



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E S2S Outlook: 2 Dec 2022

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UC San Diego



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CW3E S2S Forecasts: Glossary & Context

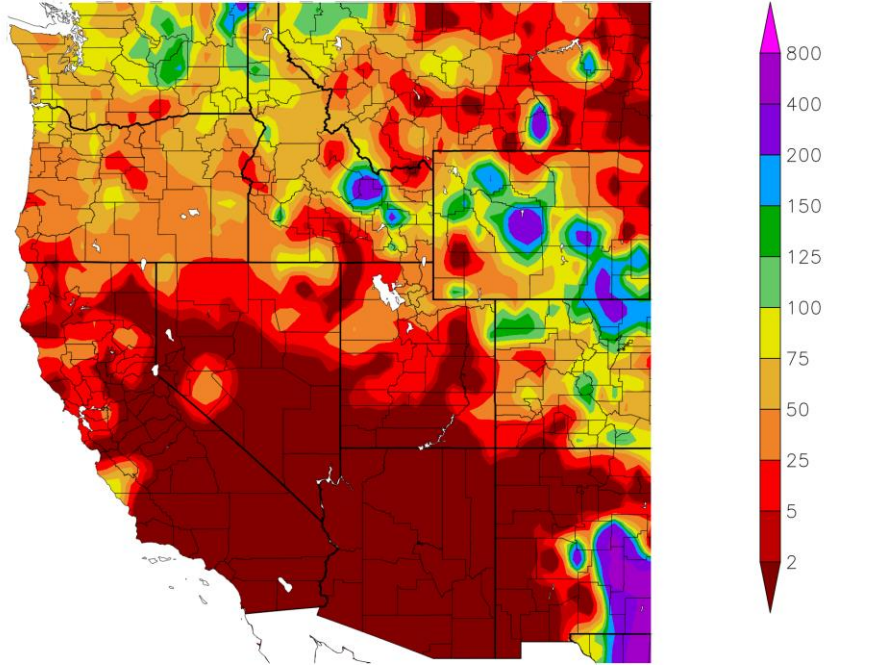
- The outlooks are based on CW3E subseasonal to seasonal forecast products that can be found here: https://cw3e.ucsd.edu/s2s_forecasts/
- CW3E subseasonal (2–6 weeks lead time) atmospheric river, ridging, and circulation regime products use three different global ensemble prediction systems to create these products:
 - NCEP GFS (US Model): Weeks 2–3
 - NCEP CFSv2 (US Model): Weeks 2–6
 - ECCC (Canadian Model): Weeks 2–3
 - ECMWF (European model): Weeks 2–6
- CW3E seasonal precipitation products are produced using statistical and machine learning models. The suite of models includes:
 - CCA (canonical correlation analysis) based statistical model
 - Machine learning model, which also includes comparison to NMME (North American Multi-Model Ensemble)

Summary

- **Week 2 forecasts (9–15 Dec):** Models agree on low likelihood of AR activity over California
 - NCEP is forecasting slightly higher probabilities (> 30%) of AR activity over Northern CA than ECCO and ECMWF
- **Week 3 forecasts (16–22 Dec):** Models agree on low amount of AR activity over California
 - NCEP is predicting slightly more AR activity over Northern CA and near the Southern CA coast than ECCO and ECMWF
- NCEP shows low confidence in the occurrence of persistent ridging activity near the US West Coast during Weeks 1–2
- NCEP shows a moderate likelihood of a West Coast Ridge during Weeks 3–4, which favors dry and warm conditions across California

Looking Back: Recent Precipitation and Drought Conditions

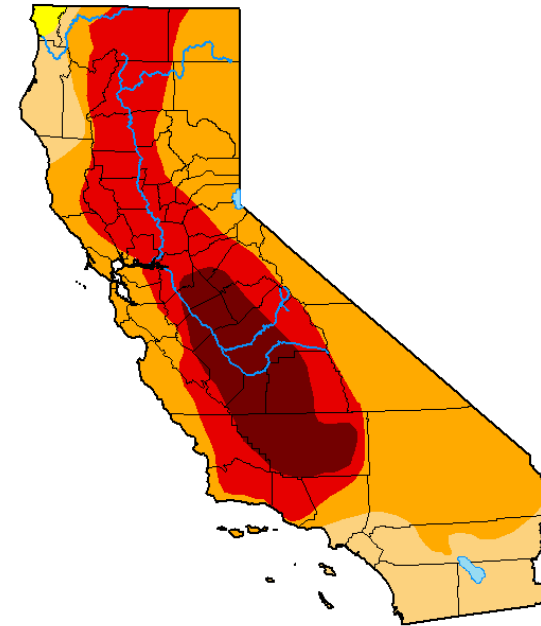
Percent of Normal Precipitation (%)
11/18/2022 – 12/1/2022



Generated 12/2/2022 at HPRCC using provisional data.

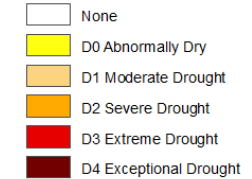
NOAA Regional Climate Centers

U.S. Drought Monitor California



November 29, 2022
(Released Thursday, Dec. 1, 2022)
Valid 7 a.m. EST

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

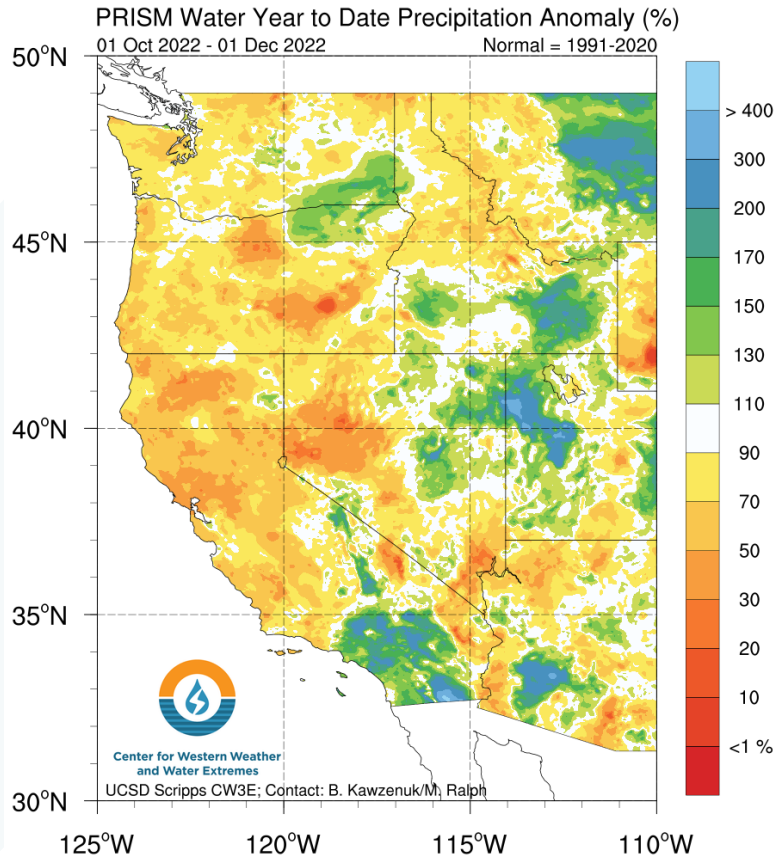


droughtmonitor.unl.edu

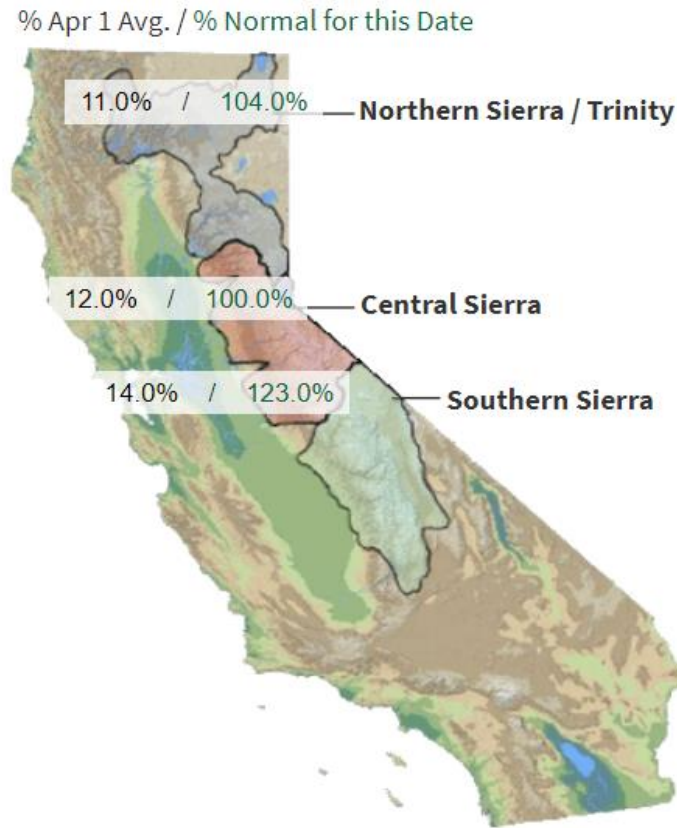
- Much of the southwestern US, especially California and Arizona, has experienced very dry conditions over the past two weeks
- Observed precipitation in California is consistent with a lack of landfalling AR activity, which was poorly predicted by the Week 3 forecasts initialized in early Nov
- As of 29 Nov, much of California remains in severe or extreme drought, with exceptional drought conditions over the San Joaquin Valley

