



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E Subseasonal Outlook: 3 January 2024

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

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 GFS (US Model): Weeks 2–3
 - 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 1 Jan 2024

Region	Week 2 (9–15 Jan)			Week 3 (16–22 Jan)			Week 4 (23–29 Jan)		
	NCEP ^{2,3,4}	ECMWF ^{2,4}	Multi-Model Forecast	NCEP ^{2,3}	ECMWF ²	Multi-Model Forecast	NCEP ^{2,3}	ECMWF ²	Multi-Model Forecast
WA/OR	Green dots	Green dots	Green dots						
Northern CA	Green dots								
Central CA									
Southern CA				Orange dots					

Higher Confidence | Lower Confidence

Below normal	Orange dots
Near normal	Grey dots
Above normal	Green dots
? Uncertain/lack of skill	

- Large uncertainty in Weeks 2–4 forecasts due to lack of agreement between forecasts products
- Wet conditions are predicted in WA/OR during Week 2 with low 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](#))

⁴CW3E Extended-Range AR Landfall Forecasts

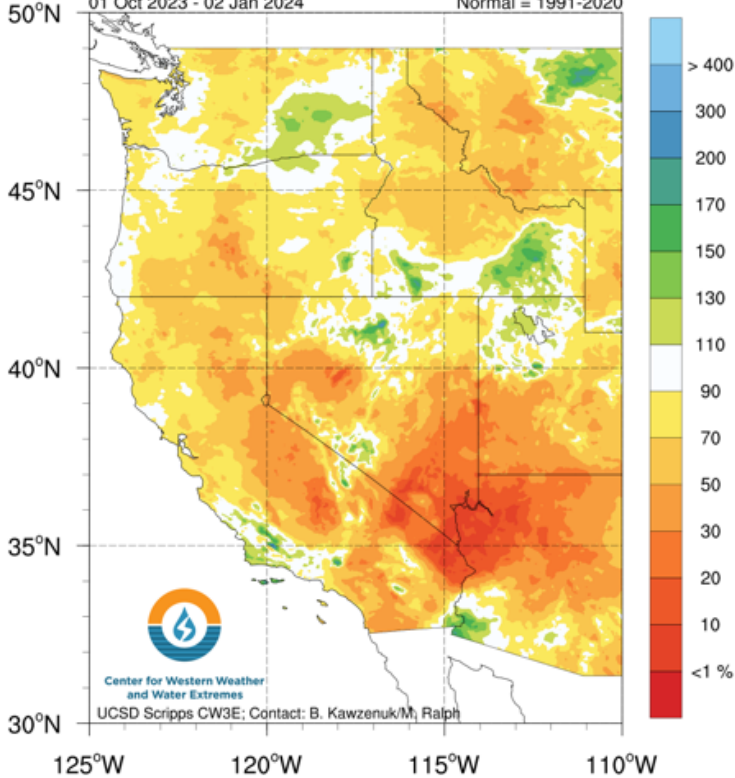
Summary

- **Week 2 forecasts (9–15 Jan):** Models agree on low likelihood of AR conditions over Central and Southern CA during Week 2, but disagree on likelihood of AR conditions over Northern CA
 - NCEP is predicting a higher likelihood of AR conditions in Northern CA compared to ECMWF
- Models are predicting strong MJO activity during the next two weeks located in the Indian Ocean, which is historically associated with a significantly decreased likelihood of wet extremes in Northern, Central, and Southern CA at lag times of 1–4 weeks
- NCEP is predicting below-normal ridging activity near the US West Coast during Weeks 1–2
- **Week 3 forecasts (16–22 Jan):** NCEP is predicting moderate likelihood of persistent South Ridge activity, which is typically associated with dry conditions in Southern CA
- IRI North American weather regime tool shows moderate likelihood of Pacific Ridge transition to West Coast Ridge during Week 3
- Due to data availability issues, the subseasonal AR activity outlooks and ECMWF ridging outlooks are not available for this outlook

Hydrologic Summary

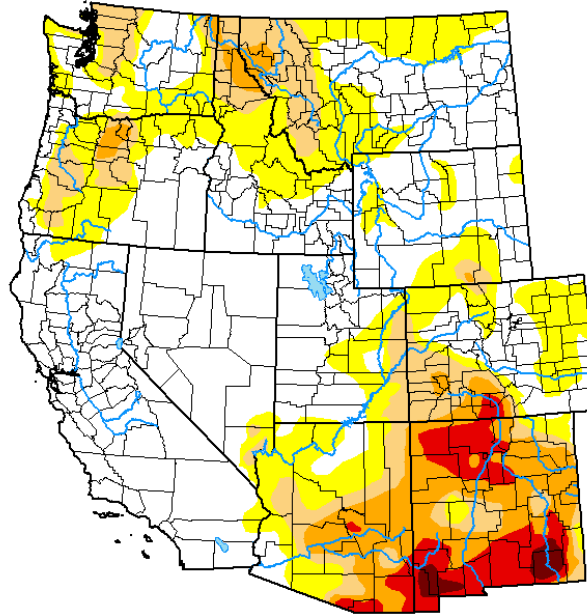
Precipitation

PRISM Water Year to Date Precipitation Anomaly (%)
01 Oct 2023 - 02 Jan 2024 Normal = 1991-2020



Drought Conditions

U.S. Drought Monitor
West



December 26, 2023

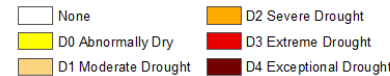
(Released Thursday, Dec. 28, 2023)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current 12-19-2023	52.79	47.21	24.17	13.46	4.95	0.66
Last Week 12-19-2023	55.06	44.94	23.85	13.69	5.07	0.66
3 Months Ago 09-26-2023	55.99	44.01	31.24	17.70	6.09	0.70
Start of Calendar Year 01-03-2023	12.08	87.92	62.42	38.84	12.41	0.27
Start of Water Year 09-26-2023	55.99	44.01	31.24	17.70	6.09	0.70
One Year Ago 12-27-2022	8.44	91.56	64.25	43.80	14.08	1.27

Intensity:



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>

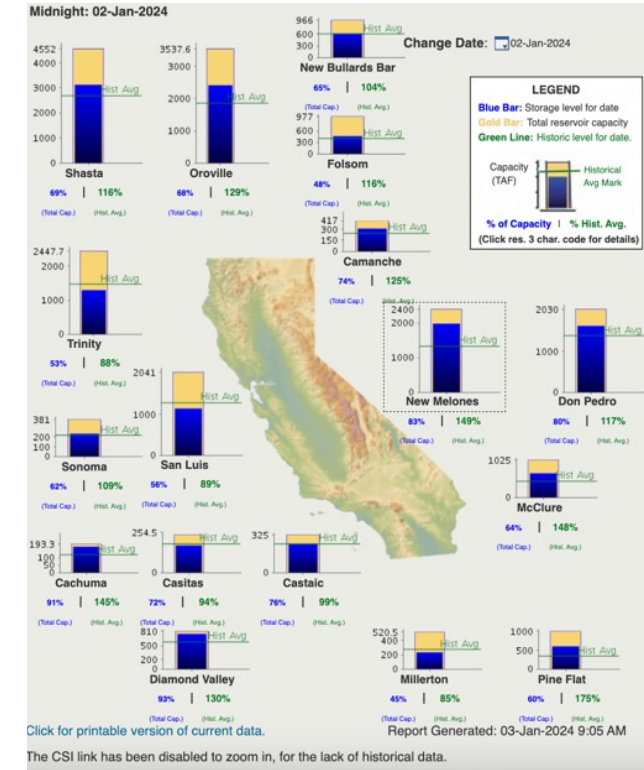
Author:

