



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E S2S Outlook: 14 Nov 2022

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

UC San Diego

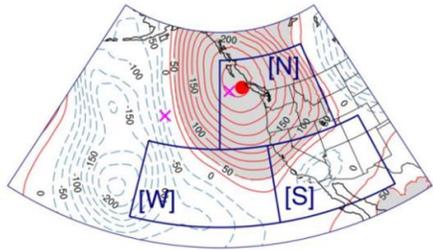


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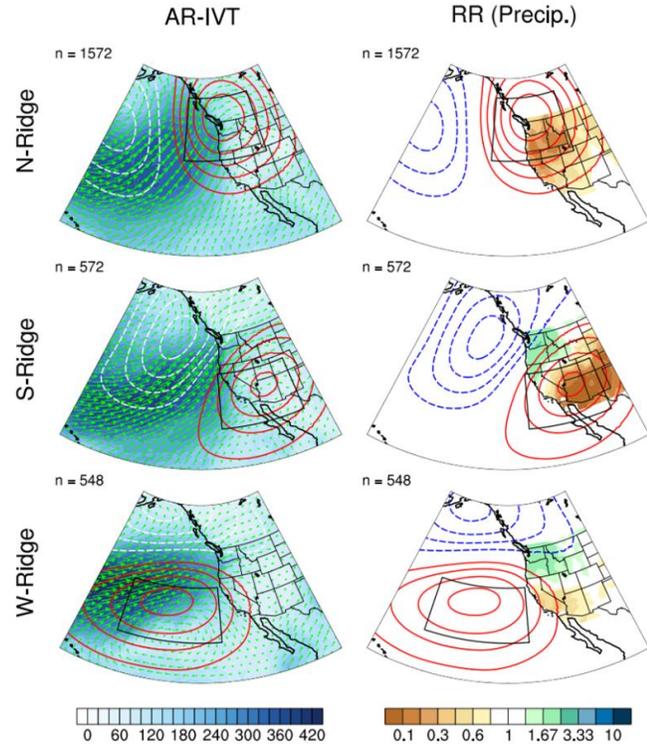
Summary

- **Week 2 forecasts (18–24 Nov):** Models agree on the likelihood of AR activity over California
 - NCEP is forecasting higher probabilities (40–60%) of AR activity over CA than ECCO and ECMWF
- **Week 3 forecasts (25 Nov–01 Dec):** Models continue to show agreement of above-normal AR activity over California
 - NCEP is predicting more significant above-normal AR activity over CA than ECCO and ECMWF
- NCEP GEFS model predicts the MJO will be in the western Pacific in week-2, which is consistent with above-normal probability of AR activity over CA in week-3
- Both NCEP and ECMWF show large uncertainty in the occurrence of ridging activity during Weeks 1–2; Both models show moderate confidence in the occurrence of the South-Ridge type during Weeks 3–4, which is typically associated with dry conditions over Southern California and wet conditions over Northern California
- **Seasonal forecasts (Nov-Jan):** Models agree on the drier than normal conditions over Southern CA but disagree on the conditions over far Northern CA
 - Statistical (Machine Learning) model is predicting drier (wetter) than normal conditions over Northern CA
- **Seasonal forecasts (Jan-Mar):** Statistical model predicts wetter than normal conditions in Northern CA and drier than normal conditions in Southern CA

Background Info: S2S Ridging Outlooks



N = North Ridge
S = South Ridge
W = West Ridge



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



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California Institute of Technology



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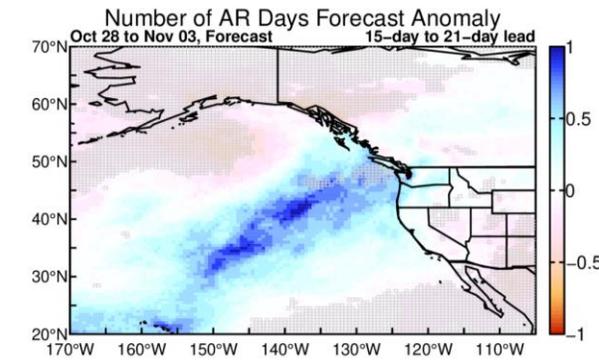
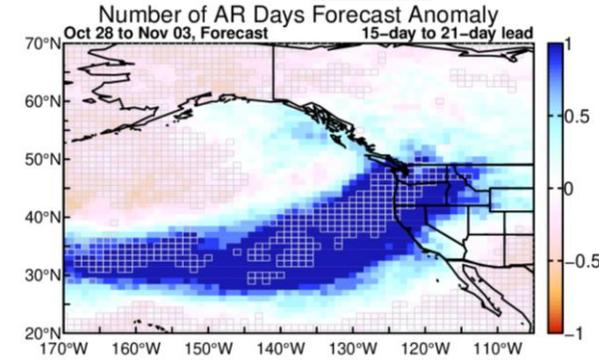
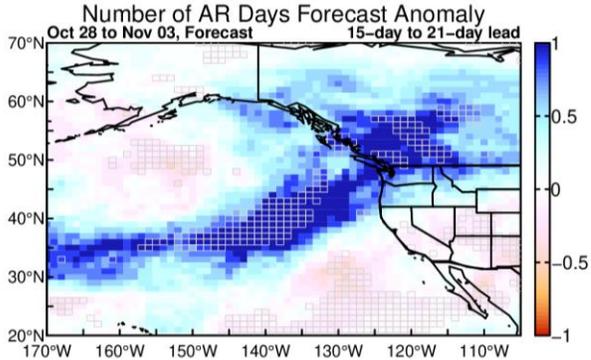
Contact: pgibson@ucsd.edu
Reference: Gibson et al. (2020)
Journal of Climate

