



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E Subseasonal Outlook: 13 December 2023

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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 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*

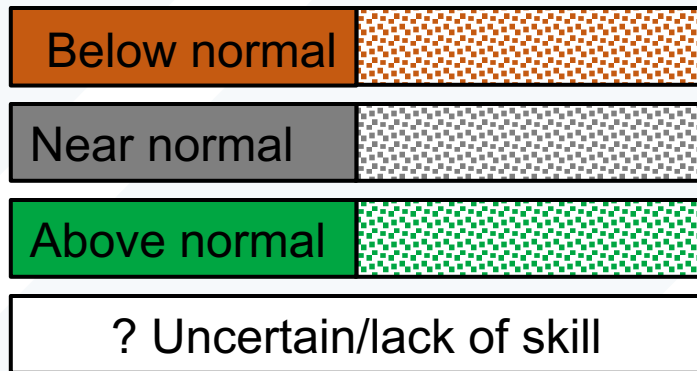
Summary: Subseasonal Precipitation Outlook by Model

This slide shows the CW3E synthesis of subseasonal products by model

Forecasts Initialized 11 Dec 2023

Region	Week 2 (19–25 Dec)			Week 3 (26 Dec – 1 Jan)			Week 4 (2–8 Jan)		
	NCEP ^{1,2,3}	ECMWF ^{1,2}	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	Uncertain	Below normal	Below normal	Uncertain	Below normal	Uncertain
Northern CA	Below normal	Below normal	Below normal	Uncertain	Above normal	Uncertain	Uncertain	Below normal	Uncertain
Central CA	Below normal	Below normal	Below normal	Uncertain	Uncertain	Uncertain	Uncertain	Below normal	Uncertain
Southern CA	Below normal	Below normal	Below normal	Uncertain	Uncertain	Uncertain	Uncertain	Below normal	Uncertain

Higher Confidence | Lower Confidence



- Models agree on below-normal precipitation over CA during Week 2; confidence in below-normal precipitation is highest over Northern CA
- Week 3 and Week 4 forecasts are uncertain due to lack of agreement between forecast products over CA

Subseasonal products included in this Outlook:

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

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

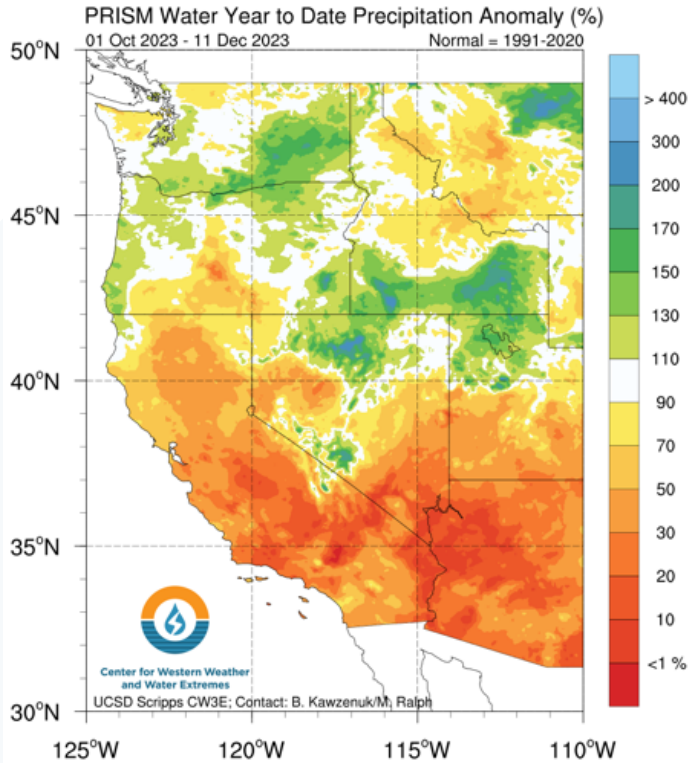
³IRI North American Weather Regime Forecasts ([Robertson et al. 2020](#))

Summary

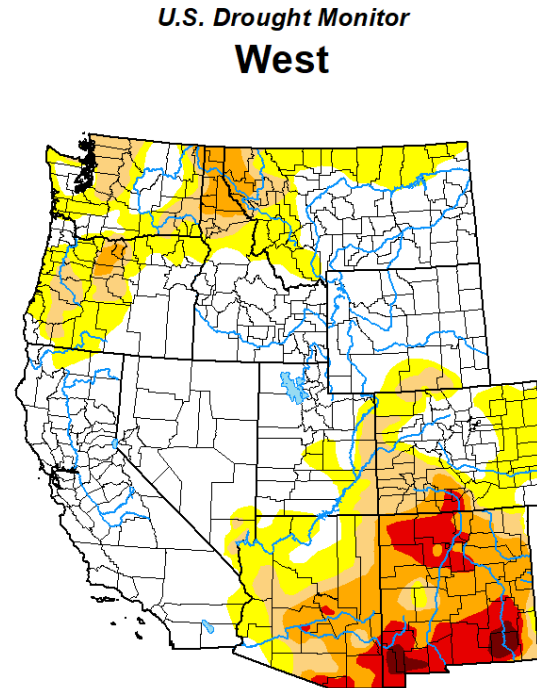
- **Week 2 forecasts (19–25 Dec):** Some model disagreement on AR activity over CA
 - ECMWF is showing higher likelihood of AR activity over Northern CA and lower likelihood of AR activity over Southern CA compared to NCEP on 19 Dec
 - ECMWF is showing higher likelihood of AR activity over Southern and Central CA on 21 Dec
- Models are predicting relatively weak MJO activity during the next two weeks
- Ridging outlooks show high likelihood of persistent North-ridge activity during Weeks 1–2
 - North-ridge is typically associated with dry conditions in CA
- **Week 3 forecasts (26 Dec – 1 Jan):** Models generally agree on near-normal AR activity over Central and Southern CA, but there is some disagreement over Northern CA
 - ECMWF is forecasting more AR activity over Northern CA compared to NCEP
- Models show potential for above-normal North Ridge activity during Weeks 3–4
- IRI weather regime forecasts show moderate likelihood of Pacific Trough during Weeks 3–4
 - Pacific Trough is typically associated with wet conditions in CA

Hydrologic Summary

Precipitation



Drought Conditions



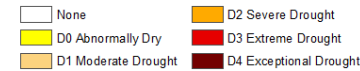
December 5, 2023

(Released Thursday, Dec. 7, 2023)

Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	55.83	44.17	24.70	14.62	5.17	0.66
Last Week 11-28-2023	54.87	45.13	27.59	16.29	5.22	0.66
3 Months Ago 09-05-2023	55.53	44.47	31.67	16.18	3.57	0.00
Start of Calendar Year 01-01-2023	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 12-06-2022	7.93	92.07	66.64	45.25	16.00	2.02

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>

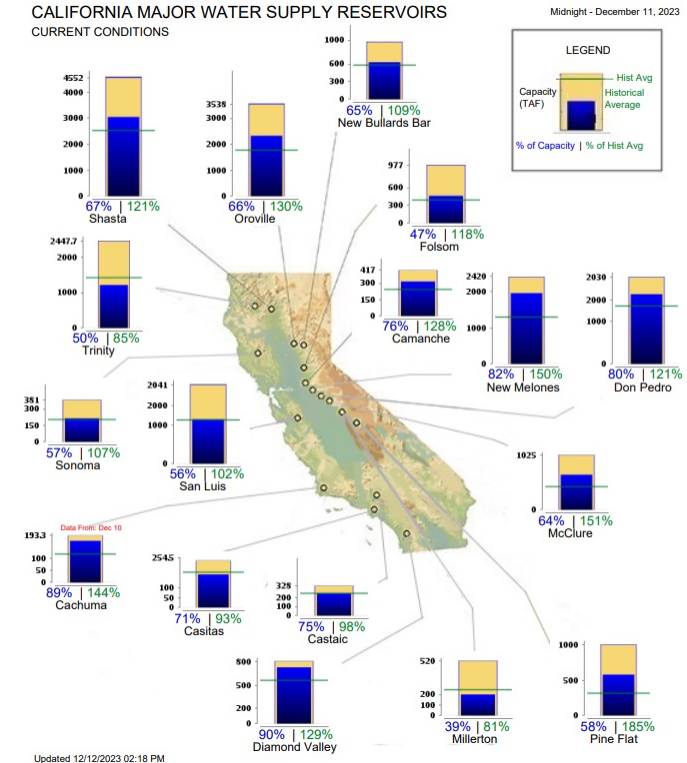
Author:

David Simeral
Western Regional Climate Center



droughtmonitor.unl.edu

Reservoir Storage

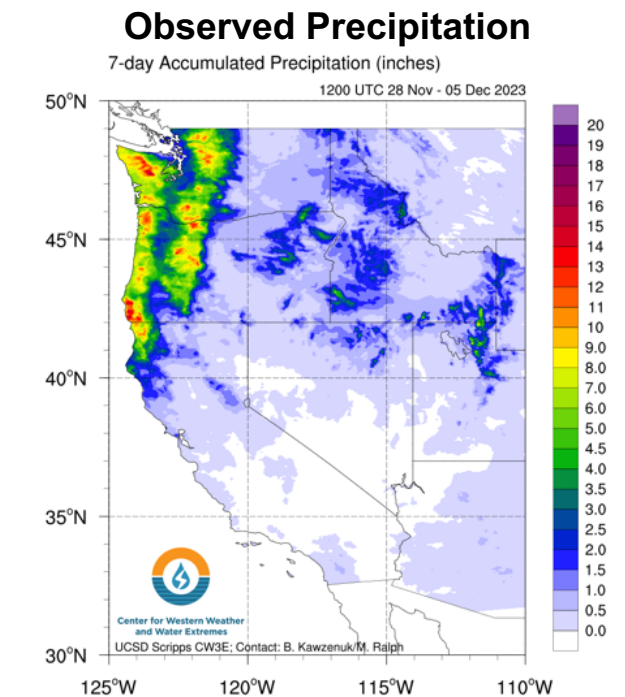
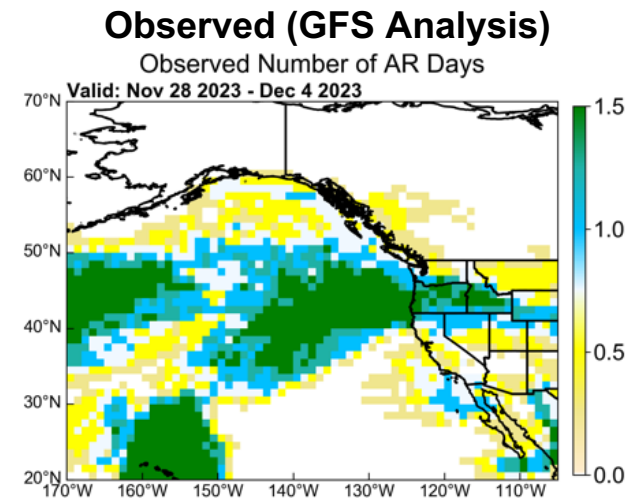
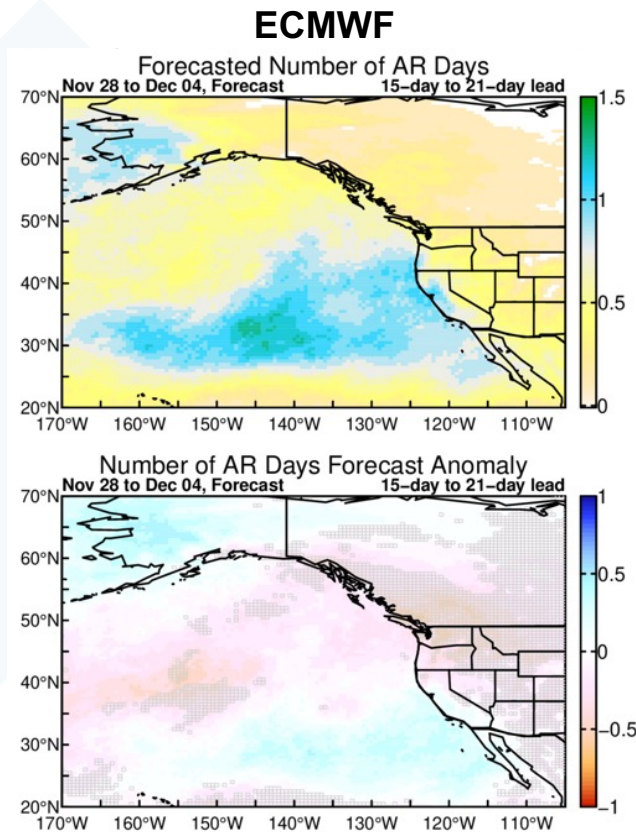
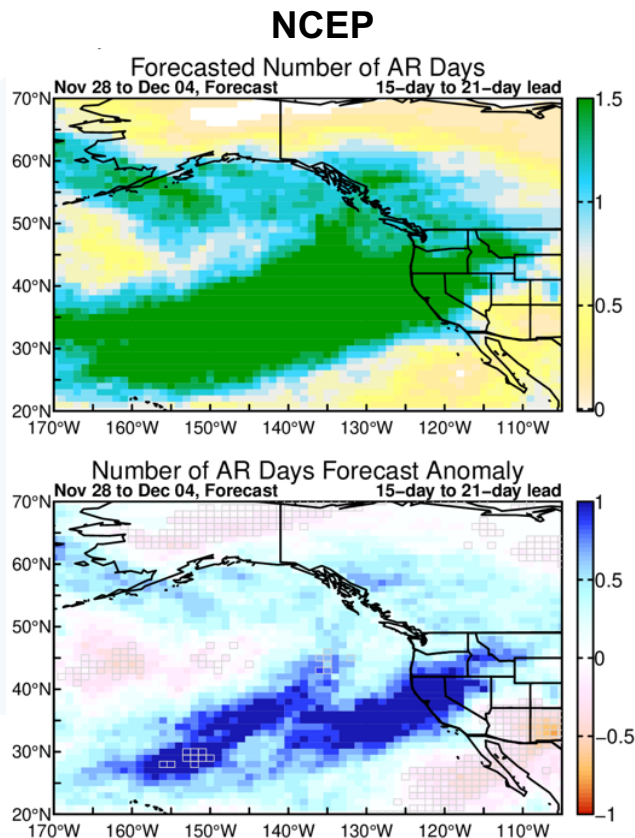


Source: California DWR

- As of 11 Dec, water-year-to-date precipitation is running well-below normal (< 50% of normal) in much of CA and 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 and higher-than-normal storage for this time of year

Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 13 Nov 2023; Valid: 28 Nov – 4 Dec 2023

