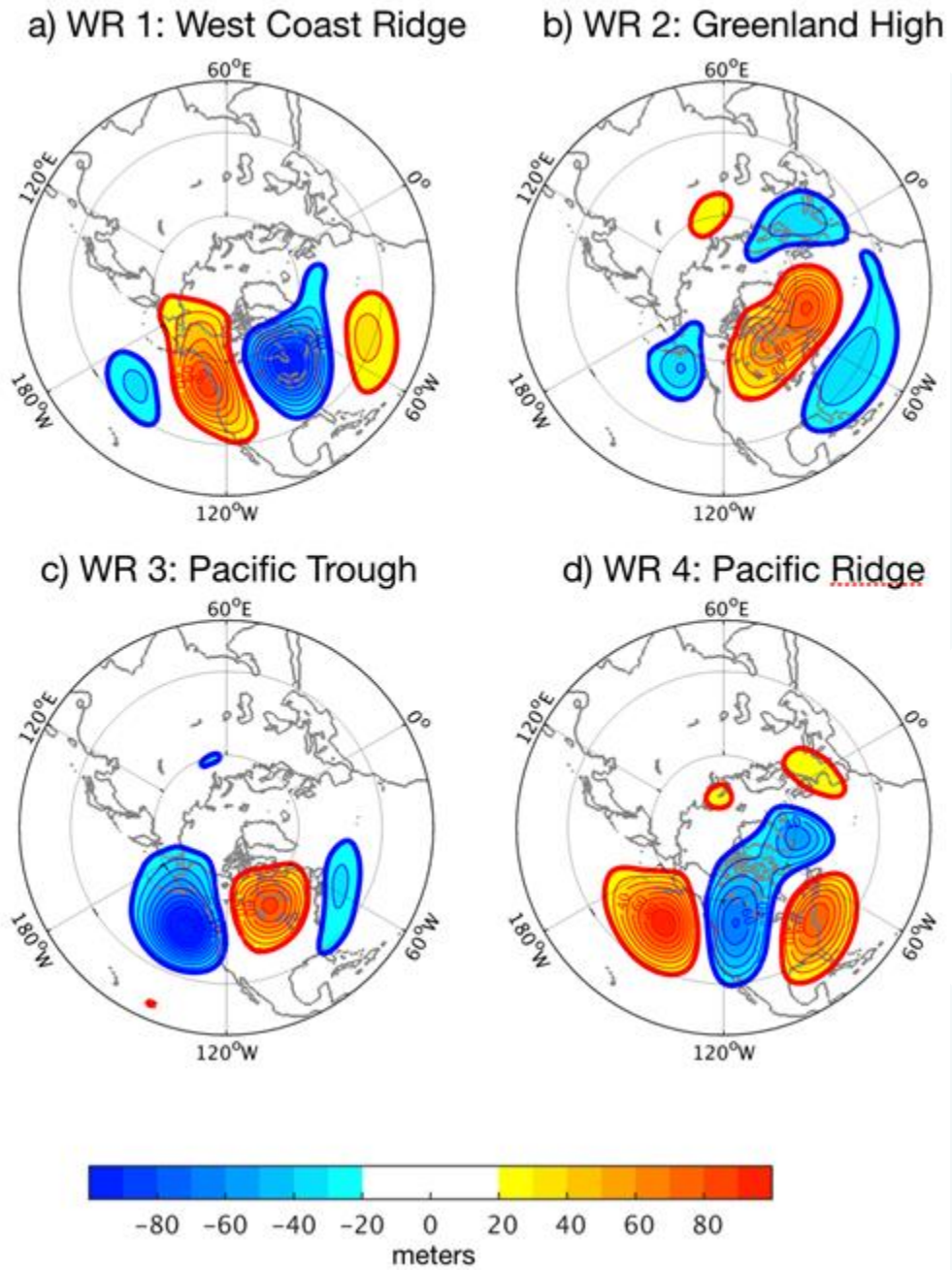
Forecasts Initialized 27 Jan 2025

- NCEP is forecasting a very high likelihood (>90% ensemble agreement) of above-normal West-ridge activity during Weeks 3–4 (10–24 Feb)
  ∗**This level of agreement is unusual at these lead times**
- ECMWF is forecasting slightly above-normal West-ridge activity, but with low confidence (<50% ensemble agreement)
- Both models are also forecasting below-normal North-ridge activity and near-normal South-ridge activity