Rocky Bilotta
NCEI/NOAA



droughtmonitor.unl.edu

Reservoir Storage

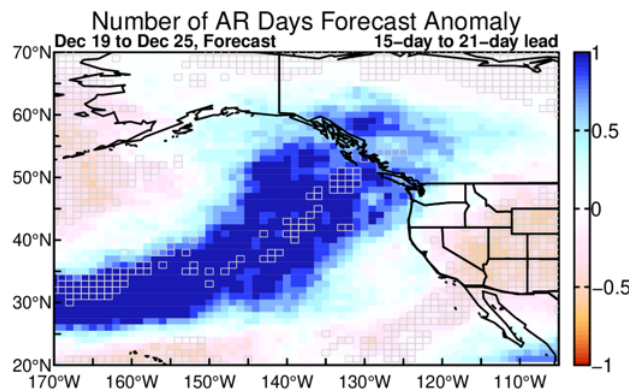
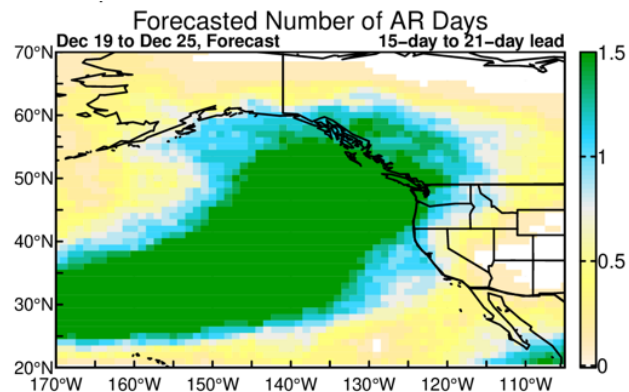


- As of 2 Jan 2024, water-year-to-date precipitation is running below normal in much of CA and AZ, especially Central to Southern CA and Northern AZ
- Nearly all of CA remains drought-free, but portions of the interior Southwest were experiencing severe, extreme, or exceptional drought conditions
- Most large reservoirs in CA are still operating at greater than 50% storage capacity

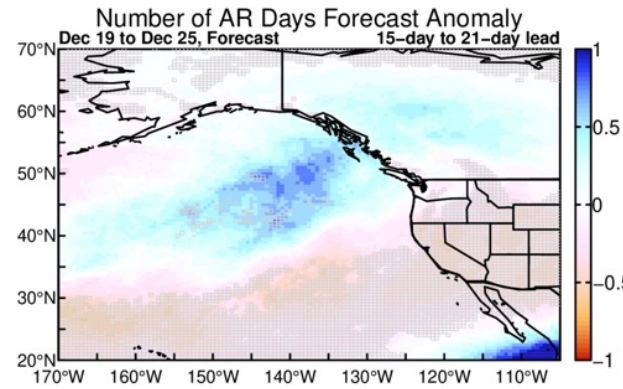
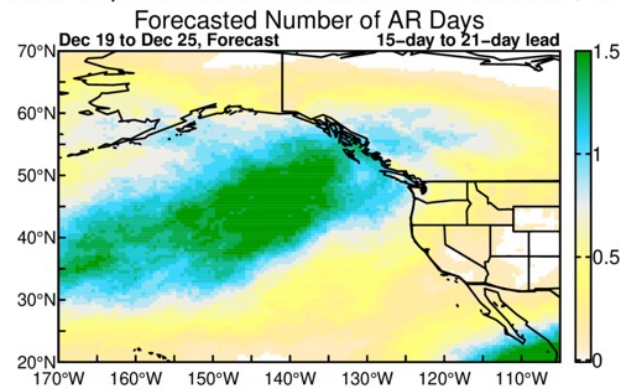
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 4 Dec 2023; Valid: 19–25 Dec 2023

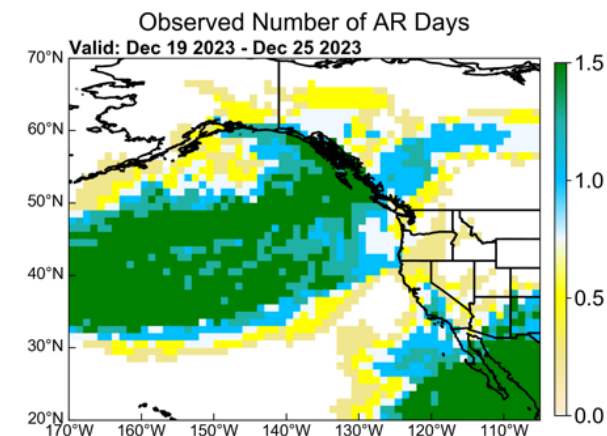
NCEP



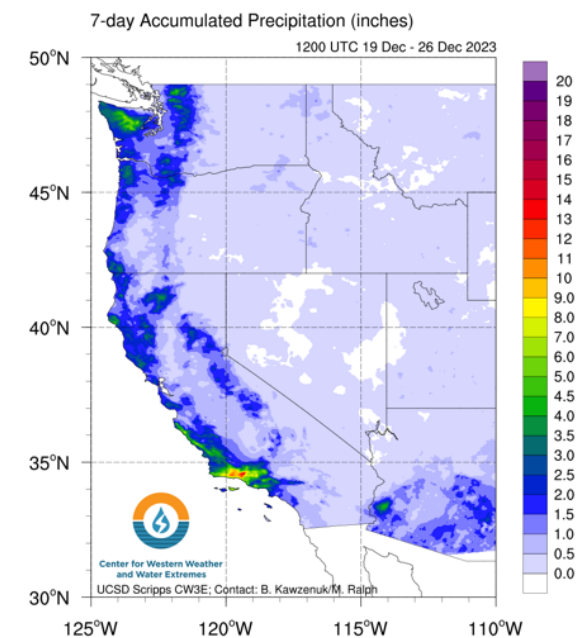
ECMWF



Observed (GFS Analysis)



