



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E Subseasonal Outlook: 31 January 2024

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

UC San Diego



SCRIPPS INSTITUTION OF
OCEANOGRAPHY

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*

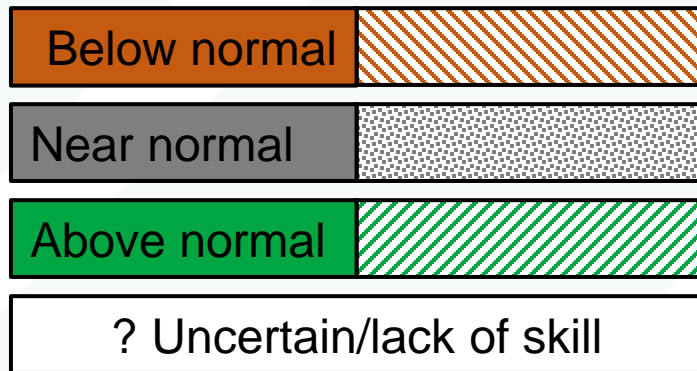
Summary: Subseasonal Precipitation Outlook by Model

This slide shows the CW3E synthesis of subseasonal products by model

Forecasts Initialized 29 Jan 2024

| Region | Week 2 (6 - 12 Feb) | | | Week 3 (13 - 19 Feb) | | | Week 4 (20 - 26 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 | | Below normal | | Below normal | Below normal | Below normal | | Below normal | |
| Northern CA | Above normal | Below normal | | Below normal | Below normal | Below normal | | Below normal | |
| Central CA | Above normal | Below normal | Below normal | Below normal | Below normal | Below normal | | Below normal | |
| Southern CA | Above normal | Above normal | Above normal | Below normal | Below normal | Below normal | | Below normal | |

Higher Confidence | Lower Confidence



- Models agree on above-normal precipitation over Central and Southern CA during Week 2 with moderate-to-high confidence, but there is uncertainty in precipitation conditions in Northern CA and WA/OR
- Models agree on below-normal precipitation over CA and WA/OR during Week 3 with high confidence
- There is large uncertainty in Week 4 forecast

Subseasonal products included in this Outlook:

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

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

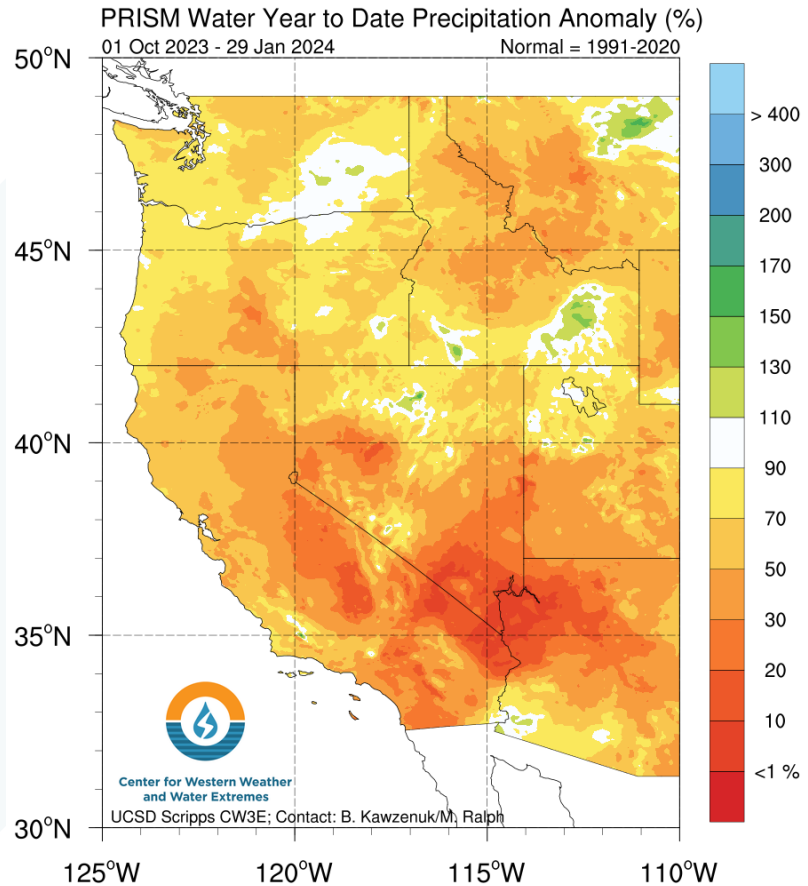
³IRI North American Weather Regime Forecasts ([Robertson et al. 2020](#))

Summary

- **Week 2 forecasts (6 - 12 Feb): Models agree on moderate-to-high likelihood of AR activity over Central and Southern CA during the beginning of Week 2**
 - Models disagree on the likelihood of AR activity over Northern CA
 - NCEP is showing high likelihood of AR activity over Northern CA on 6 Feb while ECMWF is showing low likelihood of AR activity over this region
 - Models also agree on low likelihood of AR activity over CA during the end of Week 2
- NCEP and ECMWF are forecasting MJO over the Western Pacific during Week 2
 - MJO activity over the Western Pacific during JFM is associated with increased likelihood of wet extremes in Central and Southern CA at lag times of 1-2 weeks with low confidence and decreased likelihood of wet extremes in the above regions at lag times of 3-4 weeks with high confidence
- **Week 3 forecasts (13 - 19 Feb): Models agree on below-normal AR activity over CA**
- Models are predicting very high likelihood of above-normal North-ridge activity during Weeks 3–4, which is typically associated with widespread dry conditions across the entire western US
- IRI weather regime tool shows moderate-to-high likelihood of Pacific Trough (wet conditions over CA) in Week 2, followed by a possible transition to West Coast Ridge (dry conditions over CA) in Week 3, and then a moderate likelihood of regime shift back to Pacific Trough in Week 4