Looking Back: Week 3 AR Activity Forecasts

Valid: 28 Oct – 3 Nov 2022

NCEP Experimental Forecast Initialized: Oct 13, 2022 ECCC Experimental Forecast Initialized: Oct 13, 2022

ECMWF Experimental Forecast Initialized: Oct 13, 2022



Shading: Fractional # of AR days over a 7-day period minus model climatology
Grey cells: >75% of ensemble members agree on signs of anomaly

All forecasts verified over OR and WA; ECCC verified over Northern CA

- Above-normal AR activity over WA and OR
- Above-normal AR over CA in ECCC

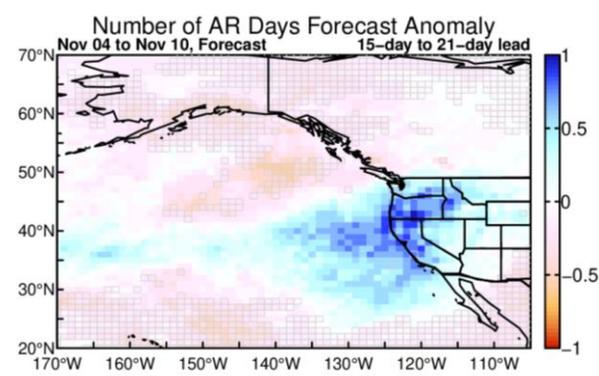
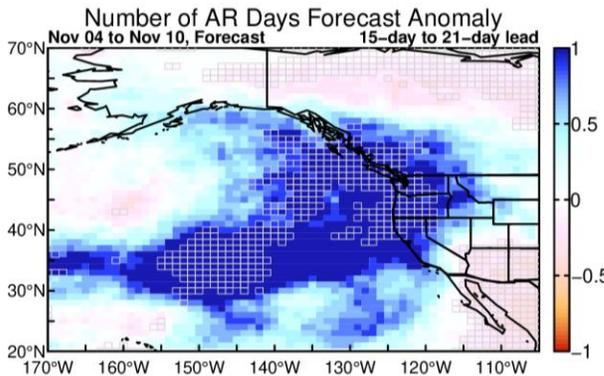
Valid: 4 – 10 Nov 2022

NCEP Experimental Forecast Initialized: Oct 20, 2022

ECCC Experimental Forecast Initialized: Oct 20, 2022

ECMWF unavailable

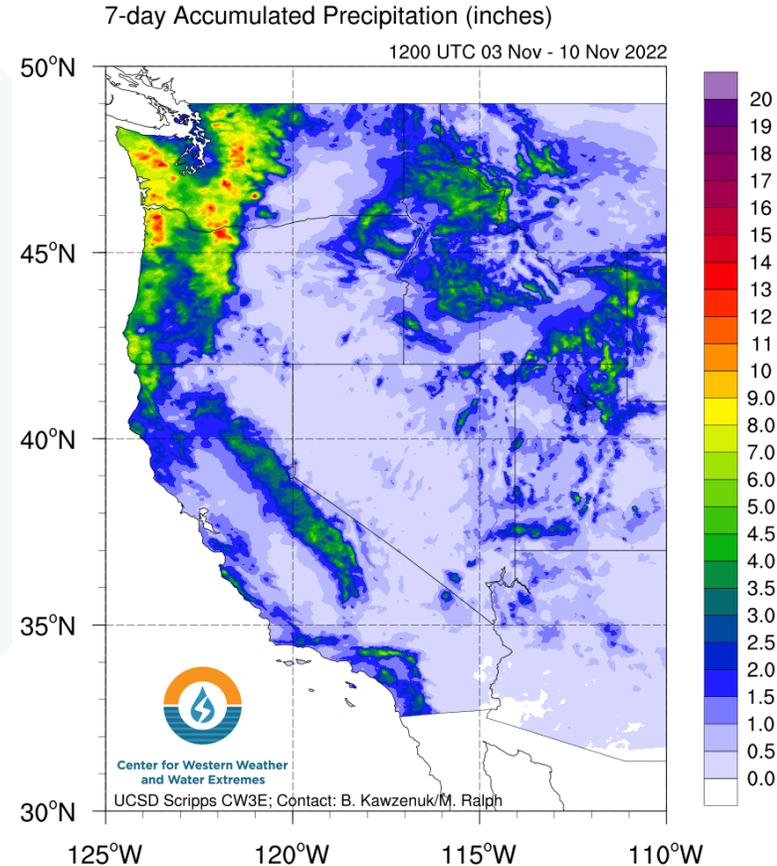
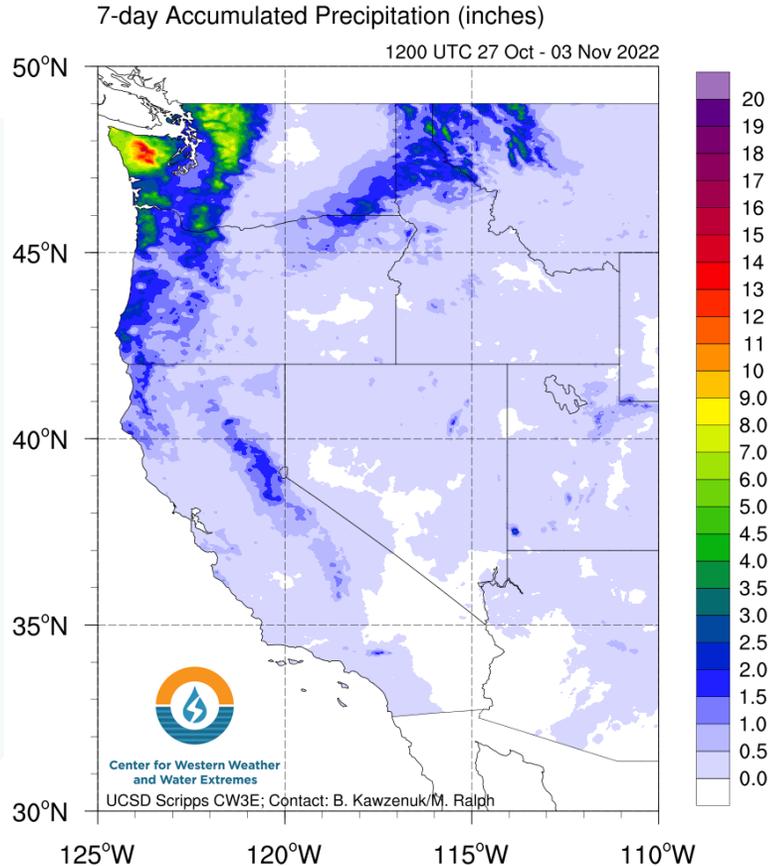
NCEP and ECCC forecasts verified over CA