Observed Precipitation



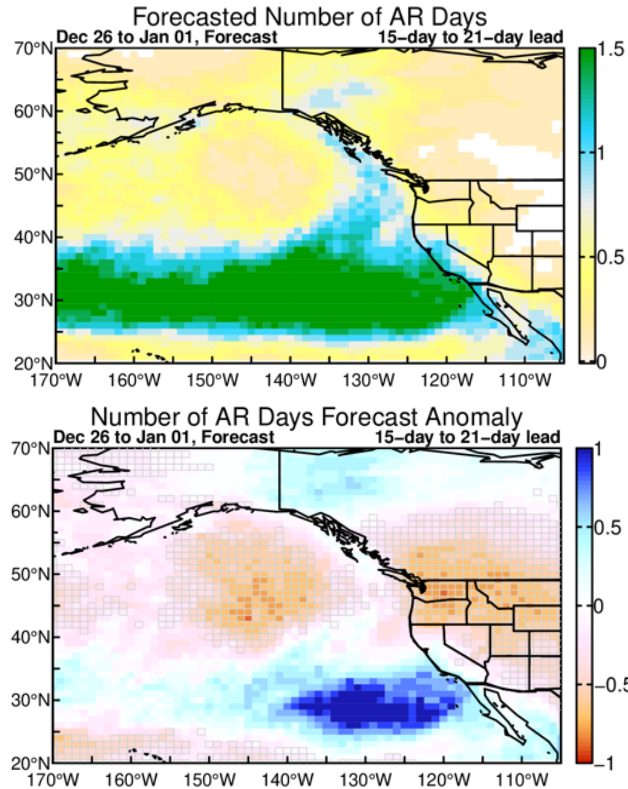
Shading: Fractional # of AR days over a 7-day period (top) and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

- Both models captured the region of high AR activity over the Northeast Pacific, but NCEP overestimated AR activity over coastal WA, OR, and Northern CA
- Both models failed to capture the AR activity over Southern CA
- An AR produced heavy precipitation in Northern CA during 18–19 Dec
- A cutoff low and a weak AR produced heavy precipitation in Southern CA during 20–21 Dec

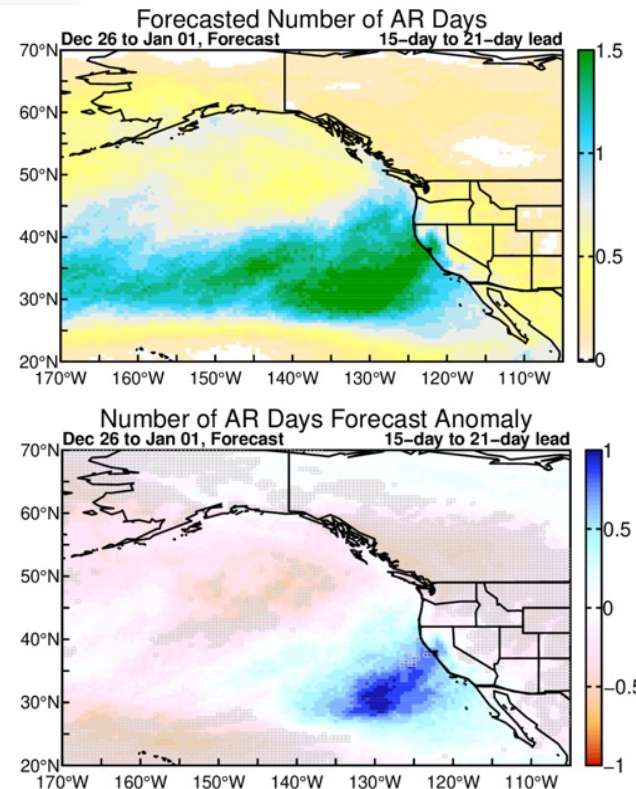
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 11 Dec 2023; Valid: 26 Dec 2023 – 1 Jan 2024

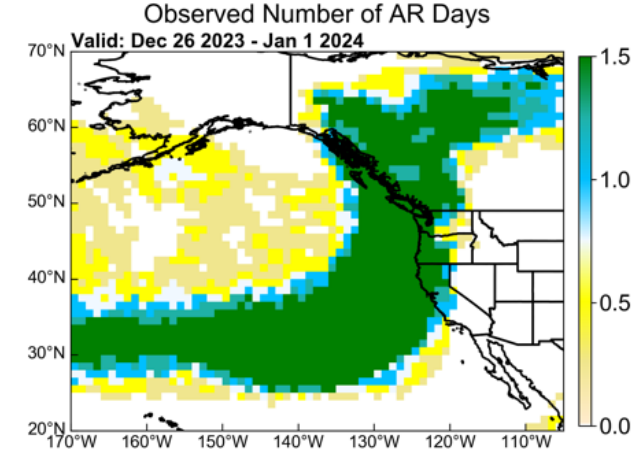
NCEP



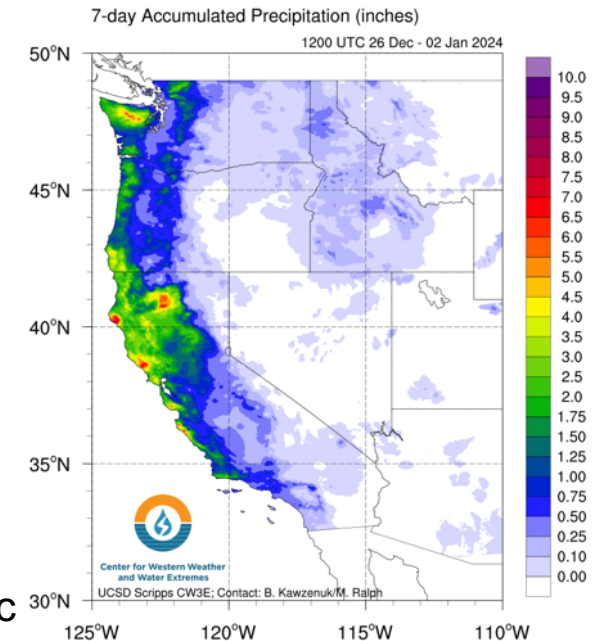
ECMWF



Observed (GFS Analysis)