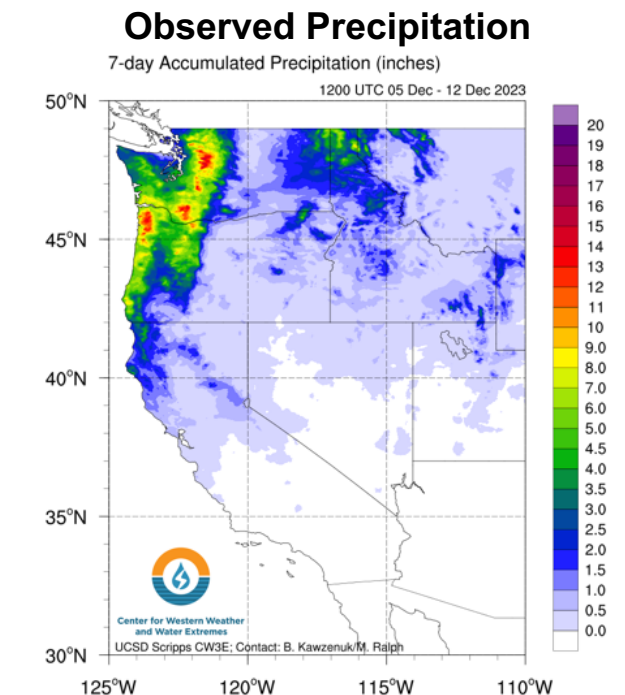
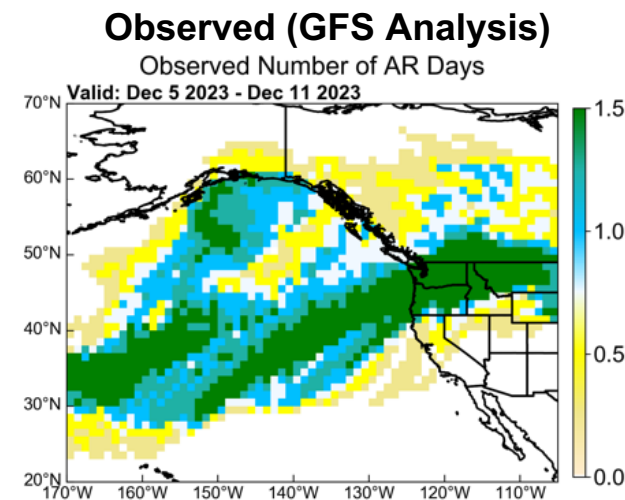
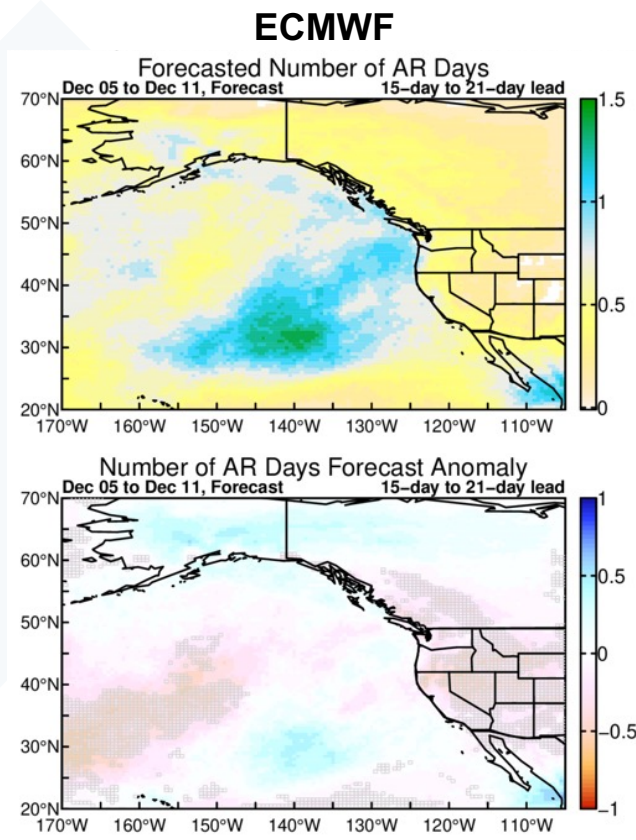
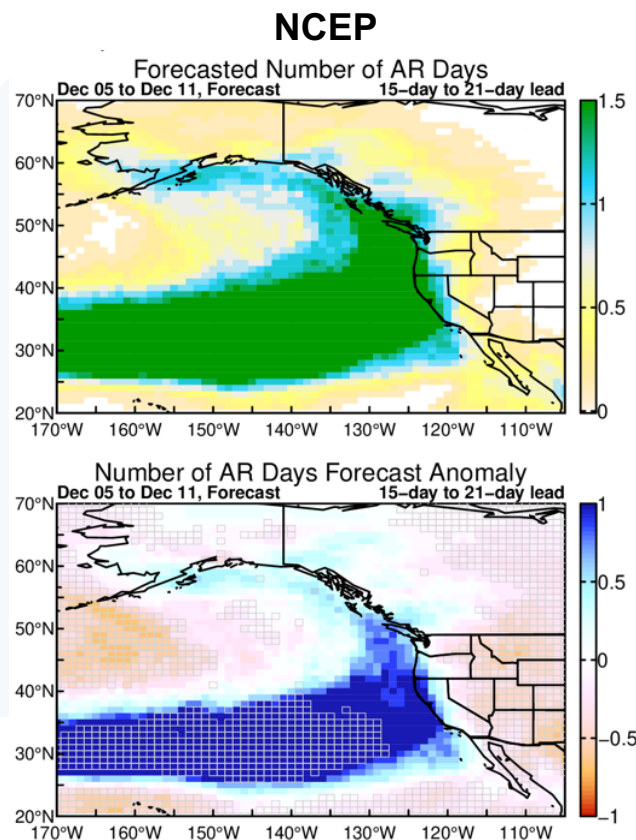


Shading: Fractional # of AR days over a 7-day period (top) and forecast minus model climatology (bottom)
 Grey cells: >75% of ensemble members agree on sign of anomaly

- NCEP captured AR activity over OR, but predicted too much AR activity over Northern and Central CA
- ECMWF significantly underestimated AR activity over the Pacific Northwest
- Multiple ARs produced heavy precipitation in western WA, western OR, and far Northern CA during 1–4 Dec

Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 20 Nov 2023; Valid: 5–11 Dec 2023

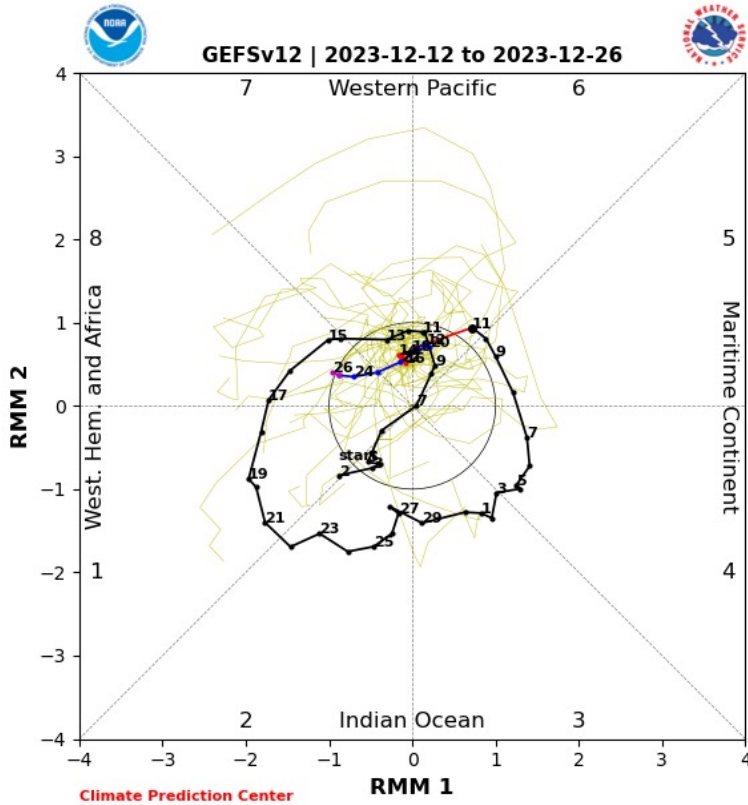


Shading: Fractional # of AR days over a 7-day period (top) and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

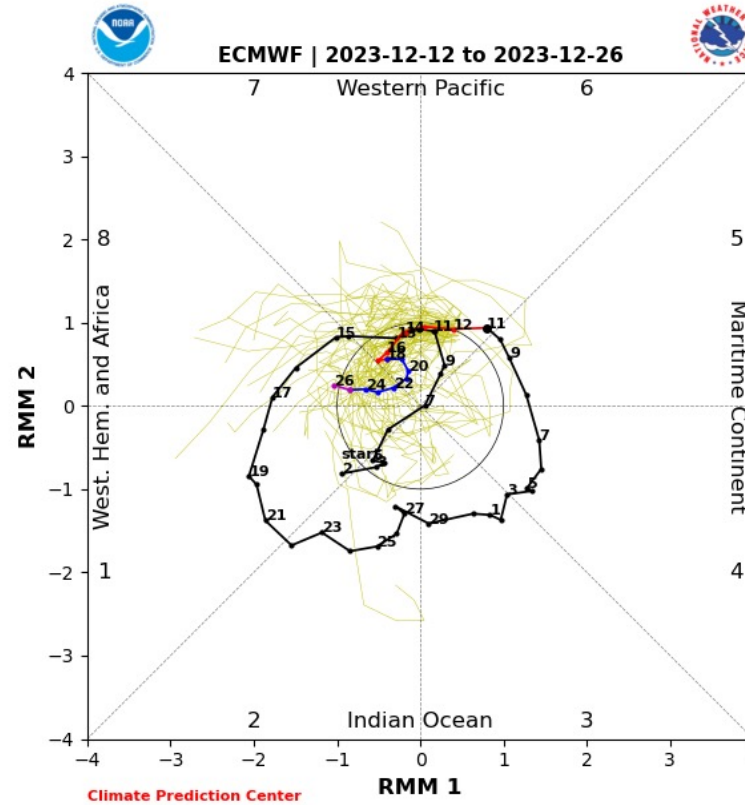
- NCEP captured AR activity along the coast of OR and WA, but overestimated AR activity over CA, and failed to capture the inland penetration of AR activity over the northwestern US
- ECMWF significantly underestimated AR activity over the northwestern US
- A strong AR produced heavy precipitation in western WA and OR during 5–6 Dec
- Another AR produced moderate precipitation in western WA and OR during 9–10 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)