Hydrologic Summary

Precipitation

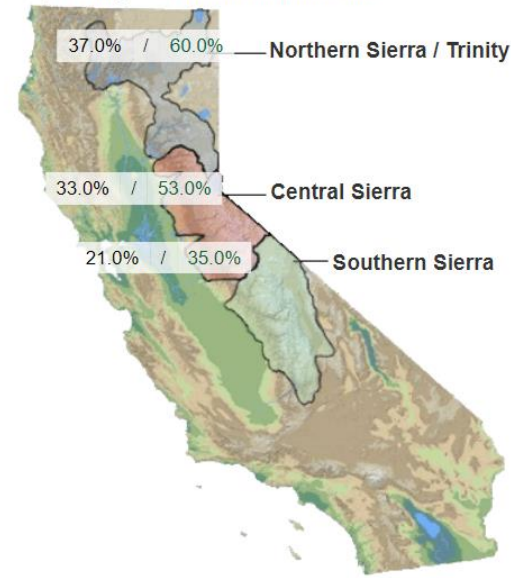


Snowpack Conditions

Provided by the California Cooperative Snow Surveys

Data For: 30-Jan-2024

% Apr 1 Avg. / % Normal for this Date



Change Date : 30-Jan-2024

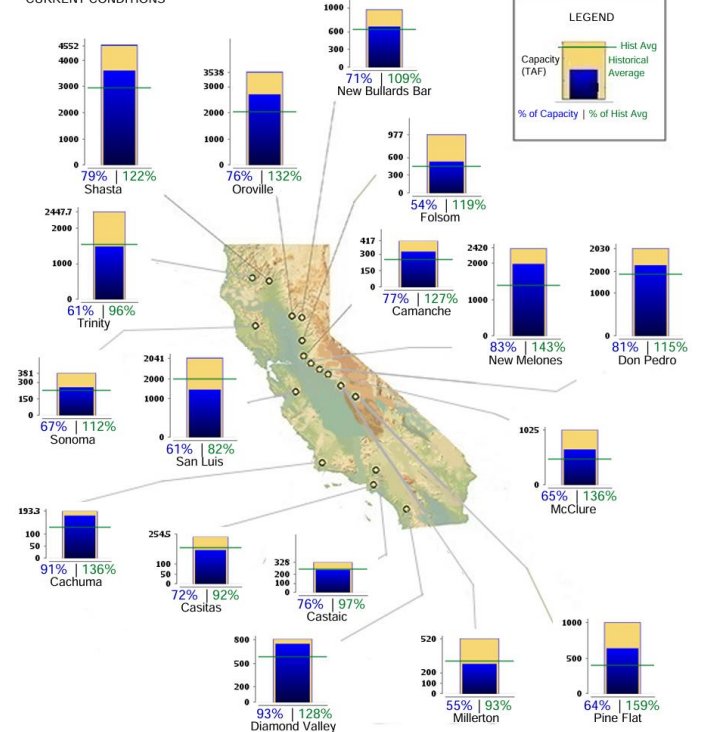
Source: California DWR

Reservoir Storage

CALIFORNIA MAJOR WATER SUPPLY RESERVOIRS

CURRENT CONDITIONS

Midnight - January 29, 2024



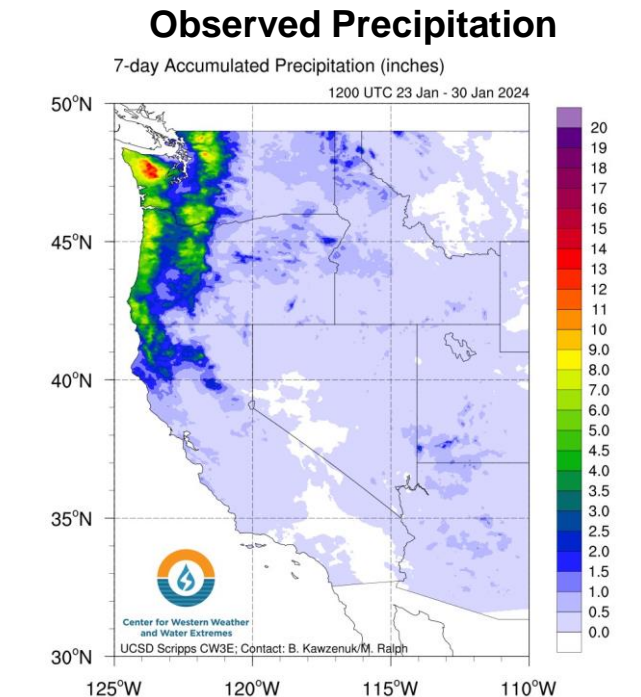
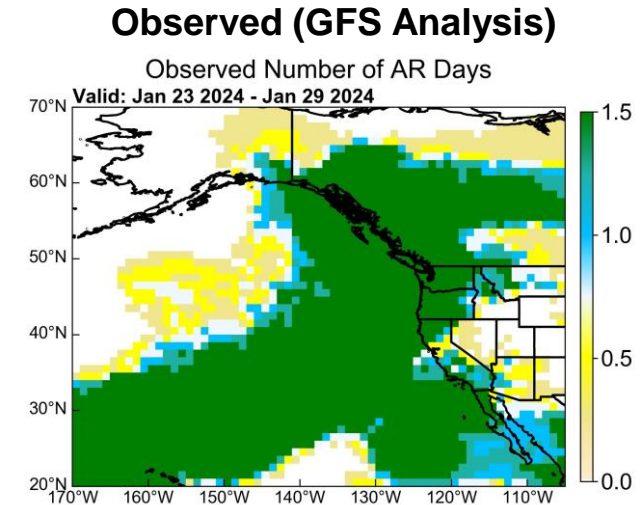
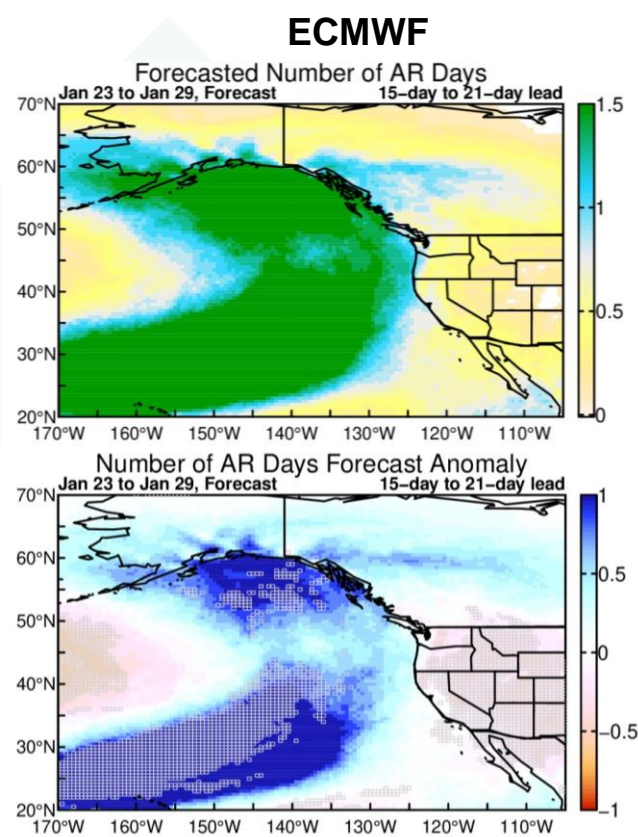
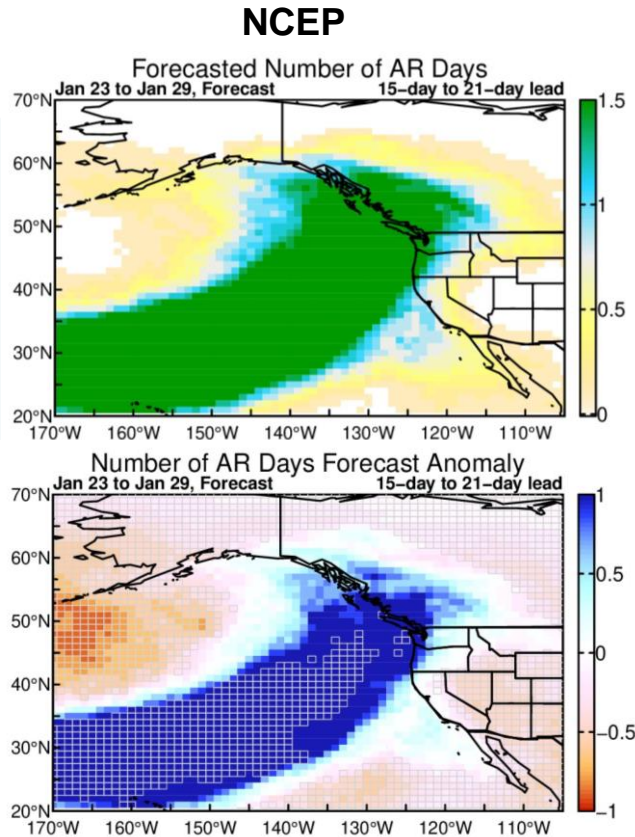
Updated 01/30/2024 04:18 PM

