



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E Subseasonal Outlook: 26 January 2024

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UC San Diego



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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/s2s_forecasts/
- CW3E subseasonal (2–6 weeks lead time) atmospheric river, ridging, and circulation regime products use three different global ensemble prediction systems to create these products:
 - NCEP CFSv2 (US Model): Weeks 2–6
 - ECCO (Canadian Model): Weeks 2–3
 - ECMWF (European model): Weeks 2–6
- *On the following slides, the term confidence refers to the forecasters' interpretation of the magnitude of the anomalies, the level of ensemble agreement, and the skill of the products used to generate the forecasts. All the tools used are shown in the outlook presentation.*
- *The thresholds for below-normal, near-normal, and above-normal conditions are determined by forecast product and noted on each forecast product slide*

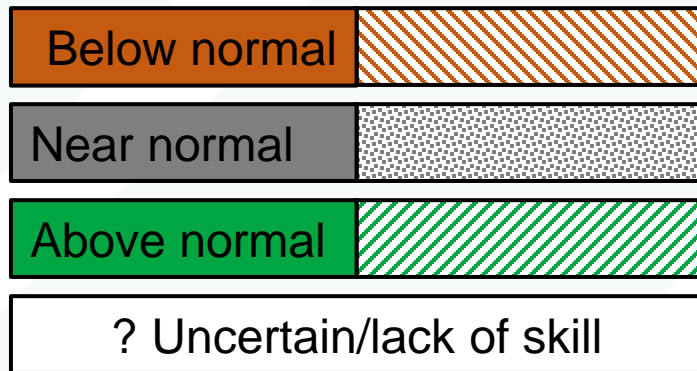
Summary: Subseasonal Precipitation Outlook by Model

This slide shows the CW3E synthesis of subseasonal products by model

Forecasts Initialized 25 Jan 2024

Region	Week 2 (2 - 8 Feb)			Week 3 (9 - 15 Feb)			Week 4 (16 - 22 Feb)		
	NCEP ^{1,3}	ECMWF ¹	Multi-Model Forecast	NCEP ^{1,2,3}	ECMWF ^{1,2}	Multi-Model Forecast	NCEP ^{2,3}	ECMWF ²	Multi-Model Forecast
WA/OR	Diagonal Green	Orange	White	White	Orange	White	Diagonal Orange	Orange	Diagonal Orange
Northern CA	Green	Orange	White	White	Orange	White	Diagonal Orange	Orange	Diagonal Orange
Central CA	Green	Orange	White	White	Orange	White	Diagonal Orange	Orange	Diagonal Orange
Southern CA	Green	Orange	White	White	Orange	White	Diagonal Orange	Orange	Diagonal Orange

Higher Confidence | Lower Confidence



- Models disagree on precipitation outlook over CA during Weeks 2-3; NCEP products show above-normal precipitation in Week 2, whereas ECMWF products are more confident in below-normal precipitation
- NCEP and ECWMF agree on below-normal precipitation during Week 4 with moderate-to-high confidence

Subseasonal products included in this Outlook:

¹CW3E/JPL Atmospheric River Activity Forecasts ([DeFlorio et al. 2019](#))

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

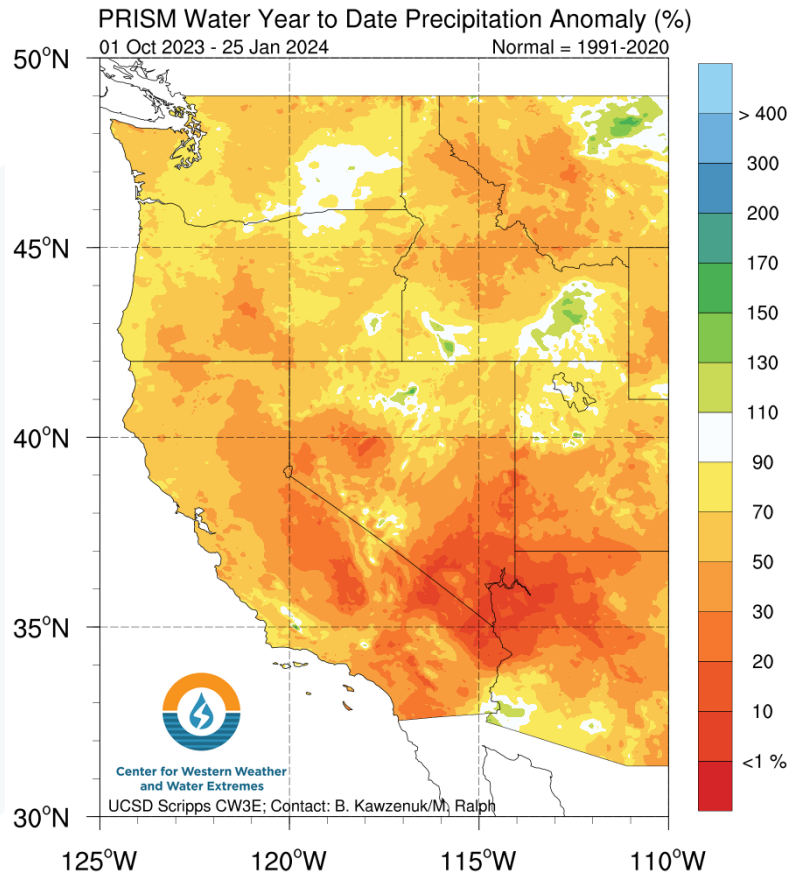
³IRI North American Weather Regime Forecasts ([Robertson et al. 2020](#))

Summary

- **Week 2 forecasts (2 - 8 Feb): Models** are predicting low likelihood of AR activity during the end of Week 2 over CA
 - NCEP is showing a high likelihood of AR activity over CA during 2-4 Feb
 - ECCC and ECMWF are showing a low likelihood of AR activity over most of CA and WA/OR
- NCEP and ECMWF are forecasting MJO over the Western Pacific during Week 2
 - MJO activity over the Western Pacific during JFM is associated with a decreased likelihood of wet extremes in Central and Southern CA at lag times of 4 weeks
- **Week 3 forecasts (9 - 15 Feb): Models show uncertainty in AR activity over CA**
 - NCEP and ECCC are predicting above-normal AR activity over coastal CA
 - ECMWF is predicting below-normal AR activity over CA with high confidence
- Models are predicting a high likelihood of above-normal North-ridge activity during Weeks 3–4
- IRI weather regime tool shows high likelihood of Pacific Trough (wet conditions over CA) in Week 2, followed by a possible transition to prolonged West Coast Ridge (dry conditions over CA) through Week 4
- MJO and QBO forecast model is predicting high probability of below-normal AR occurrence and precipitation during Week 3 in CA in general

Hydrologic Summary

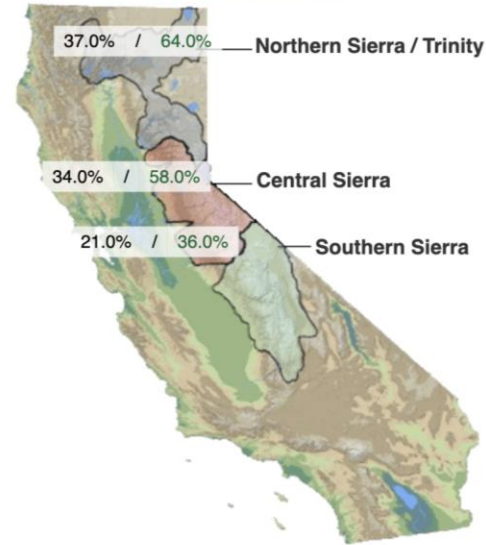
Precipitation



Snowpack Conditions

Provided by the California Cooperative Snow Surveys

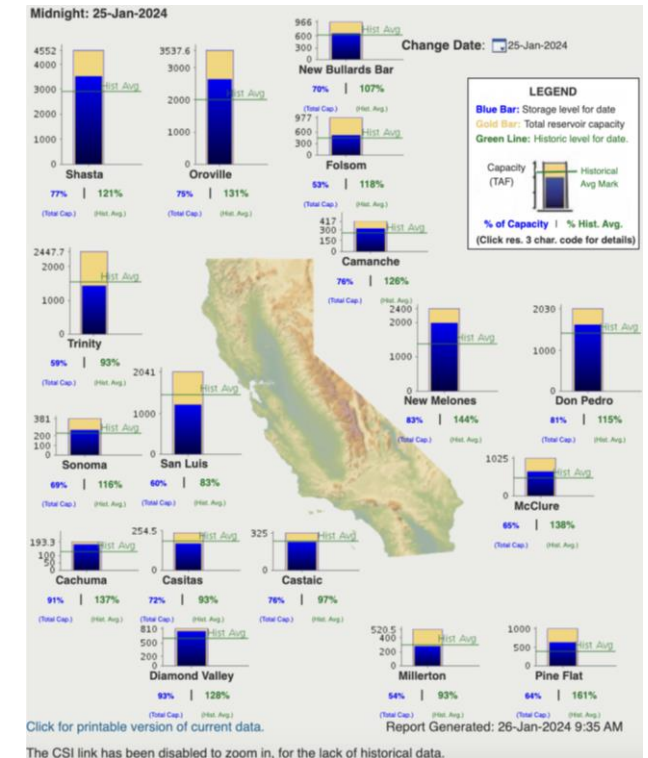
Data For: 25-Jan-2024
% Apr 1 Avg. / % Normal for this Date