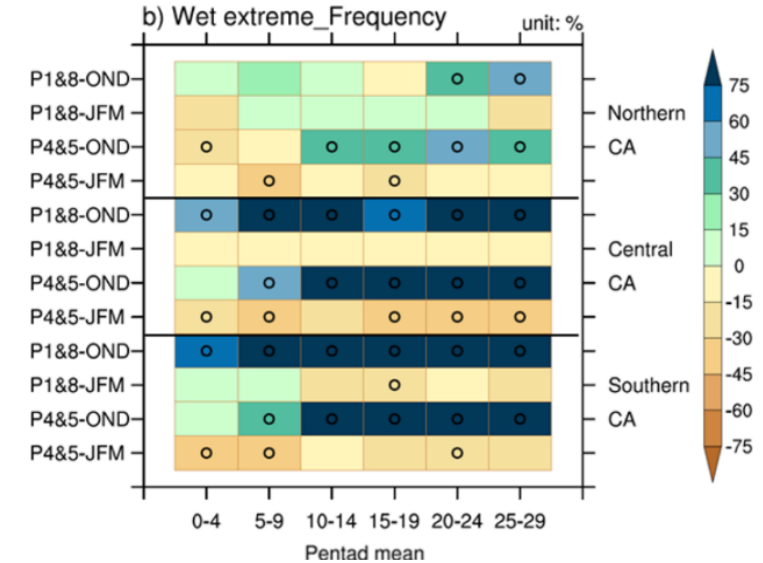
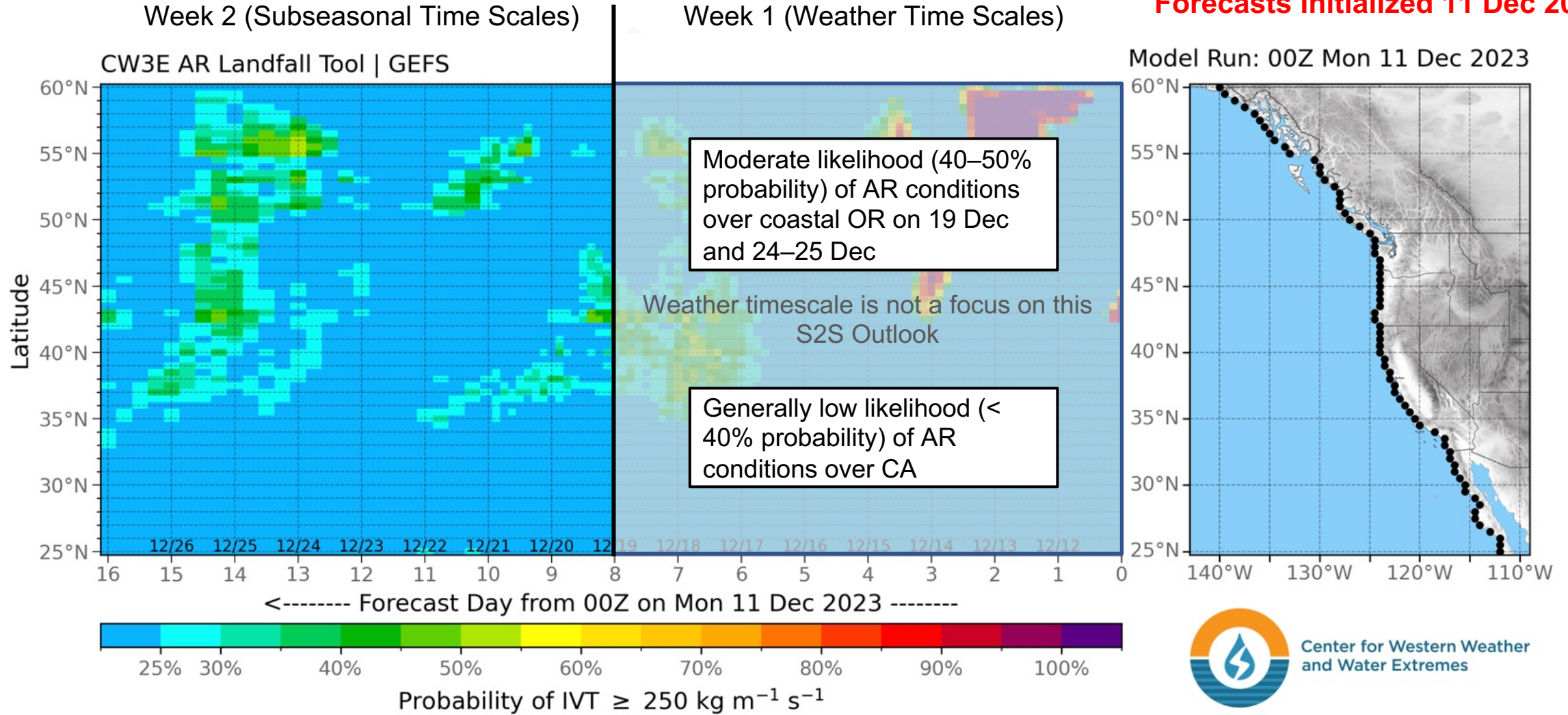


Figure S6 from Wang et al. (2023)

- MJO convection that was located over the Maritime Continent last week is expected to weaken and remain relatively weak through the end of Week 2
- MJO activity over the Maritime Continent during OND is associated with an increased likelihood of wet extremes in Central and Southern CA at lag times of 1–4 weeks and in Northern CA at lag times of 2–4 weeks

NCEP GEFS AR Landfall Tool: Valid 00Z 11 Dec – 00Z 27 Dec

Forecasts Initialized 11 Dec 2023

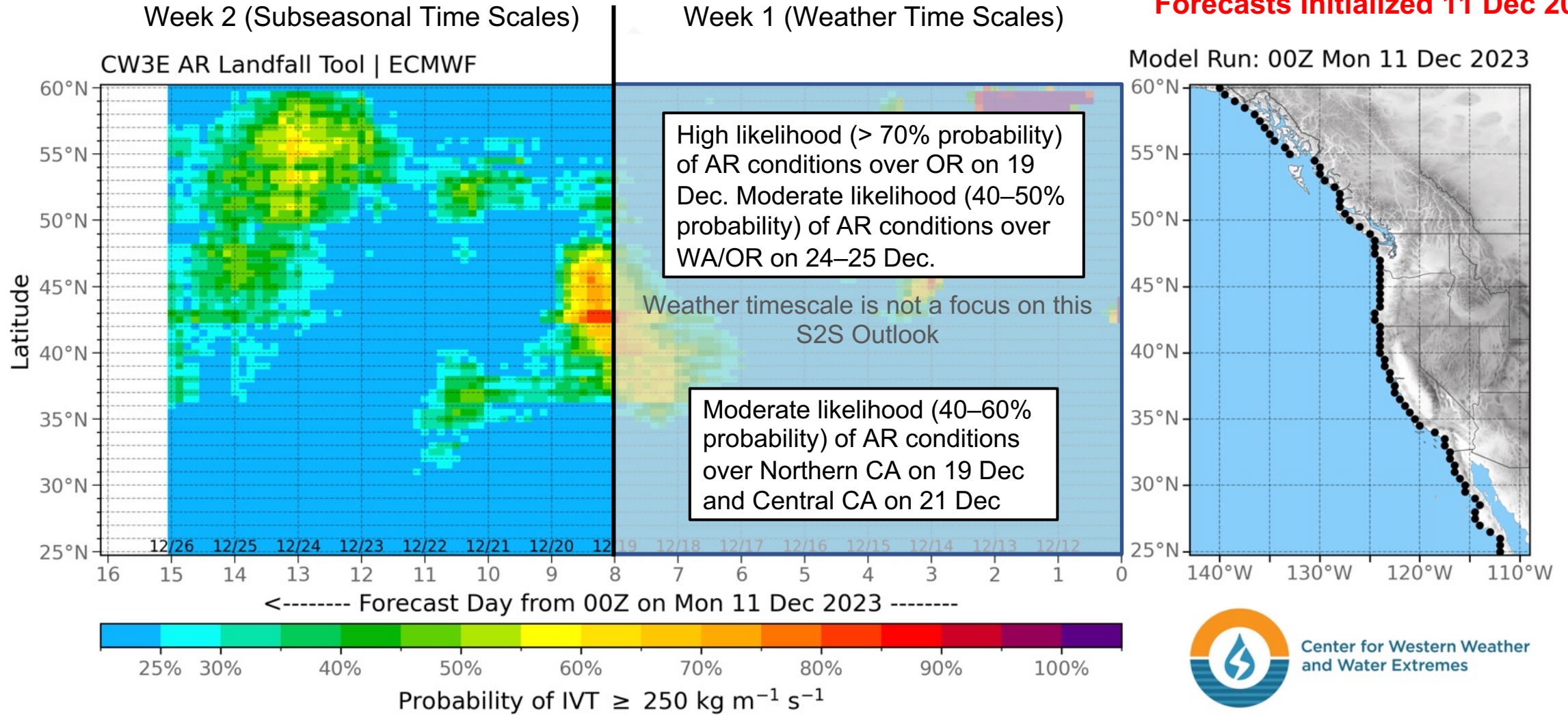


Forecasts support FIRO/CA-AR Program and NSF #2052972 | Intended for research purposes only