- Above-normal AR activity over CA



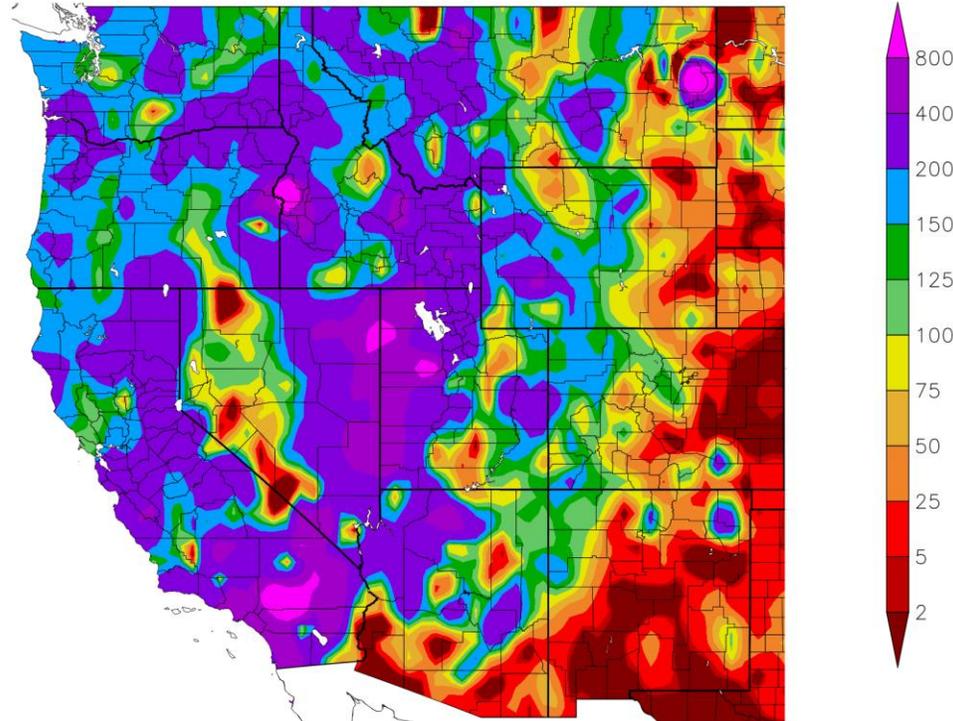
Looking Back: Accumulated Precipitation (27 Oct – 10 Nov 2022)



- A strong AR produced heavy precipitation (at least 5-10 inches) over portions of western WA and northwestern OR and some precipitation over Northern CA during 3-5 Nov
- Another moderate strength AR brought heavy rain and snow throughout CA during 7-8 Nov; Precipitation totals in the Transverse Ranges of Southern CA exceeded 8 inches with totals around the state exceeding 2 inches; Much of the Sierra Nevada received more than 2 feet of snow
- Observed precipitation in most of CA during the past two weeks was consistent with model week-3 forecasts of AR activity

Looking Back: 14-day Precipitation Anomaly (28 Oct – 10 Nov 2022)