Change Date : 25-Jan-2024

Source: California DWR

Reservoir Storage



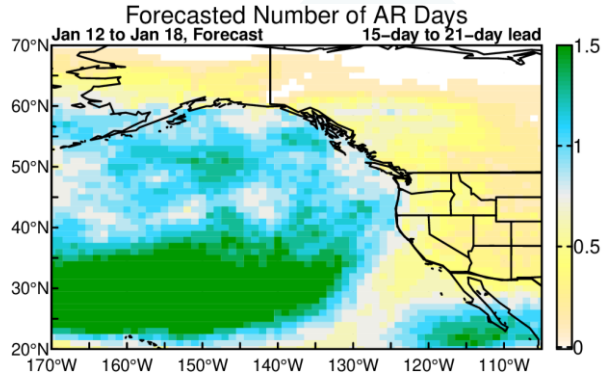
Source: California DWR

- As of 25 Jan, water-year-to-date precipitation continues to be below-normal throughout CA
- Large portions of Central and Southern CA have received < 50% of normal precipitation since 1 Oct 2023
- Statewide snowpack is also running below-normal for this time of year, especially in the Southern Sierra Nevada
- Most large reservoirs in CA are still operating at greater than 60% storage capacity and near- or above-normal storage for this time of year

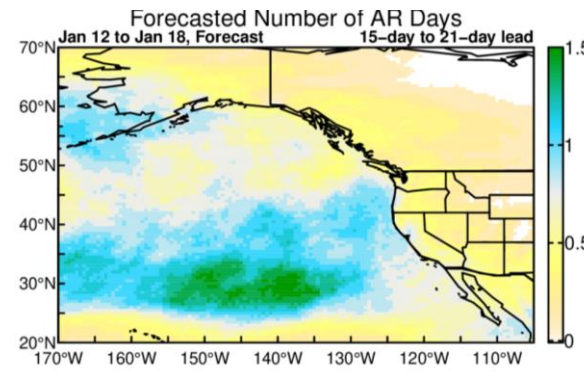
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 28 Dec 2023; Valid: 12–18 Jan 2024

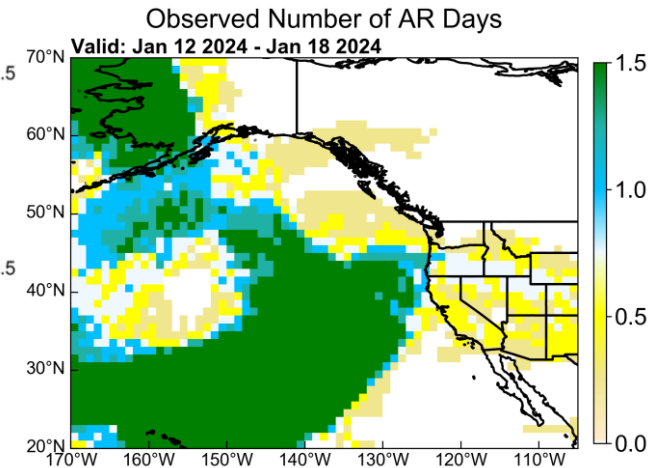
ECCC



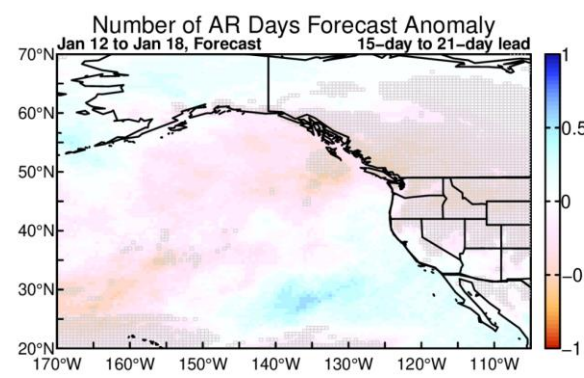
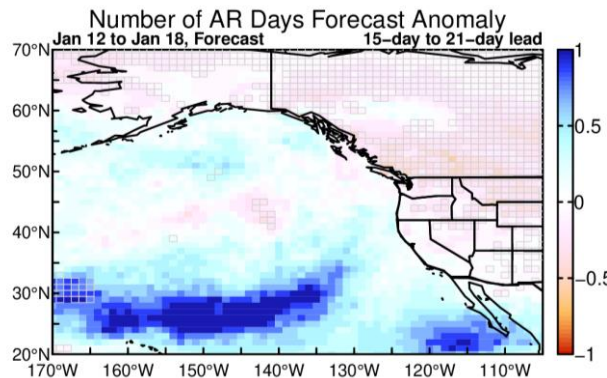
ECMWF



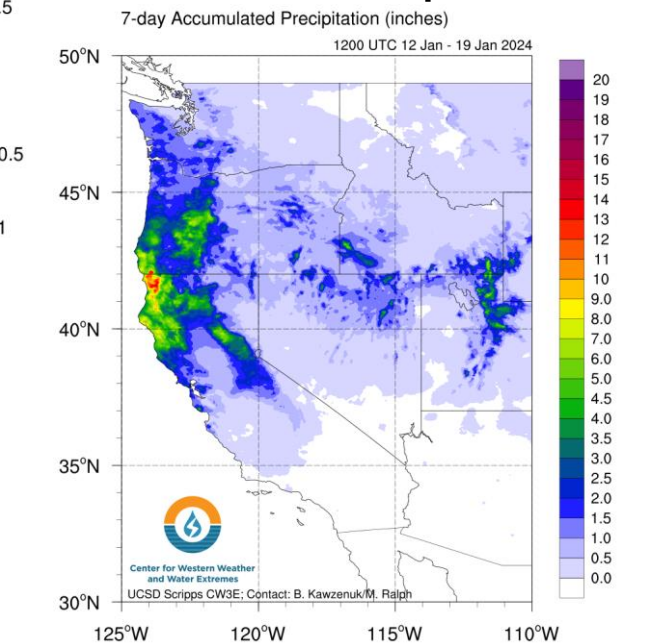
Observed (GFS Analysis)



NCEP unavailable



Observed Precipitation



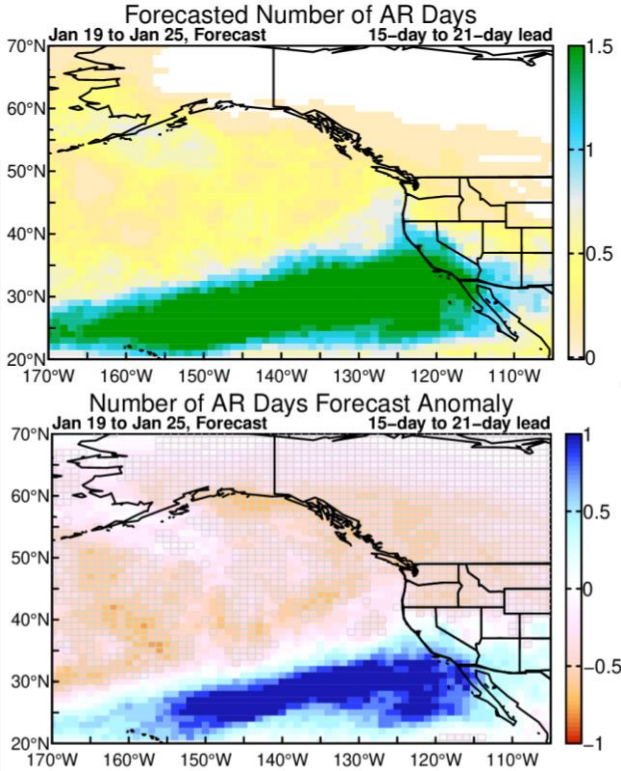
Shading: Fractional # of AR days over a 7-day period (top) and forecast minus model climatology (bottom)
 Grey cells: >75% of ensemble members agree on sign of anomaly