Water Year Hydrologic Summary

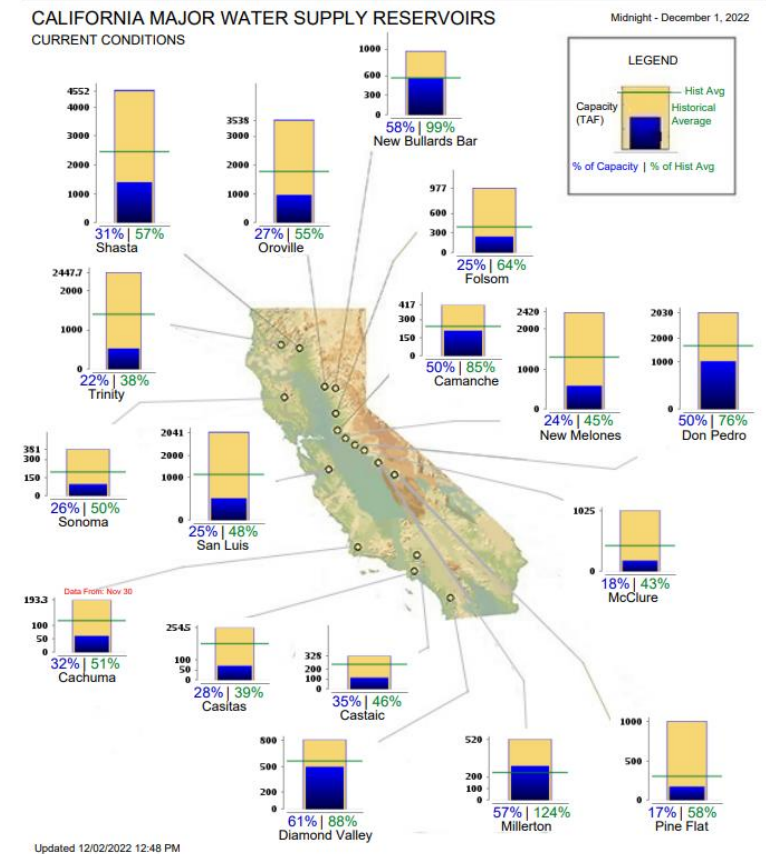
Precipitation



Snowpack Conditions



Reservoir Storage



Source: California Department of Water Resources

- As of 1 Dec, water-year-to-date precipitation is above normal across Southern CA and below normal across Central and Northern CA
- Snowpack is near normal for this date in the Northern/Central Sierra Nevada and slightly above normal in the Southern Sierra Nevada, but most of the seasonal snowpack was provided by an early November storm
- Most major reservoirs in California are operating at below-normal storage due to the multi-year drought

Looking Back: Week 3 AR Activity Forecasts

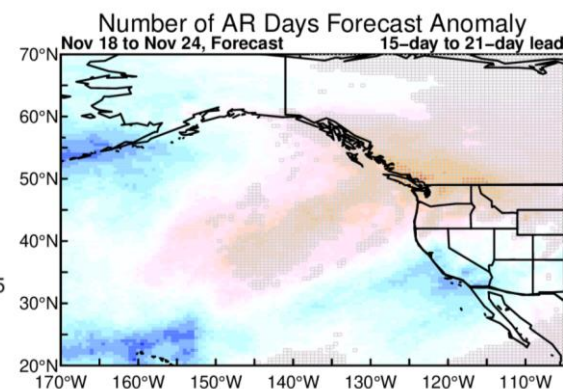
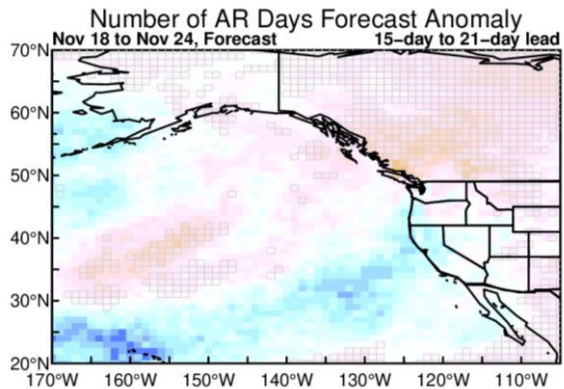
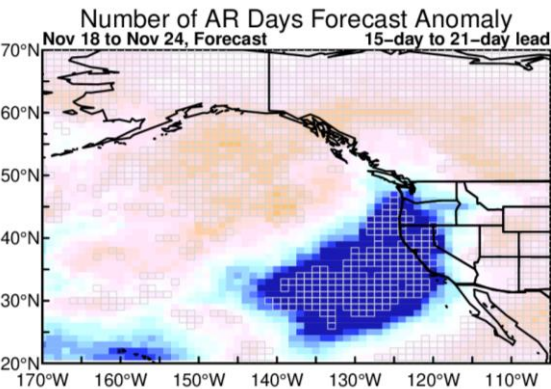
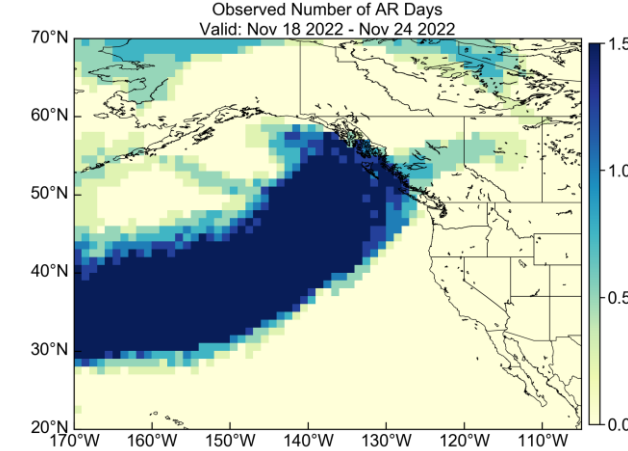
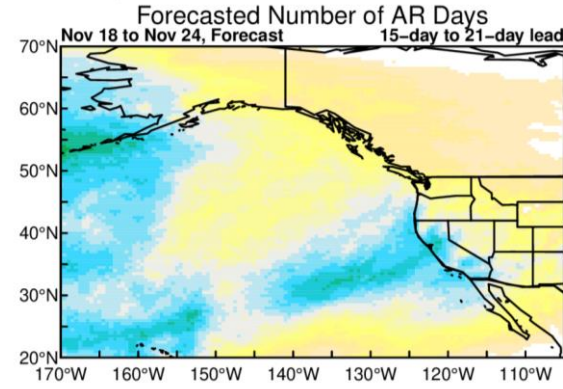
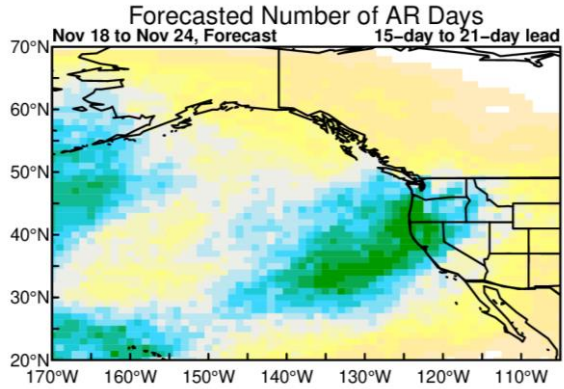
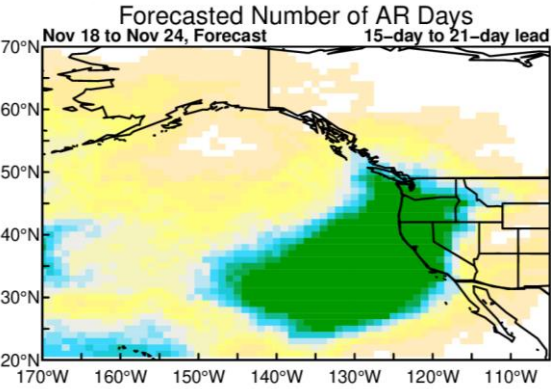
Forecasts Initialized 3 Nov; Valid: 18–24 Nov 2022

NCEP

ECNC

ECMWF

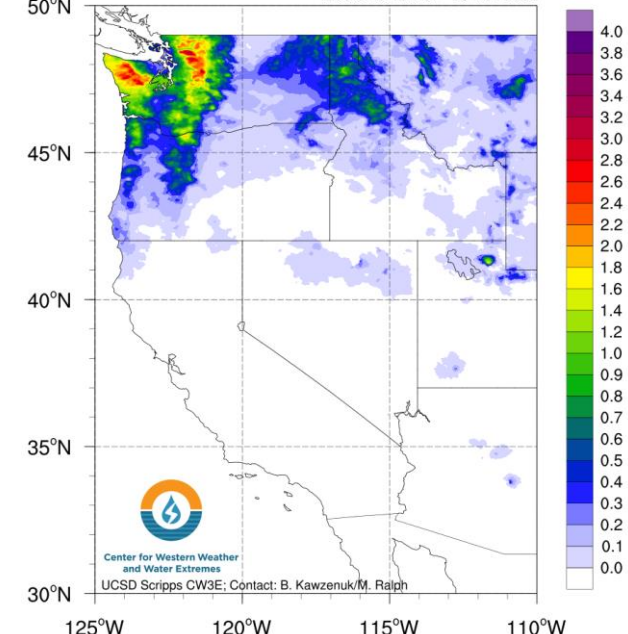
Observed (GFS Analysis)



Observed Precipitation

7-day Accumulated Precipitation (inches)

1200 UTC 18 Nov - 25 Nov 2022



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

None of the forecasts verified over CA

All models predicted AR activity over the West Coast of North America, but too far south

- A weak cold front produced 1–3 inches of precipitation over the Olympic Peninsula and Washington Cascades on 22–23 Nov
- No precipitation was observed over most of California