Percent of Normal Precipitation (%)
10/28/2022 – 11/10/2022

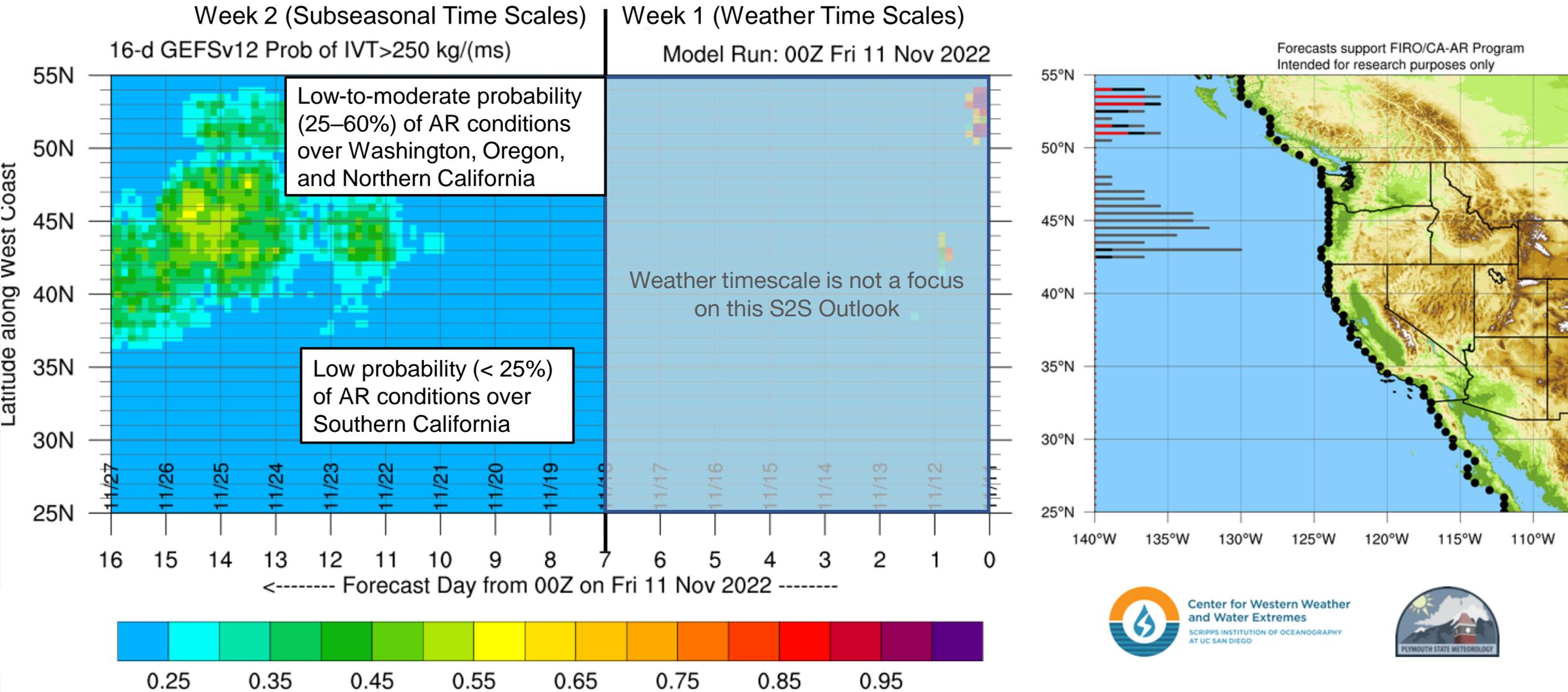


- Above-normal precipitation over the western US especially CA (Southern CA received >400% of the normal precipitation) during the past two weeks
- Consistent with previous model week-3 AR forecasts

Generated 11/11/2022 at HPRCC using provisional data.