Models show potential for above-normal ridging activity west of CA during Weeks 3–4 (10–24 Feb), but disagree on likelihood

Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

Background Info: IRI Subseasonal Weather Regime Forecasts

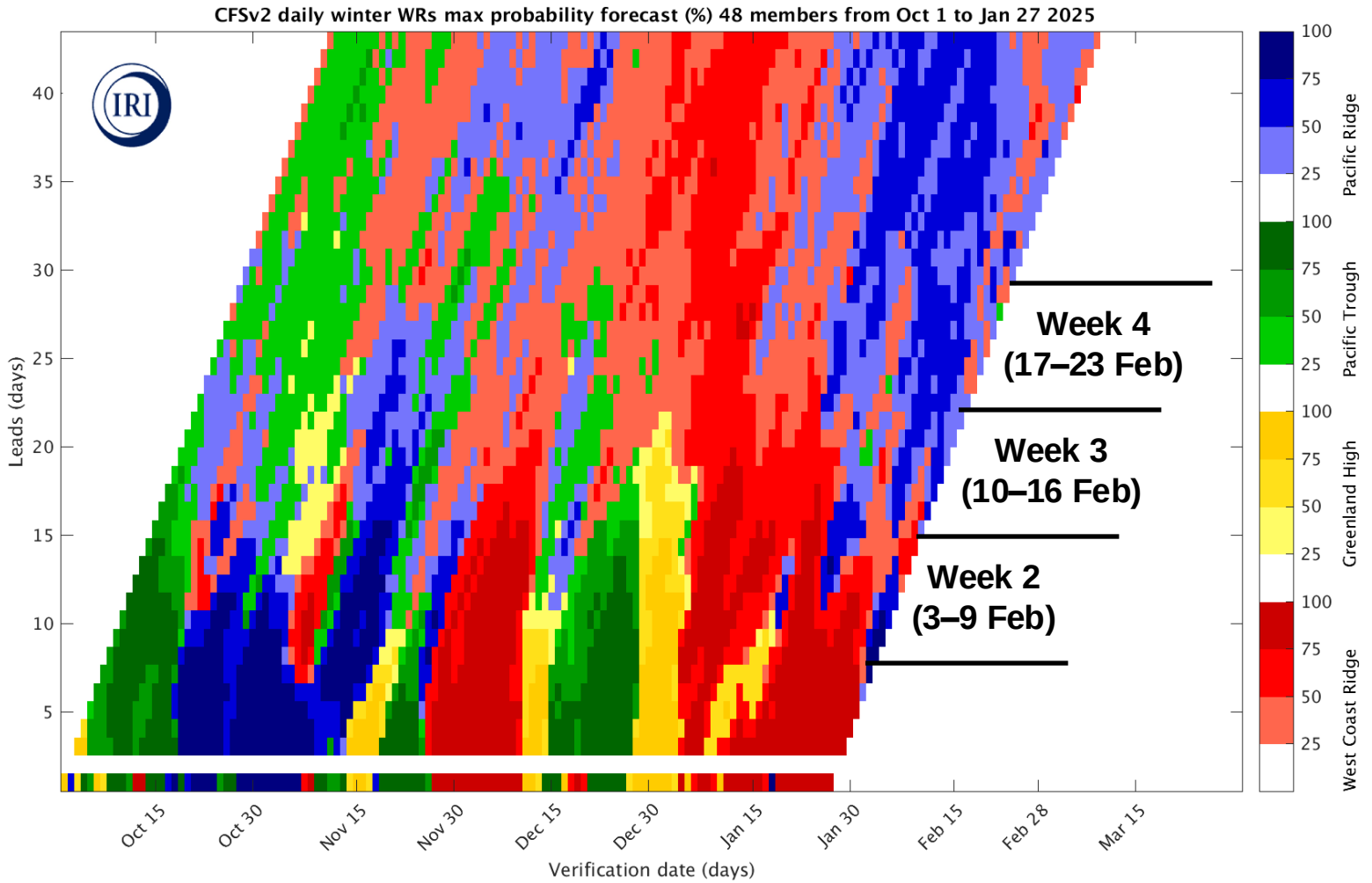


This slide contains background information about IRI's North American weather regime forecast product