Looking Back: Week 3 AR Activity Forecasts

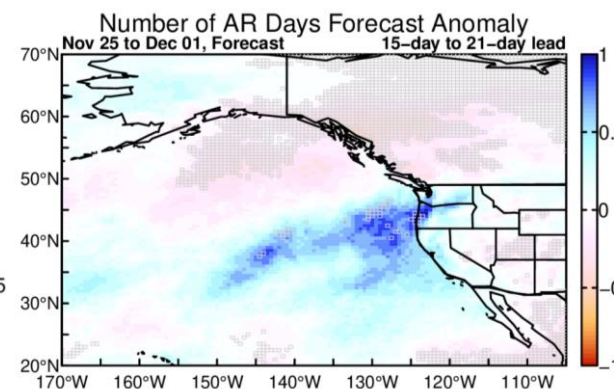
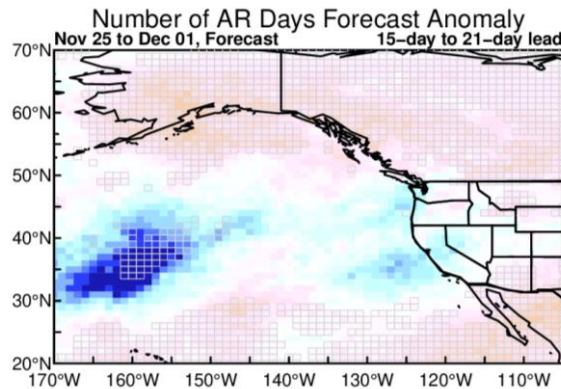
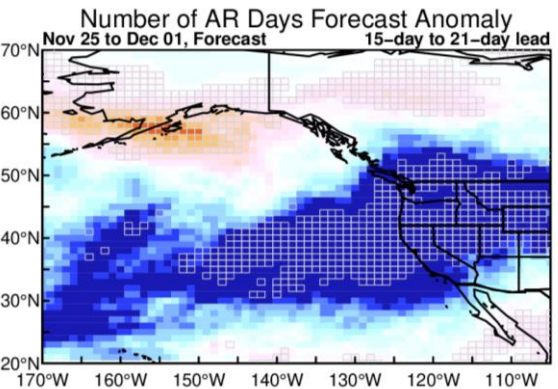
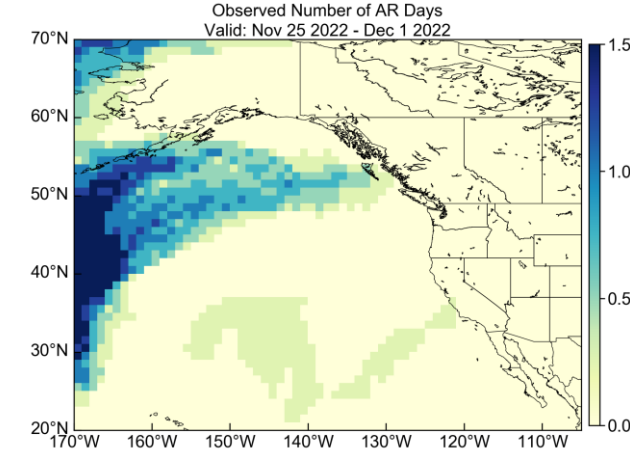
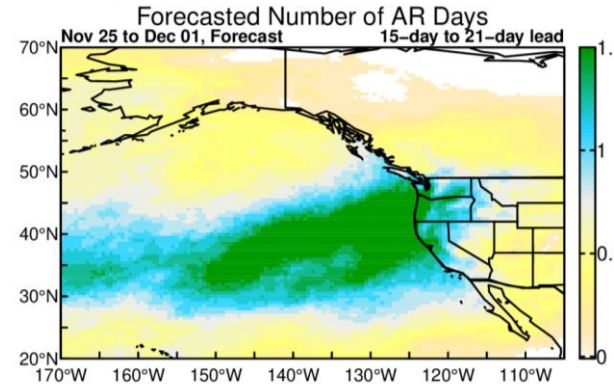
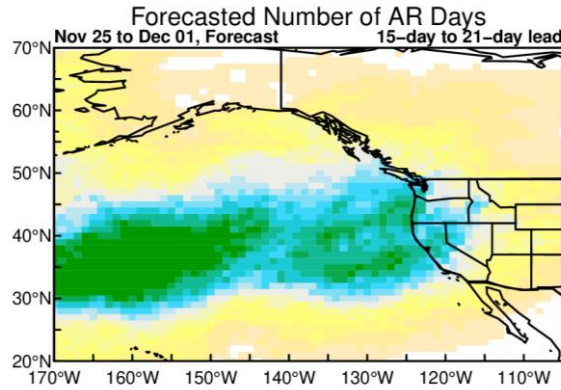
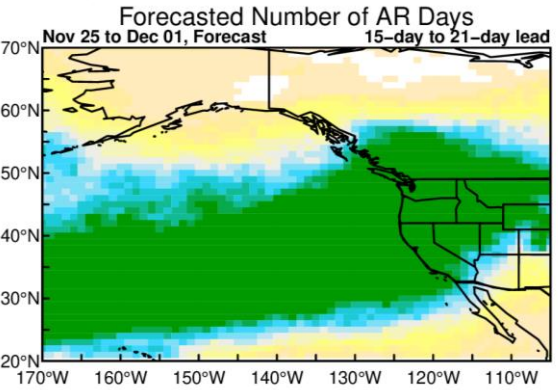
Forecasts Initialized 10 Nov; Valid: 25 Nov – 1 Dec 2022

NCEP

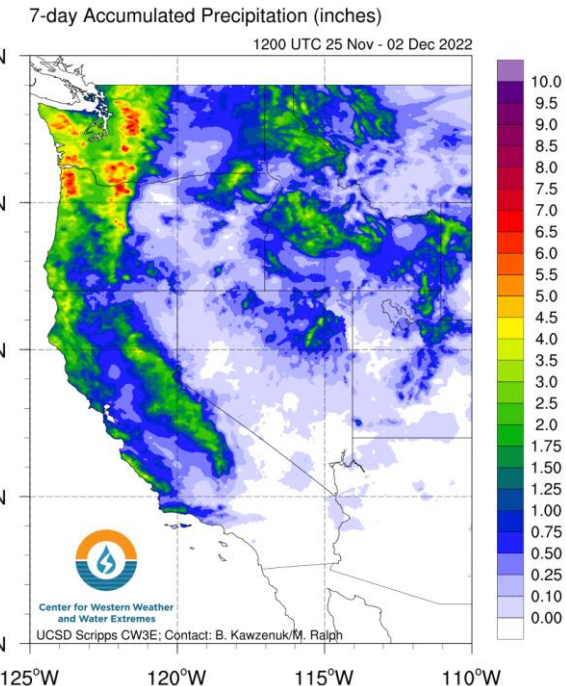
ECMC

ECMWF

Observed (GFS Analysis)



Observed Precipitation



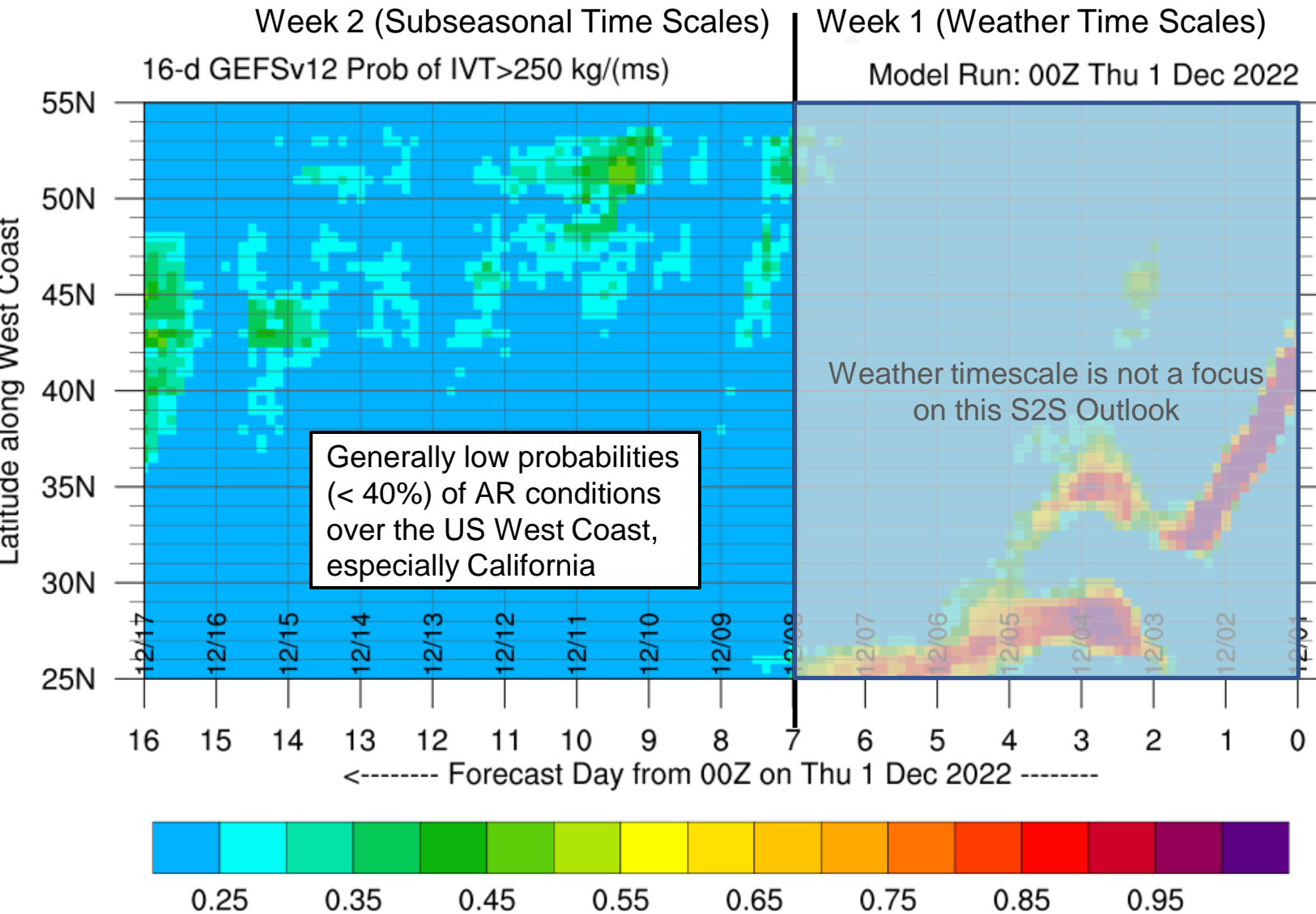
Shading: Fractional # of AR days over a 7-day period (top) and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