Observed Precipitation



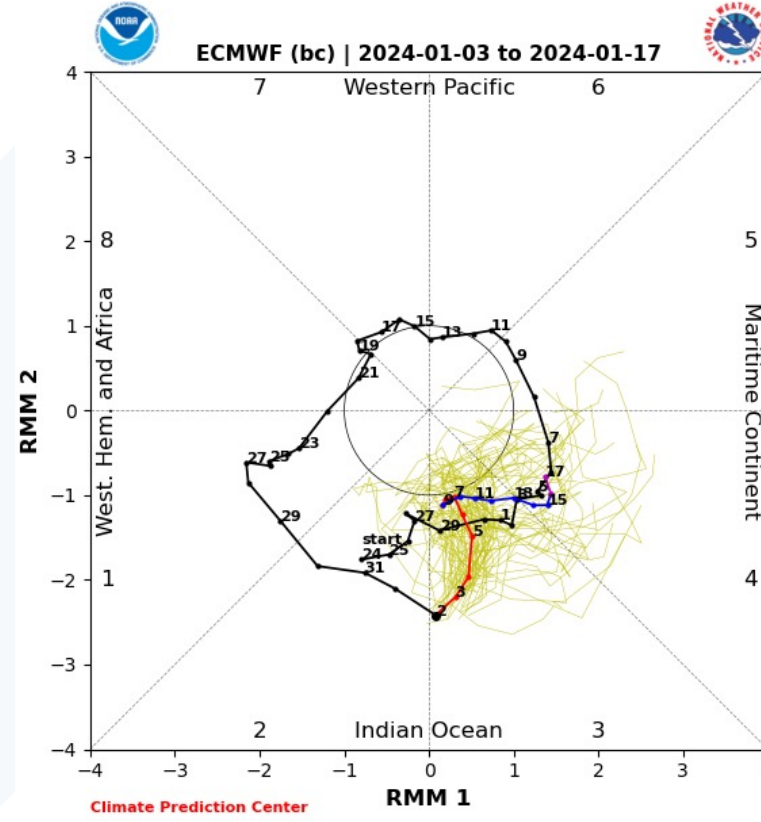
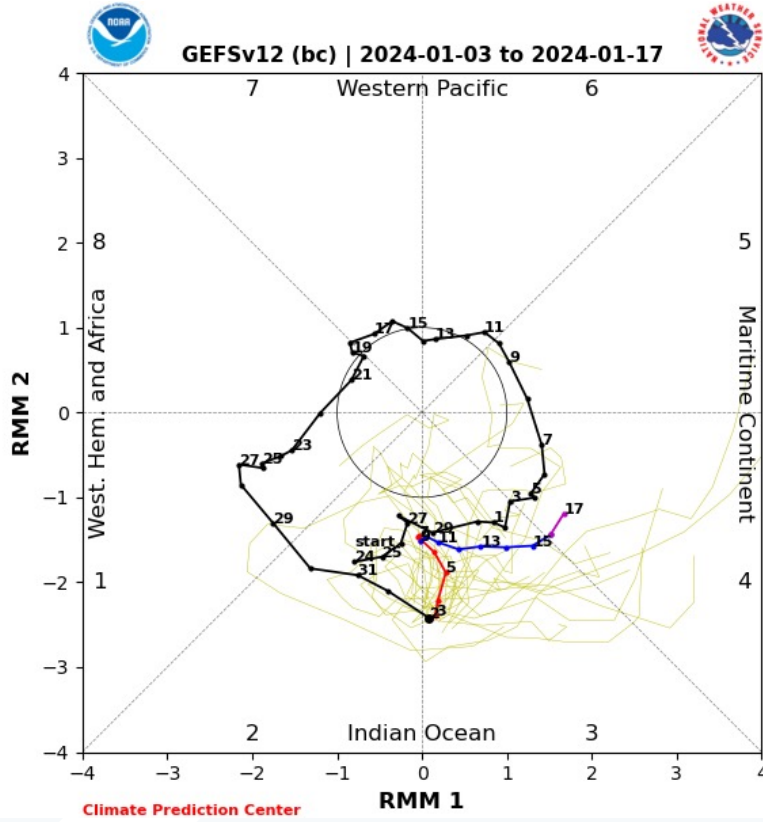
Shading: Fractional # of AR days over a 7-day period (top) and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

- Both models captured landfalling AR activity over CA, but NCEP overestimated AR activity in Southern CA and models underestimated AR activity in Northern CA
- NCEP and ECMWF failed to capture the inland penetration of AR activity over WA/OR
- An AR produced moderate precipitation in coastal WA/OR and CA during 28 Dec
- Another AR brought moderate-to-heavy precipitation to Central and Northern CA during 30–31 Dec

Dynamical Model MJO Forecasts (NCEP vs. ECMWF)

NCEP

ECMWF



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

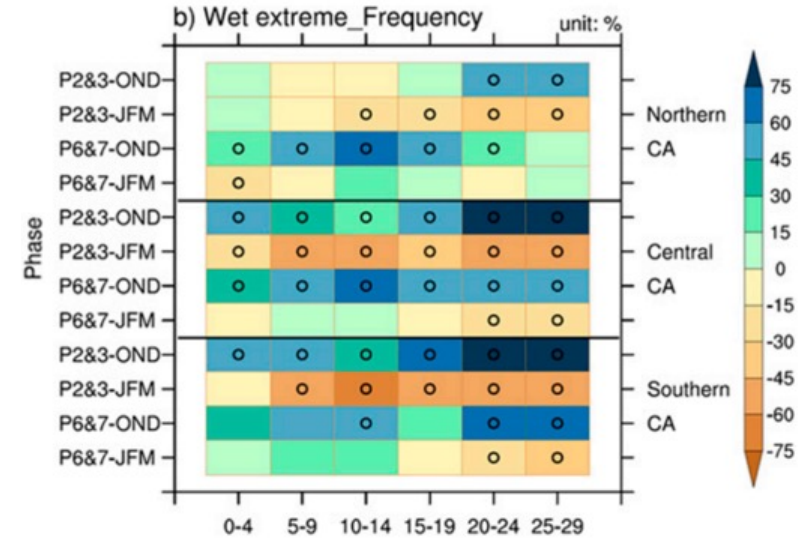
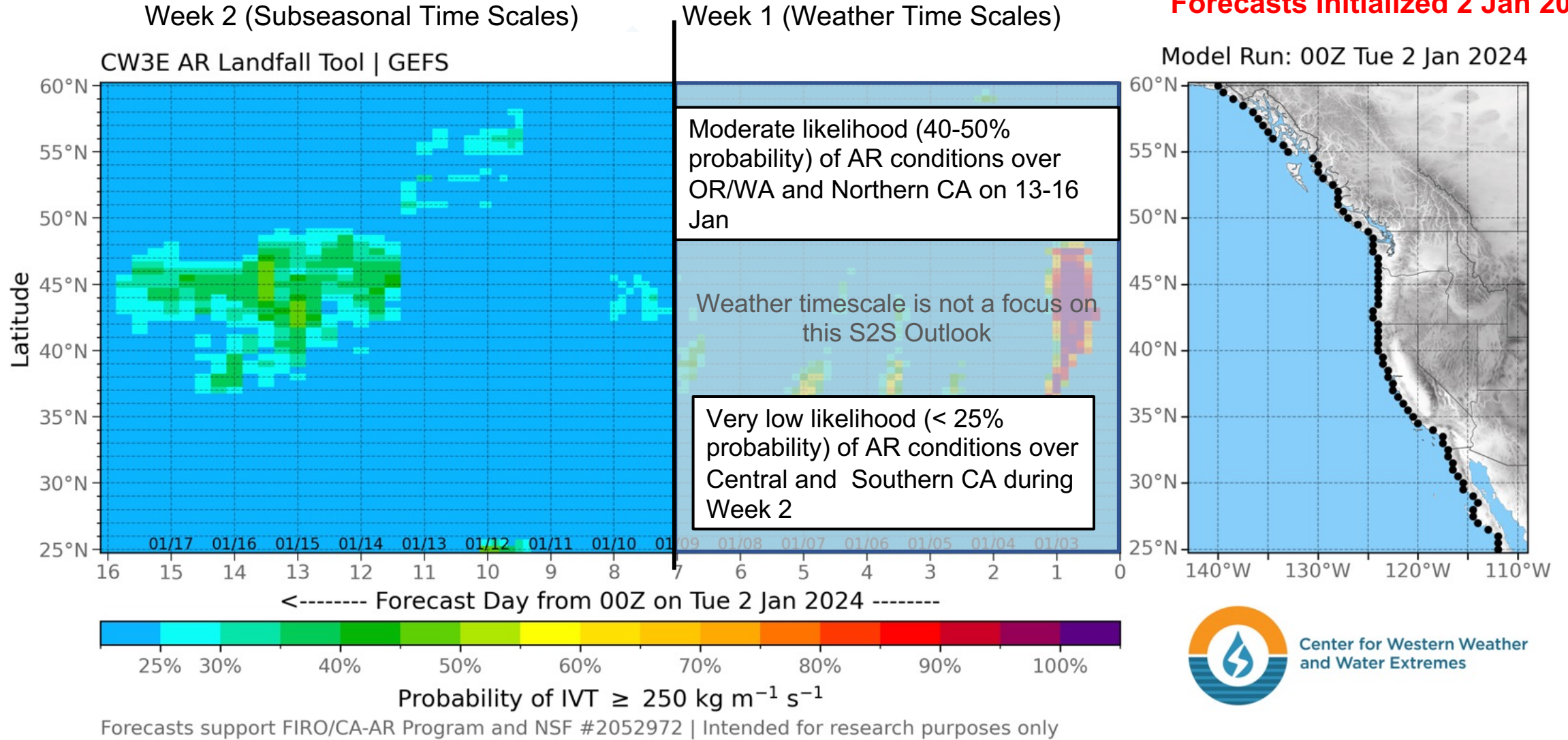