- NCEP is forecasting low likelihood of AR conditions over CA during Week 2

EPS Minus GEFS AR Landfall Tool: Valid 00Z 11 Dec – 00Z 26 Dec

Forecasts Initialized 11 Dec 2023

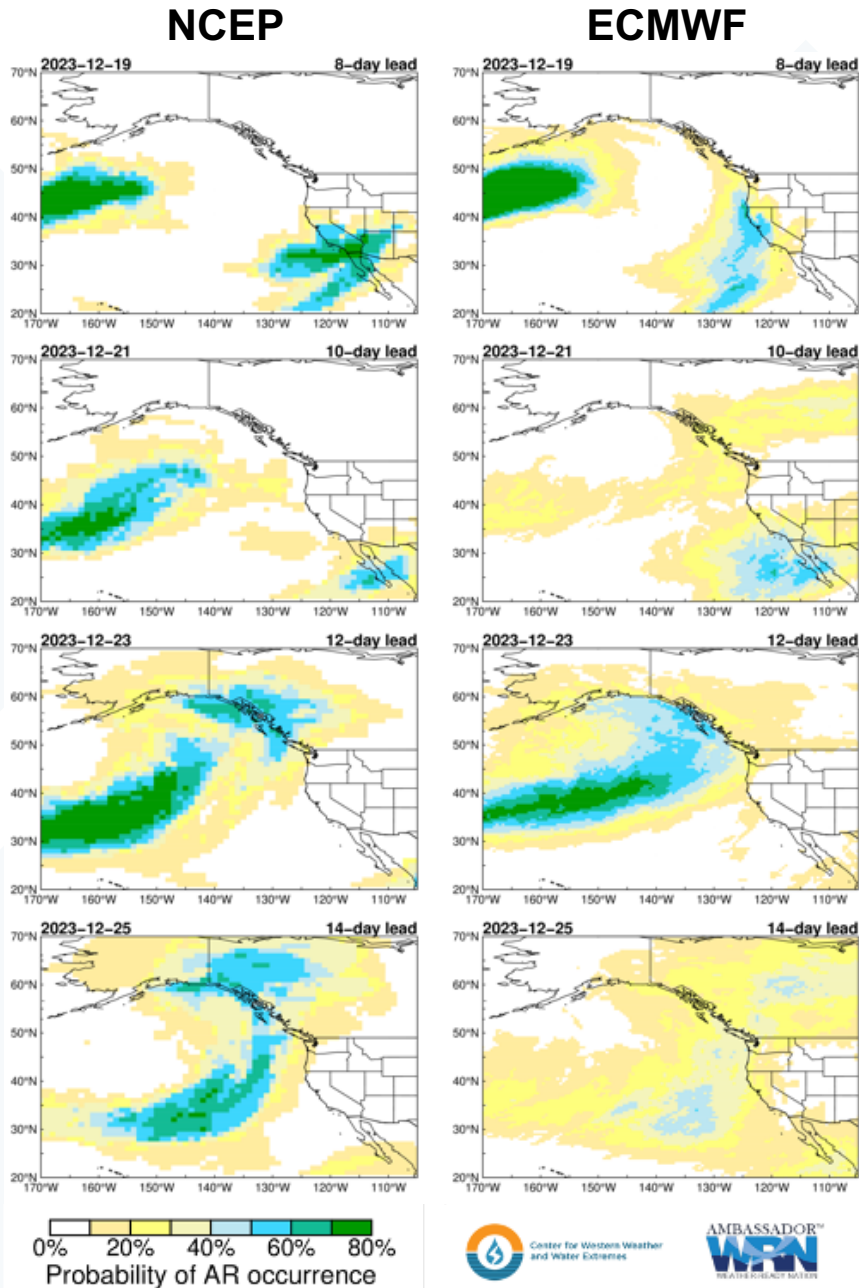


Forecasts support FIRO/CA-AR Program and NSF #2052972 | Intended for research purposes only

- Compared to NCEP, ECMWF is forecasting higher likelihood of AR conditions over Northern CA on 19 Dec and Central CA on 21 Dec

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

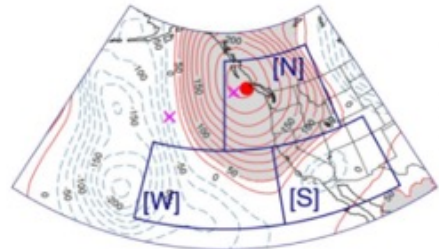
Forecasts Initialized 11 Dec 2023



- NCEP is showing high likelihood (> 70% probability) of AR activity over Southern CA, moderate likelihood (50–60% probability) over Central CA, and low likelihood of AR activity (< 40% probability) over Northern CA on 19 Dec
- Compared to NCEP, ECMWF is showing higher likelihood of AR activity over Northern CA and lower likelihood of AR activity over Southern CA on 19 Dec
- ECMWF is also showing higher likelihood of AR activity over Central and Southern CA on 21 Dec

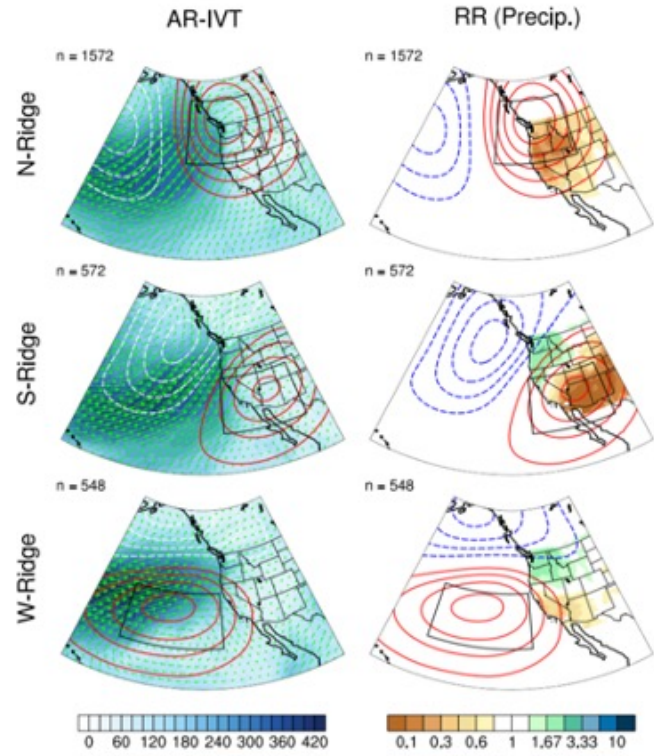
Some model disagreement on AR activity over CA during Week 2

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



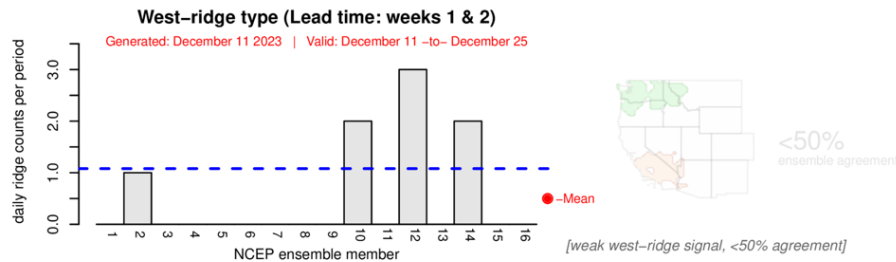
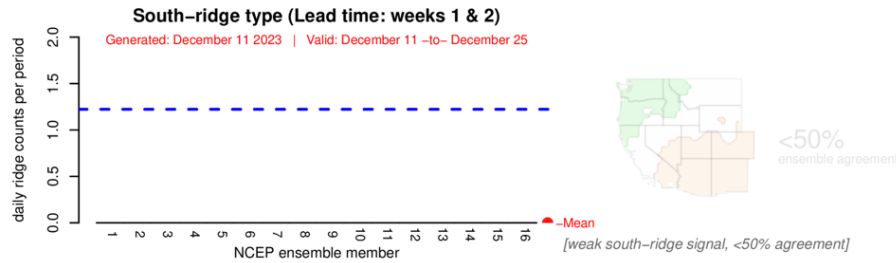
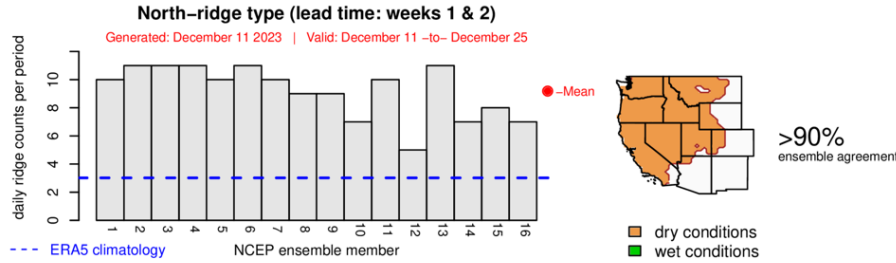
Contact: pgibson@ucsd.edu
Reference: Gibson et al. (2020)
Journal of Climate