- ECCC and ECMWF captured offshore AR activity near WA/OR and Northern CA
- Both ECCC and ECMWF correctly forecast low AR activity over CA
- Both models underestimated AR activity over the subtropical Northeast Pacific
- Low-pressure systems produced precipitation over WA/OR during 12-14 Jan, as well as 2–10 inches of precipitation in the Northern CA Coast Ranges and Sierra Nevada

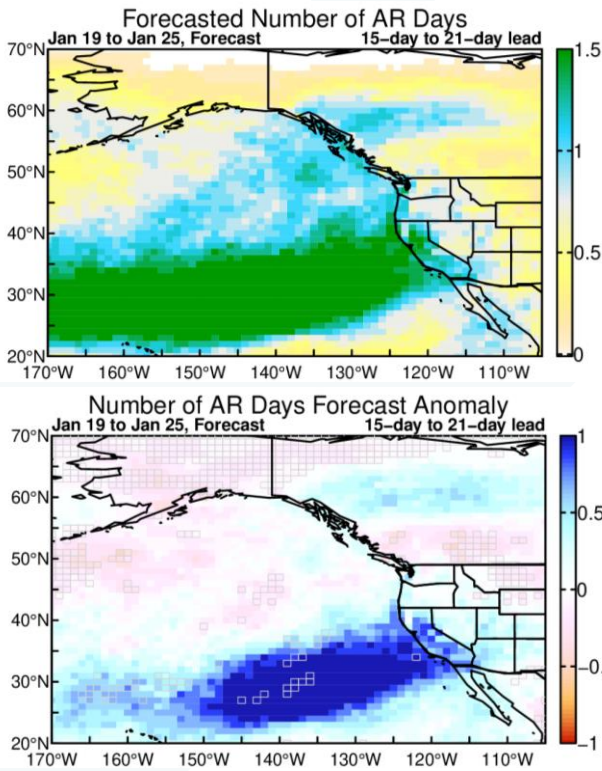
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 4 Jan 2023; Valid: 19–25 Jan 2024

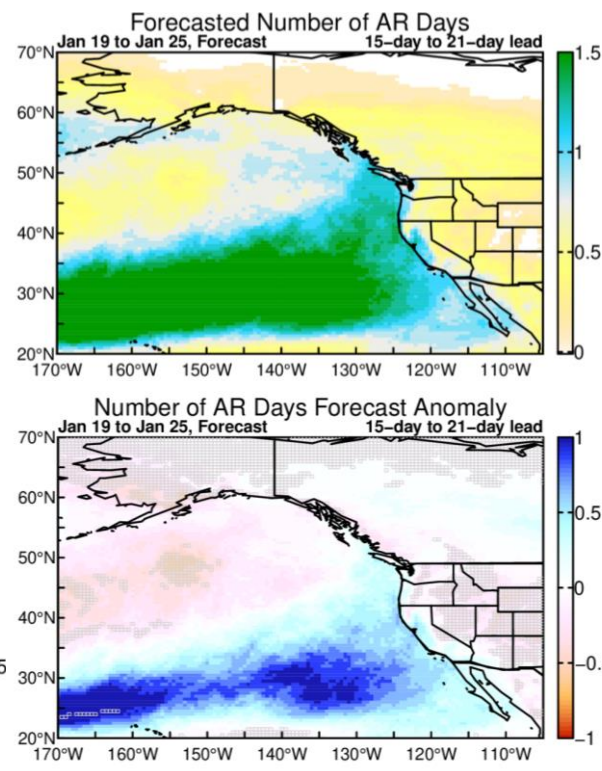
NCEP



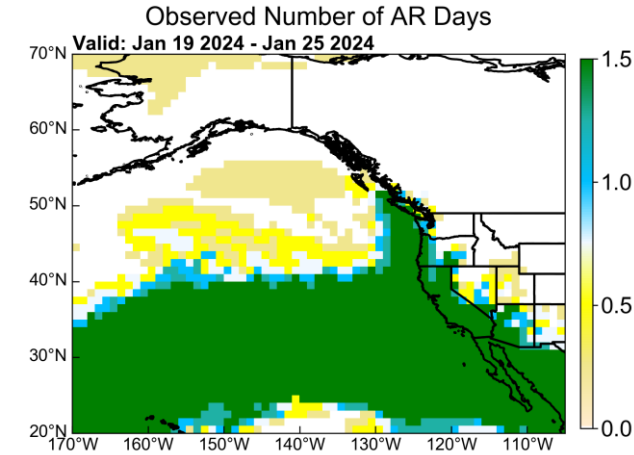
ECCC



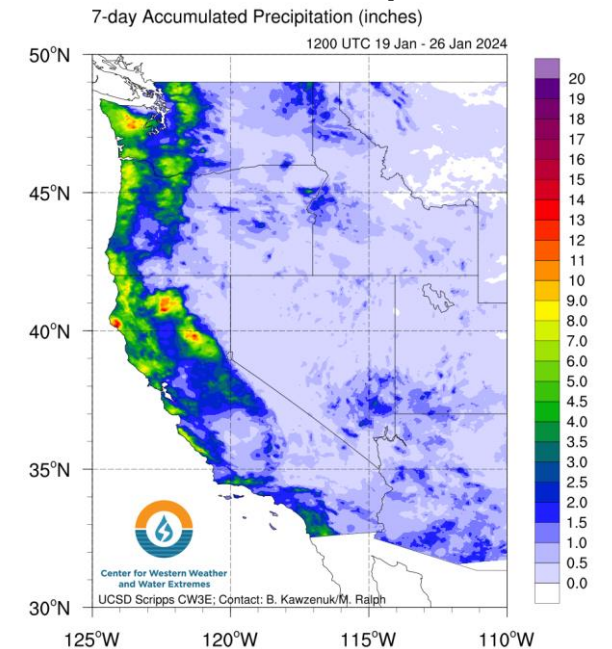
ECMWF



Observed (GFS Analysis)