- 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 27 Jan 2025

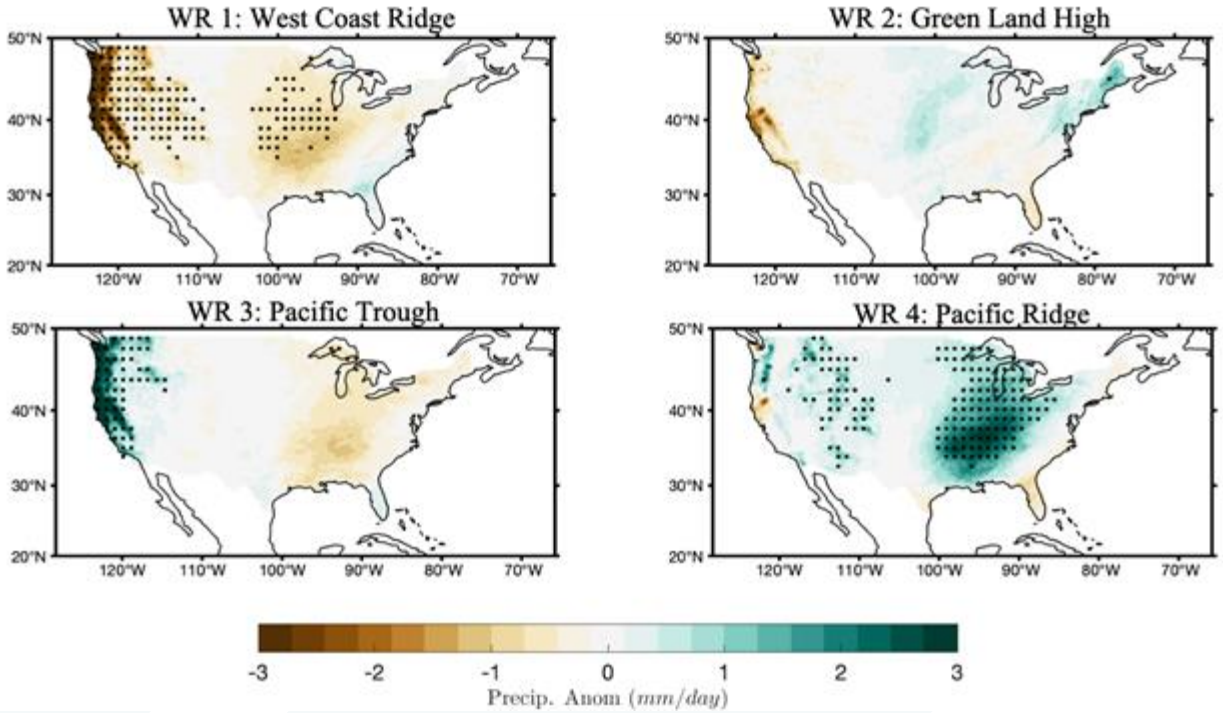
- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- Moderate-to-high likelihood (≥ 50% ensemble agreement) of Pacific Ridge during first half Week 2 (3–6 Feb), with brief transition to West Coast Ridge possible in second half of Week 2 (7–9 Feb)
- Low-to-moderate likelihood (25–75% ensemble agreement) of Pacific Ridge during Week 3 (10–16 Feb)
- High degree of uncertainty in regime type during Week 4 (17–23 Feb)

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.