None of the forecasts verified over CA

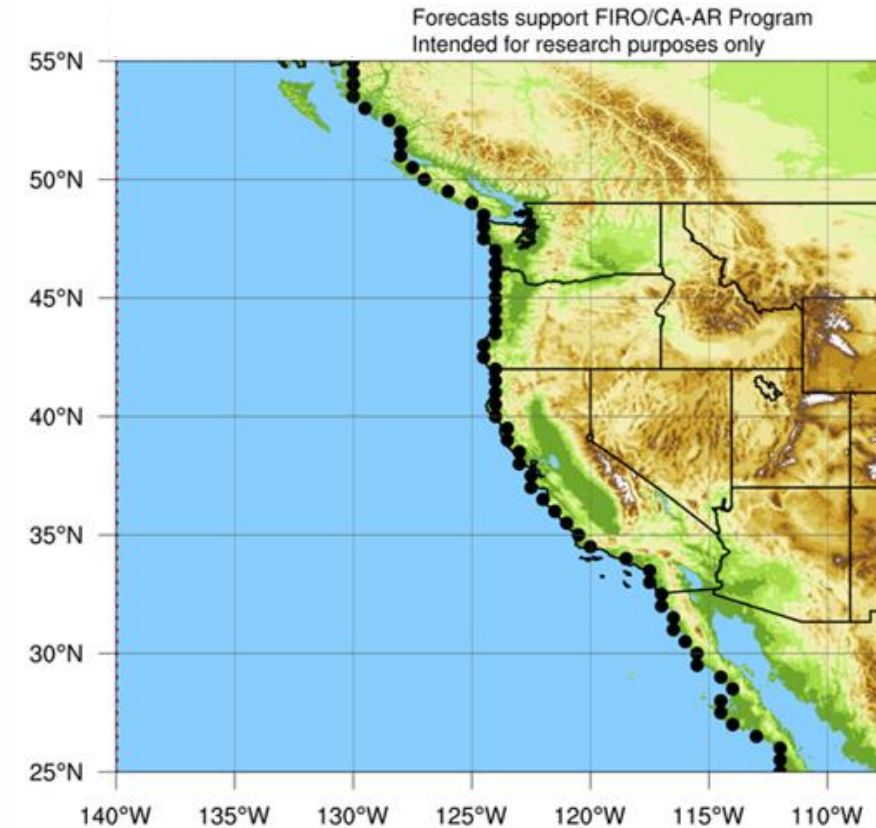
AR activity was mostly confined to the central North Pacific Ocean during this period

- A strong low-pressure system produced 2–4 inches of precipitation over portions of western WA, western OR, the Northern CA Coast Ranges, and the Sierra Nevada during 30 Nov – 2 Dec

NCEP GEFS AR Landfall Tool: Valid 00Z 1 Dec – 00Z 17 Dec

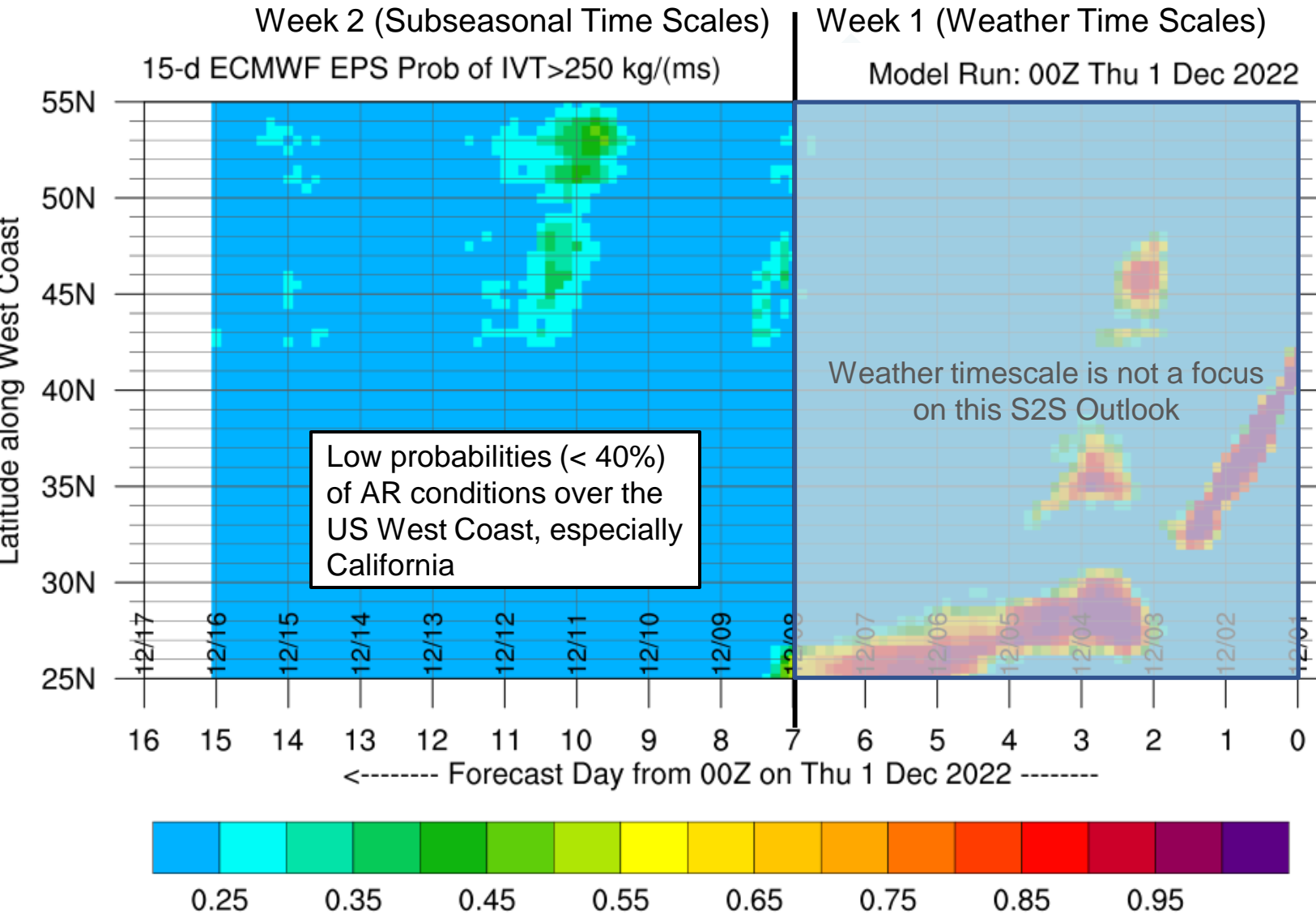


Forecasts Initialized 1 Dec 2022

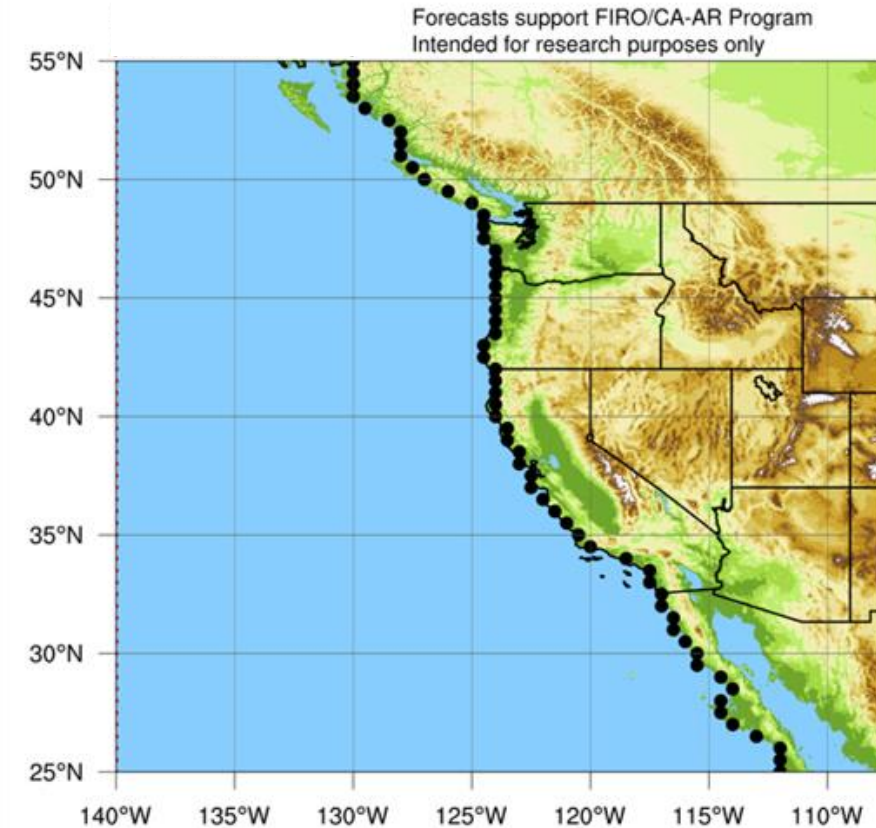


- NCEP is forecasting low probabilities of AR conditions over California in Week 2 with weak MJO activity predicted in Week 1 and low ridging activity predicted during Weeks 1–2