Source: California DWR

- As of 29 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

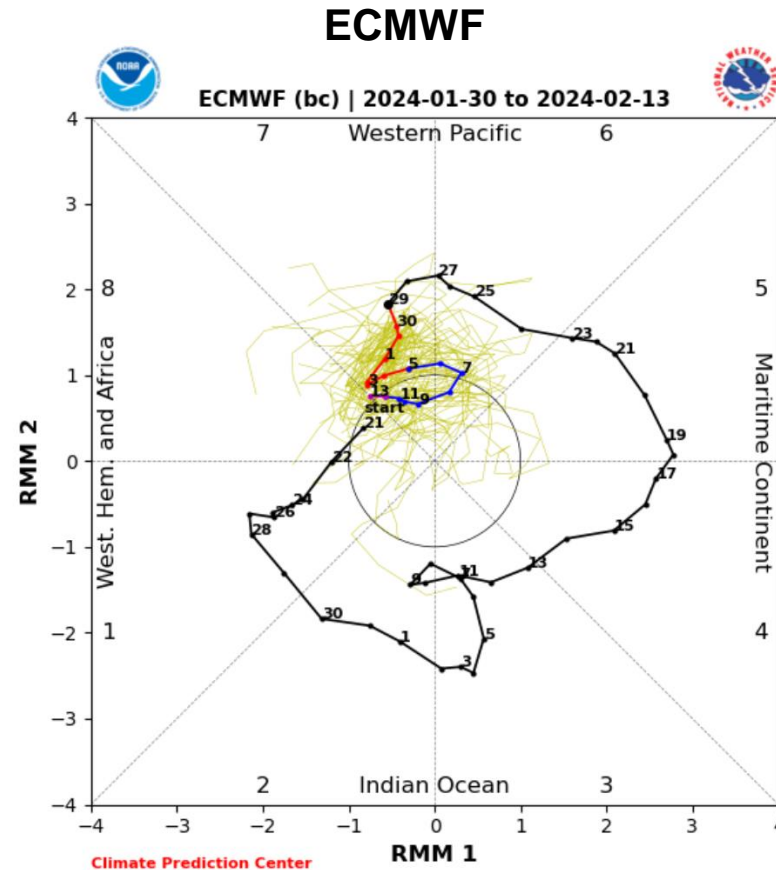
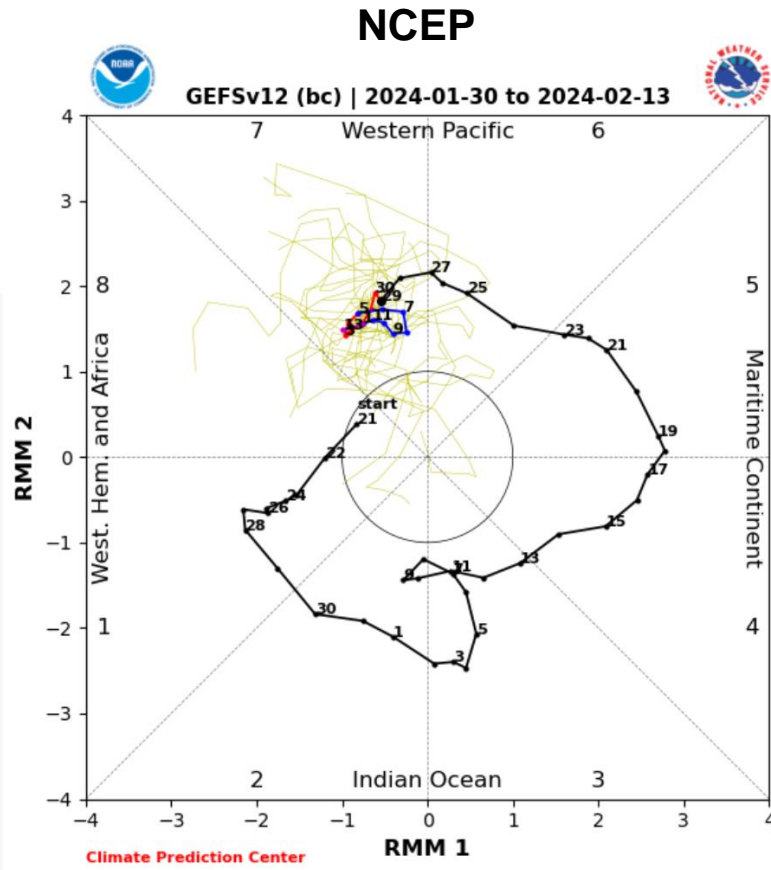
Forecasts Initialized 8 Jan 2023; Valid: 23–29 Jan 2024



