



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E Subseasonal Outlook: 3 November 2023

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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/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***

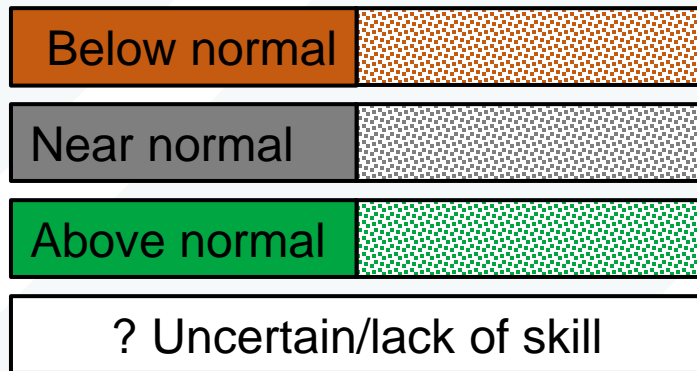
Summary: Subseasonal Precipitation Outlook by Model

This slide shows the CW3E synthesis of subseasonal products by model

Forecasts Initialized 2 Nov 2023

Region	Week 2 (10–16 Nov)				Week 3 (17–23 Nov)				Week 4 (24–30 Nov)		
	NCEP ^{1,2,3}	ECMWF ¹	ECMWF ^{1,2}	Multi-Model Forecast	NCEP ^{1,2,3}	ECMWF ¹	ECMWF ^{1,2}	Multi-Model Forecast	NCEP ^{2,3}	ECMWF ²	Multi-Model Forecast
WA/OR	Below normal	Near normal	Below normal	Below normal	Below normal	Below normal	Below normal	Below normal	Above normal	Below normal	Uncertain
Northern CA	Below normal	Near normal	Below normal	Below normal	Below normal	Below normal	Below normal	Below normal	Above normal	Below normal	Uncertain
Central CA	Below normal	Below normal	Below normal	Below normal	Below normal	Near normal	Below normal	Below normal	Above normal	Below normal	Uncertain
Southern CA	Below normal	Below normal	Below normal	Below normal	Below normal	Near normal	Below normal	Below normal	Above normal	Below normal	Uncertain

Higher Confidence | Lower Confidence



- Models agree on below-normal precipitation over Central and Southern CA during Week 2; less agreement over Northern CA
- Models agree on below-normal precipitation over Northern CA during Week 3; less agreement over Southern and Central CA
- Week 4 forecasts are uncertain

Subseasonal products included in this Outlook:

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

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

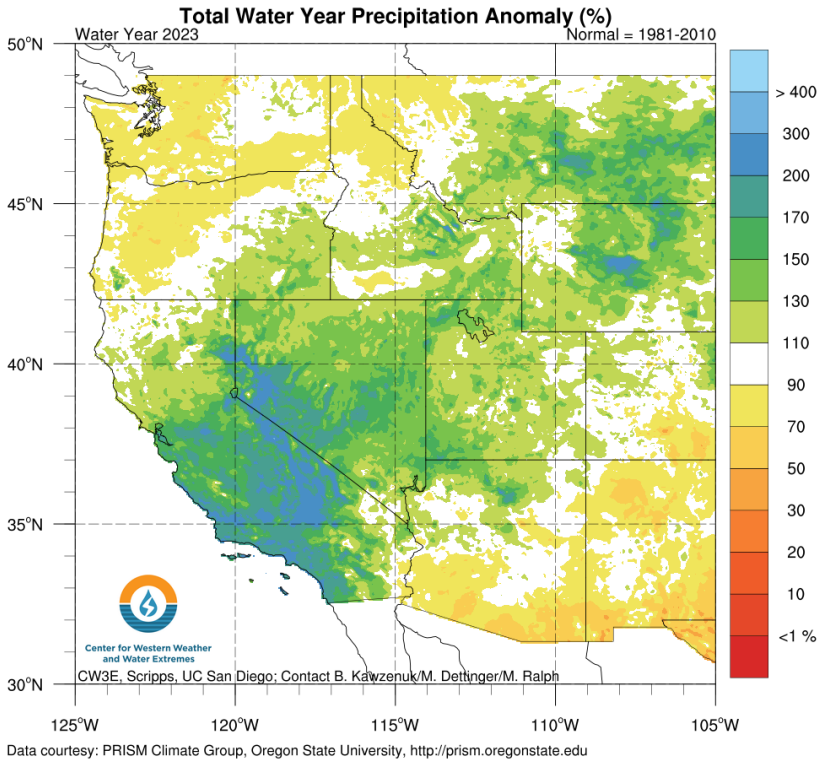
³IRI North American Weather Regime Forecasts ([Robertson et al. 2020](#))

Summary

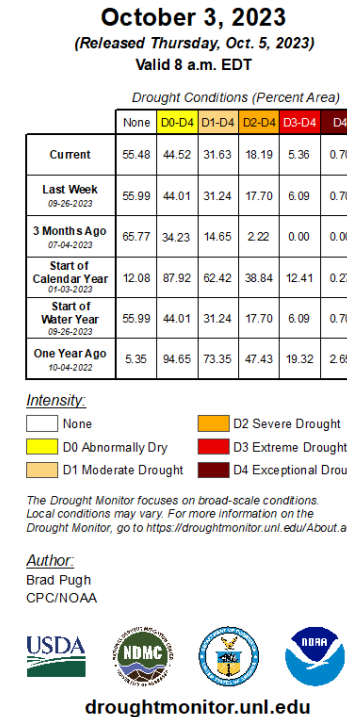
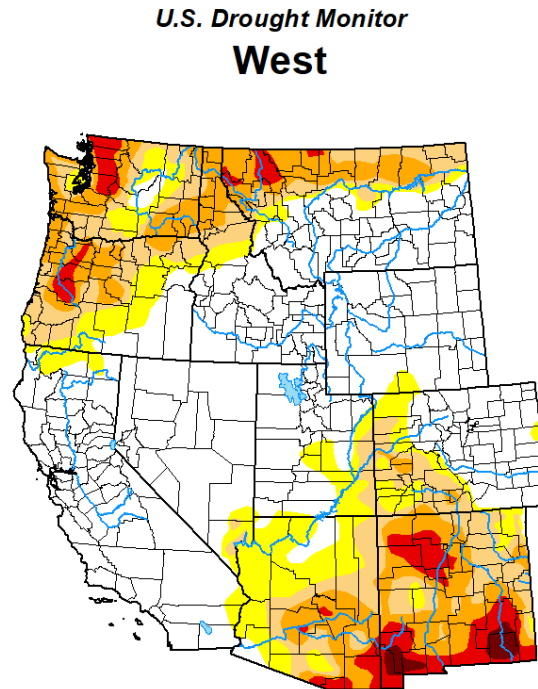
- **Week 2 forecasts (10–16 Nov):** Models agree on low likelihood of AR activity over Southern and Central CA, but disagree on likelihood of AR activity over Northern CA
 - NCEP and ECCO show higher likelihood of AR activity in Northern CA compared to ECMWF
- Models show potential for strengthening MJO activity over the Western Hemisphere (near the Date Line) during Week 2
 - Enhanced MJO convection in the Western Hemisphere during OND is associated with an increased likelihood of wet extremes in Central and Southern CA
- Ridging outlooks show low likelihood of persistent ridging activity near the US West Coast during Weeks 1–2, but IRI weather regime forecasts show moderate-to-high likelihood of a West Coast Ridge, which is typically associated with dry conditions in CA
- **Week 3 forecasts (17–23 Nov):** Models generally agree on below-normal AR activity over Northern CA, but there is some disagreement over Southern and Central CA
 - ECCO is forecasting more AR activity over Southern and Central CA compared to NCEP and ECMWF
 - ECMWF is showing strongest signal of below-normal AR activity over CA
- Models show potential for above-normal North Ridge activity during Weeks 3–4, but ECMWF is more confident than NCEP
 - North Ridge is associated with dry conditions over the entire US West Coast

End of WY 2023 Hydrologic Summary

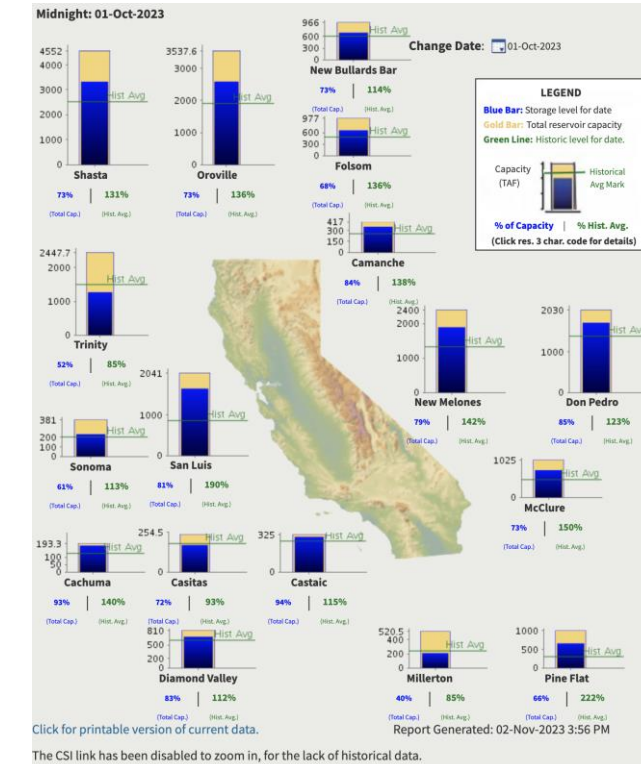
Precipitation



Drought Conditions



Reservoir Storage



Source: California DWR

- WY 2023 precipitation was well-above normal in Southern CA, Central CA, and Nevada, slightly above-normal in Northern CA, and below-normal in western OR and WA
- Nearly all of CA was drought-free at the beginning of WY 2024, but portions of the Pacific Northwest and interior Southwest were experiencing severe, extreme, or exceptional drought conditions
- As of 1 Oct, most large reservoirs in CA were operating at greater than 70% storage capacity and higher-than-normal storage