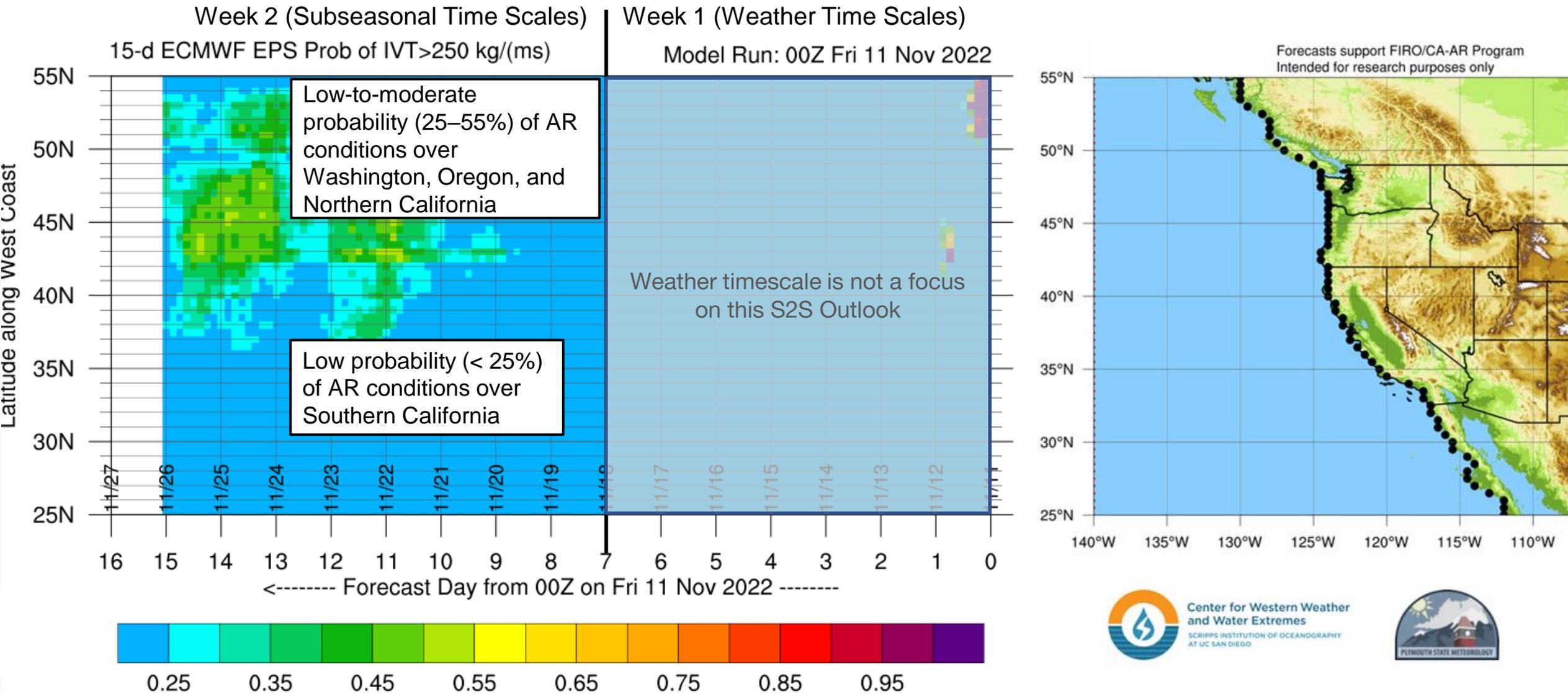
NOAA Regional Climate Centers

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



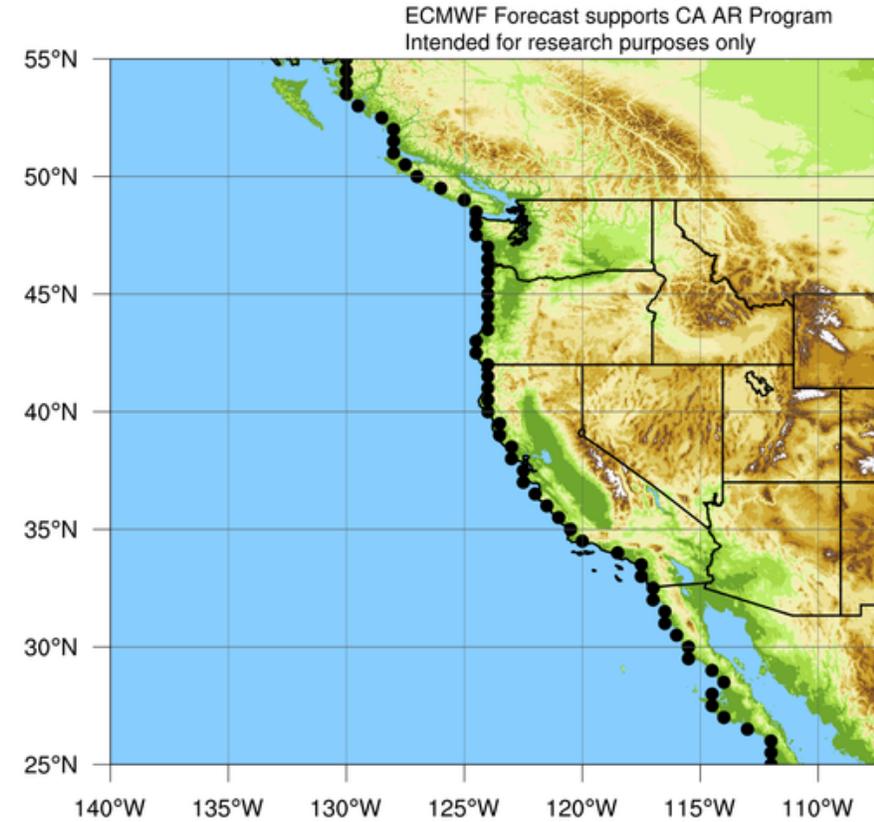
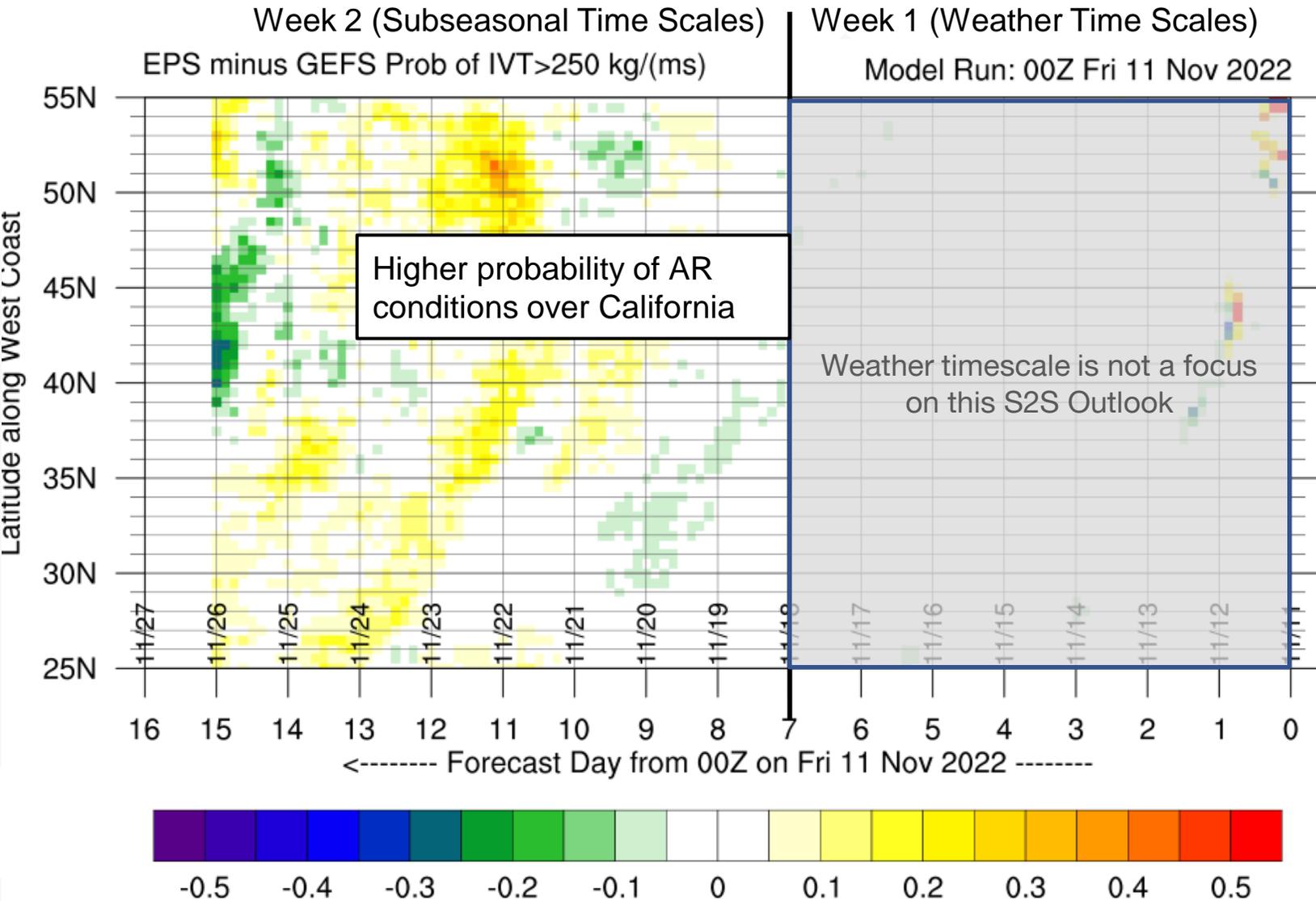
- NCEP is forecasting a low-to-moderate probability of AR conditions over California in Week 2 with weak MJO in week 1 and ridging activity during weeks 1-2