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

- Models skillfully captured the broad pattern of AR anomalies across the North Pacific/British Columbia region
- Models did not capture AR activity over CA and the inland penetration of AR activity over the Pacific Northwest, especially in ECMWF
- A series of ARs produced >10 inches of precipitation over the Olympic Mountains, > 5 inches of precipitation in Western WA/OR, and > 2 inches of precipitation in portions of Northern CA
- Model forecasts are unavailable for verification during 16-22 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)

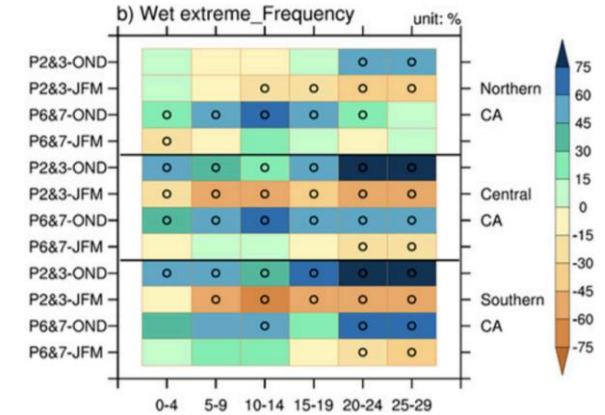


Figure 8 from Wang et al. (2023)

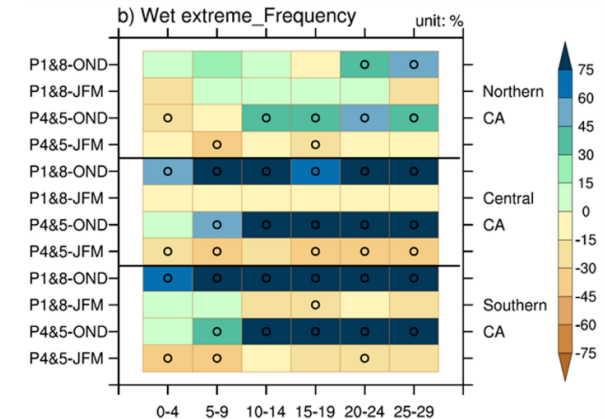
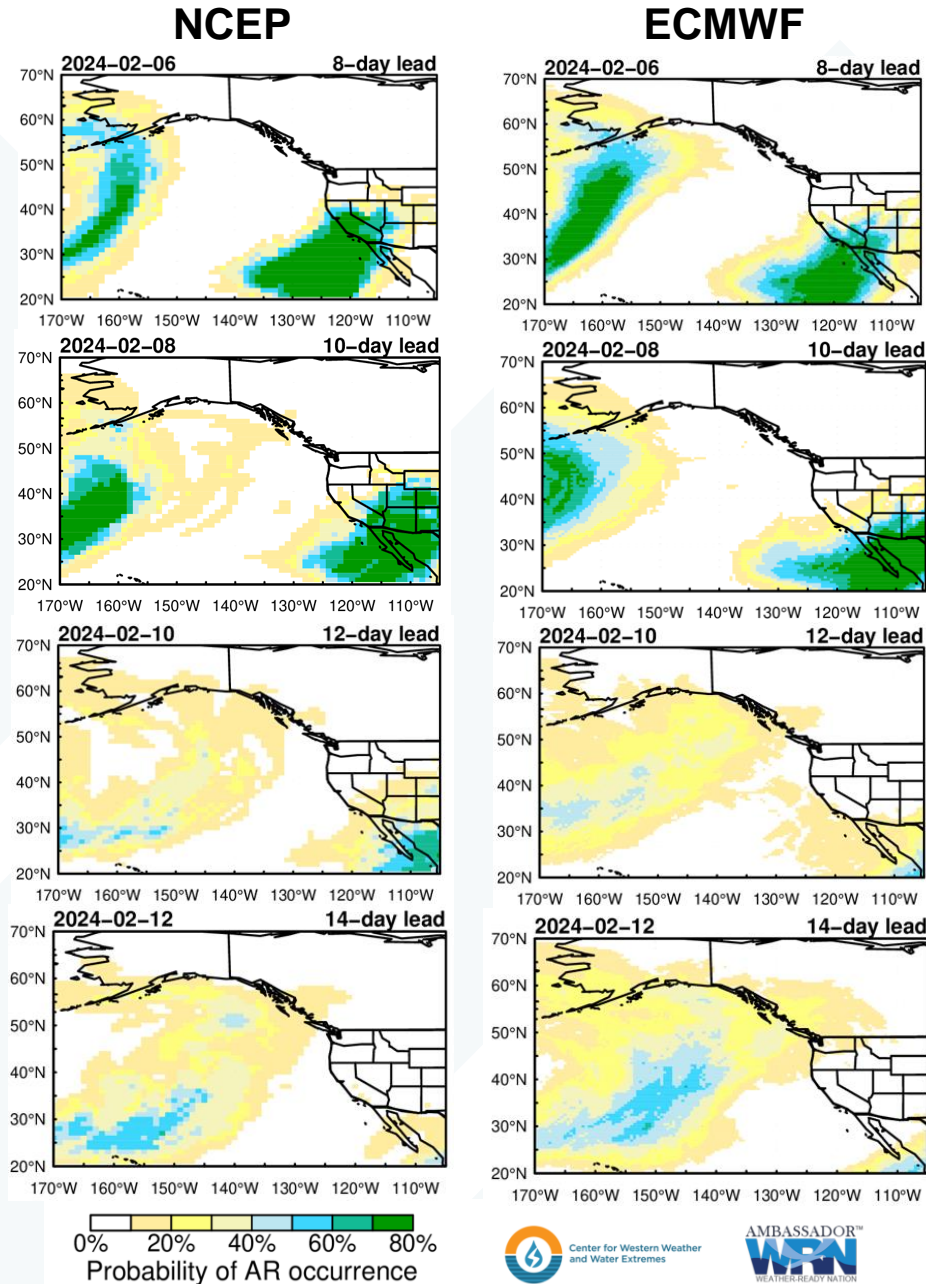


Figure S6 from Wang et al. (2023)

- NCEP and ECMWF are forecasting strong MJO convection in the Western Pacific in Week 1
- MJO convection is forecast to remain strong in Week 2 in NCEP but weaken in ECMWF
- MJO over the Western Pacific (Phases 6-7) in JFM is associated with increased likelihood of wet extremes in Central and Southern CA at lag times of 1-2 weeks with low confidence and decreased likelihood of wet extremes in the above regions at lag times of 3-4 weeks with high confidence