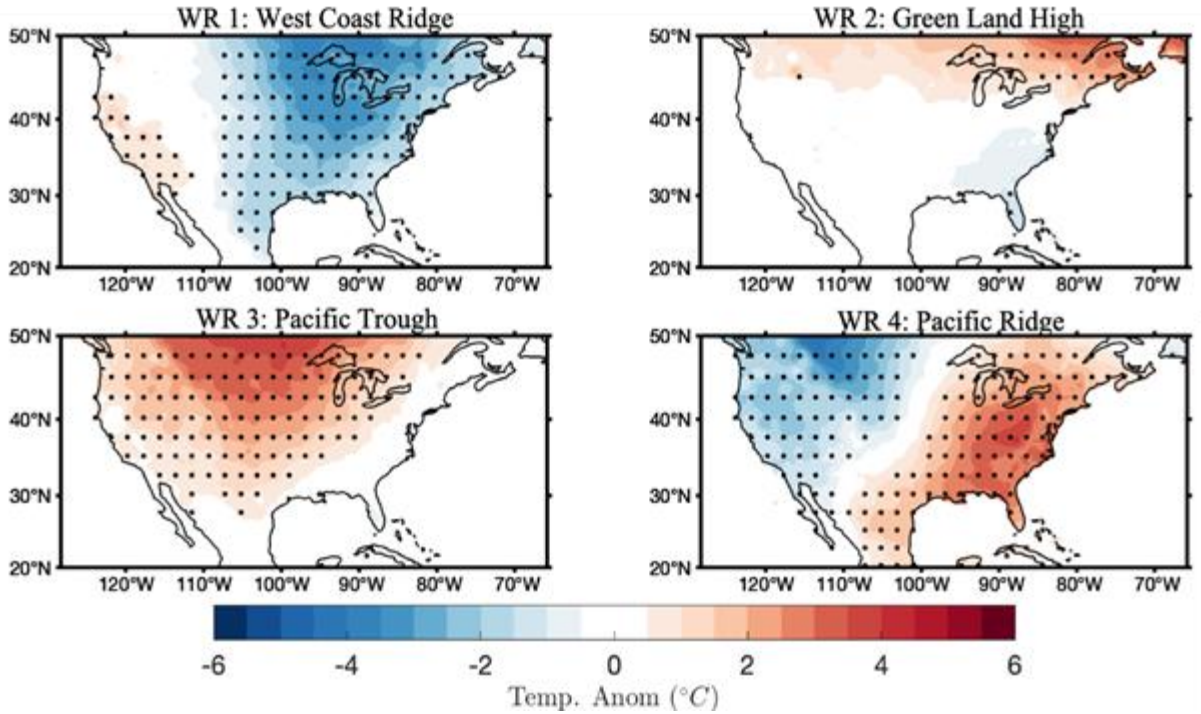
For more information about the forecast product: https://wiki.iri.columbia.edu/index.php?n=Climate.S2S-WRs

IRI North American Weather Regime Forecasts

Precipitation



Temperature

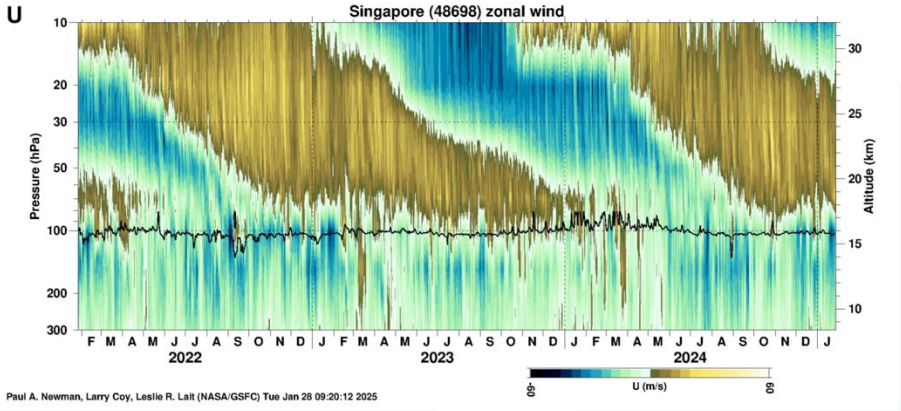


This graphic shows composite mean precipitation (left) and temperature (right) anomalies associated with each weather regime. Stippling (black dots) indicate statistically significant anomalies.