ECMWF EPS AR Landfall Tool: Valid 00Z 11–26 Nov



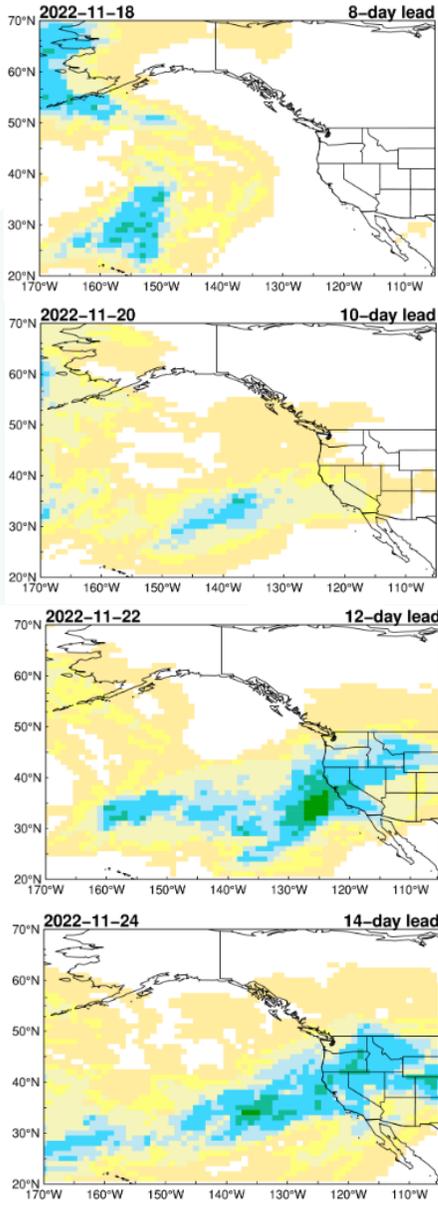
- ECMWF is forecasting a low-to-moderate probability of AR conditions over California in Week 2 with weak MJO in week 1 and ridging activity during weeks 1-2