ECMWF EPS AR Landfall Tool: Valid 00Z 1 Dec – 00Z 16 Dec

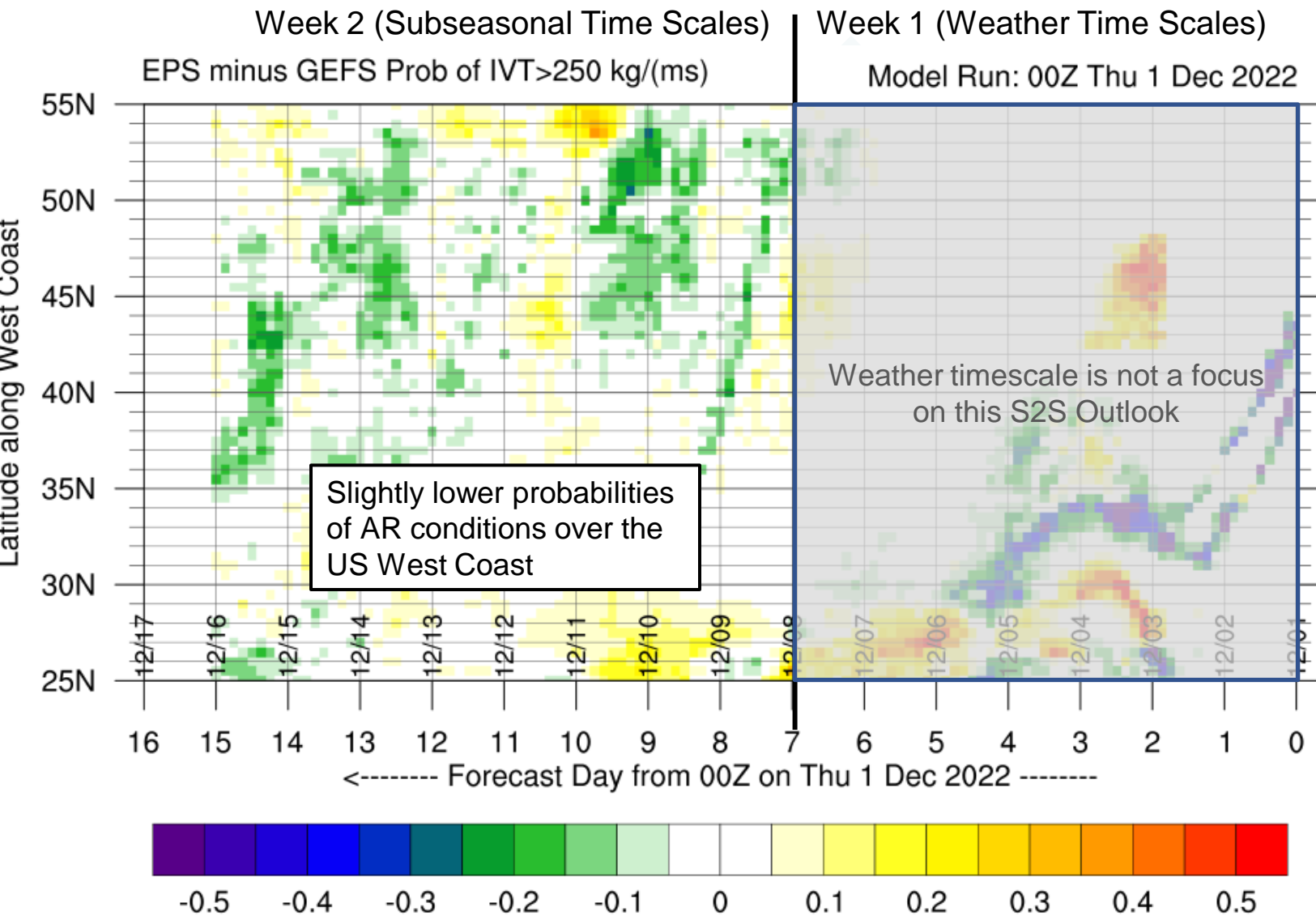


Forecasts Initialized 1 Dec 2022

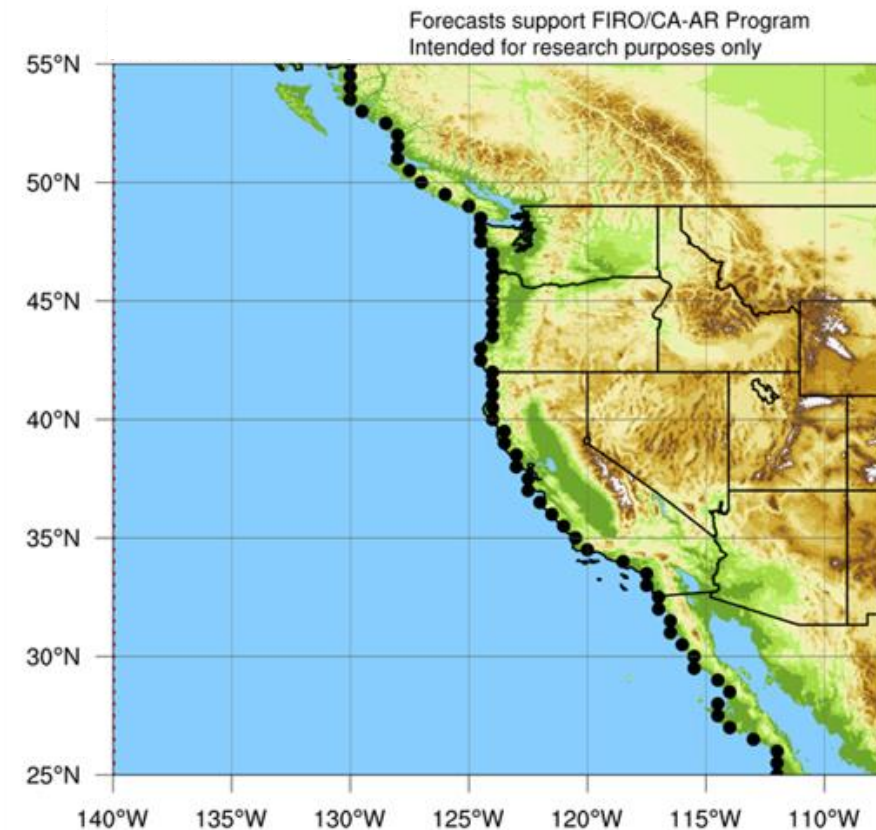


- ECMWF is forecasting low probabilities of AR conditions over California in Week 2 with weak MJO activity predicted in Week 1

EPS Minus GEFS AR Landfall Tool: Valid 00Z 1 Dec – 00Z 16 Dec



Forecasts Initialized 1 Dec 2022

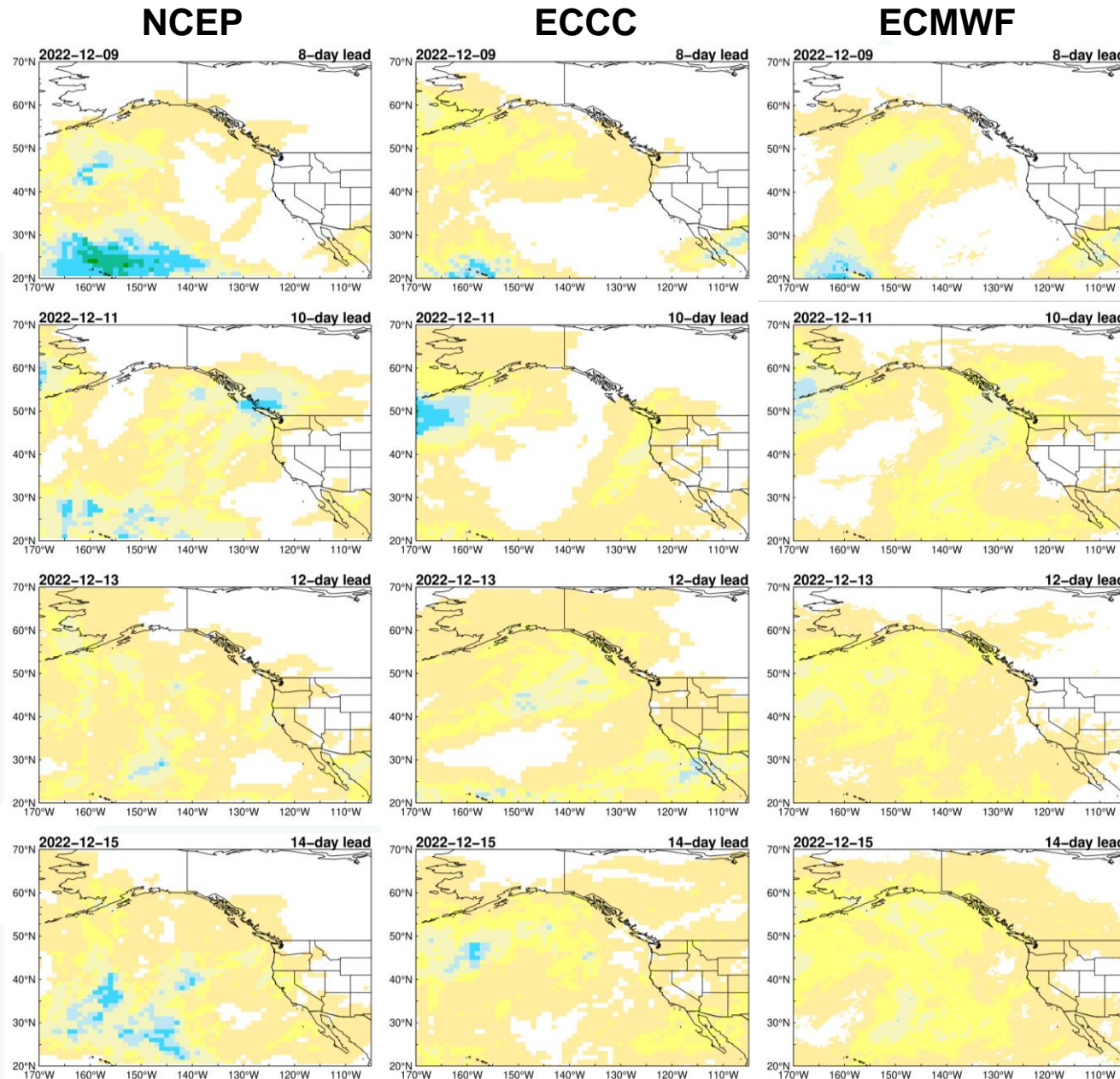
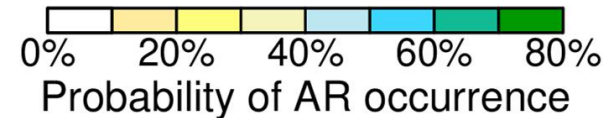