Figure 8 from Wang et al. (2023)

- Both models are forecasting strong MJO convection in the next two weeks located in the Indian Ocean (Phases 2 and 3)
- MJO activity in the Indian Ocean during JFM is associated with a significant decrease in the likelihood of wet extremes in Northern, Central, and Southern CA at lag times of 1–4 weeks

NCEP GEFS AR Landfall Tool: Valid 00Z 2 Jan – 00Z 18 Jan

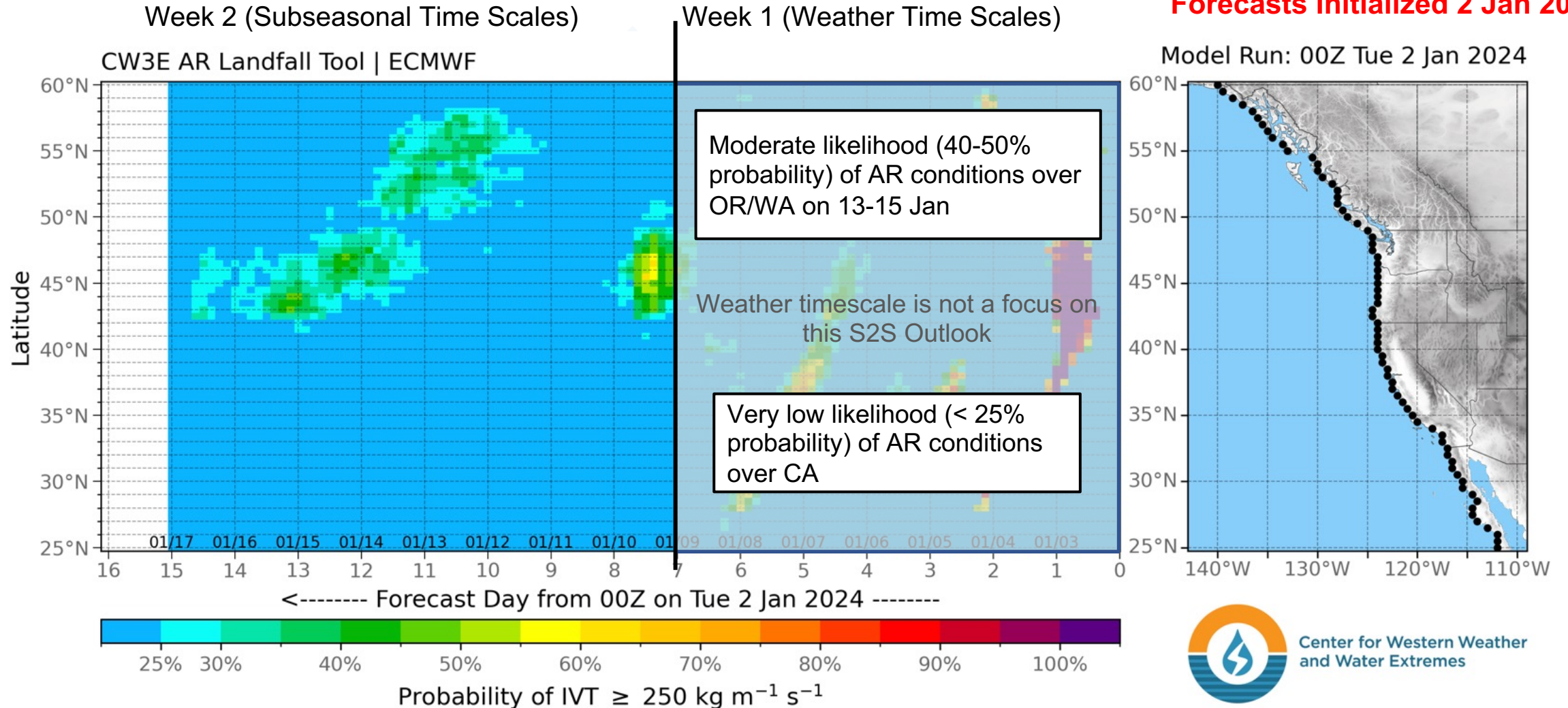
Forecasts Initialized 2 Jan 2024



- NCEP is forecasting moderate likelihood of AR conditions over Northern CA during Week 2, and low likelihood of AR conditions over Central and Southern CA

ECMWF EPS AR Landfall Tool: Valid 00Z 2 Jan – 00Z 18 Jan

Forecasts Initialized 2 Jan 2024

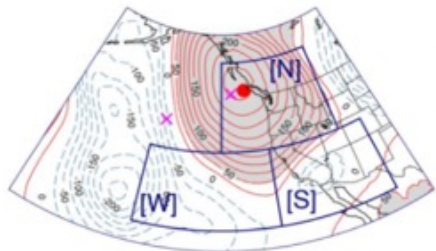


Forecasts support FIRO/CA-AR Program and NSF #2052972 | Intended for research purposes only