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

Forecasts Initialized 11 Dec 2023

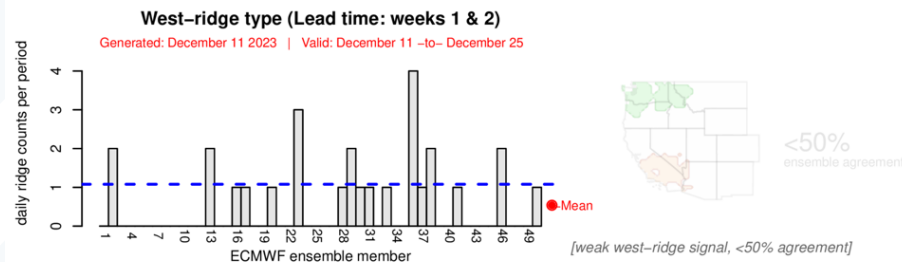
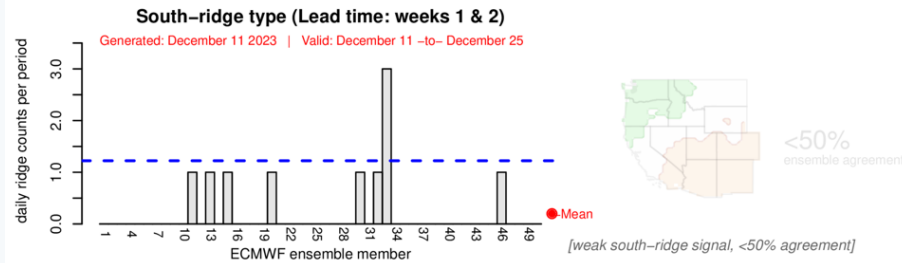
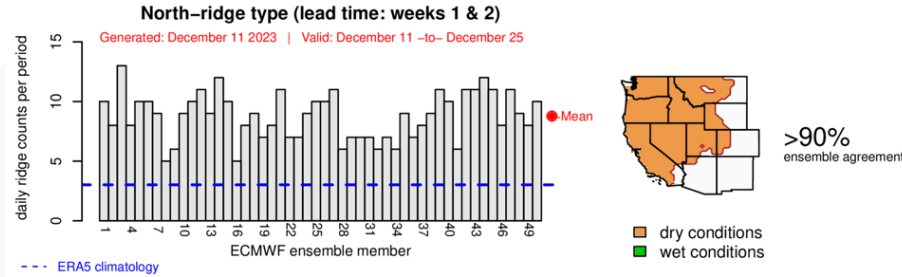
NCEP

CW3E Subseasonal Ridging Forecast (Uses NCEP CFSv2 model)



ECMWF

CW3E Subseasonal Ridging Forecast (Uses ECMWF model)

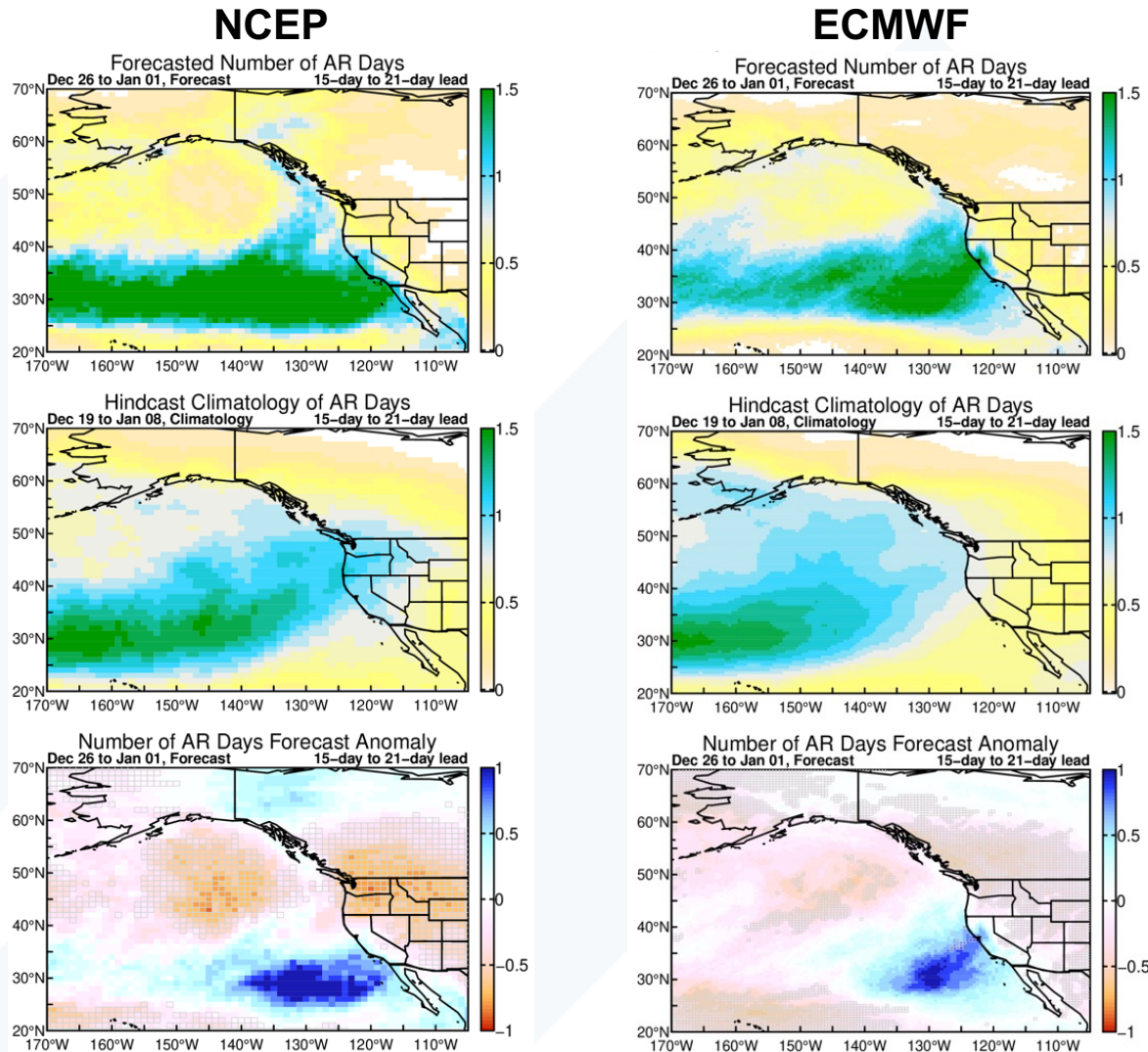


- Both NCEP and ECMWF are predicting very persistent North-ridge activity with high confidence (> 90% ensemble agreement) during Weeks 1–2 (11–25 Dec)
- Both models are also predicting low occurrence of the South-ridge and West-ridge types

Models agree on persistent ridging activity over Pacific Northwest during Weeks 1–2

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

Forecasts Initialized 11 Dec 2023



- Both models are showing the potential for significantly above-normal AR activity off the CA coast during Week 3 (26 Dec – 1 Jan), but the models disagree on AR activity over Northern CA
- NCEP is predicting near-normal AR activity over CA, but ECMWF is predicting slightly above-normal AR activity in Northern CA (albeit with low confidence)
- Both models are also predicting below-normal AR activity in the Pacific Northwest with high confidence (> 75% ensemble agreement), but the anomaly signal is stronger in NCEP

NCEP and ECMWF generally agree on potential for AR activity near CA coast during Week 3; ECMWF predicting more AR activity in Northern CA

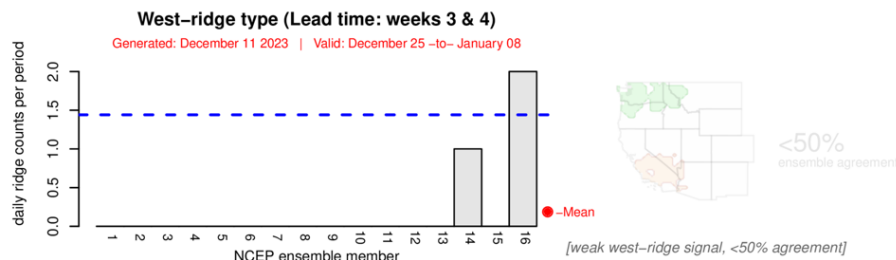
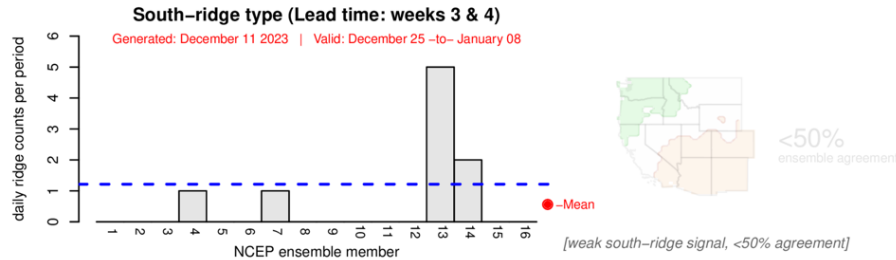
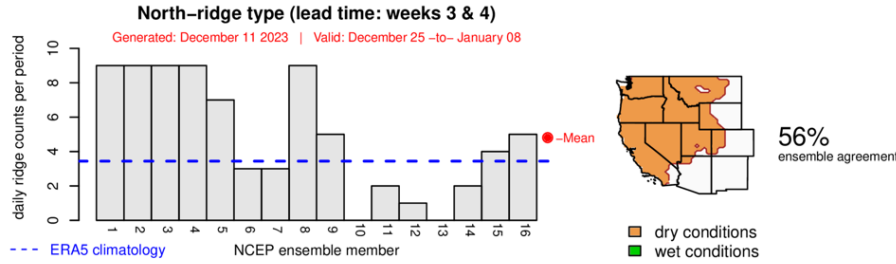
Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