Looking Back: Week 3 AR Activity Forecasts

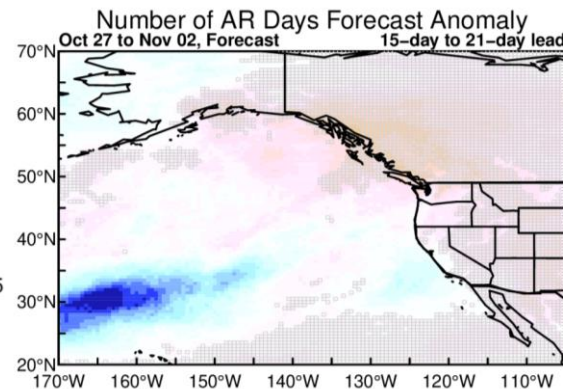
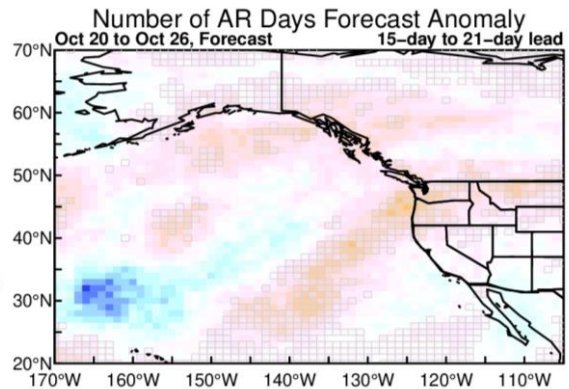
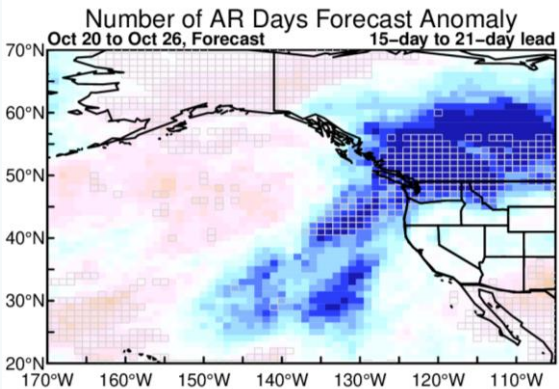
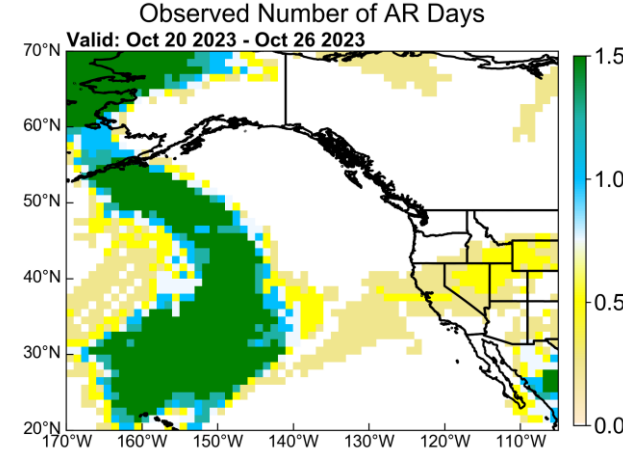
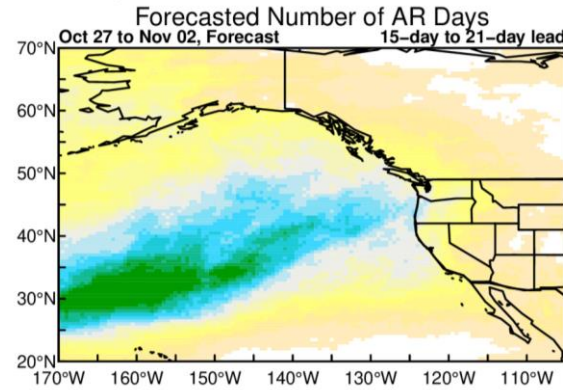
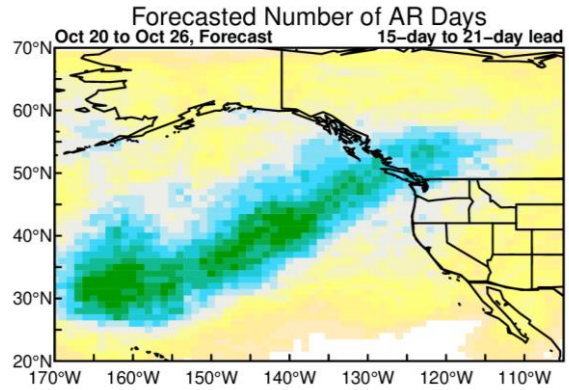
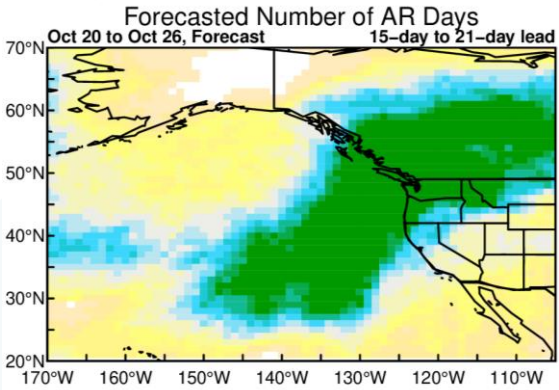
Forecasts Initialized 5 Oct 2023; Valid: 20–26 Oct 2023

NCEP

ECMWF

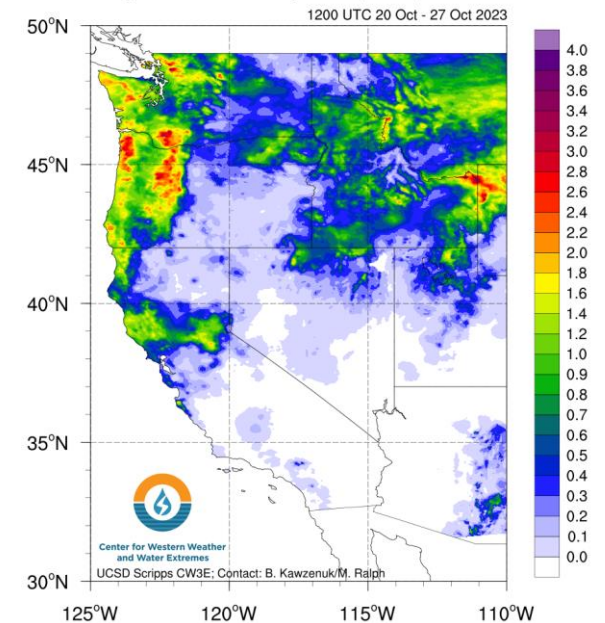
ECMWF

Observed (GFS Analysis)



Observed Precipitation

7-day Accumulated Precipitation (inches)



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

- All models correctly predicted little AR activity over Southern CA; NCEP predicted too much AR activity over Northern CA, WA/OR, and British Columbia
- Observed AR activity was primarily well offshore
- A weak low-pressure system brought light precipitation to Northern CA on 22 Oct
- A stronger low-pressure system brought 1–3 inches of precipitation to western OR and WA on 24–25 Oct