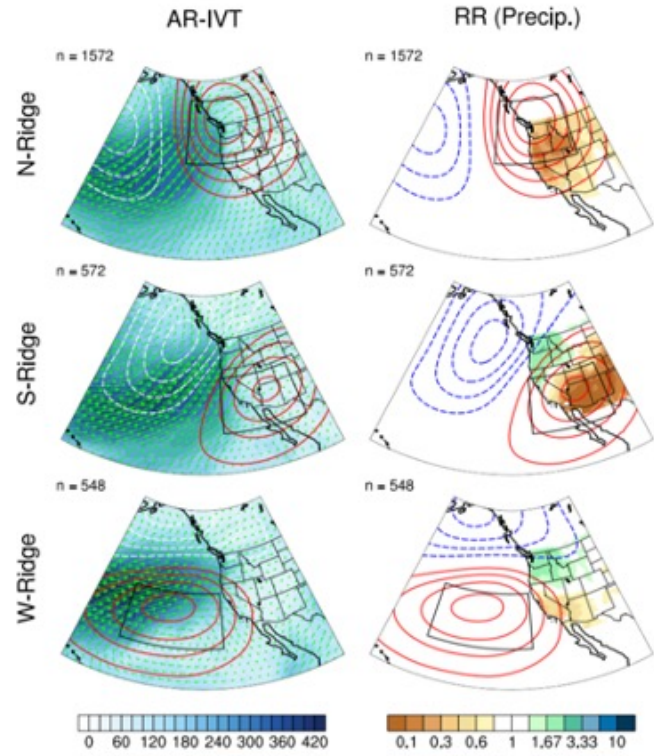
- ECMWF is forecasting low likelihood of AR conditions over CA

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



- 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

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



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

Subseasonal Outlooks: Weeks 1–2 Ridging Forecasts (NCEP)

Forecasts Initialized 1 Jan 2024

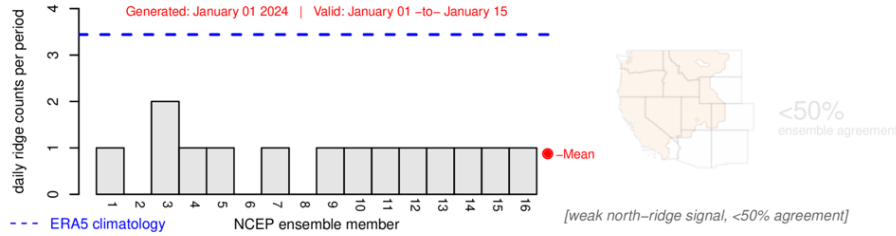
NCEP

CW3E Subseasonal Ridging Forecast

(Uses NCEP CFSv2 model)

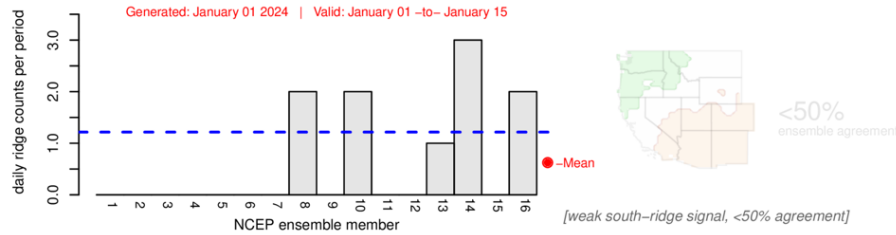
North-ridge type (lead time: weeks 1 & 2)

Generated: January 01 2024 | Valid: January 01 –to– January 15



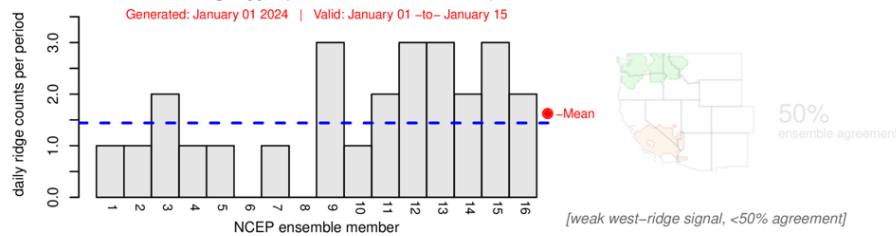
South-ridge type (Lead time: weeks 1 & 2)

Generated: January 01 2024 | Valid: January 01 –to– January 15



West-ridge type (Lead time: weeks 1 & 2)

Generated: January 01 2024 | Valid: January 01 –to– January 15



ECMWF unavailable

- NCEP is forecasting below-normal occurrence of the North- and South-ridge types, and near-normal occurrence of the West-ridge type during Weeks 1–2 (1–15 Jan)



There is below normal probability for the presence of ridge types in general during Weeks 1–2

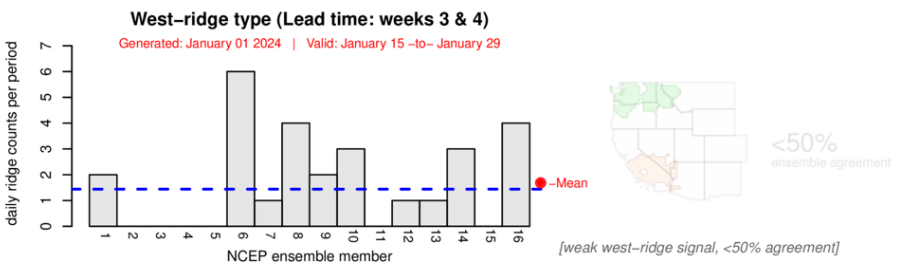
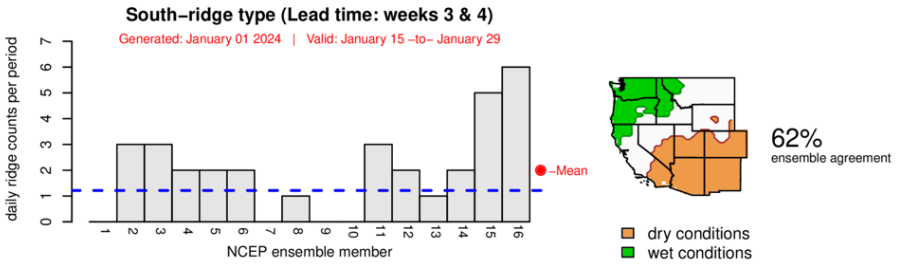
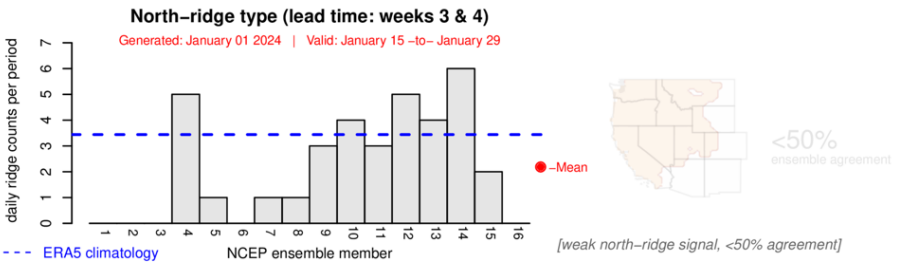


Subseasonal Outlooks: Weeks 3–4 Ridging Forecasts (NCEP)

Forecasts Initialized 1 Jan 2024

NCEP

CW3E Subseasonal Ridging Forecast (Uses NCEP CFSv2 model)



ECMWF unavailable

- NCEP is predicting moderate likelihood (62% ensemble agreement) in persistent South Ridge activity during Weeks 3–4 (15–29 Jan)