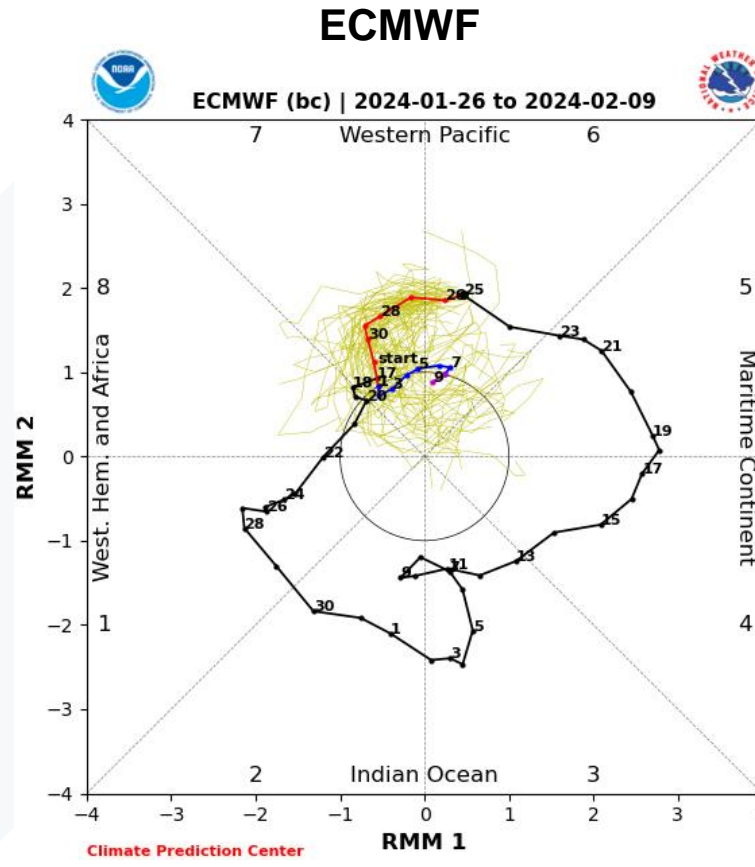
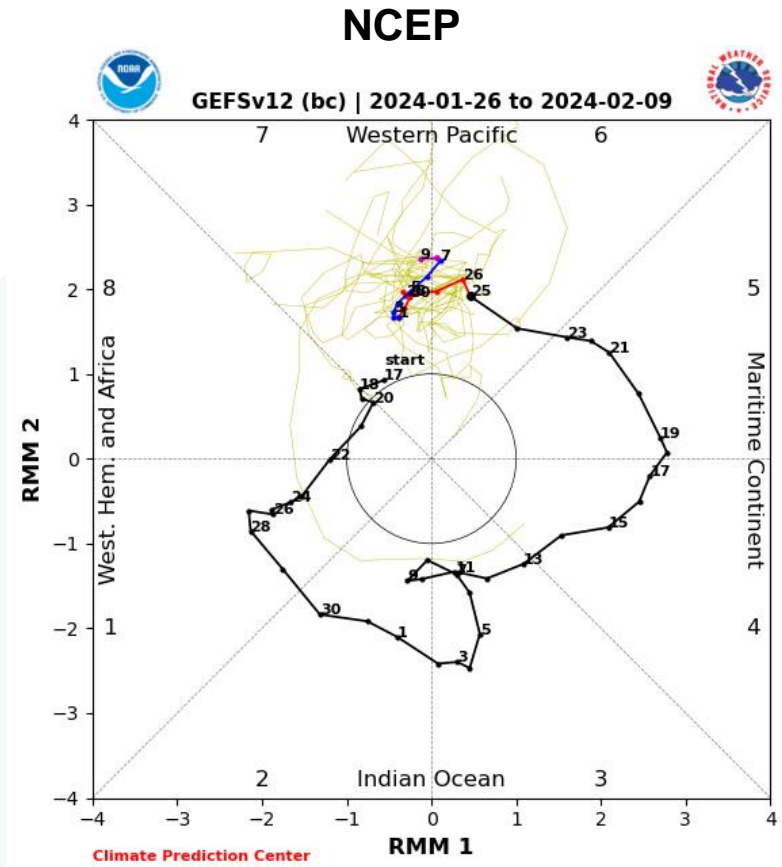
Observed Precipitation



Shading: Fractional # of AR days over a 7-day period (top) and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

- Three models captured AR activity over coastal CA and subtropical Northeast Pacific
- NCEP and ECCC forecasted AR activity over inland CA, and ECCC and ECMWF captured AR activity in coastal WA/OR
- A series of ARs and low-pressure systems and decaying ARs produced > 5 inches of precipitation in portions of western WA/OR and Northern CA
- A strong AR produced strong precipitation >2 inches in San Diego on 22 Jan

Dynamical Model MJO Forecasts (NCEP vs. ECMWF)



Black line: Last 40 days of observations; Yellow lines: Ensemble members
 Forecast: (Red: Week 1, Blue: Week 2, Purple: > Week 2)

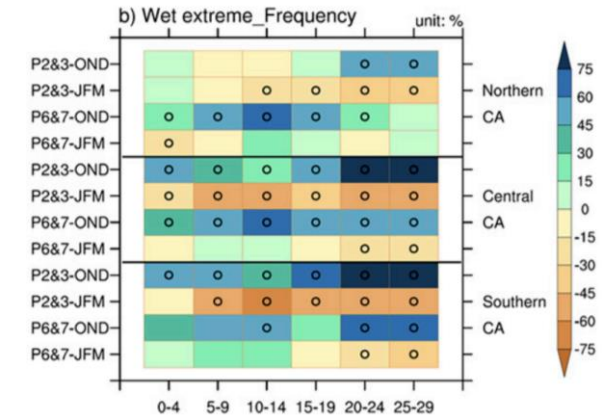


Figure 8 from Wang et al. (2023)

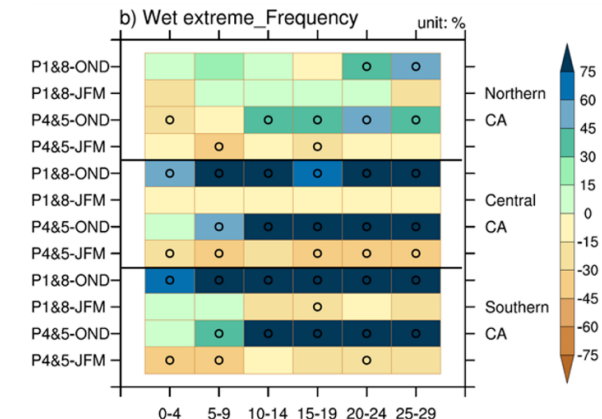


Figure S6 from Wang et al. (2023)

- NCEP and ECMWF are forecasting strong MJO convection in the next week
- Both models are forecasting MJO over the Western Pacific (Phases 6-7) during Week 1 and Week 2
- MJO activity over the Western Pacific during JFM is associated with a decreased likelihood of wet extremes in Central and Southern CA at lag times of 4 weeks

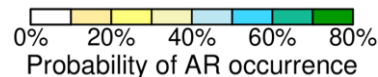
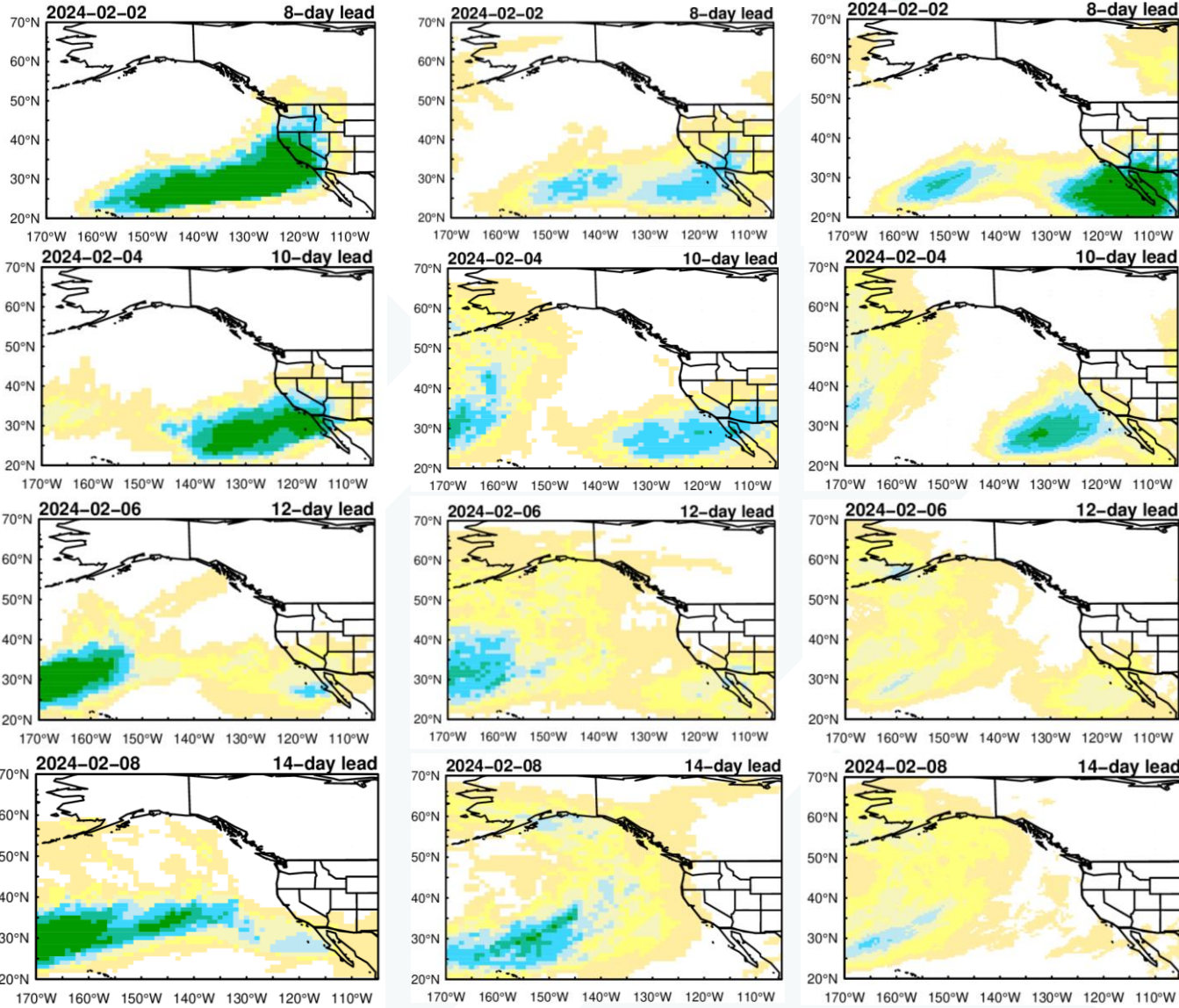
Subseasonal Outlooks: Week 2 AR Activity (NCEP vs. ECMWF)