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

Forecasts Initialized 29 Jan 2024



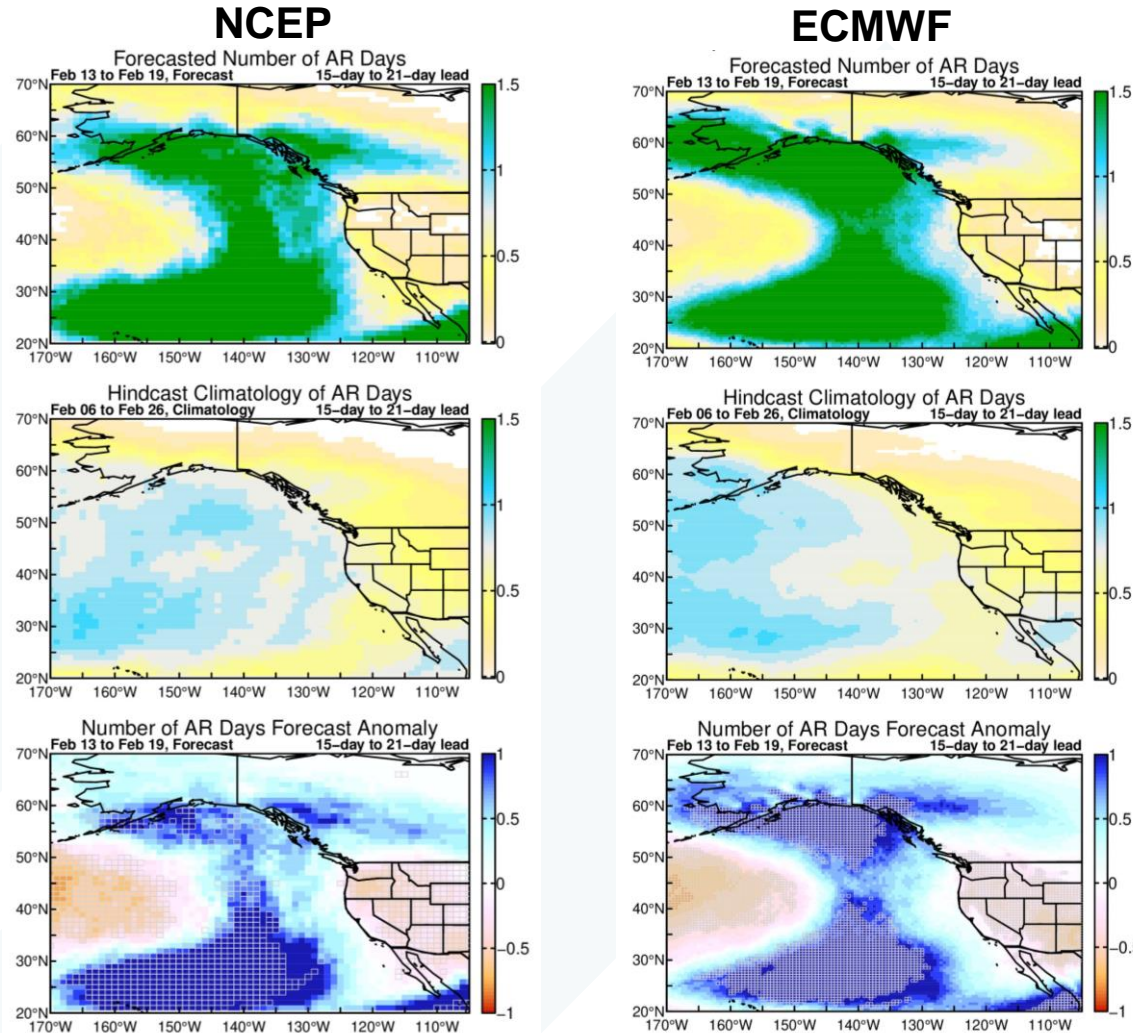
- Both NCEP and ECMWF are showing high likelihood of AR activity (>70% probability) over Southern CA on 6 Feb
- NCEP also shows high likelihood of AR activity over Central CA and moderate likelihood (40-70%) of AR activity over Northern CA on 6 Feb and predicts active AR conditions to continue over Southern CA through 8 Feb
- Both models predict low likelihood (<40% probability) of AR activity over CA during the end of Week 2 (10-12 Feb) and low likelihood of AR activity over OR/WA during the entire Week 2

Models are predicting high likelihood of AR activity over Southern CA on 6 Feb and low likelihood of AR activity during the end of Week 2 (10-12 Feb); There is uncertainty in likelihood of AR activity in Central and Northern CA during the first half 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. ECMWF)

Forecasts Initialized 29 Jan 2024

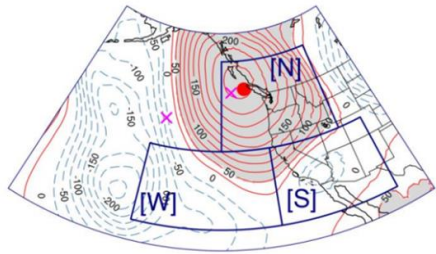


- Both NCEP and ECMWF are predicting below-normal AR activity over Central and Southern CA and WA/OR during Week 3 (13-19 Feb) with high confidence
- Both models also predict below-normal AR activity over Northern CA with higher confidence in ECMWF
- The predicted below-normal AR activity over the western U.S. is consistent with forecasted strong ridging over the western U.S. (see Slide 12)

Models agree on below-normal AR activity over CA during Week 3 with higher confidence in Central and Southern CA

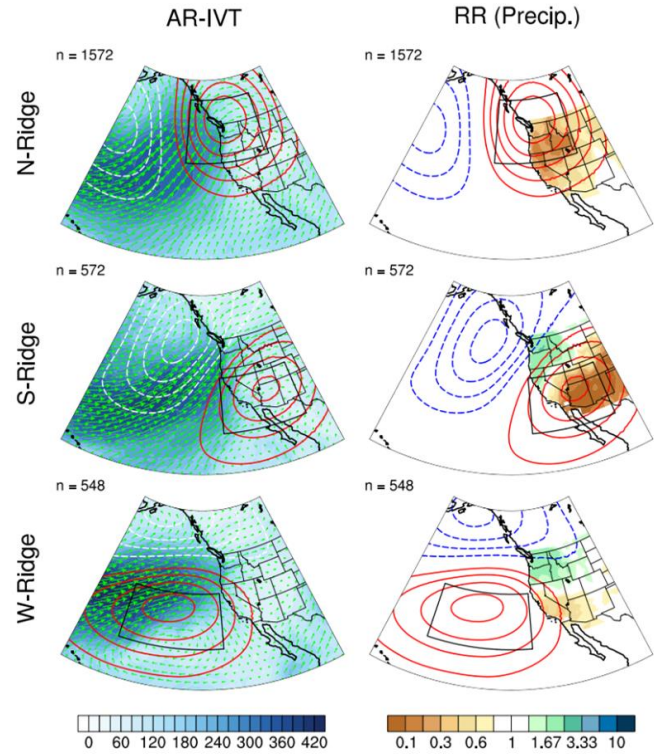
Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