Looking Back: Week 3 AR Activity Forecasts

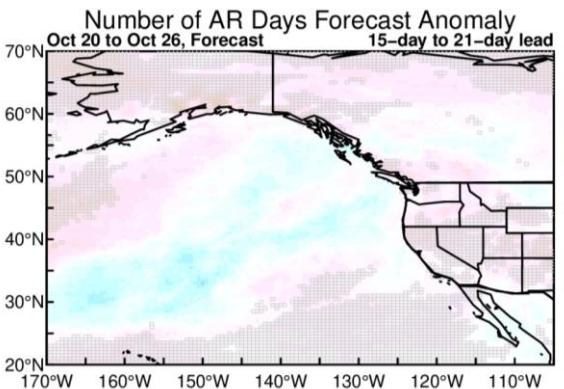
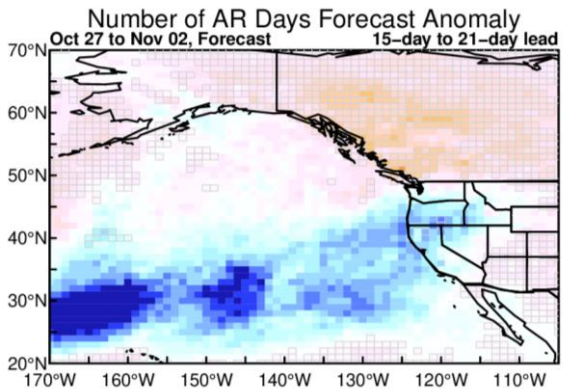
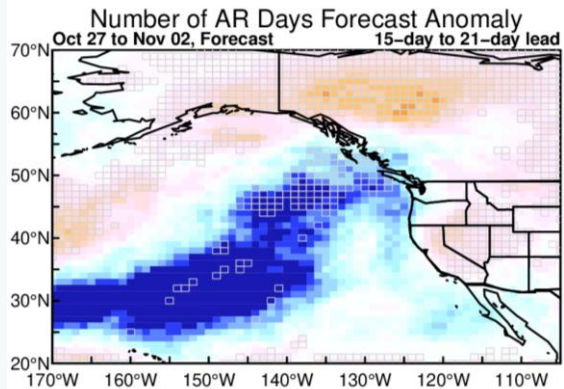
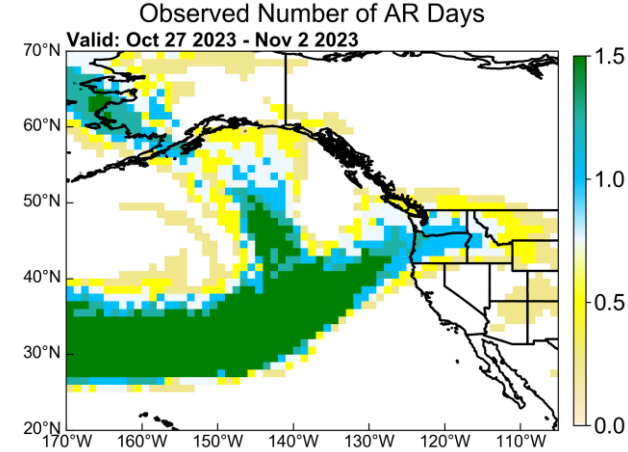
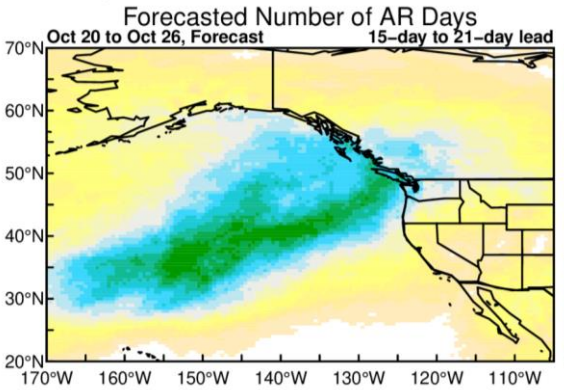
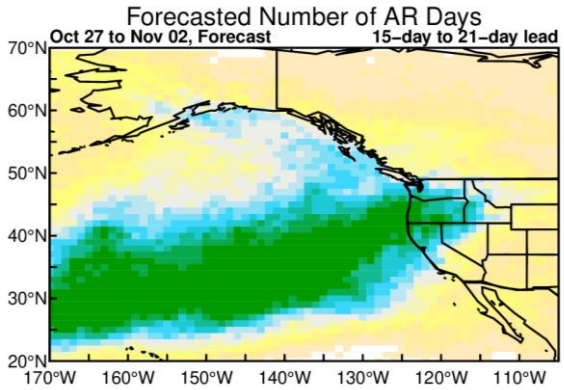
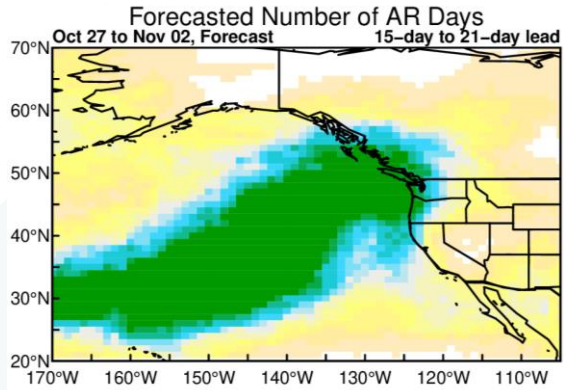
Forecasts Initialized 12 Oct 2023; Valid: 27 Oct – 2 Nov 2023

NCEP

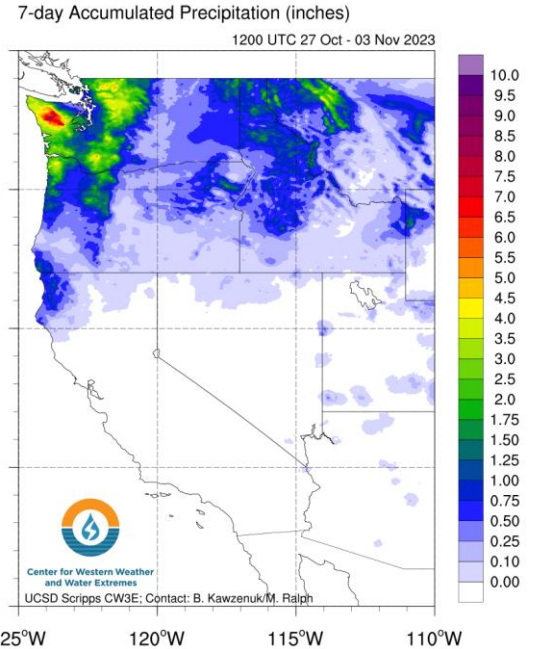
ECCC

ECMWF

Observed (GFS Analysis)



Observed Precipitation



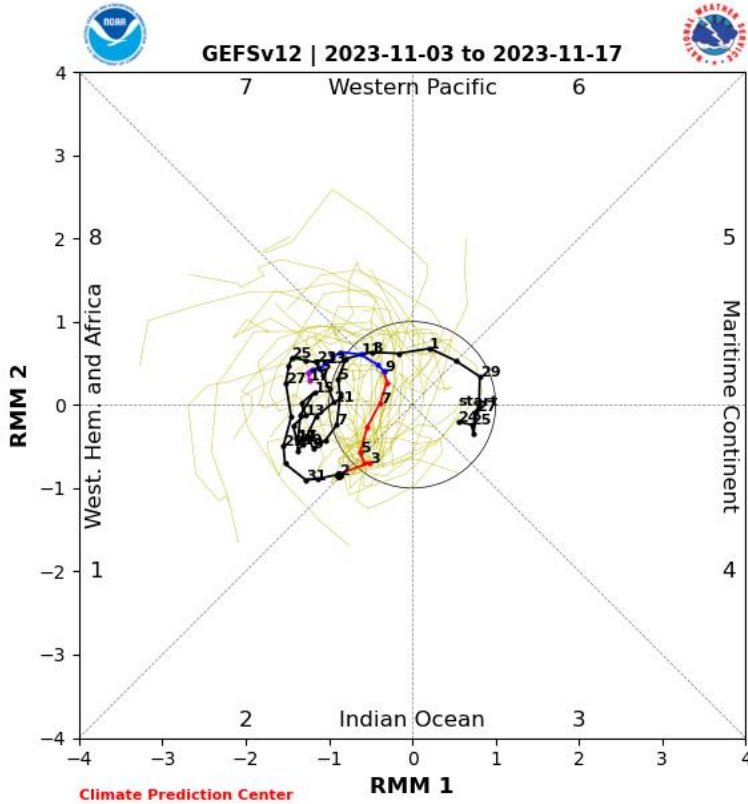
Shading: Fractional # of AR days over a 7-day period (top) and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

- All models correctly predicted AR activity extending from north of HI to the West Coast of North America
- ECMWF underestimated AR activity in WA/OR; ECCC overestimated AR activity in Northern CA
- A weak low-pressure system brought light precipitation to Northern CA on 22 Oct
- A strong AR produced > 4 inches of precipitation in the Olympic Mountains on 1–2 Nov

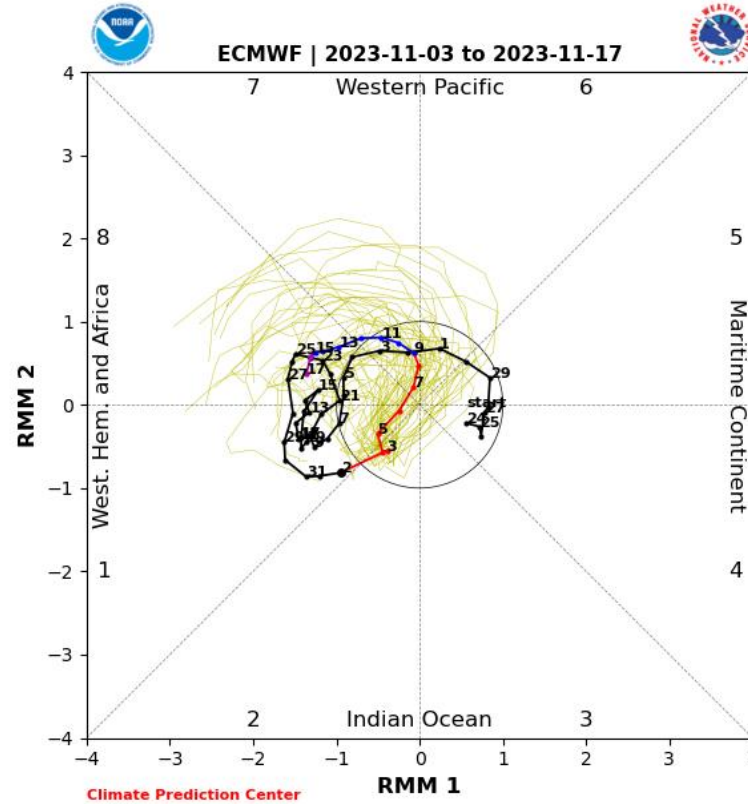


Dynamical Model MJO Forecasts (NCEP vs. ECMWF)