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

Forecasts Initialized 11 Dec 2023

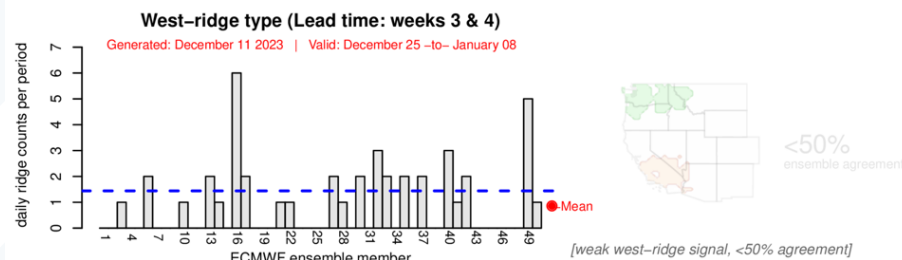
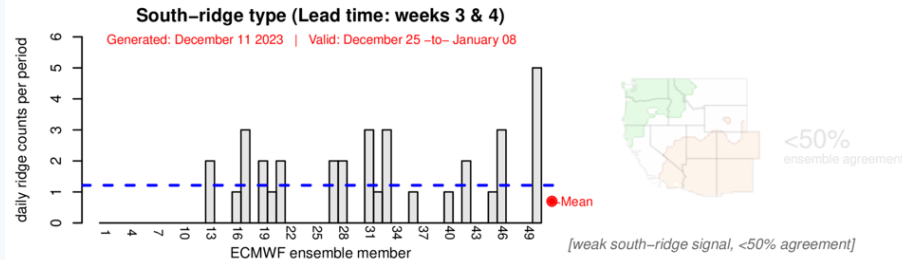
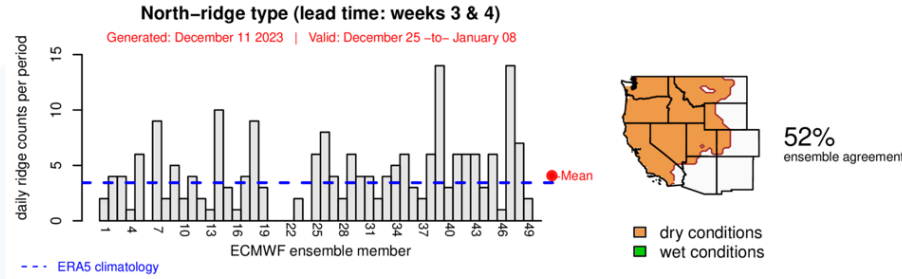
NCEP

CW3E Subseasonal Ridging Forecast (Uses NCEP CFSv2 model)



ECMWF

CW3E Subseasonal Ridging Forecast (Uses ECMWF model)



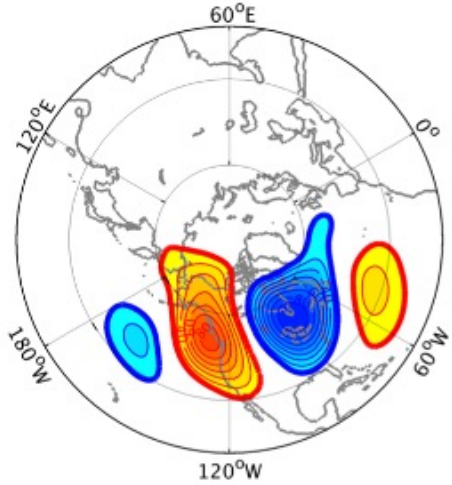
- Both NCEP and ECMWF are showing moderate likelihood (> 50% ensemble agreement) of above-normal North-ridge activity during Weeks 3–4 (25 Dec – 8 Jan)
- Both models are predicting low occurrence of the South-ridge and West-ridge types

Models show potential for persistent ridging activity over the Pacific Northwest during Weeks 3–4

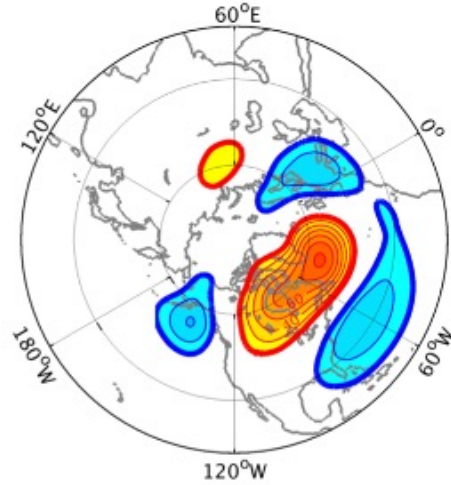


Background Info: IRI Subseasonal Weather Regime Forecasts

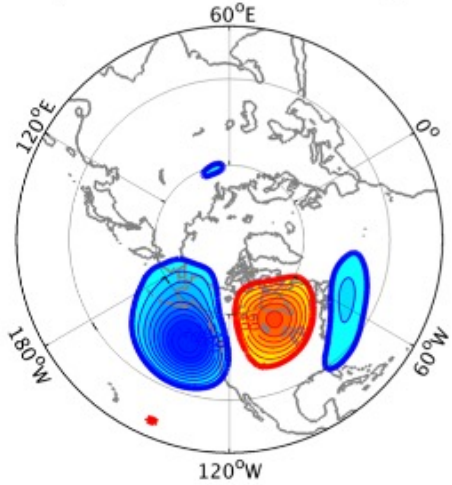
a) WR 1: West Coast Ridge



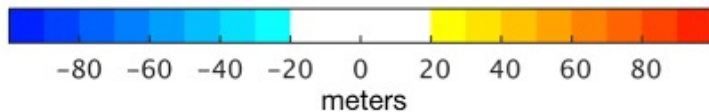
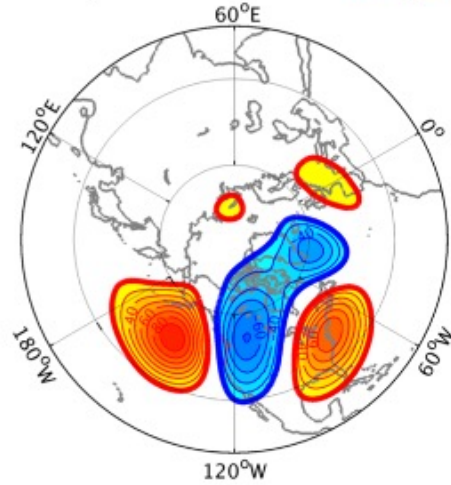
b) WR 2: Greenland High