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



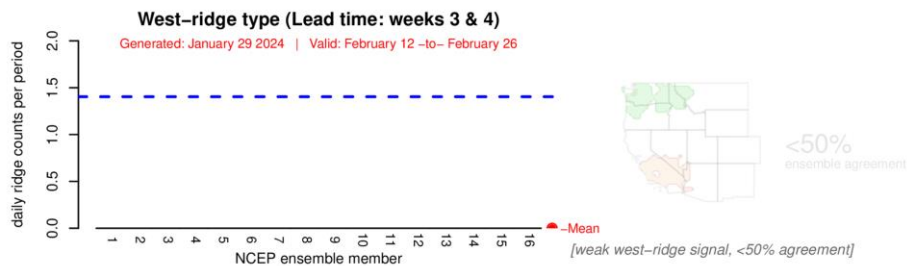
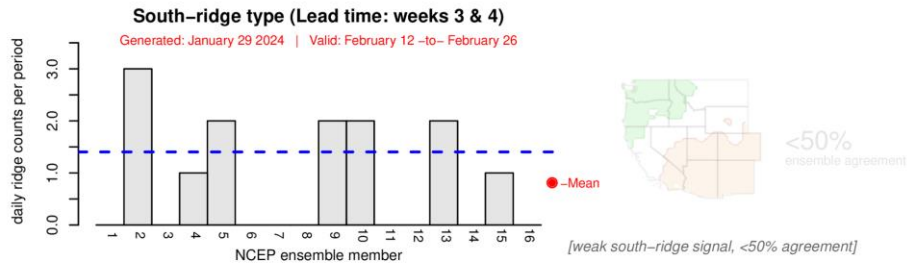
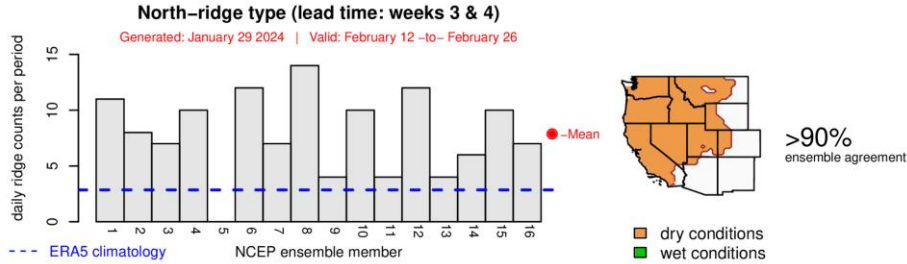
Contact: pgibson@ucsd.edu
Reference: Gibson et al. (2020)
Journal of Climate

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

Forecasts Initialized 29 Jan 2024

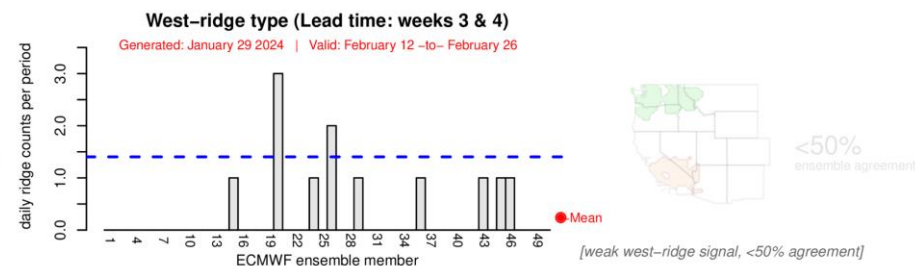
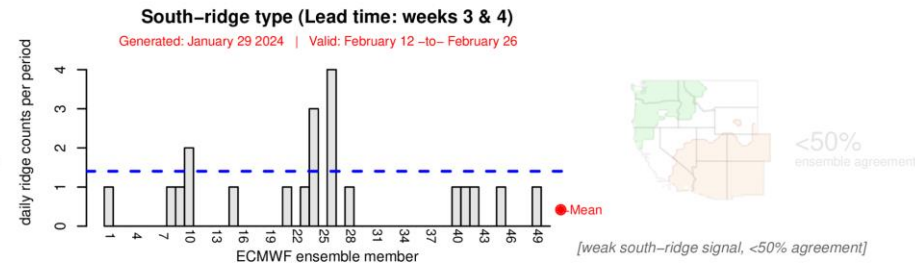
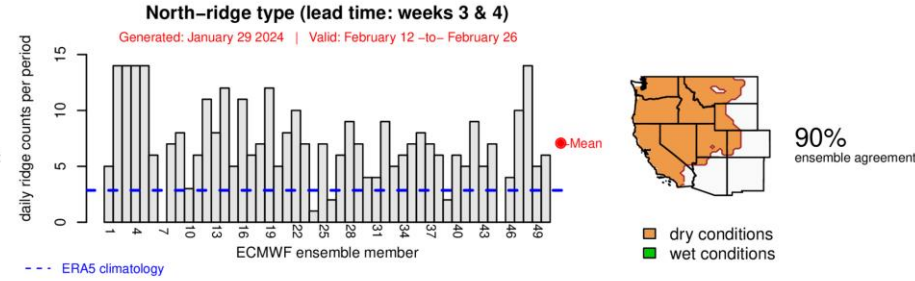
NCEP

CW3E Subseasonal Ridging Forecast (Uses NCEP CFSv2 model)



ECMWF

CW3E Subseasonal Ridging Forecast (Uses ECMWF model)



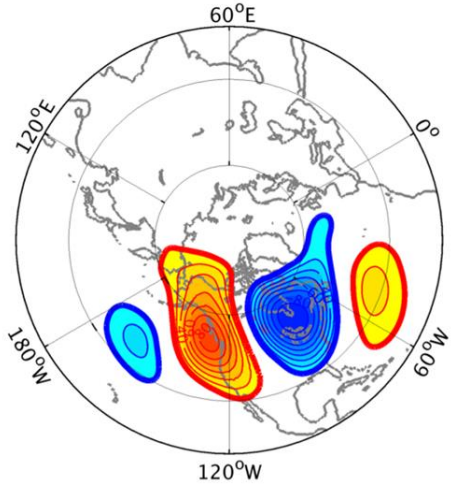
- NCEP and ECMWF are predicting very high likelihood (>90% ensemble agreement) of above-normal North-ridge activity during Weeks 3–4 (12-26 Feb)
- Both models are predicting below-normal occurrence of the South- and West-ridge type