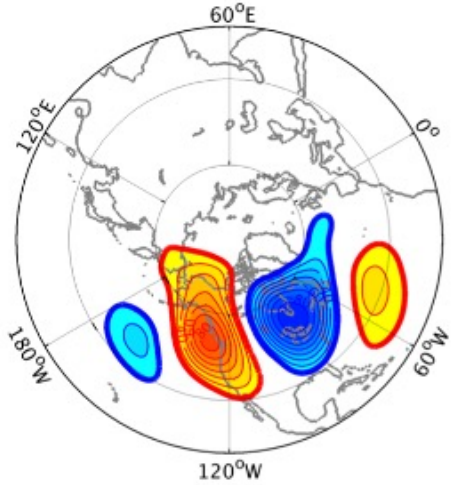


Moderate likelihood in persistent South Ridge activity during Weeks 3–4

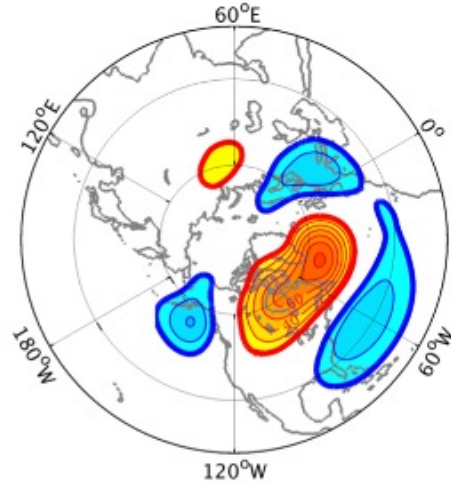


Background Info: IRI Subseasonal Weather Regime Forecasts

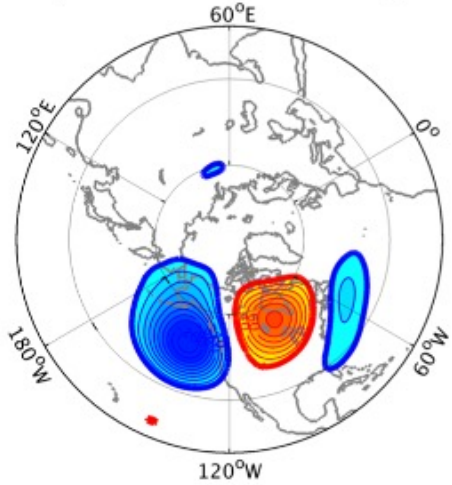
a) WR 1: West Coast Ridge



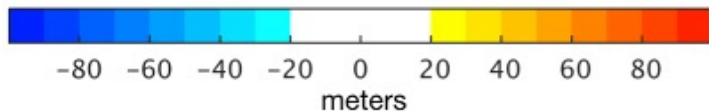
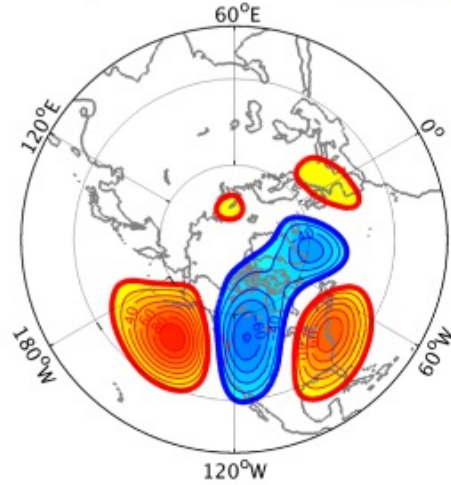
b) WR 2: Greenland High



c) WR 3: Pacific Trough



d) WR 4: Pacific Ridge



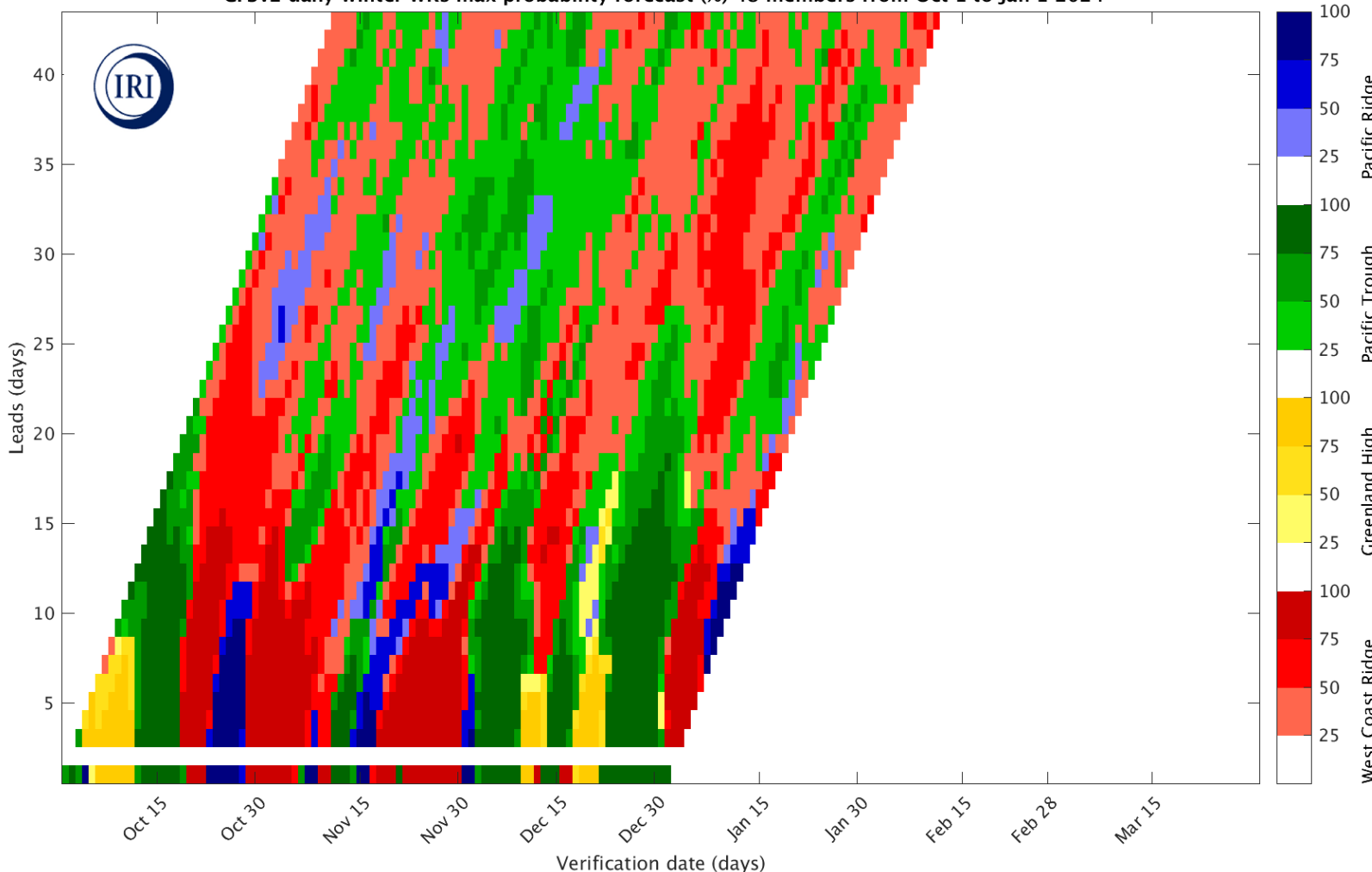
This slide contains background information about IRI's North American weather regime forecast product