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

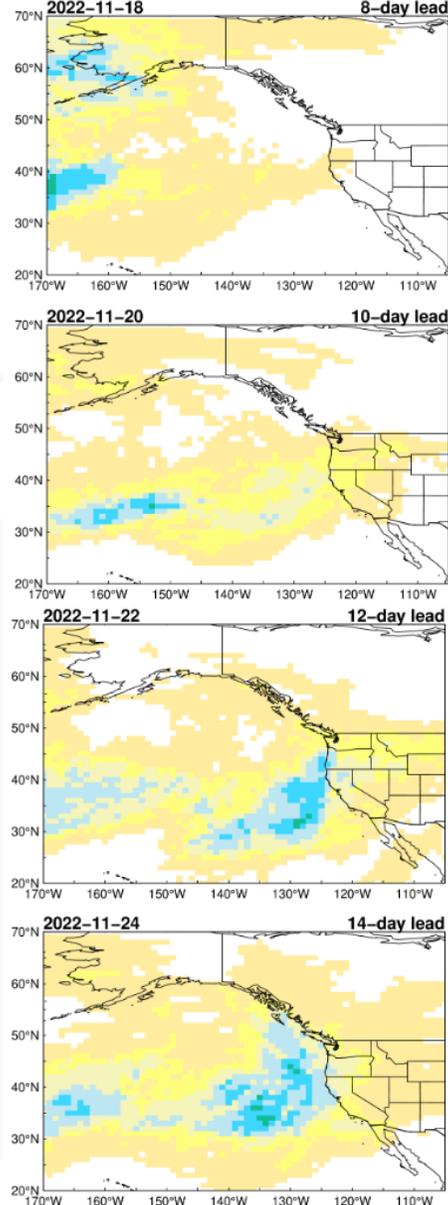


Subseasonal Outlooks: Week 2 AR Activity (NCEP vs. ECCC vs. ECMWF)

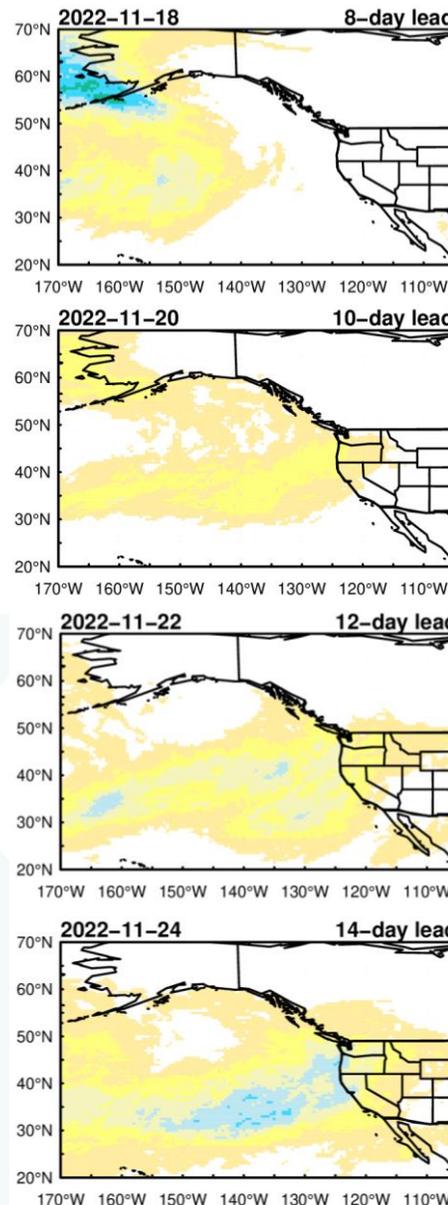
NCEP



ECCC

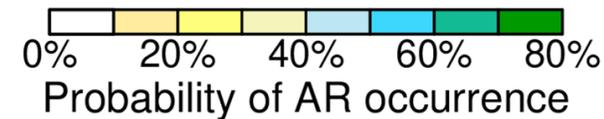


ECMWF



- All models are showing low-to-moderate probabilities (20-60%) of AR activity in California during 22-24 Nov with the highest probability predicted by NCEP

All models show low-to-moderate probabilities (20-60%) of AR activity over California in Week 2 (18-24 Nov)



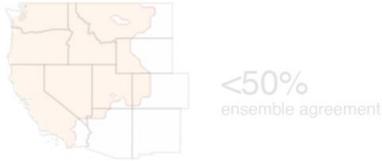
Initialized: Nov 10, 2022

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

NCEP

Generated: November 10 2022 | Valid: November 10 –to– November 24

North-Ridge



[north-ridge signal, <50% agreement]

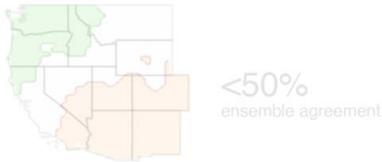
ECMWF

North-Ridge



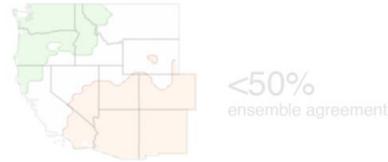
[north-ridge signal, <50% agreement]

South-Ridge



[south-ridge signal, <50% agreement]

South-Ridge



[south-ridge signal, <50% agreement]

West-Ridge



[west-ridge signal, <50% agreement]

West-Ridge



[west-ridge signal, <50% agreement]

- NCEP and ECMWF both show large uncertainty (< 50% ensemble agreement) in the occurrence of ridging activity near the US West Coast during Weeks 1–2 (10 – 24 Nov 2022)