- Near-normal precipitation and temperature predicted over CA during first half of Week 2 (3–6 Feb) with moderate-to-high confidence in Pacific Ridge regime
- Below-normal precipitation and above-normal temperature predicted over CA during remainder of Week 2 (7–9 Feb) with low-to-moderate confidence in West Coast Ridge regime
- Near-normal precipitation and temperature predicted over CA during Week 3 (10–16 Feb) with low-to-moderate confidence in Pacific Ridge regime
- Uncertain precipitation and temperature anomalies over CA during Week 4 (17–23 Feb)

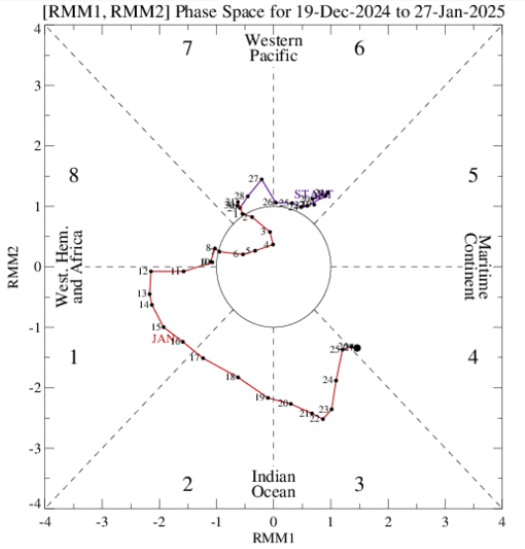
Background Info: AR Activity and Precipitation Based on MJO and QBO

QBO Conditions



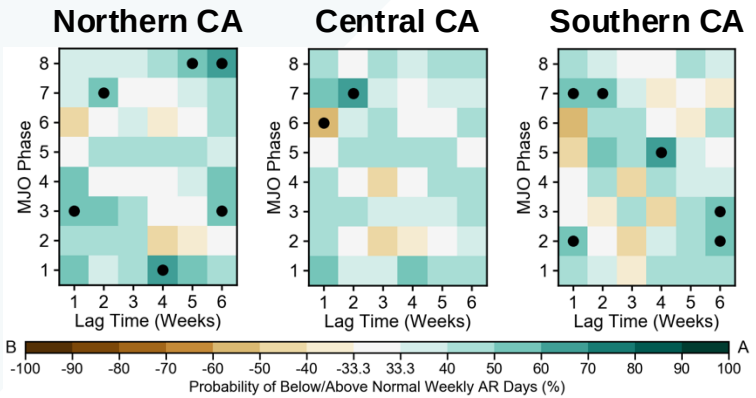
QBO is in the westerly phase at 50-hPa

MJO Conditions

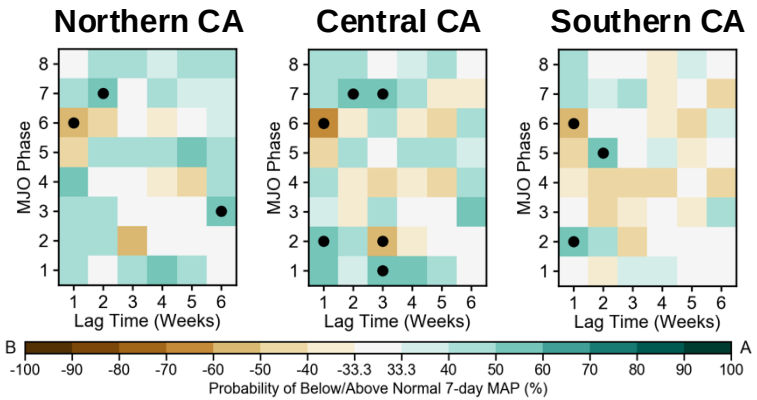


MJO convection is currently located over the Maritime Continent (Phase 4)