- Four dominant weather regimes identified using cluster analysis on daily 500-hPa geopotential height anomalies from MERRA data (1981–2015)

More info: <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 1 2024



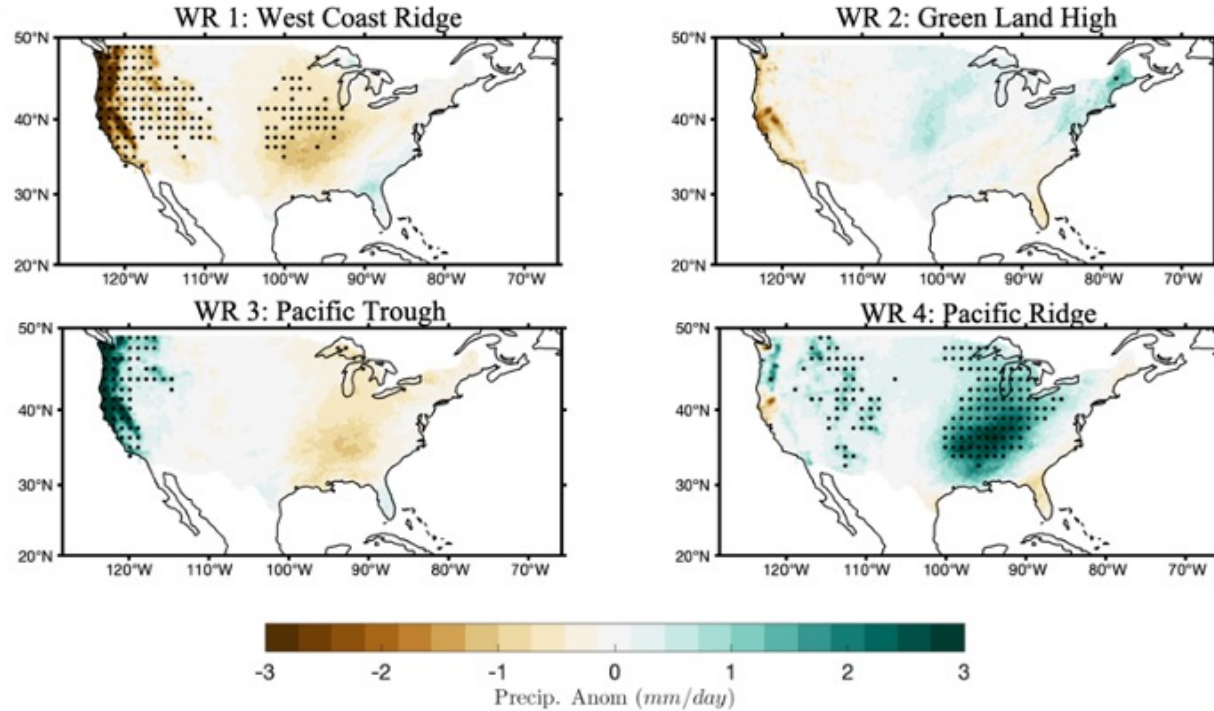
Forecast Initialized 1 Jan 2024

- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- High likelihood (> 75% ensemble agreement) of Pacific Ridge during Week 2
- Moderate likelihood (50–75% ensemble agreement) of transition from Pacific Ridge to West Coast Ridge during Week 3
- Low likelihood (25–50% ensemble agreement) of West Coast Ridge and Pacific Trough during Week 4

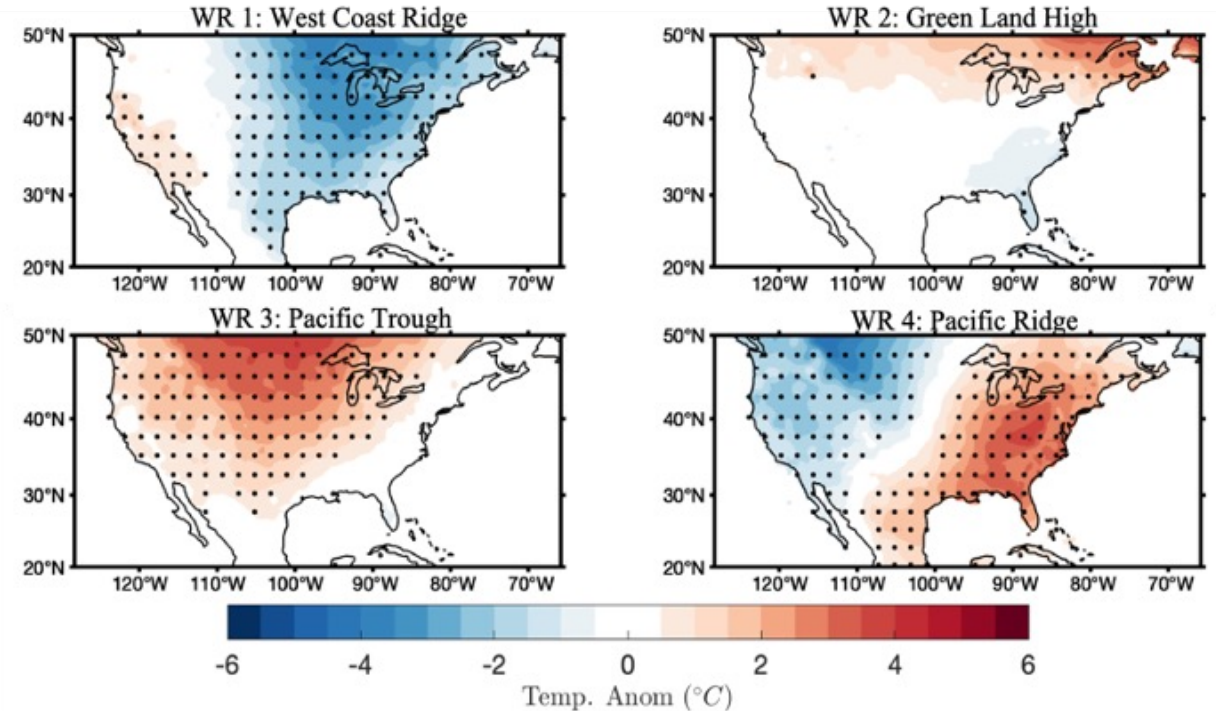
This graphic shows the which of the four North American weather regimes (different colors) is most likely to occur over the next 45 days. Darker (lighter) shading denotes higher (lower) probability of a particular regime. See the next slide for temperature/precipitation implications.

Subseasonal Outlooks: IRI North American Weather Regime Forecasts

Precipitation



Temperature



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

- Cold conditions are predicted over CA during the week 2 of January with high confidence
- Warm and dry conditions are predicted over CA during week 3 of January with moderate confidence