Models agree on very high likelihood of above-normal North-ridge activity during Weeks 3–4

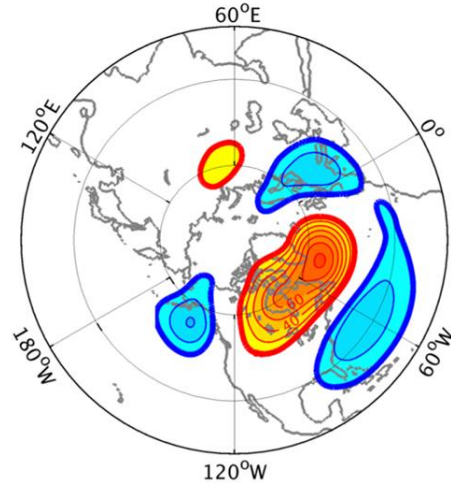


Background Info: IRI Subseasonal Weather Regime Forecasts

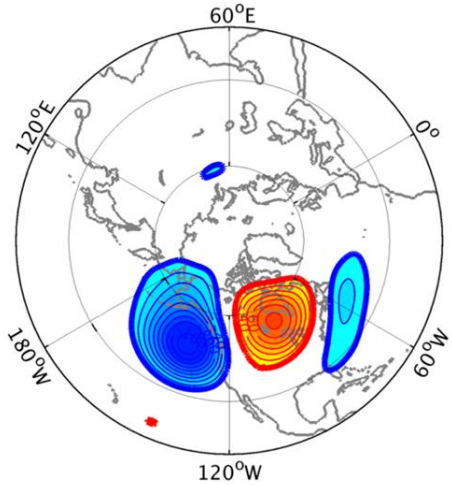
a) WR 1: West Coast Ridge



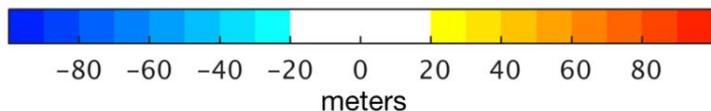
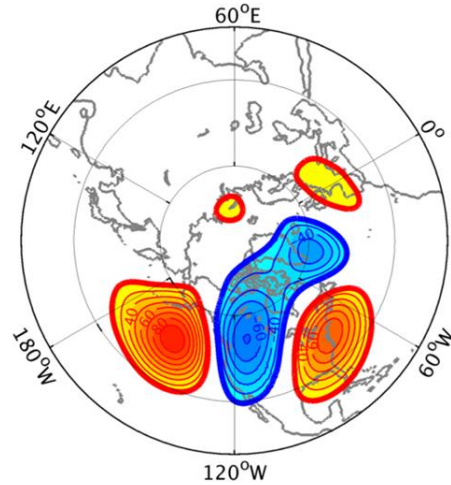
b) WR 2: Greenland High



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)

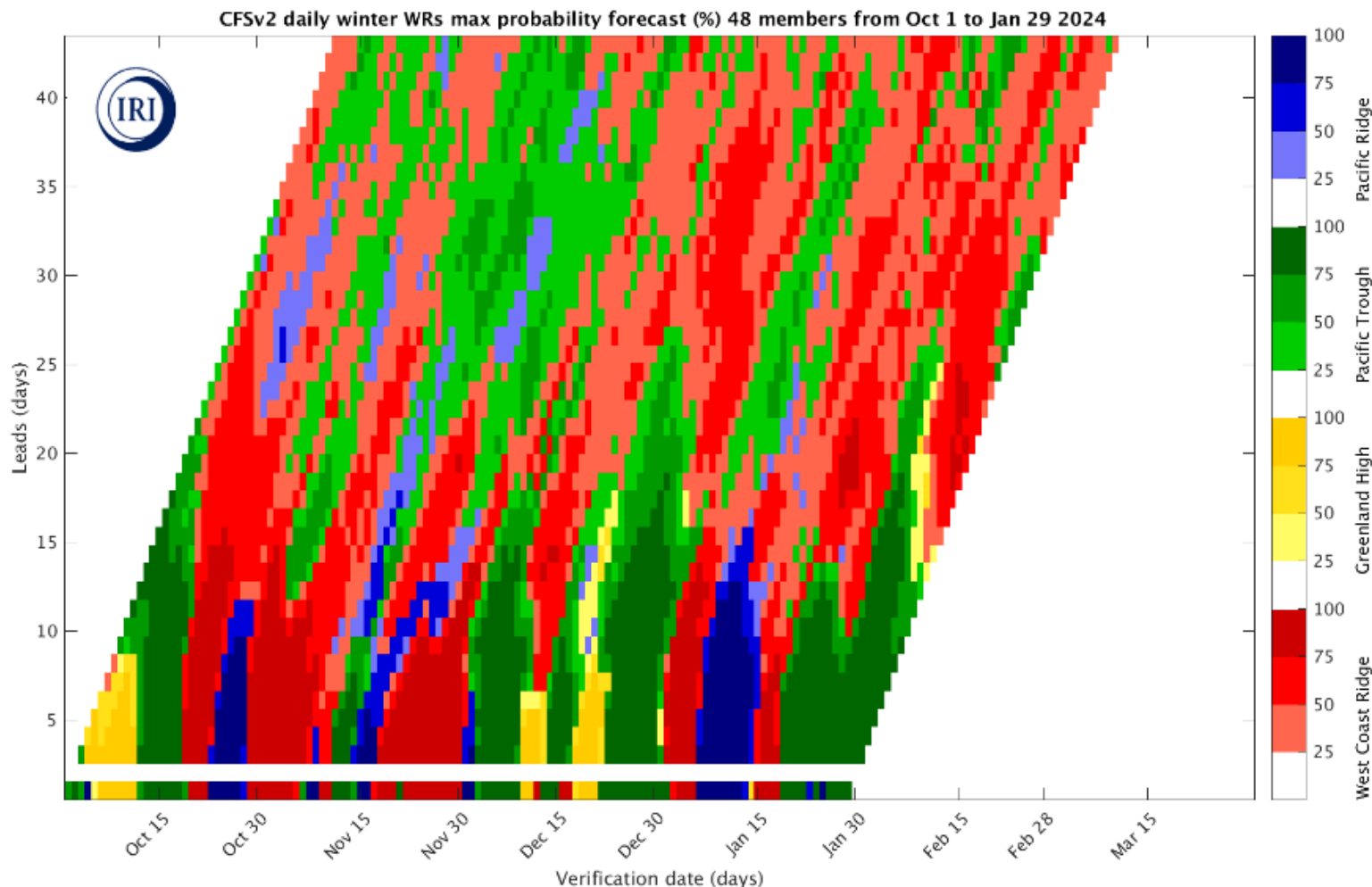
Reference: [Robertson et al. \(2020\)](#)