NCEP



ECMWF



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

b) Wet extreme_Frequency

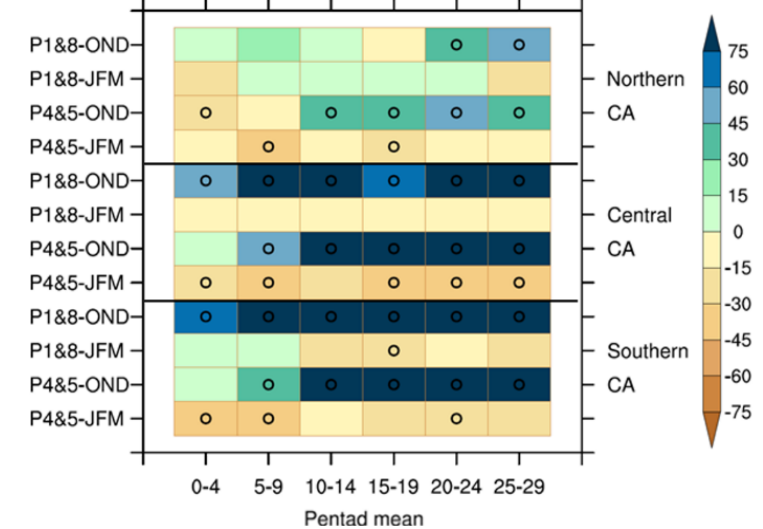
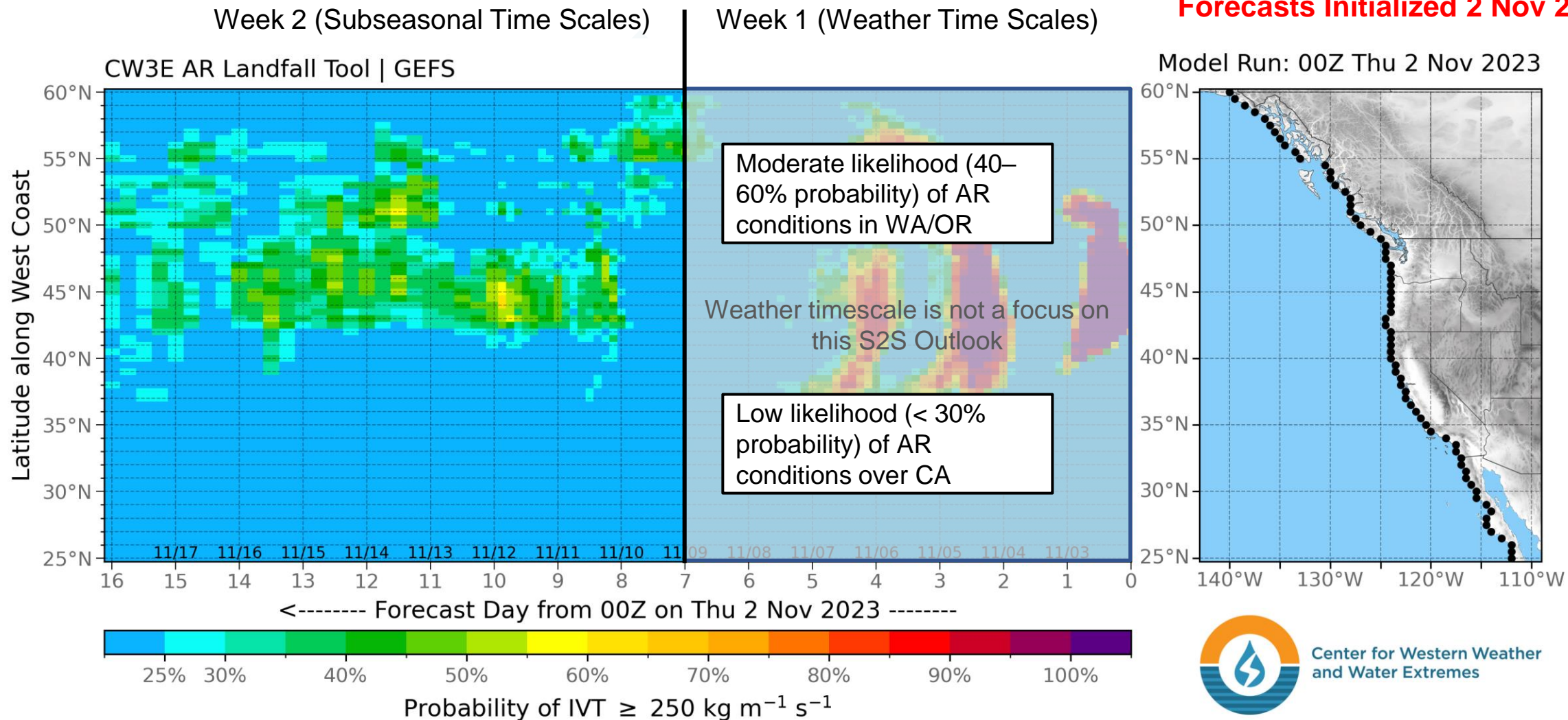


Figure S6 from Wang et al. (2023)

- Weak MJO activity is expected during Week 1
- NCEP and ECMWF are forecasting MJO activity to strengthen over the Western Hemisphere (RMM Phase 8) during Week 2, but there is considerable uncertainty
- MJO activity in the Western Hemisphere during OND is associated with an increased likelihood of wet extremes in Central and Southern CA at lag times of 1–4 weeks

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

Forecasts Initialized 2 Nov 2023

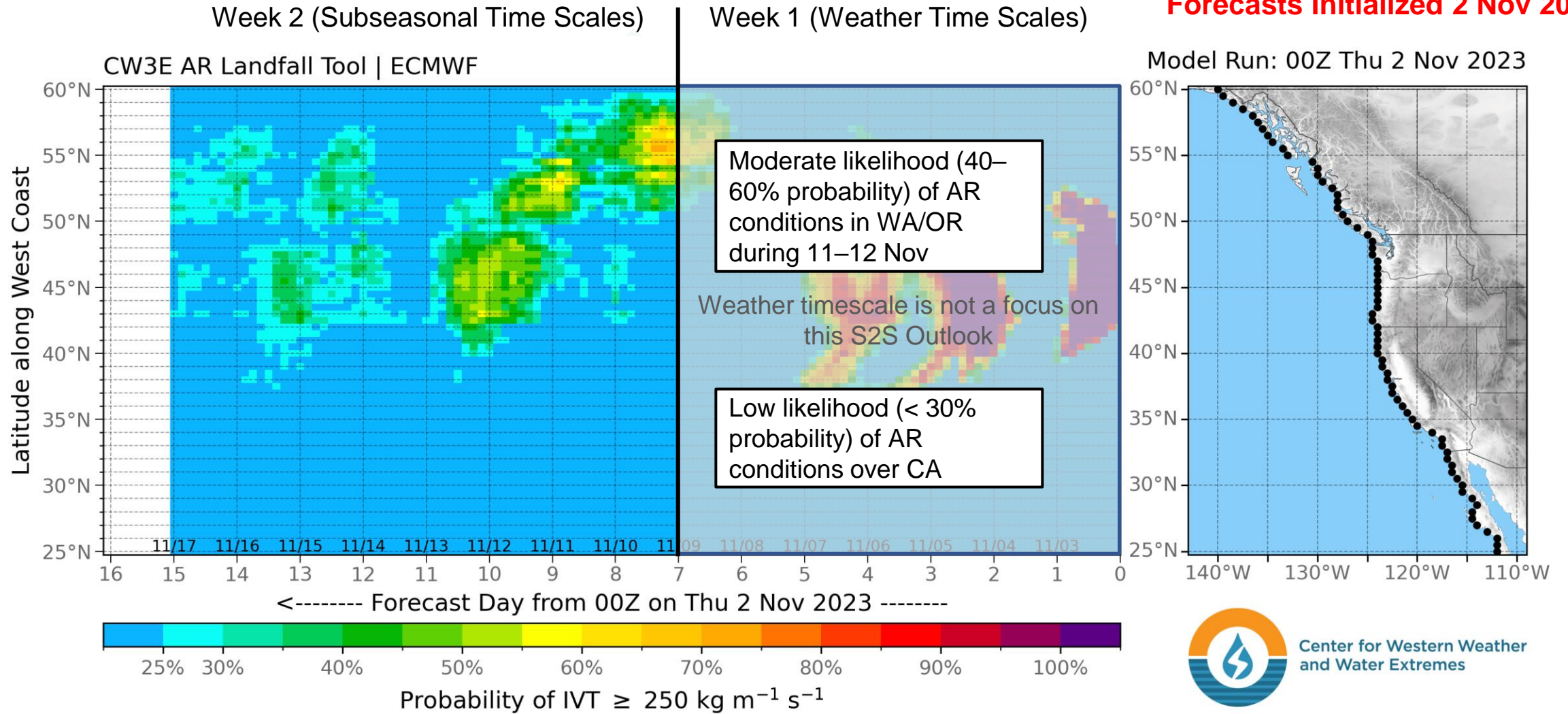


Forecasts support FIRO/CA-AR Program and NSF #2052972 | Intended for research purposes only