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



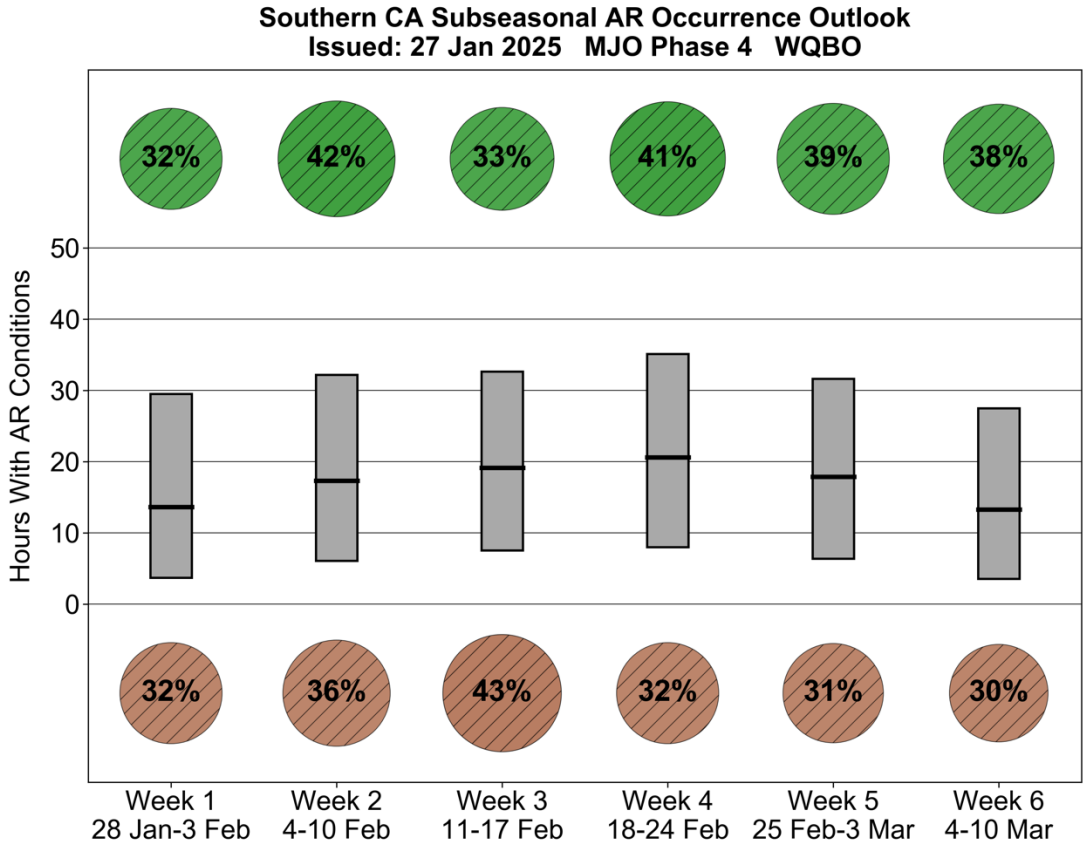
Probability of Above/Below-Normal Precipitation (WQBO in JFM)

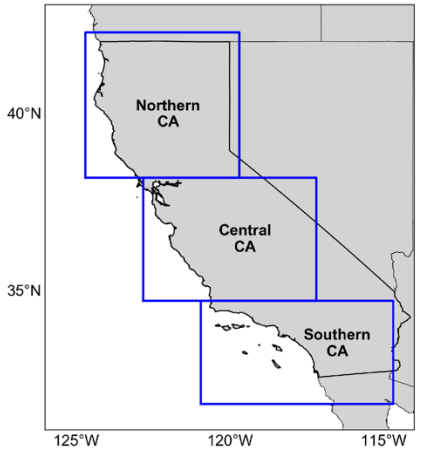


Probability matrices illustrating the weeks 1–6 lagged probability of below-normal (brown shading) or above-normal (green shading) AR occurrence and precipitation for all MJO phases when the QBO is in the westerly phase during OND in Northern CA (left), Central CA (middle), and Southern CA (right). White squares indicate that the near-normal category has the highest probability. The black dots denote statistically significant probabilities of below- or above-normal conditions based on a bootstrapping analysis. Historical observations less (more) than the lower (upper) tercile of climatology (1981–2019 period) are considered below (above) normal.

AR Activity and Precipitation Based on MJO and QBO

AR Occurrence: Southern CA





Forecasts Initialized 27 Jan 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 Weeks 2 (4–10 Feb) & 4 (18–24 Feb) and below-normal AR occurrence during Week 3 (11–17 Feb) in Southern CA**
- Moderate likelihood of below-normal AR occurrence in Central CA during Week 3 (11–17 Feb)