Forecasts Initialized 25 Jan 2024

NCEP

ECMWF

ECMWF



- ECCM and ECMWF are showing a low likelihood of AR activity (< 40% probability) over most of CA and WA/OR during Week 2 (2–8 Feb)
- NCEP and ECCM are showing moderate likelihood of AR activity (40-60% probability) early in week 2 for Southern CA
- NCEP is showing a high likelihood of AR activity (> 70% probability) over CA during 2-4 Feb
- NCEP is also showing low likelihood of AR activity over WA/OR (during 4-8 Feb) and CA (during 6-8 Feb)

Models are predicting low likelihood of AR activity over CA during the end of Week 2 and show uncertainty during the early of Week 2

**Note that the probabilities of AR occurrence in the Week 2 AR activity plots may differ from the probabilities of AR conditions in the AR landfall tool. These discrepancies exist due to the use of different models (e.g., GEFS vs. CFSv2), model configurations (S2S models are coupled between ocean, land, and atmosphere), and methods for AR detection.*

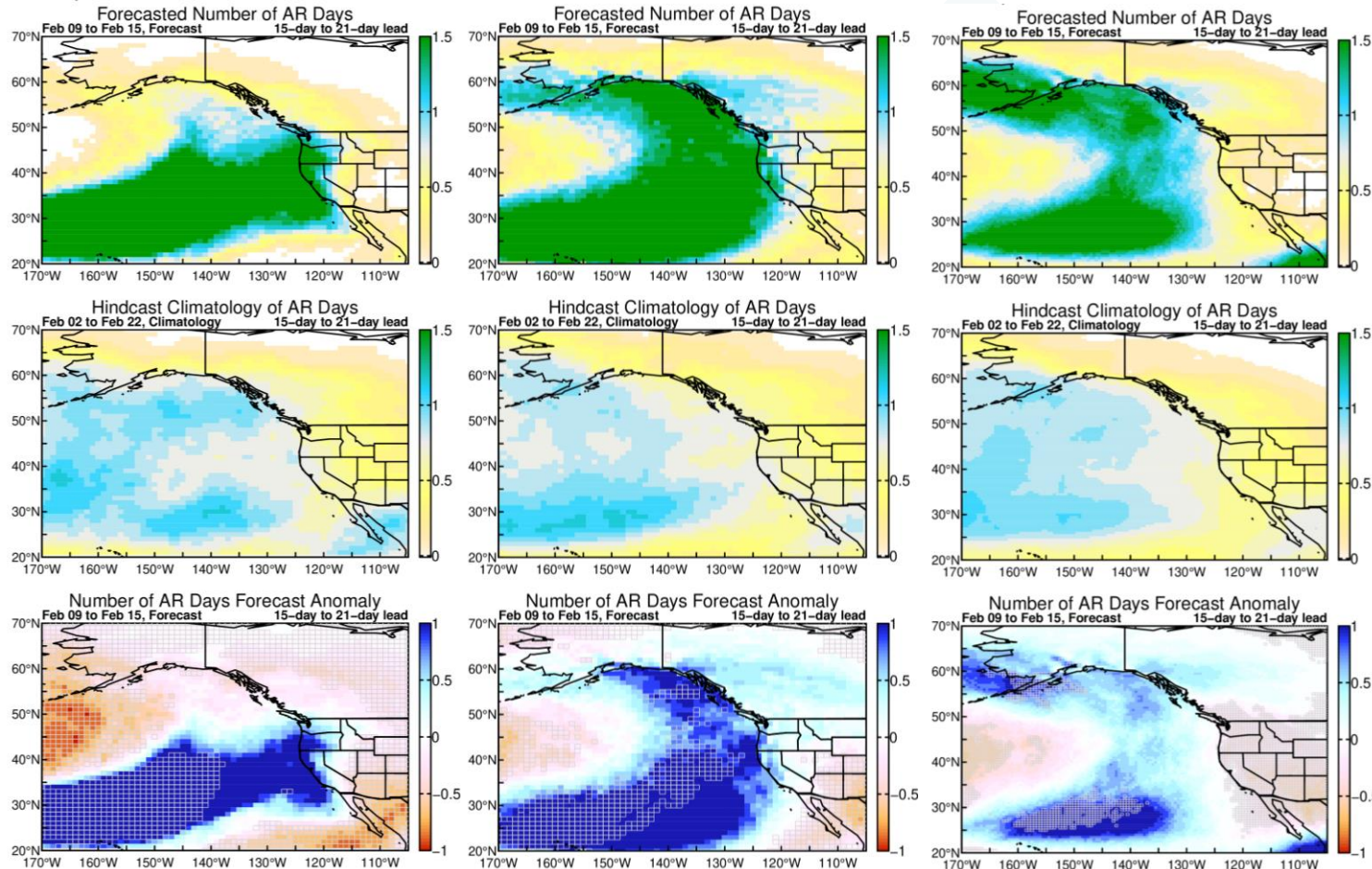
Subseasonal Outlooks: Week 3 AR Activity (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 25 Jan 2024

NCEP

ECCC

ECMWF

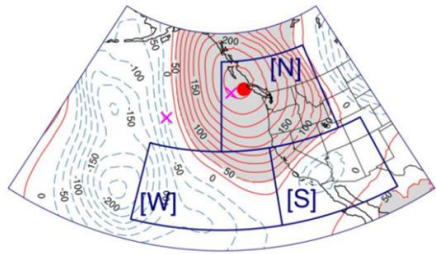


- NCEP and ECCC are predicting above-normal AR activity over a portion of WA/OR and coastal CA during Week 3 (9-15 Feb)
- ECMWF is predicting below-normal AR activity over WA/OR and CA with high confidence during Week 3

Models show uncertainty in AR activity during Week 3

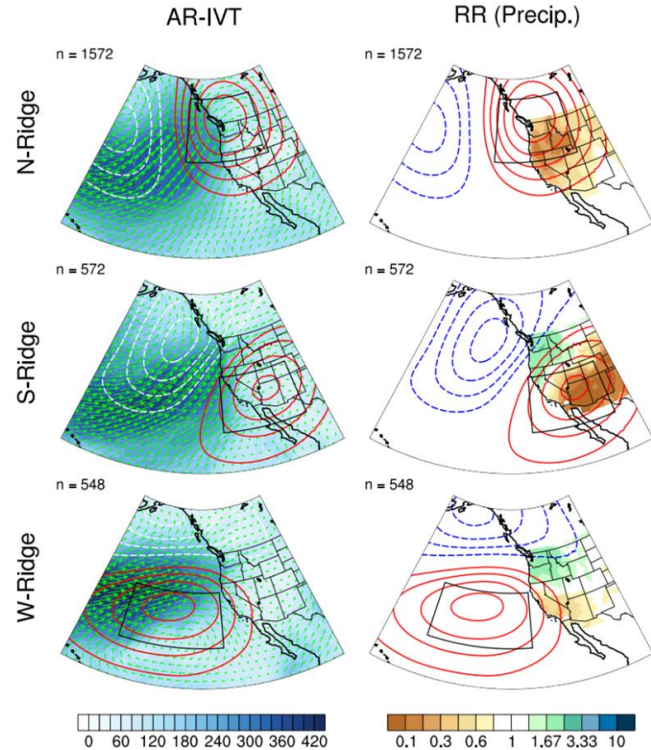
Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

Background Info: Subseasonal Ridging Outlooks



N = North Ridge
S = South Ridge
W = West Ridge

This slide contains background information about the three different ridge types in CW3E's subseasonal ridging outlook tool



How each ridge type typically influences precipitation

Left: Maps showing the average influence of each ridge type (red contours) on integrated vapor transport (IVT, blue shading indicates greater moisture transport, arrows indicate direction) during atmospheric river events