c) WR 3: Pacific Trough



d) WR 4: Pacific Ridge



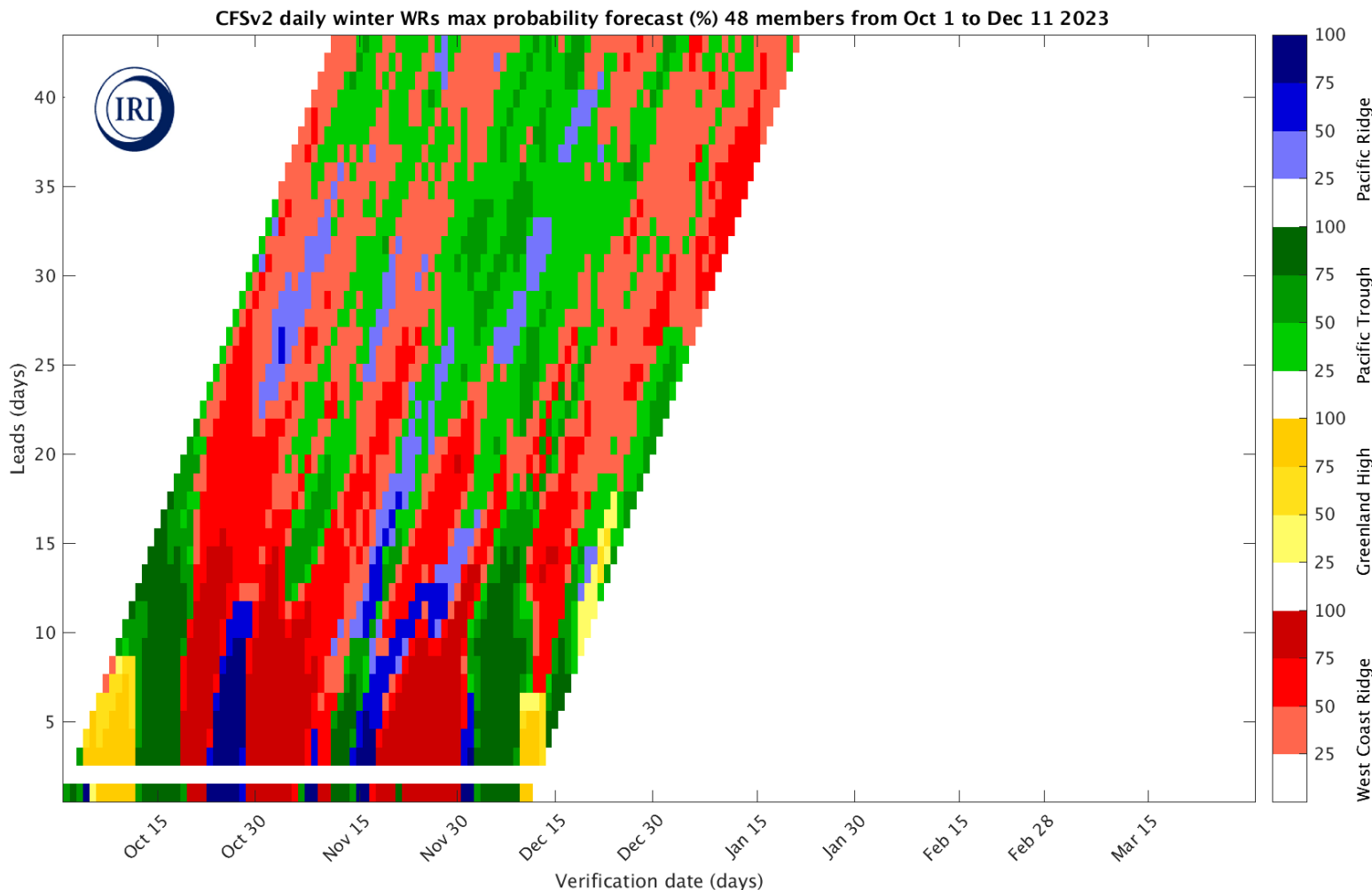
This slide contains background information about IRI's North American weather regime forecast product

- 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

Forecast Initialized 11 Dec 2023

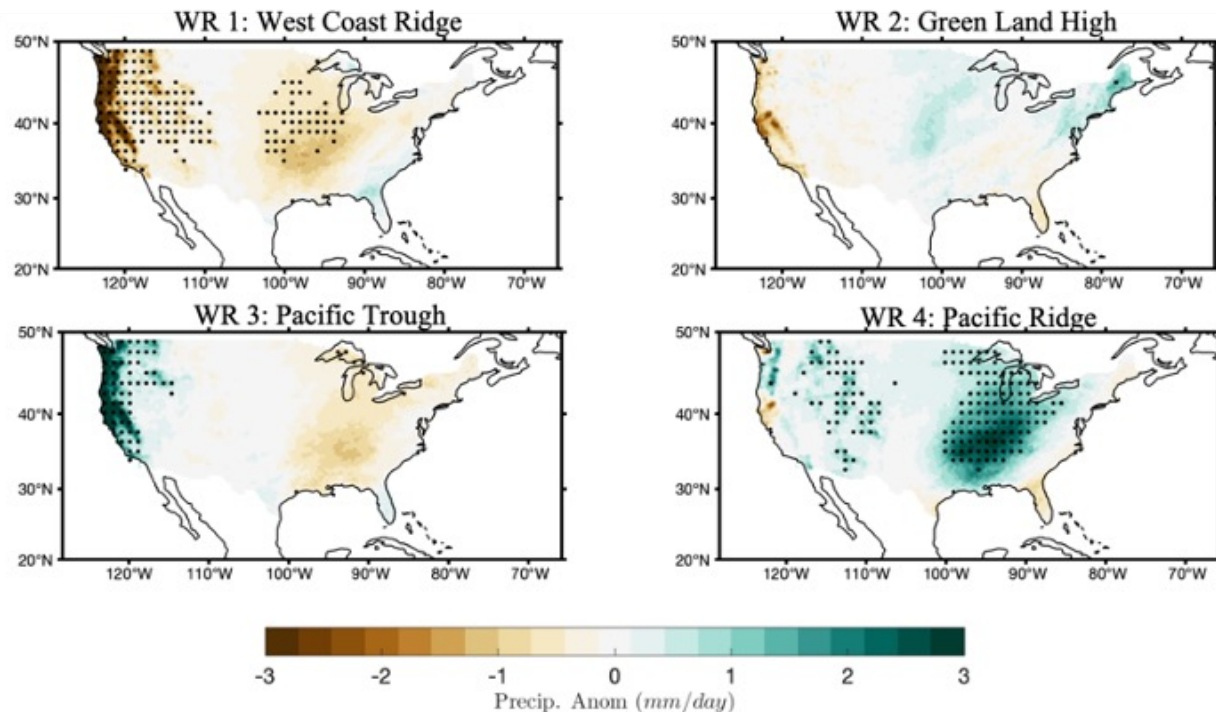


- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- High likelihood (> 75% ensemble agreement) of Pacific Trough developing during Week 1
- Low confidence (< 50% ensemble agreement) in brief transition to Greenland High during Week 2
- Moderate likelihood (50-75% ensemble agreement) of Pacific Trough during Weeks 3 and 4
- Moderate likelihood (50–75% ensemble agreement) of West Coast Ridge during Week 5

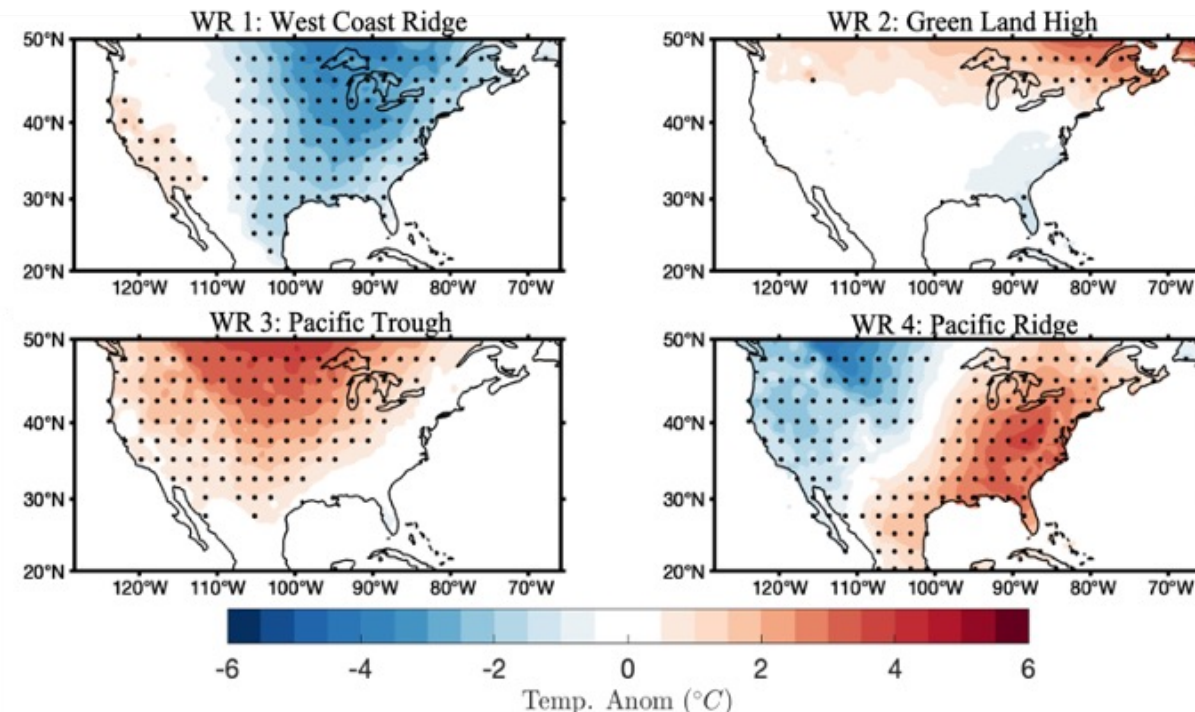
This graphic shows the which of the four North American weather regimes (different colors) is most likely to occur over the next 45 days. Darker (lighter) shading denotes higher (lower) probability of a particular regime. See the next slide for temperature/precipitation implications.

Subseasonal Outlooks: IRI North American Weather Regime Forecasts

Precipitation



Temperature



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

- Uncertainty in precipitation and temperature anomalies over CA next week
- Warm and wet conditions are predicted over CA during the last week of December and first week of January with moderate confidence
- Warm and dry conditions are predicted over CA during the 2nd week of January with moderate confidence