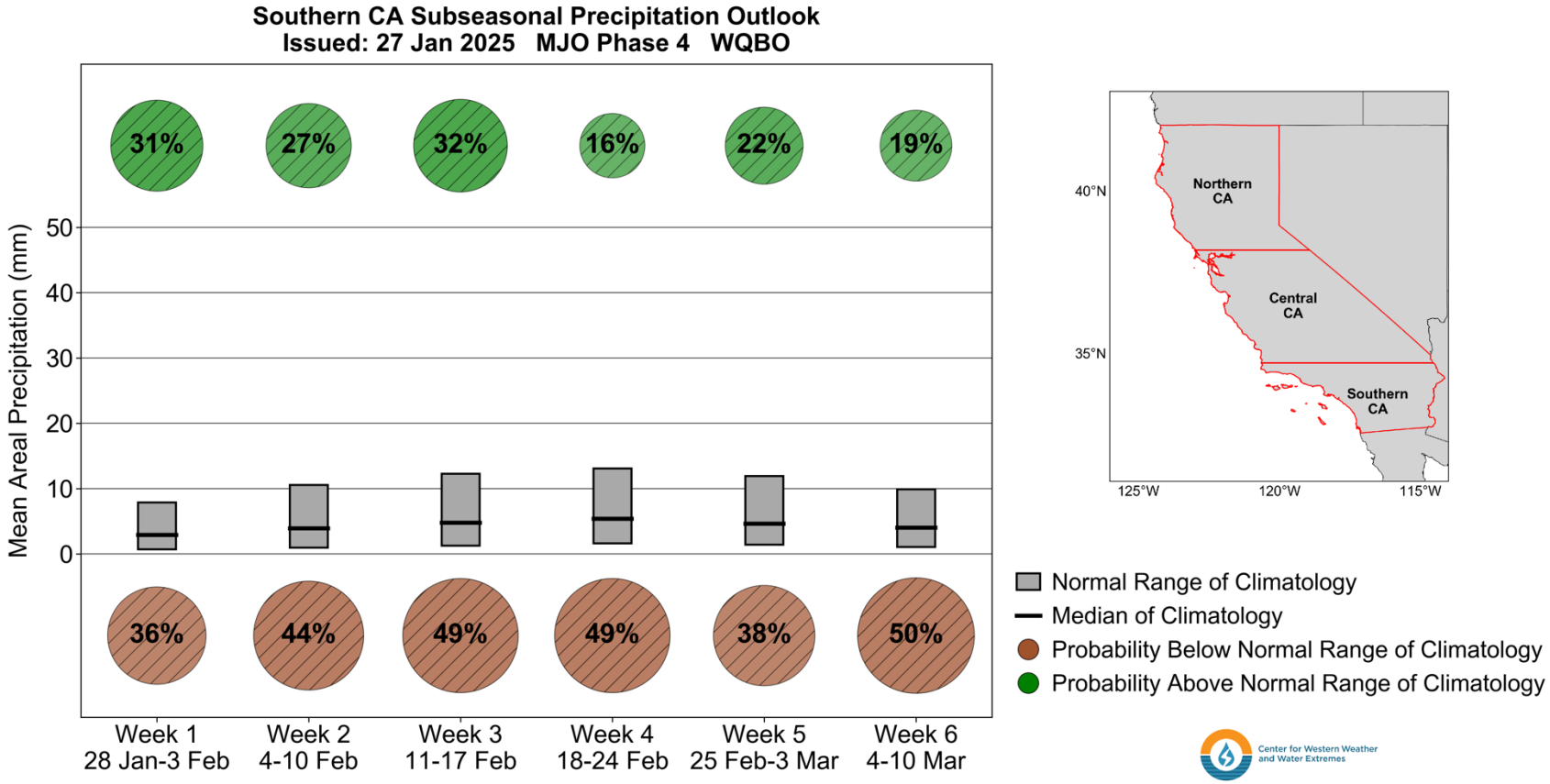
This product shows weekly probabilities of above-normal and below-normal AR occurrence in California. These probabilities are calculated for lead times of 1–6 weeks based on the current season (i.e., OND or JFM) and phases of the Madden-Julian Oscillation (MJO) and Quasi-biennial Oscillation (QBO). If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

AR Activity and Precipitation Based on MJO and QBO

Forecasts Initialized 27 Jan 2025

Precipitation: Southern 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 precipitation forecast based on current MJO and QBO conditions (see forecast for all regions here)
- **Moderate likelihood of below-normal precipitation in Southern CA during Weeks 2–4 (4–24 Feb)**
- Moderate likelihood of below-normal precipitation in Central CA during Week 3 (11–17 Feb)

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)

Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT 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/

- **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***