Subseasonal Outlooks: Week 2 AR Activity (NCEP vs. ECCC vs. ECMWF)

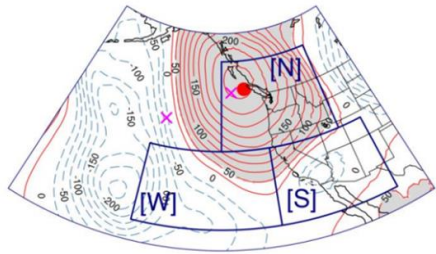
Forecasts Initialized 1 Dec 2022

- All models are showing generally low probabilities (< 30%) of AR activity in California during Week 2 (9–15 Dec),
- NCEP is predicting slightly higher probabilities (> 30%) of AR activity in Northern CA on 13–15 Dec

All models agree on low likelihood of AR activity over California in Week 2 (9–15 Dec)

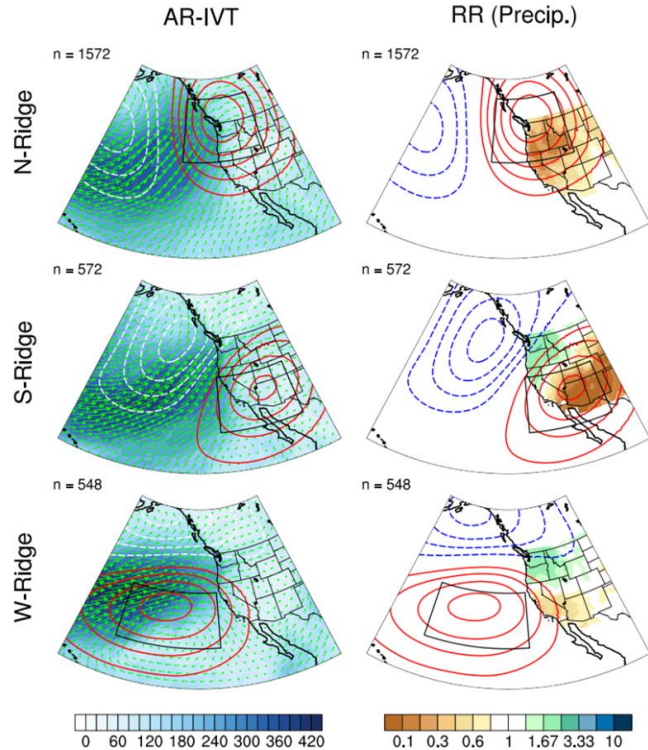


Background Info: Subseasonal Ridging Outlooks



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 California and the Colorado River Basin and wet conditions in the Pacific Northwest
- The West-Ridge type is typically associated with dry conditions over California and wet conditions over the Pacific Northwest



Jet Propulsion Laboratory
California Institute of Technology



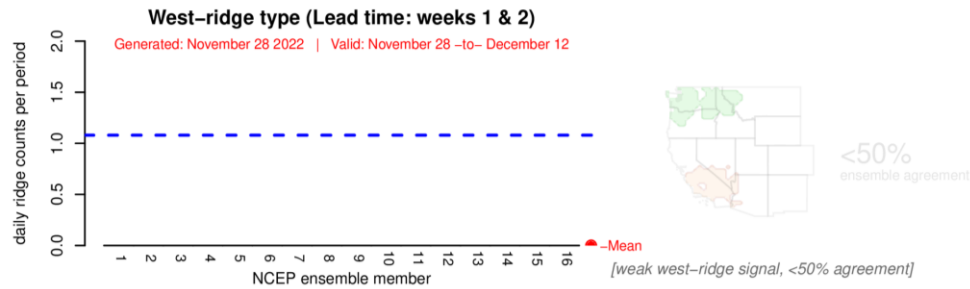
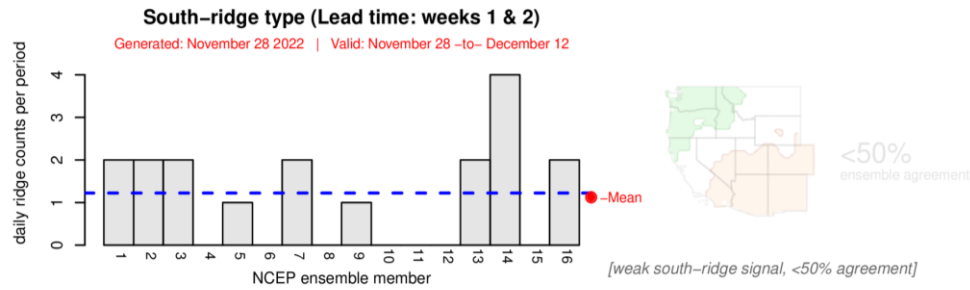
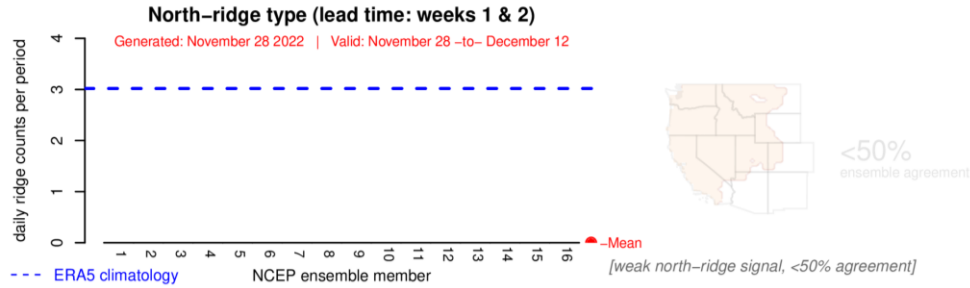
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AT UC SAN DIEGO

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

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

Forecasts Initialized 1 Dec 2022

NCEP



ECMWF
Unavailable

- NCEP shows low confidence (< 50% ensemble agreement) in persistent ridging activity near the US West Coast during Weeks 1–2 (1–15 Dec)
- NCEP is predicting near-normal occurrence of the South Ridge, which favors dry conditions in Southern CA

There is low likelihood of persistent ridging activity near the US West Coast during 1–15 Dec