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

EPS Minus GEFS AR Landfall Tool: Valid 00Z 2 Nov – 00Z 17 Nov

Forecasts Initialized 2 Nov 2023



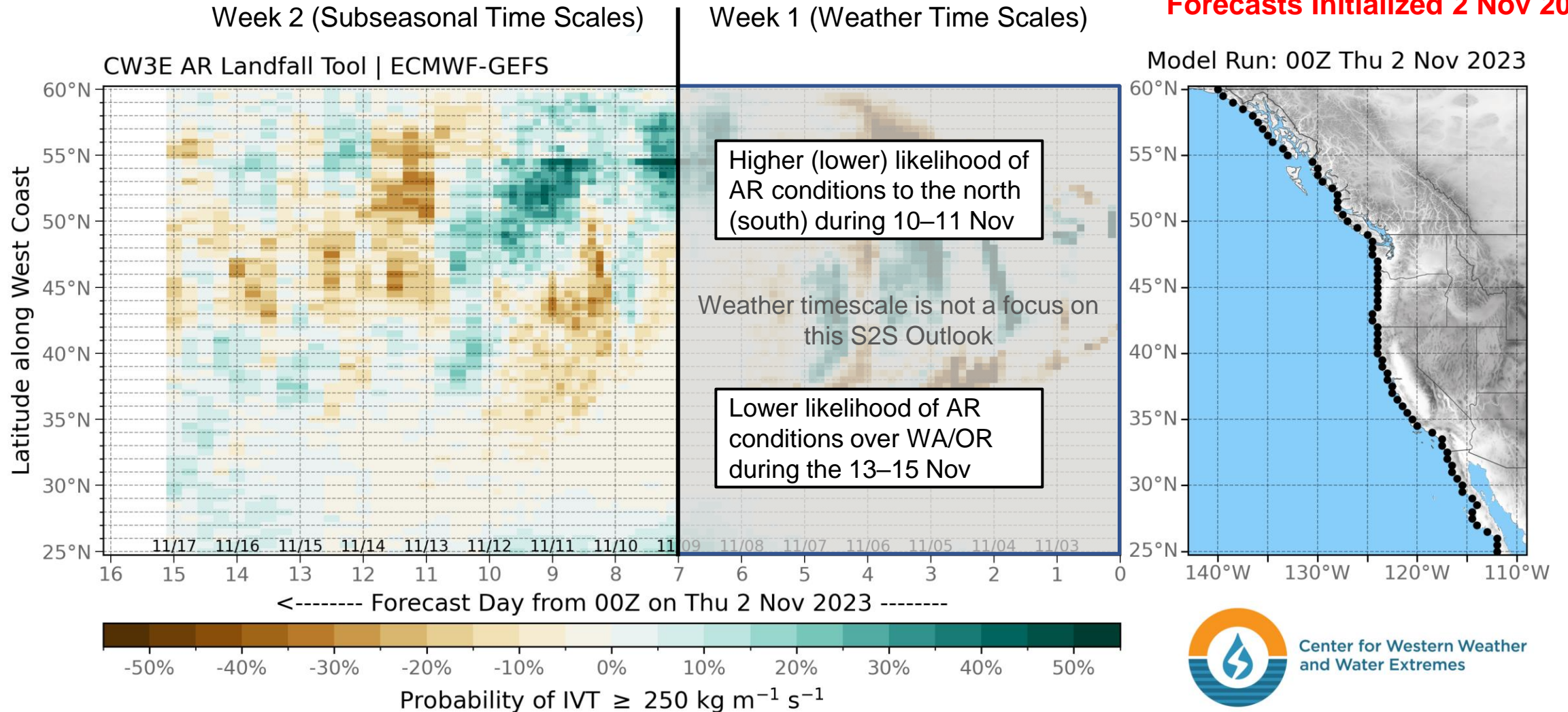
Forecasts support FIRO/CA-AR Program and NSF #2052972 | Intended for research purposes only



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

ECMWF EPS AR Landfall Tool: Valid 00Z 2 Nov – 00Z 17 Nov

Forecasts Initialized 2 Nov 2023

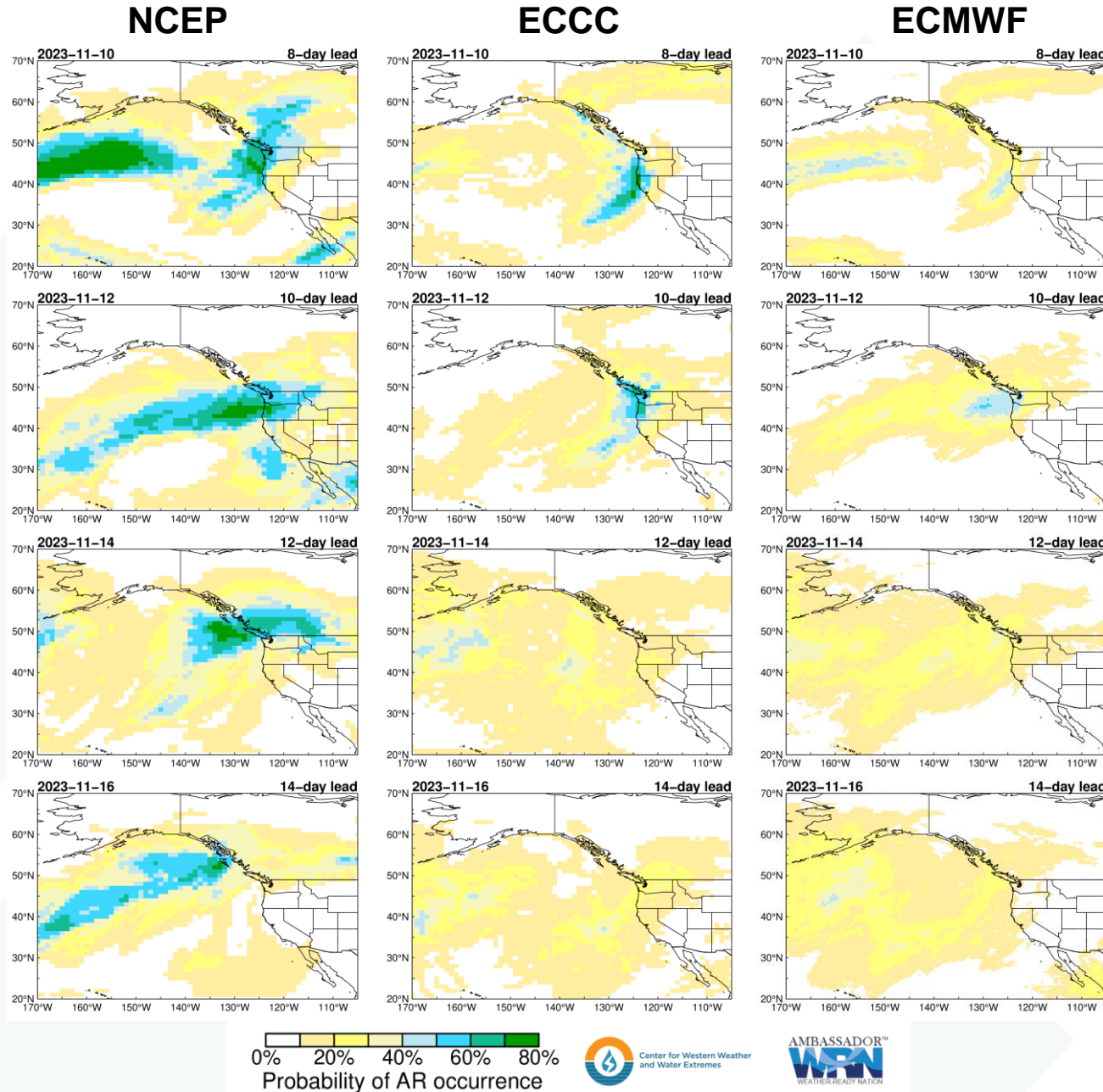


Forecasts support FIRO/CA-AR Program and NSF #2052972 | Intended for research purposes only

- Models differ on location of landfalling AR activity on 10–11 Nov, with ECMWF forecasting higher (lower) likelihood of AR conditions to farther north (south)
- Models generally agree on low likelihood of AR conditions over much of CA throughout Week 2

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

Forecasts Initialized 2 Nov 2023



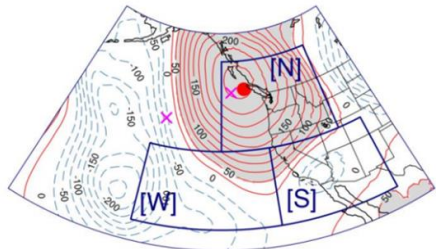
- ECMWF is showing very low likelihood (< 20%) of AR activity over CA during Week 2 (10–16 Nov)
- NCEP and ECCC are showing moderate likelihood (40–70%) of AR activity in WA/OR and Northern CA on 10 Nov and 12 Nov
- Similar to ECMWF, NCEP and ECCC are showing low likelihood (< 40%) of AR activity over Central and Southern CA

Some model disagreement on AR activity over Northern CA during Week 2; models agree on low likelihood of AR activity in Central and Southern CA