Right: Maps showing the 'Relative Risk' (RR) of precipitation under each ridge type. Brown shading indicates a reduced chance of precipitation when ridging occurs. For example, a RR value of 0.2 indicates a 5-fold reduction in the likelihood of precipitation

- The North-Ridge type is typically associated with widespread dry conditions across the entire western US
- The South-Ridge type is typically associated with dry conditions in Southern CA and the Colorado River Basin and wet conditions in the Pacific Northwest
- The West-Ridge type is typically associated with dry conditions over Central and Southern CA and wet conditions over the Pacific Northwest



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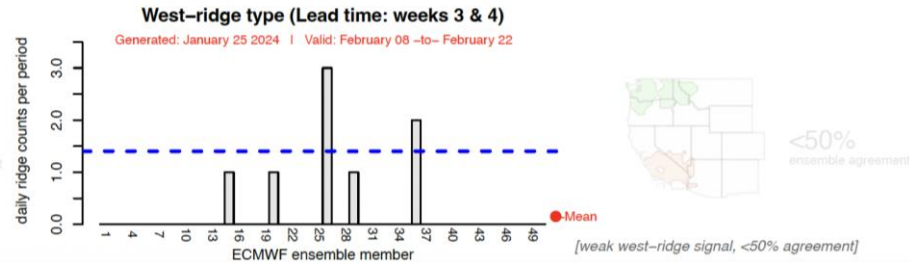
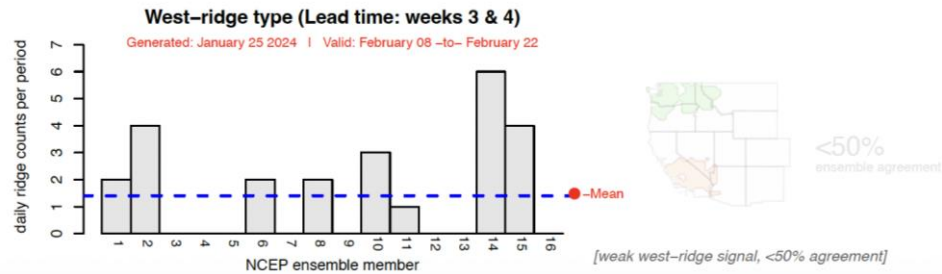
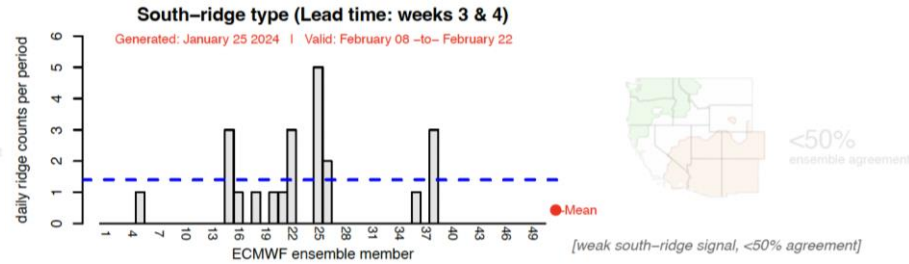
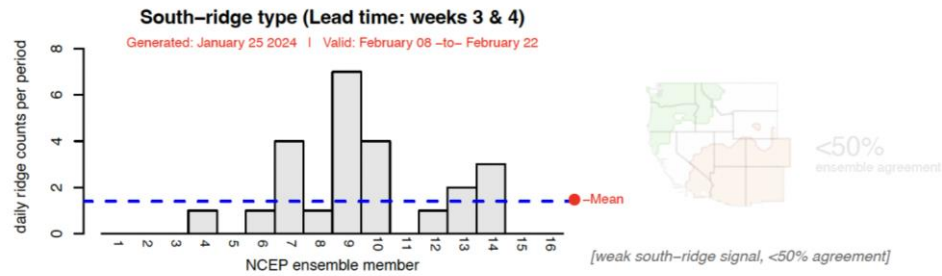
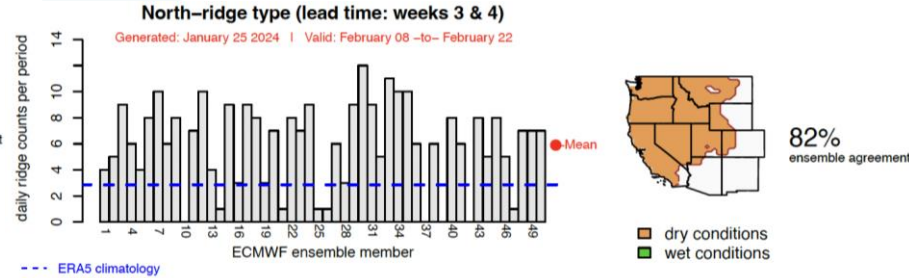
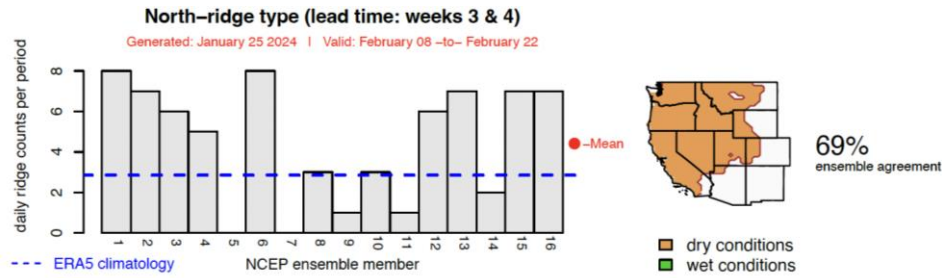
Contact: pgibson@ucsd.edu
Reference: Gibson et al. (2020)
Journal of Climate

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

Forecasts Initialized 25 Jan 2024

NCEP

ECMWF



- NCEP/ECMWF is predicting a moderate/high likelihood (>69% ensemble agreement NCEP, >82% ensemble agreement ECMWF) of above-normal North-ridge activity during Weeks 3–4 (8-22 Feb)

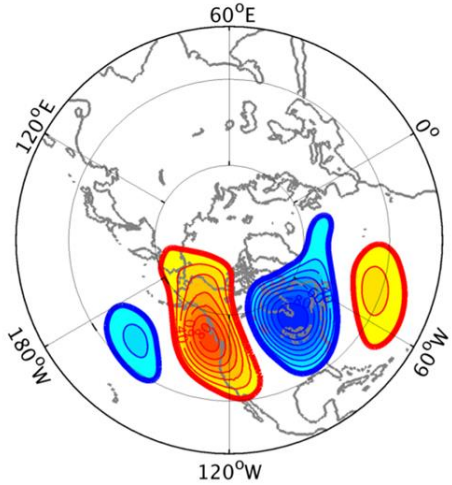
- NCEP is also predicting near-normal occurrence of the South- and West-ridge type

- ECMWF is predicting very low South- and West-ridge activity

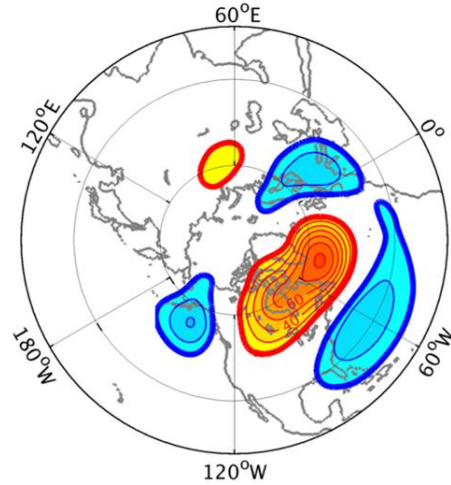
NCEP/ECMWF is predicting a moderate/high likelihood of above-normal North-ridge activity during Weeks 3–4