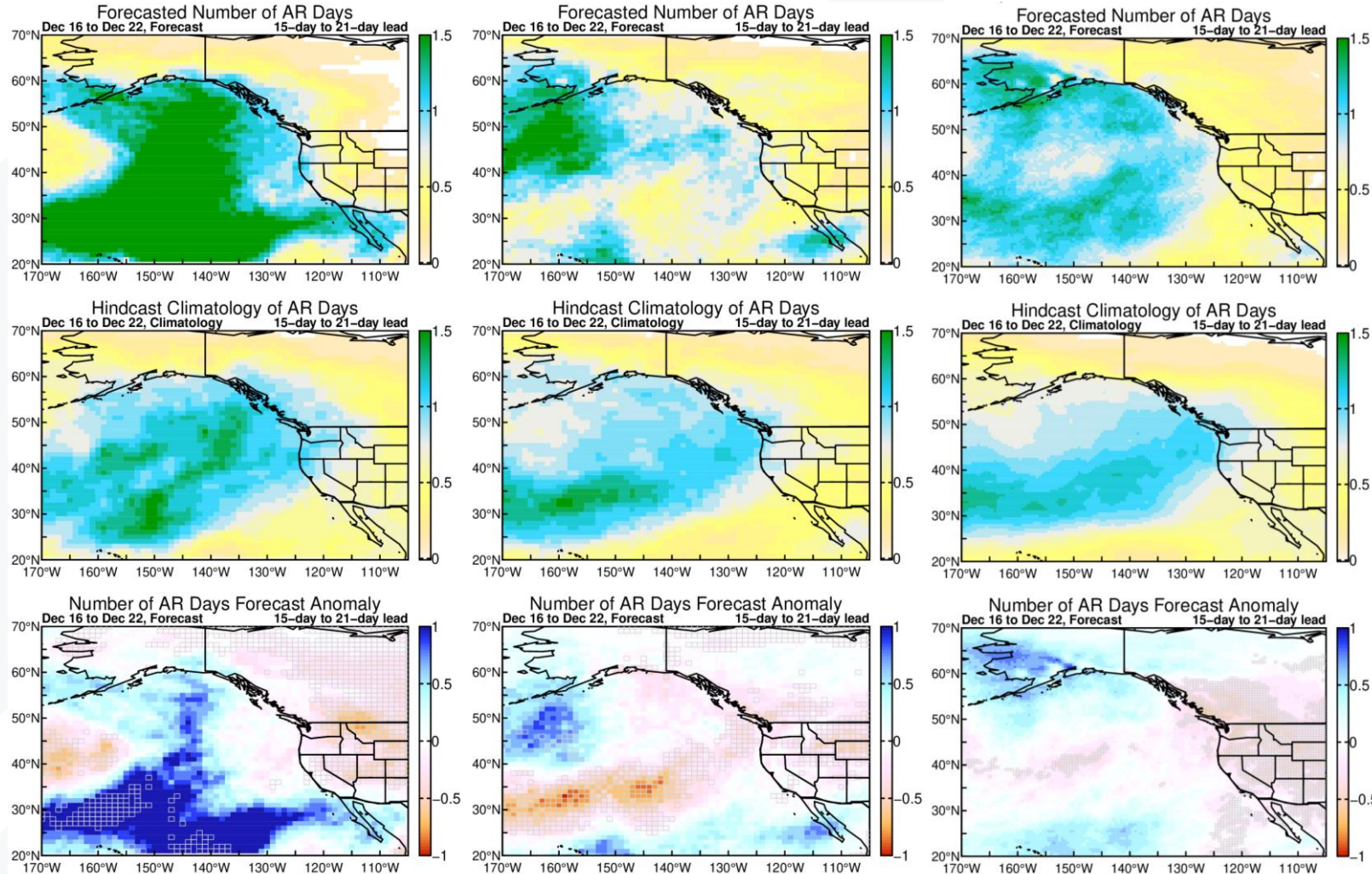
Subseasonal Outlooks: Week 3 AR Activity (NCEP vs. ECCO vs. ECMWF)

Forecasts Initialized 1 Dec 2022

NCEP

ECCC

ECMWF



- All models are predicting near-to-below-normal AR activity over CA during Week 3 (16–22 Dec)
- NCEP is predicting slightly higher AR activity over Northern CA and near the Southern CA coast

Generally little AR activity is predicted over California during Week 3 (16–22 Dec)

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

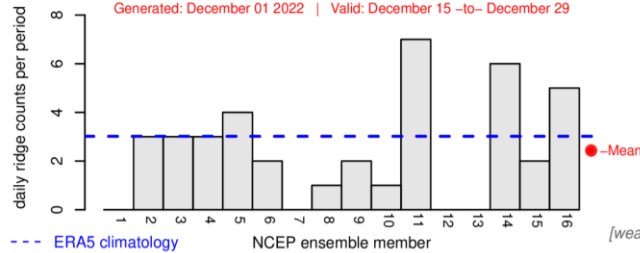
Subseasonal Outlooks: Weeks 3–4 Ridging Forecasts (NCEP vs. ECMWF)

Forecasts Initialized 1 Dec 2022

NCEP

North-ridge type (lead time: weeks 3 & 4)

Generated: December 01 2022 | Valid: December 15 –to– December 29

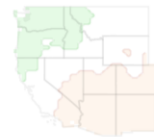
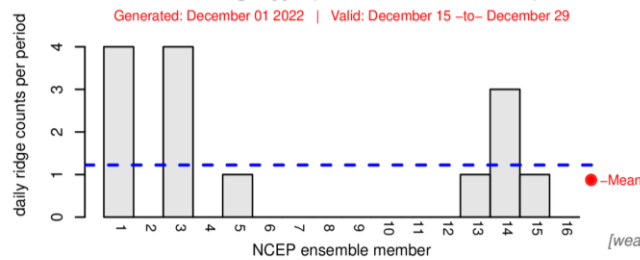


<50% ensemble agreement

[weak north-ridge signal, <50% agreement]

South-ridge type (Lead time: weeks 3 & 4)

Generated: December 01 2022 | Valid: December 15 –to– December 29

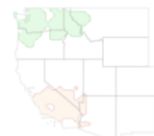
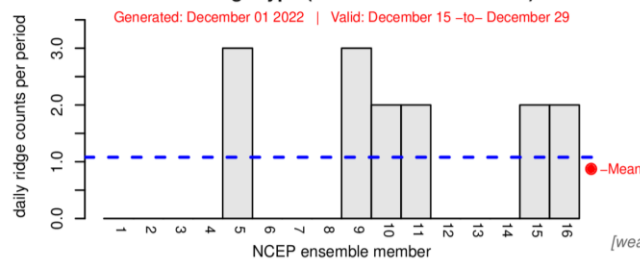


<50% ensemble agreement

[weak south-ridge signal, <50% agreement]

West-ridge type (Lead time: weeks 3 & 4)

Generated: December 01 2022 | Valid: December 15 –to– December 29



<50% ensemble agreement

[weak west-ridge signal, <50% agreement]

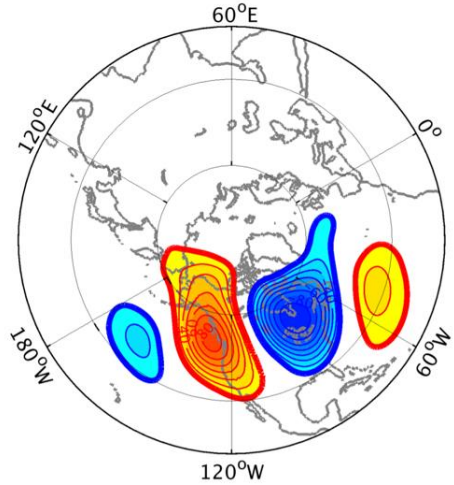
ECMWF
Unavailable

- NCEP shows low confidence (< 50% ensemble agreement) in any one particular ridge type during Weeks 3–4 (15–29 Dec)
- Despite lack of ensemble agreement on ridge location, most ensemble members are forecasting ridging activity near the US West Coast during this period

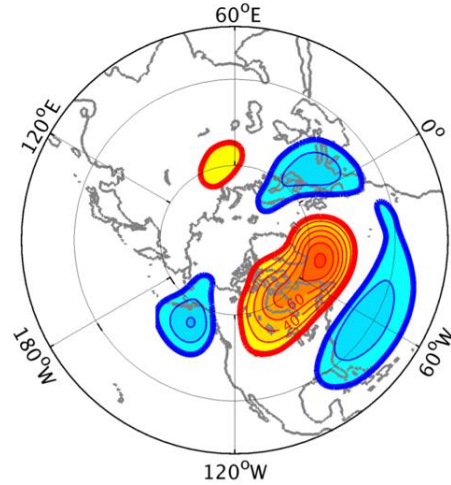
There is low likelihood of persistent ridging activity near the US West Coast during 15–29 Dec

Background Info: IRI Subseasonal Weather Regime Forecasts

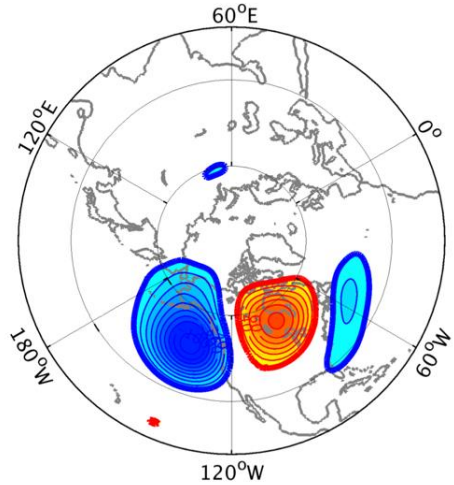
a) WR 1: West Coast Ridge



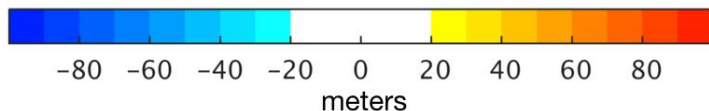
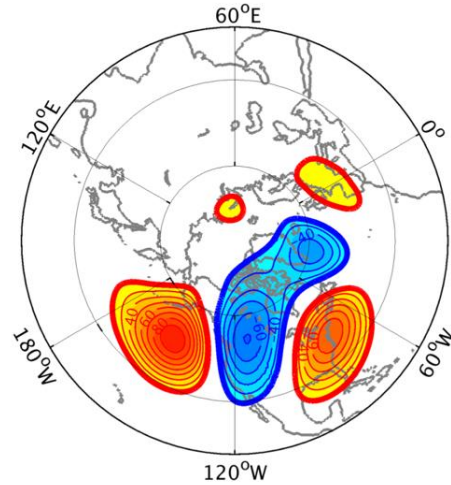
b) WR 2: Greenland High