0% 20% 40% 60% 80%
Probability of AR occurrence

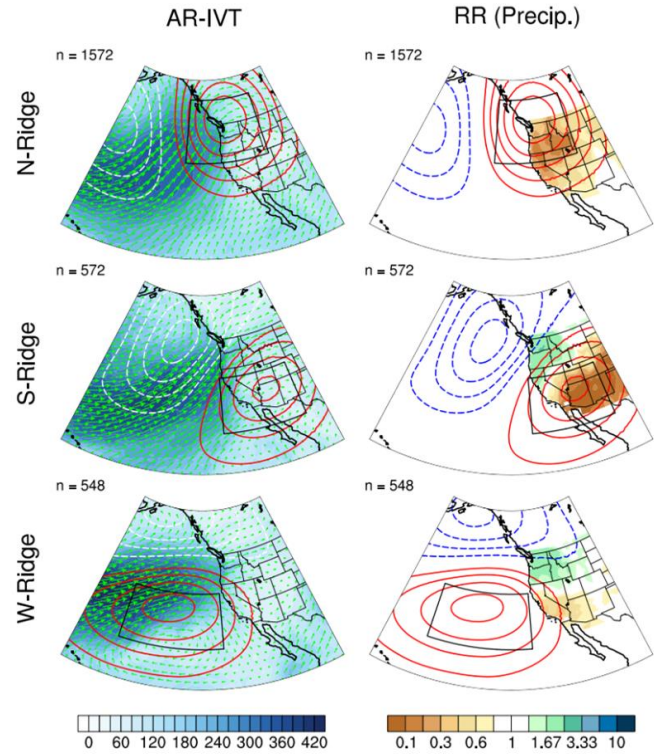


Background Info: Subseasonal Ridging Outlooks



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



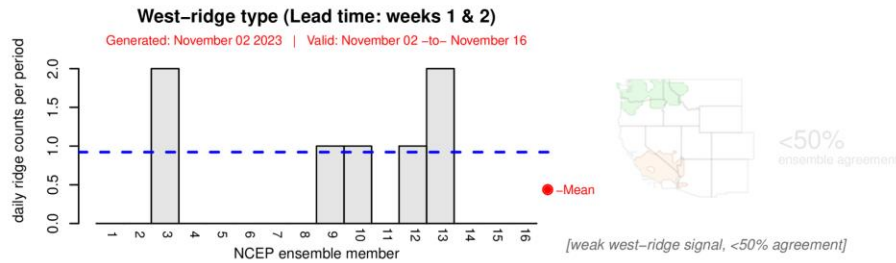
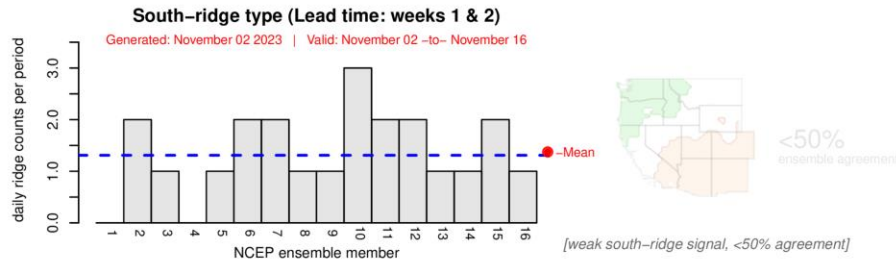
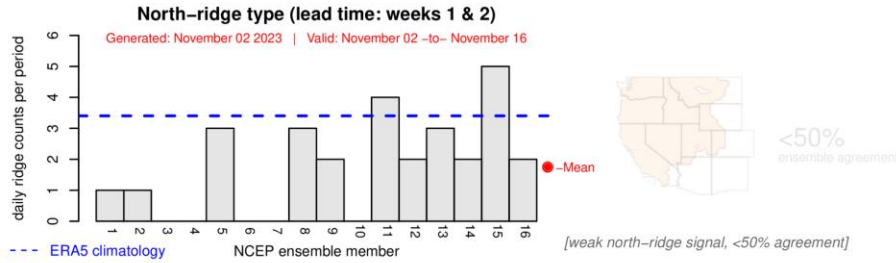
Contact: pgibson@ucsd.edu
 Reference: Gibson et al. (2020) Journal of Climate

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

Forecasts Initialized 2 Nov 2023

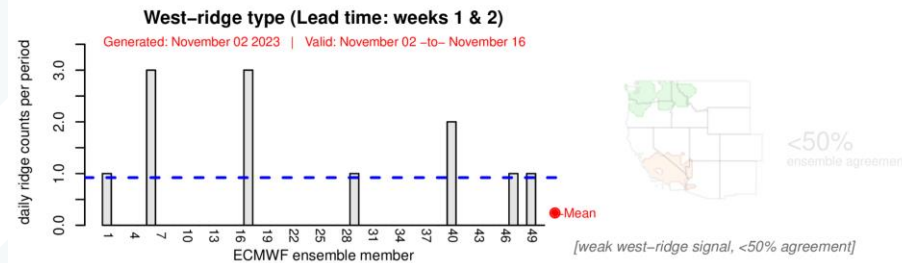
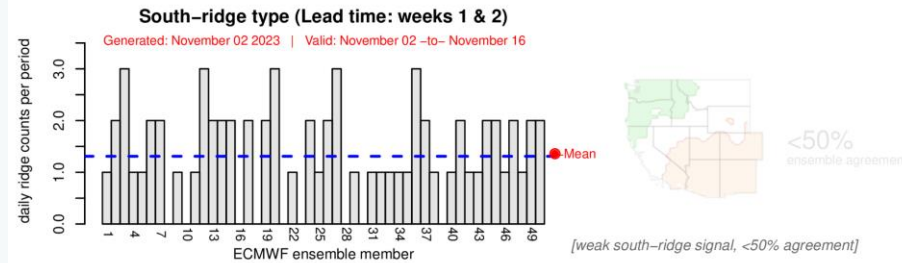
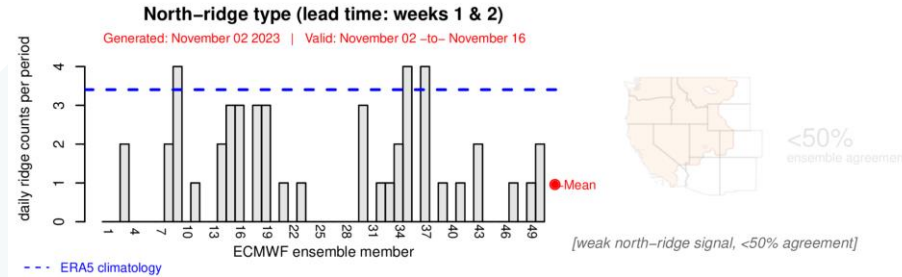
NCEP

CW3E Subseasonal Ridging Forecast (Uses NCEP CFSv2 model)



ECMWF

CW3E Subseasonal Ridging Forecast (Uses ECMWF model)



- Both NCEP and ECMWF are predicting low occurrence of the North- and West-ridge types during Weeks 1–2 (2–16 Nov)
- Both models are also predicting near-normal occurrence of the South-ridge type

Generally low likelihood of persistent ridging activity near the US West Coast during Weeks 1–2

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

Forecasts Initialized 2 Nov 2023

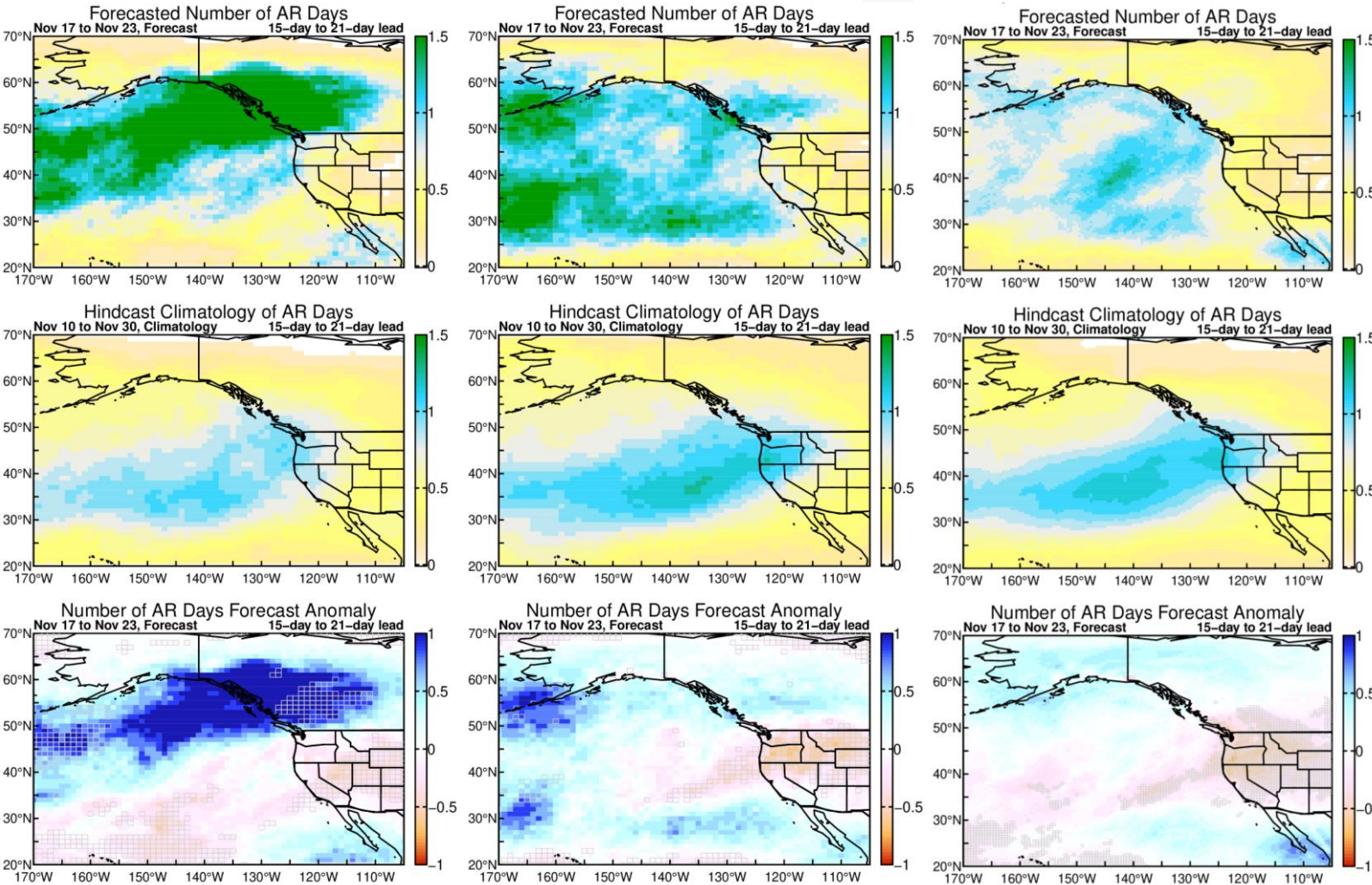
NCEP

ECCC

ECMWF

- NCEP is predicting below-normal AR activity in Southern and Central CA during Week 3 (17–23 Nov) with high confidence (> 75% ensemble agreement)
- ECCC is predicting below-normal AR activity in Northern CA with high confidence and near-normal AR activity in Southern and Central CA
- ECMWF is predicting below-normal AR activity in all of CA with high confidence

NCEP and ECMWF generally agree on predicted AR activity over CA during Week 3; ECCC is predicting more AR activity in Central and Southern CA