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

Forecast Initialized 29 Jan 2024

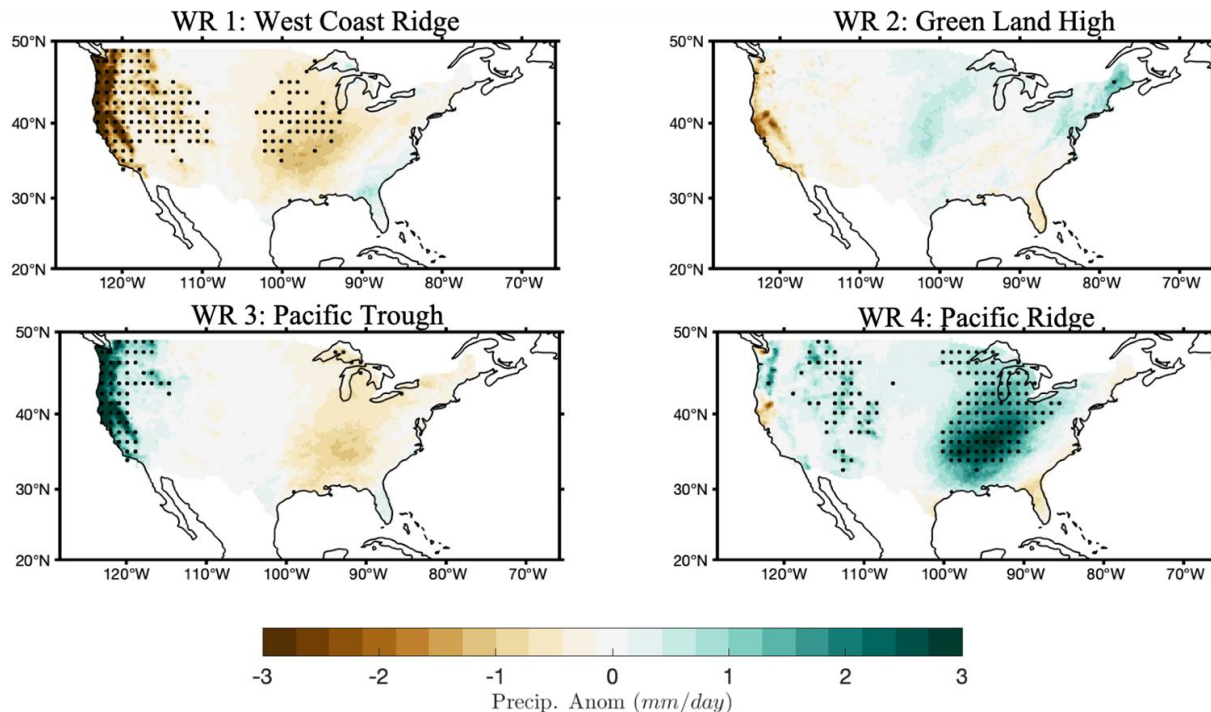


- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- Moderate-to-high likelihood (>50% ensemble agreement) of Pacific Trough conditions during Week 2 (6-12 Feb)
- Low-to-moderate likelihood (25-75% ensemble agreement) of West Coast Ridge conditions during much of Week 3 (13-19 Feb)
- Moderate likelihood (50-75%) of transition to Pacific Trough during Week 4 (20-26 Feb)

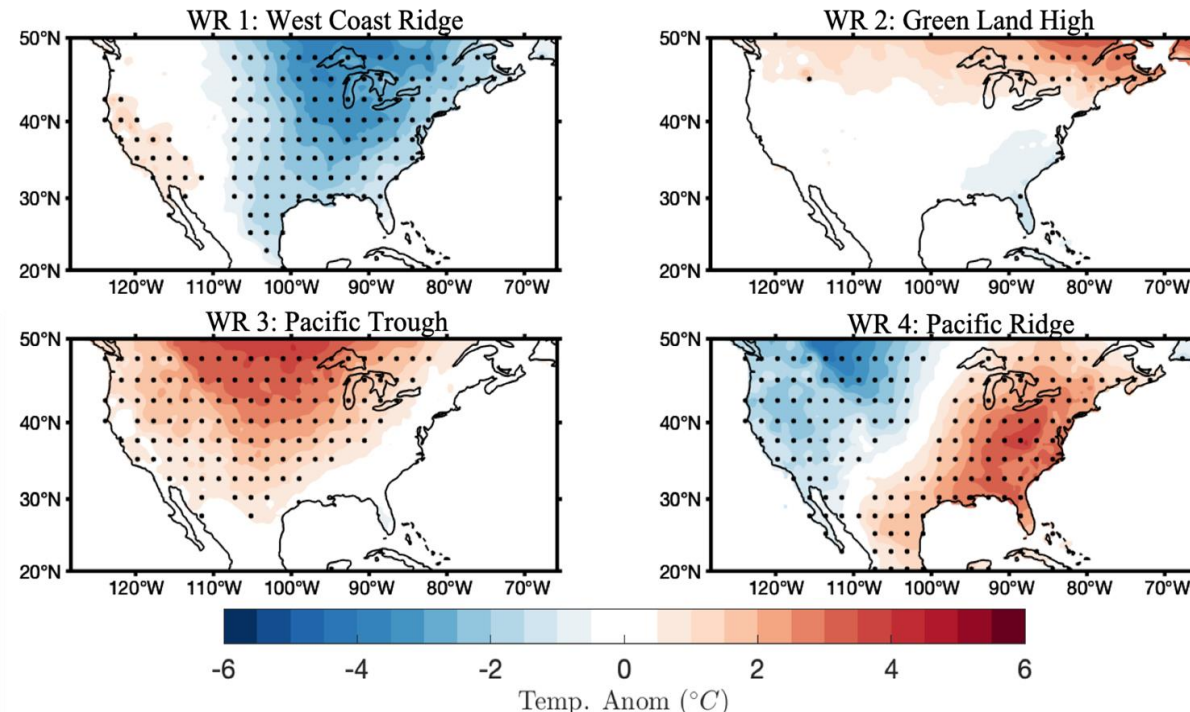
This graphic shows the which of the four North American weather regimes (different colors) is most likely to occur over the next 45 days. Darker (lighter) shading denotes higher (lower) probability of a particular regime. See the next slide for temperature/precipitation implications.

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 moderate-to-high confidence
- Warm and dry conditions are predicted over CA in mid-February with low-to-moderate confidence
- Warm and wet conditions are predicted over CA in late February with moderate confidence