c) WR 3: Pacific Trough



d) WR 4: Pacific Ridge



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

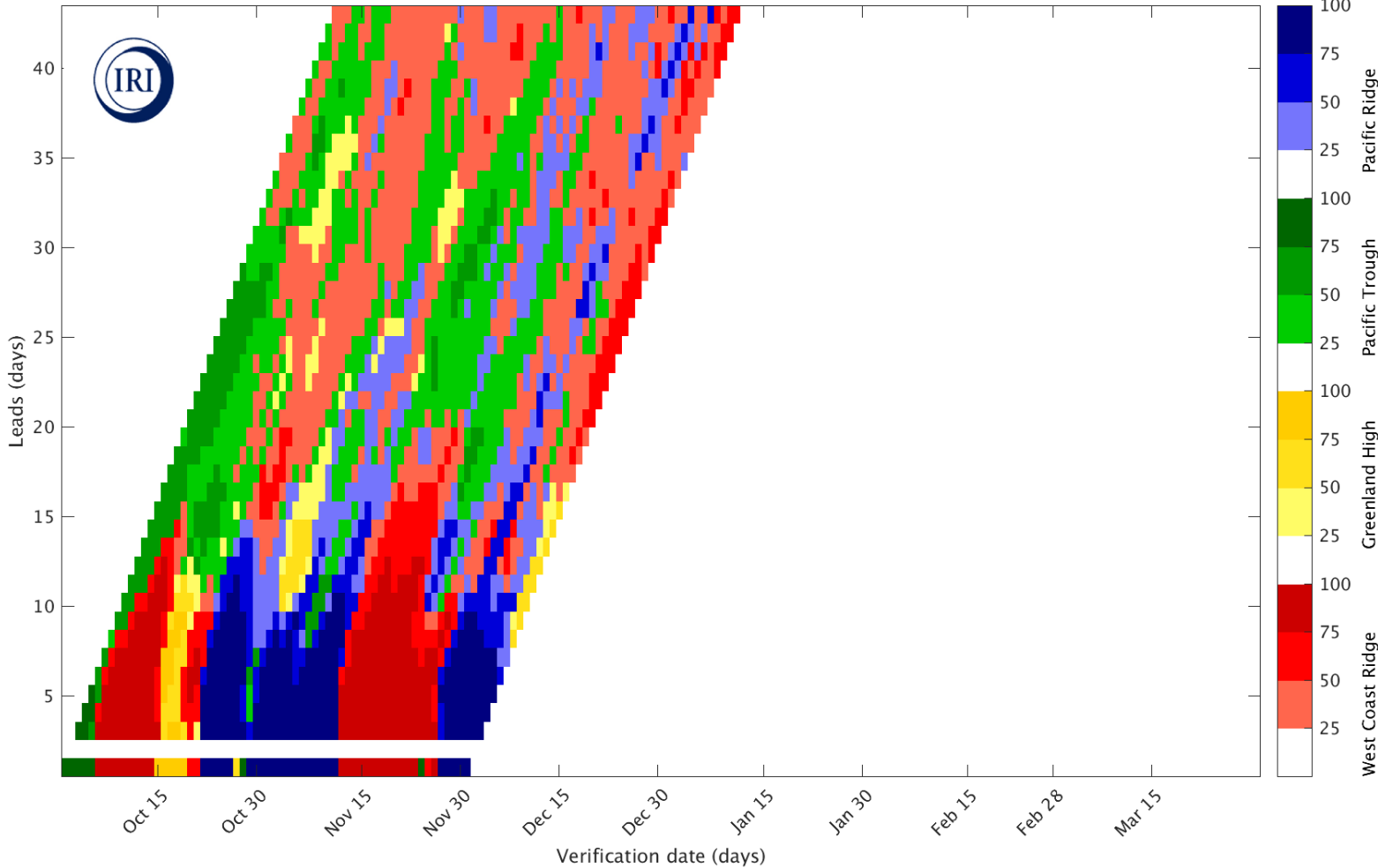
- Four dominant weather regimes identified using cluster analysis on daily 500-hPa geopotential height anomalies from MERRA data (1981–2015)

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

Subseasonal Outlooks: IRI North American Weather Regime Forecast

Latest Forecast Initialized 1 Dec 2022

CFSv2 daily winter WRs max probability forecast (%) 48 members from Oct 1 to Dec 1 2022



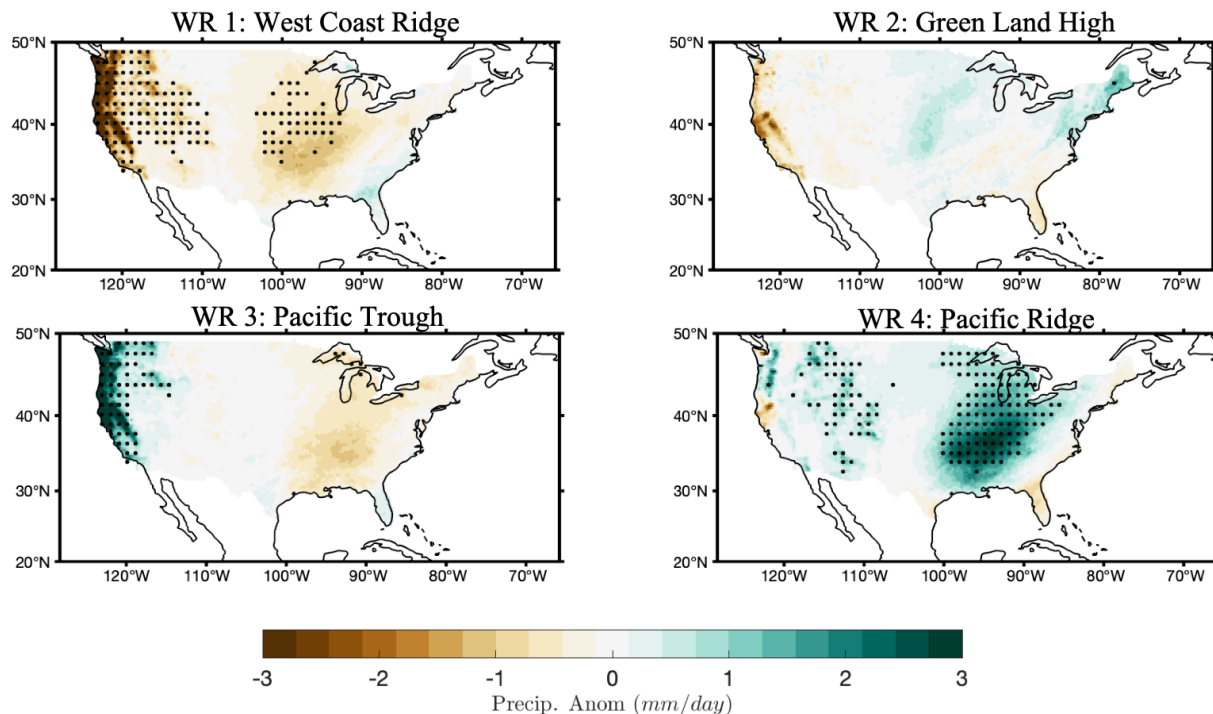
- Daily forecast out to 45-day lead time shown on CW3E S2S website
- Uses NCEP CFSv2 ensemble
- High likelihood (> 75%) of Pacific Ridge during Week 1
- Moderate likelihood (> 50%) of Greenland High during Week 2
- Moderate likelihood of West Coast Ridge (which favors dry conditions in California) during Weeks 3–4

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.

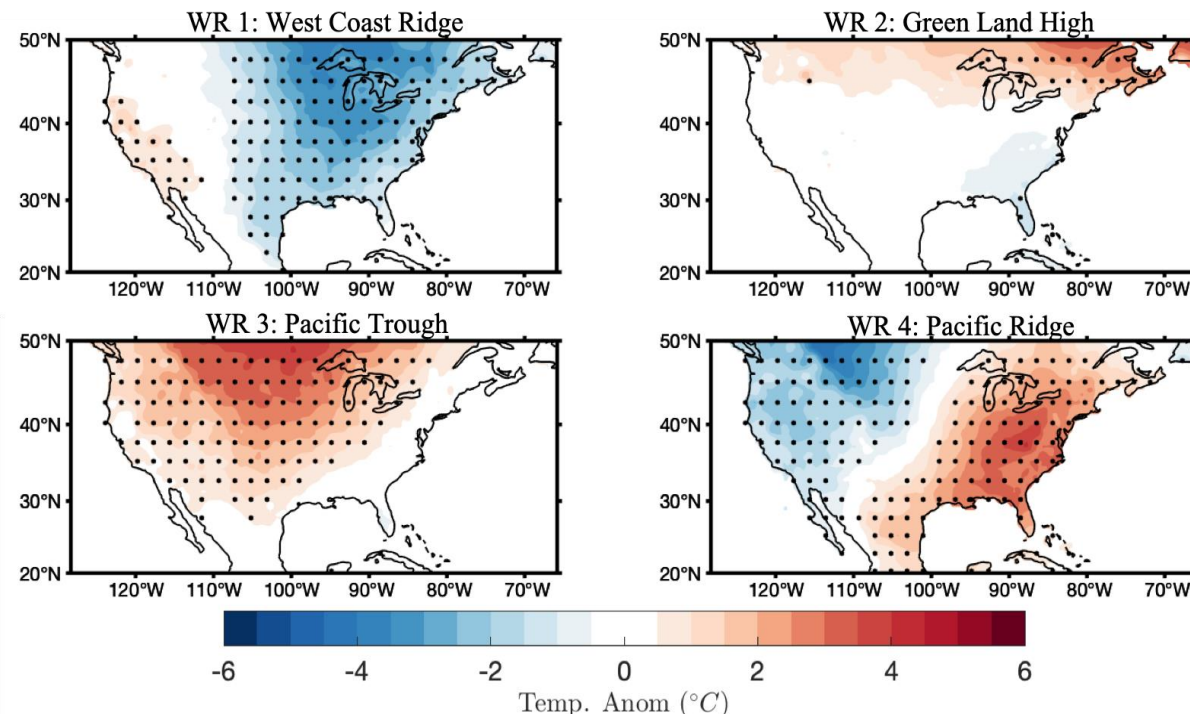
For more information about the forecast product: <https://wiki.iri.columbia.edu/index.php?n=Climate.S2S-WRs>

Subseasonal Outlooks: IRI North American Weather Regime Forecasts

Precipitation



Precipitation



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

- Dry conditions over Northern CA are predicted in mid-December with moderate confidence
- Dry and warm conditions over all of California are predicted in late December with moderate confidence