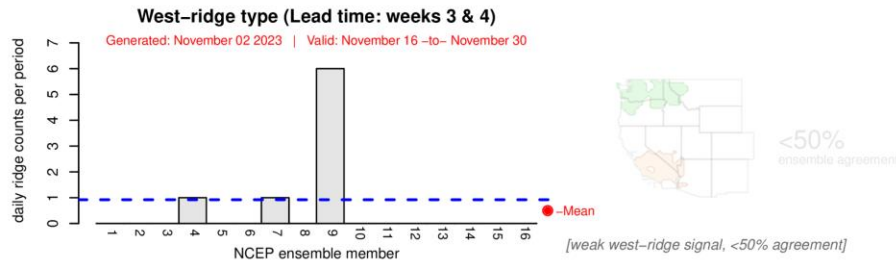
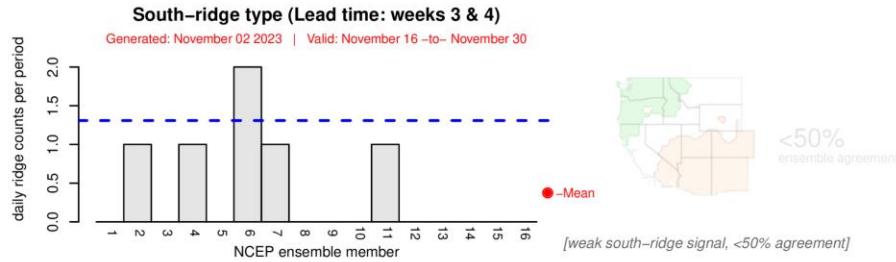
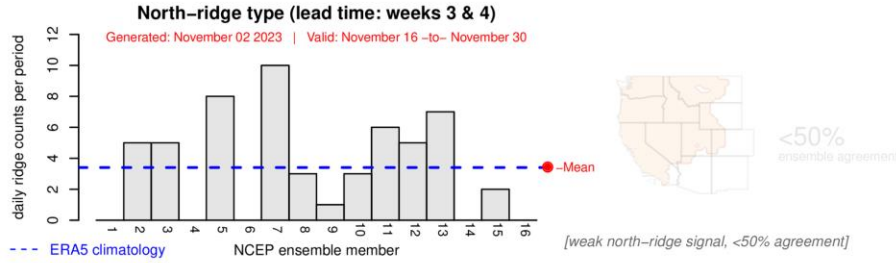
Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom)
 Grey cells: >75% of ensemble members agree on sign of anomaly

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

Forecasts Initialized 2 Nov 2023

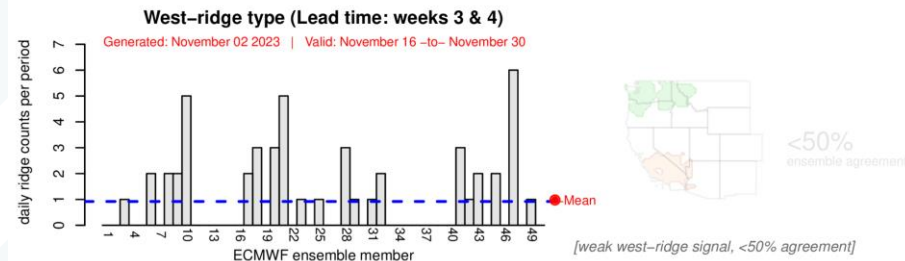
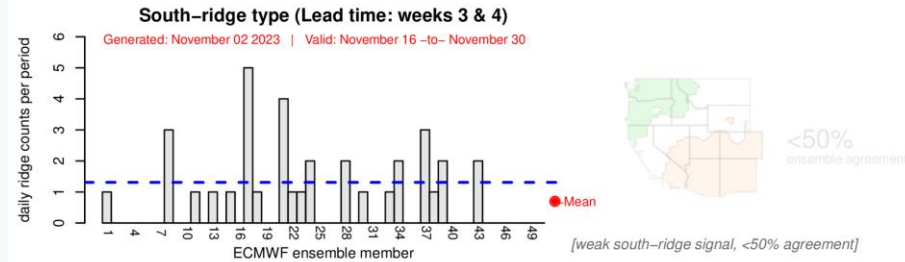
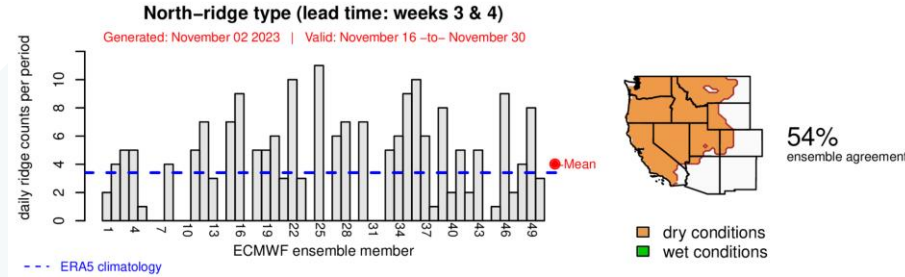
NCEP

CW3E Subseasonal Ridging Forecast (Uses NCEP CFSv2 model)



ECMWF

CW3E Subseasonal Ridging Forecast (Uses ECMWF model)

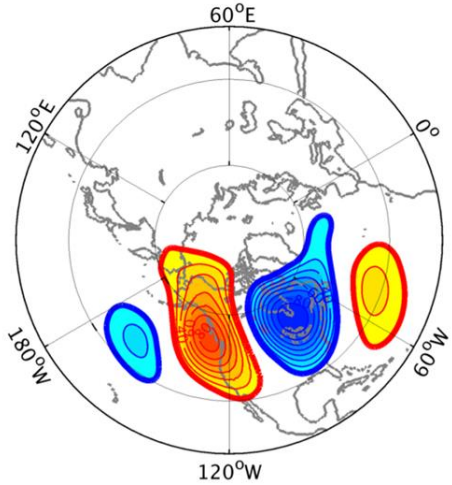


- NCEP is predicting near normal occurrence of the North-ridge type during Weeks 3–4 (16–30 Nov)
- ECMWF is showing moderate likelihood (> 50% ensemble agreement) in persistent North Ridge activity
- Both models are predicting low occurrence of the South-ridge type

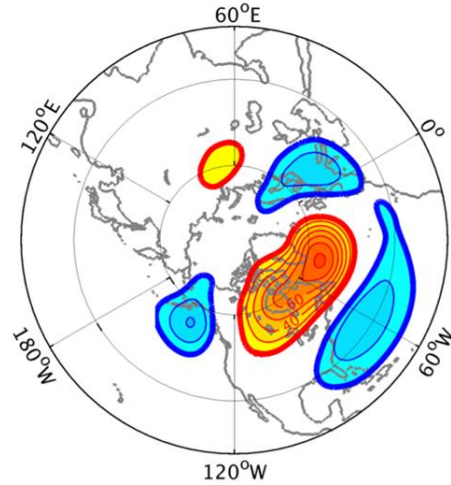
Models show some potential for above-normal ridging activity over US West Coast during Weeks 3–4, but ECMWF is more confident than NCEP

Background Info: IRI Subseasonal Weather Regime Forecasts

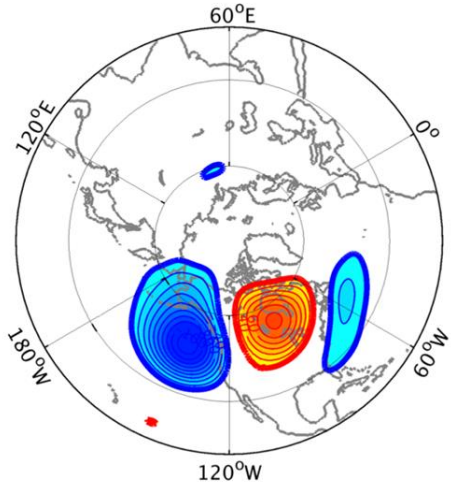
a) WR 1: West Coast Ridge



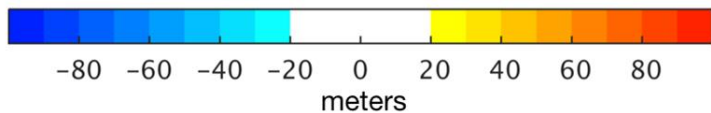
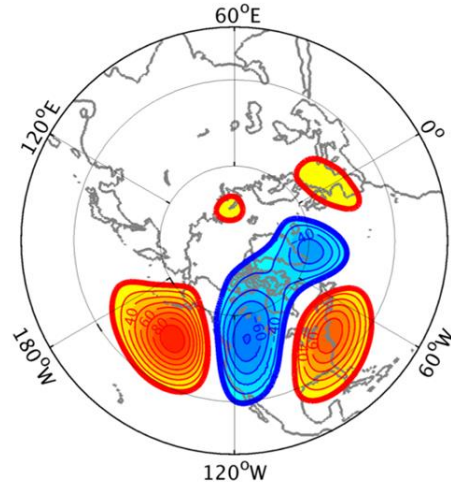
b) WR 2: Greenland High