Background Info: IRI Subseasonal Weather Regime Forecasts

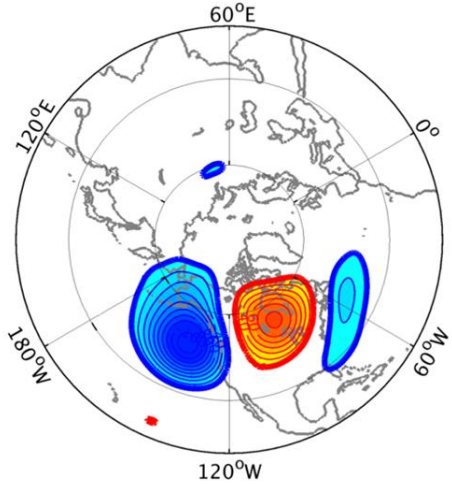
a) WR 1: West Coast Ridge



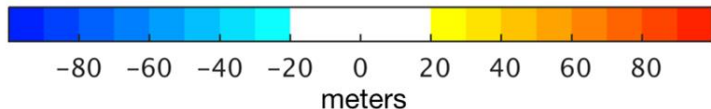
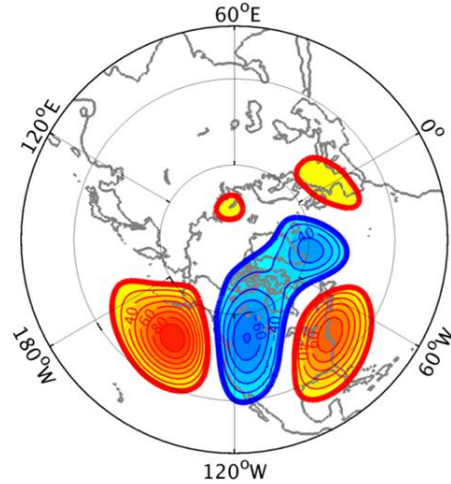
b) WR 2: Greenland High



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)

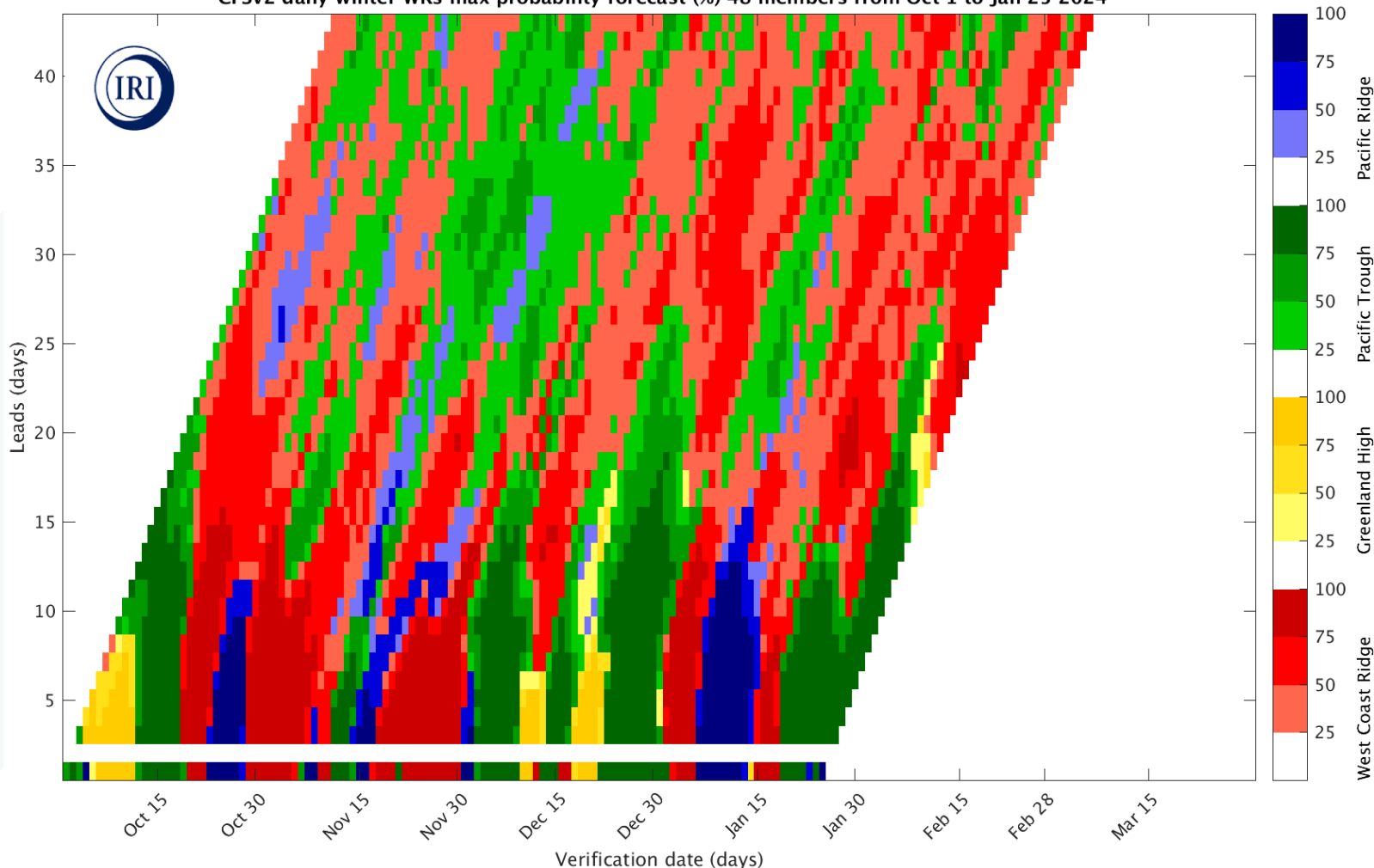
Reference: [Robertson et al. \(2020\)](#)

For more information about the forecast product:

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

Subseasonal Outlooks: IRI North American Weather Regime Forecasts

CFSv2 daily winter WRs max probability forecast (%) 48 members from Oct 1 to Jan 25 2024



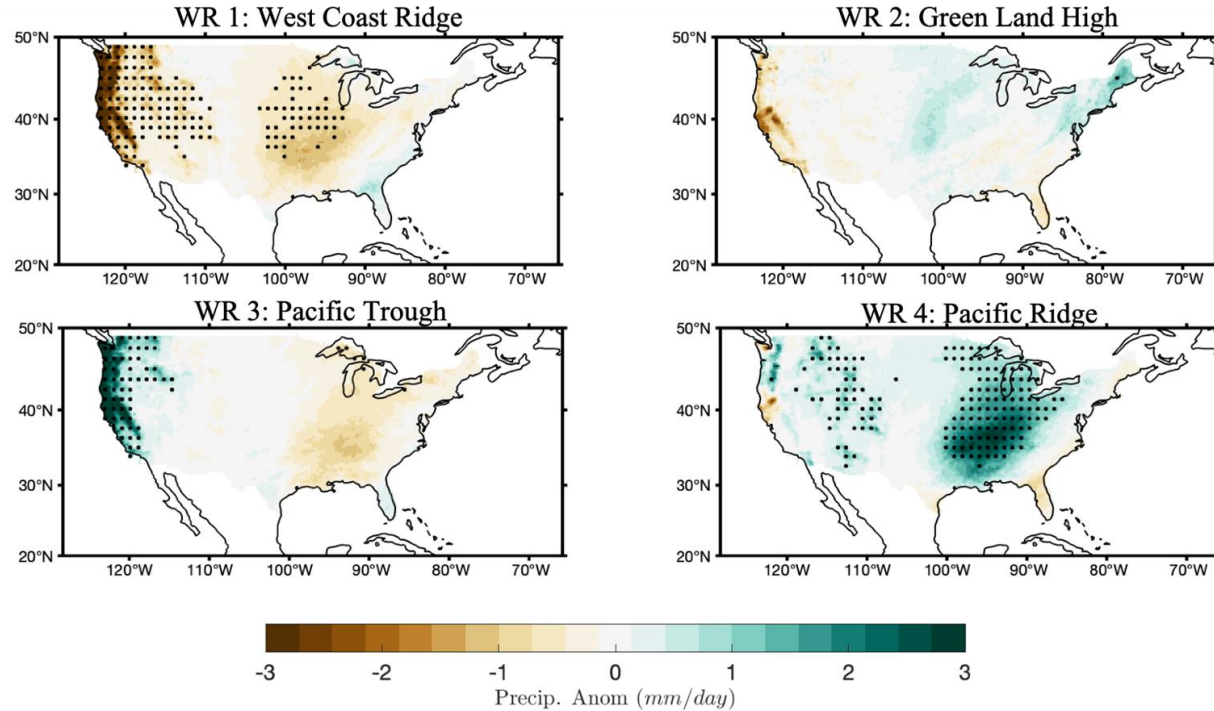
Forecast Initialized 25 Jan 2024

- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- High likelihood (>75% ensemble agreement) of Pacific Trough conditions in Week 2 (2 - 8 Feb)
- Low-to-moderate likelihood (25-75% ensemble agreement) of transition to Greenland High and then to West Coast Ridge conditions in Week 3 (9 - 15 Feb)
- Moderate likelihood of West Coast Ridge conditions continuing through Weeks 4 and 5 (15– 29 Feb)