c) WR 3: Pacific Trough



d) WR 4: Pacific Ridge



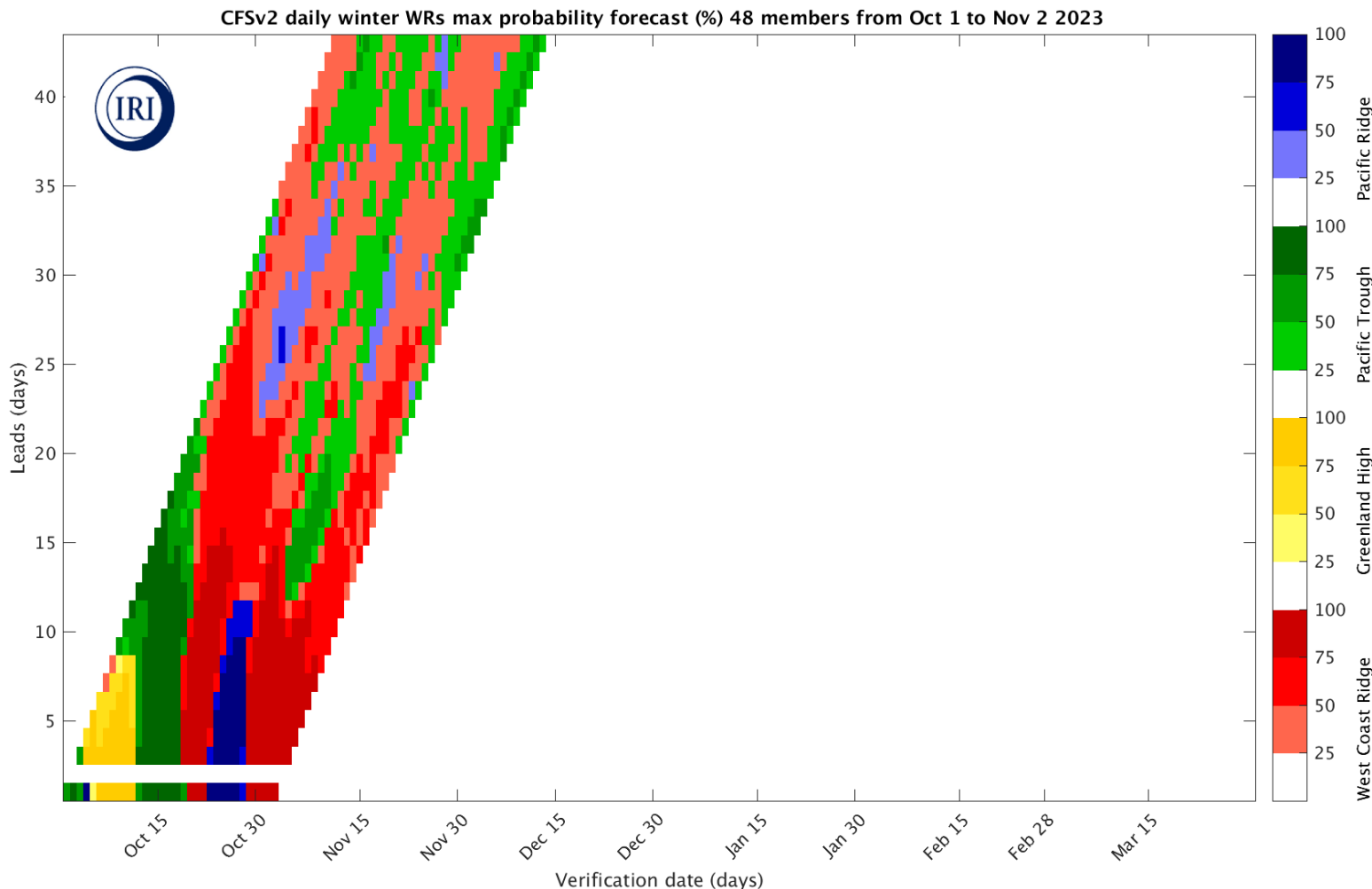
This slide contains background information about IRI's North American weather regime forecast product

- 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 2 Nov 2023

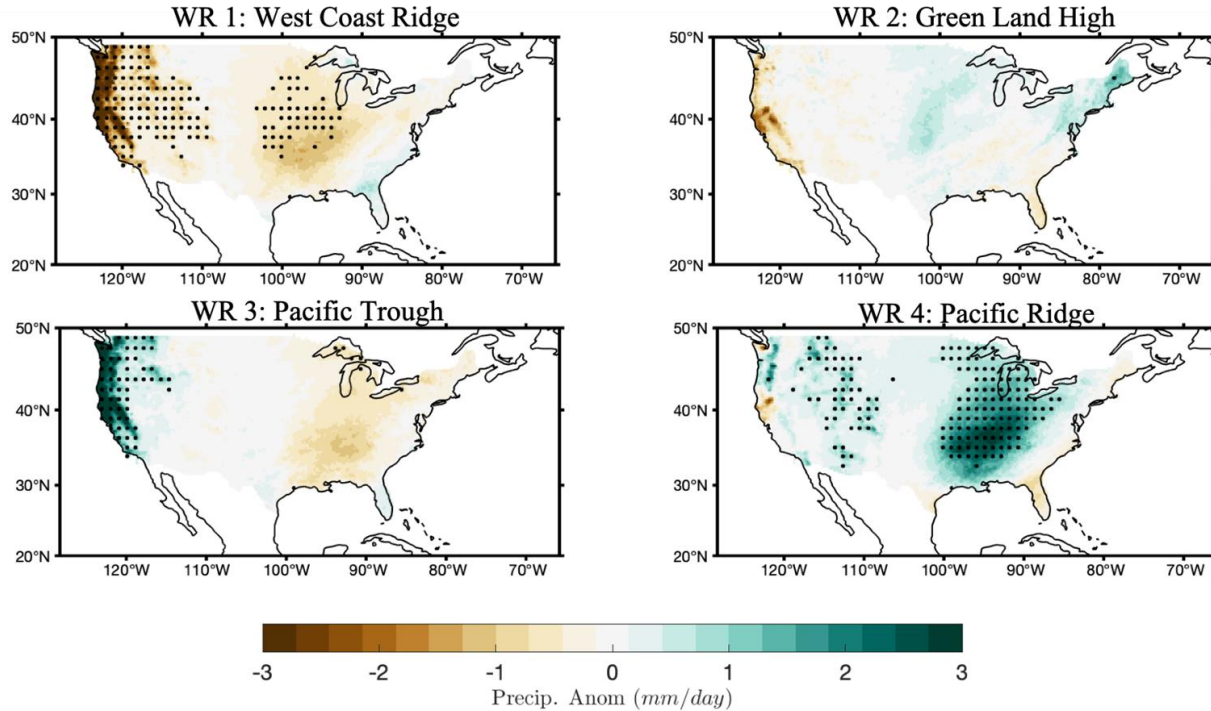


- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- Moderate-to-high likelihood (> 50% ensemble agreement) of West Coast Ridge during Week 2
- Low-to-moderate likelihood (25-75% ensemble agreement) of West Coast Ridge during Week 3
- Possible regime change in Week 4, but low confidence (< 50% ensemble agreement) in transition to Pacific Trough

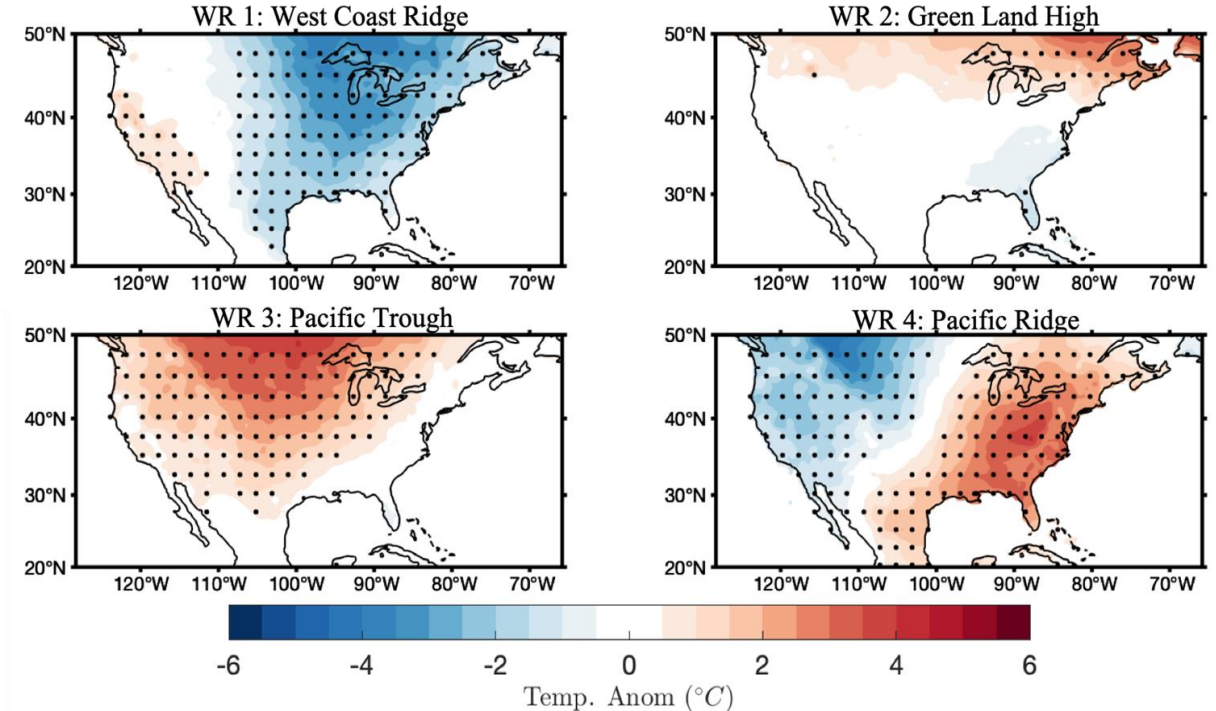
This graphic shows the which of the four North American weather regimes (different colors) is most likely to occur over the next 45 days. Darker (lighter) shading denotes higher (lower) probability of a particular regime. See the next slide for temperature/precipitation implications.

Subseasonal Outlooks: IRI North American Weather Regime Forecasts

Precipitation



Temperature



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

- Warm and dry conditions are predicted over CA in the first two weeks of November with moderate-to-high confidence
- Warm and dry conditions are predicted over CA in the 3rd week of November with low-to-moderate confidence
- Wet conditions are predicted over CA in late November with low confidence