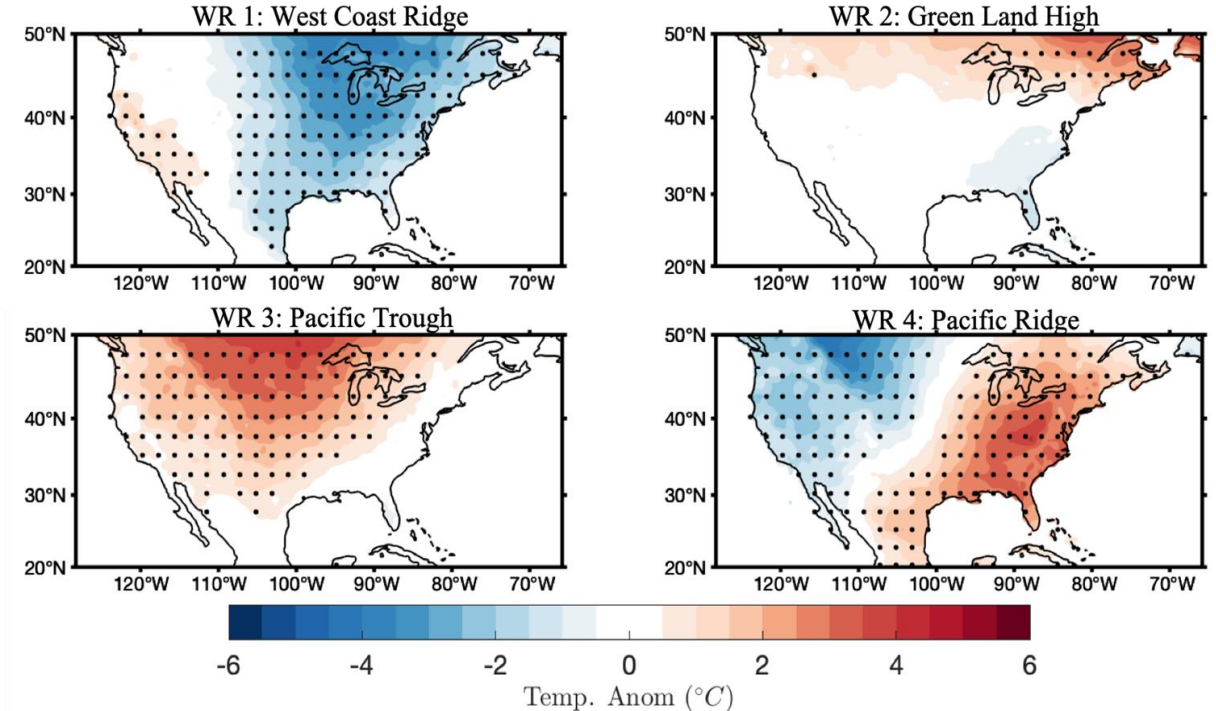
This graphic shows the which of the four North American weather regimes (different colors) is most likely to occur over the next 45 days. Darker (lighter) shading denotes higher (lower) probability of a particular regime. See the next slide for temperature/precipitation implications.

Subseasonal Outlooks: IRI North American Weather Regime Forecasts

Precipitation



Temperature



Historical precipitation (left) and temperature (right) composites associated with each regime

- Warm and wet conditions are predicted over CA in early February with high confidence
- Warm and dry conditions are predicted over CA during the last two weeks of February with moderate confidence

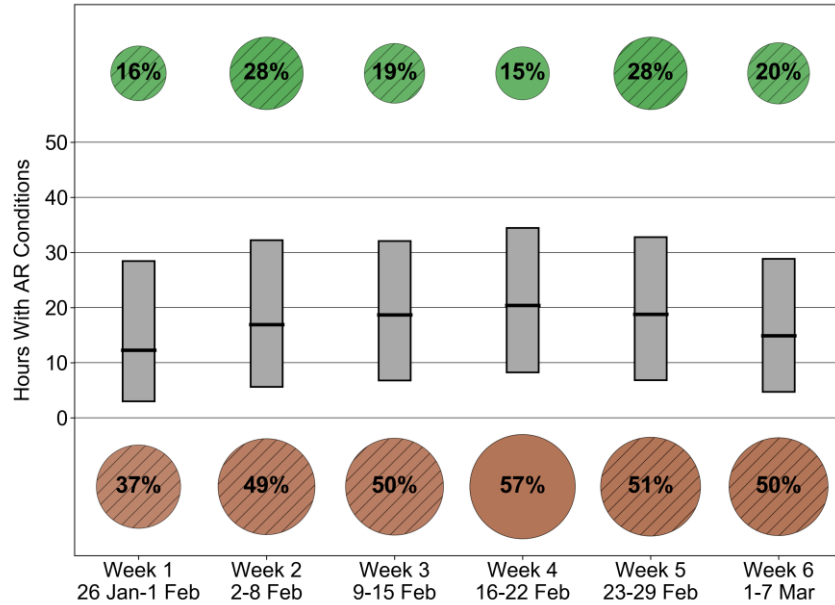
Subseasonal Outlooks: AR Activity and Precipitation Based on MJO and QBO

Forecasts Initialized 25 Jan 2024

Southern CA

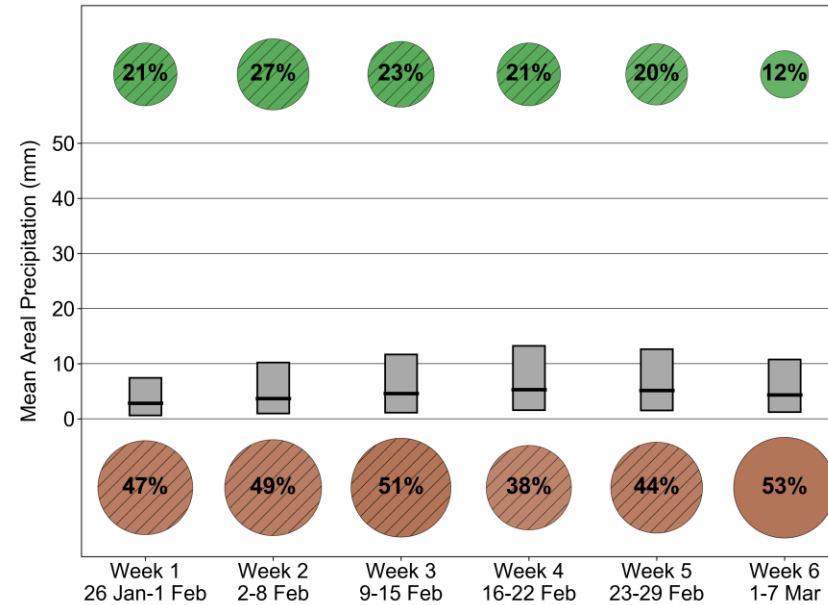
AR Occurrence Outlook

Southern CA Subseasonal AR Occurrence Outlook
Issued: 25 Jan 2024 MJO Phase 6 EQBO



Precipitation Outlook

Southern CA Subseasonal Precipitation Outlook
Issued: 25 Jan 2024 MJO Phase 6 EQBO



Map of Regions



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



- CW3E's statistical forecast tool based on current MJO and QBO conditions is predicting high probability (>50%) of below-normal AR occurrence during Weeks 3-6 in Southern CA
- Model is also predicting high probability (>50%) of below-normal precipitation during Weeks 3 and 6 in Southern CA
- Central (not shown) and Southern CA are showing similar probabilities.

This product shows weekly probabilities of above-normal and below-normal AR activity and 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.

The grey bars show the normal range of values based on the long-term climatology (1981–2019 period) for the corresponding calendar weeks. The lower bound of the “normal range of climatology” is defined as the lower tercile (33.33rd percentile) of climatology. The upper bound of the “normal range of climatology” is defined as the upper tercile (66.67th percentile) of climatology. The horizontal black lines within the grey bars denote the climatological median (50th percentile) values. Circles without hatching denote periods with higher predictability based on the hindcast skill assessment in [Castellano et al. \(2023\)](#)