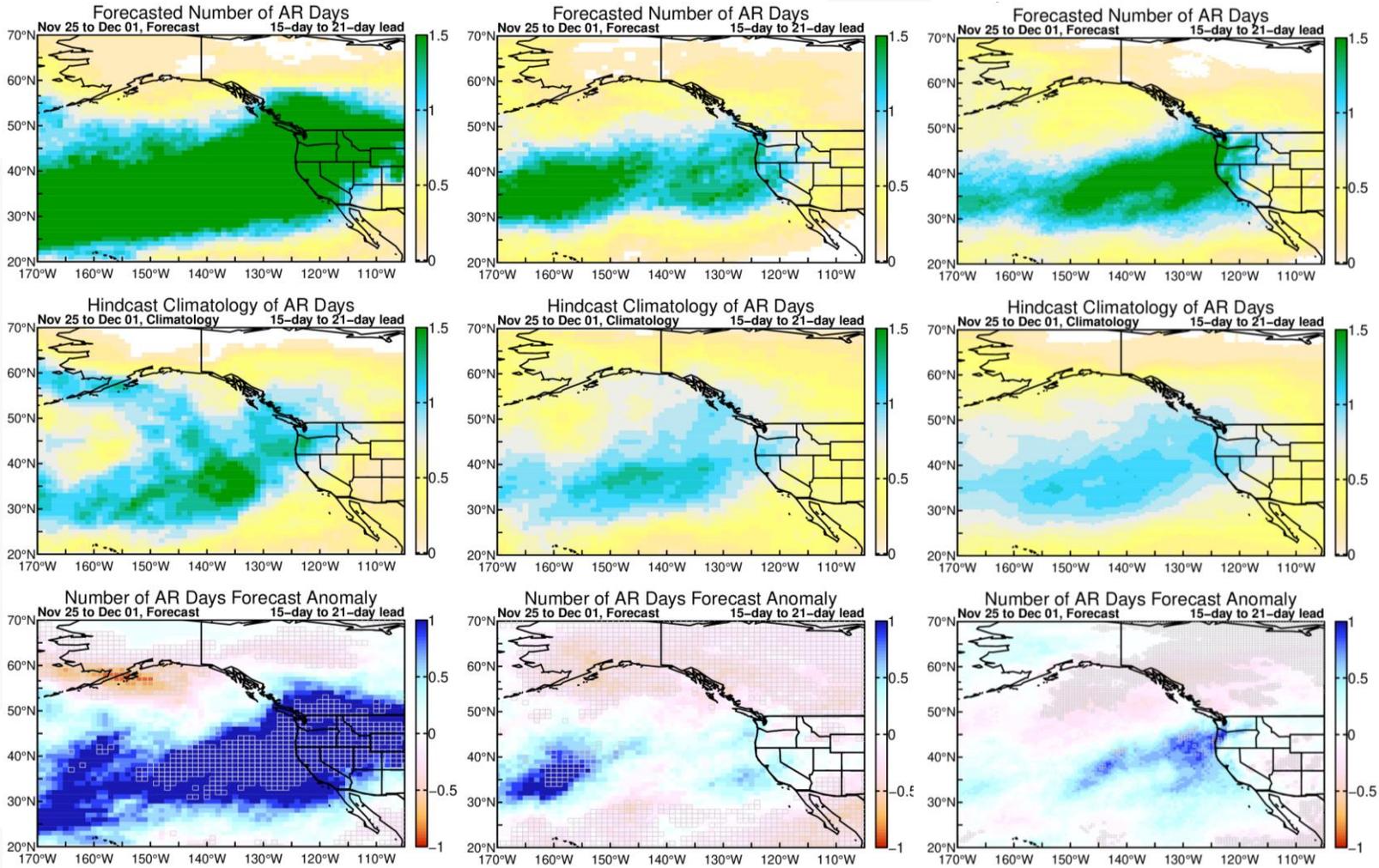
There is low confidence in the ridging forecasts during 10 – 24 Nov 2022

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

NCEP

ECCC

ECMWF



- NCEP model is predicting significantly above-normal AR activity over CA during Week 3 (25 Nov–1 Dec)
- ECCC and ECMWF models are predicting slightly above-normal AR activity over CA

There is a likelihood of AR activity over CA in week-3 (25 Nov–1 Dec) with the highest probability in NCEP due to active MJO convection over the western Pacific during Weeks 2-3

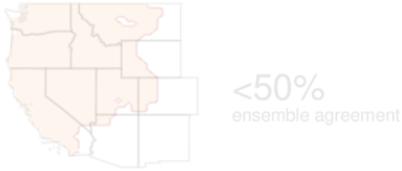
Shading (Bottom): Fractional # of AR days/7-day period (top) minus model climatology (middle)
Grey cells: >75% of sign agreement between ensemble members

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

NCEP

Generated: November 10 2022 | Valid: November 24 –to– December 08

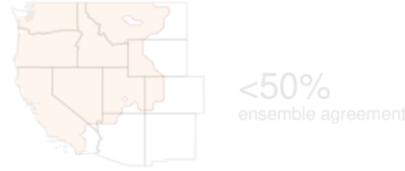
North-Ridge



north-ridge signal, <50% agreement]

ECMWF

North-Ridge



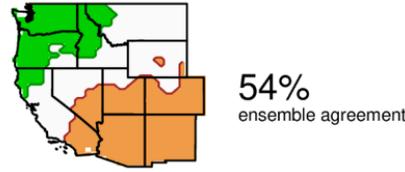
north-ridge signal, <50% agreement]

South-Ridge



dry conditions
wet conditions

South-Ridge



dry conditions
wet conditions

West-Ridge



west-ridge signal, <50% agreement]

West-Ridge

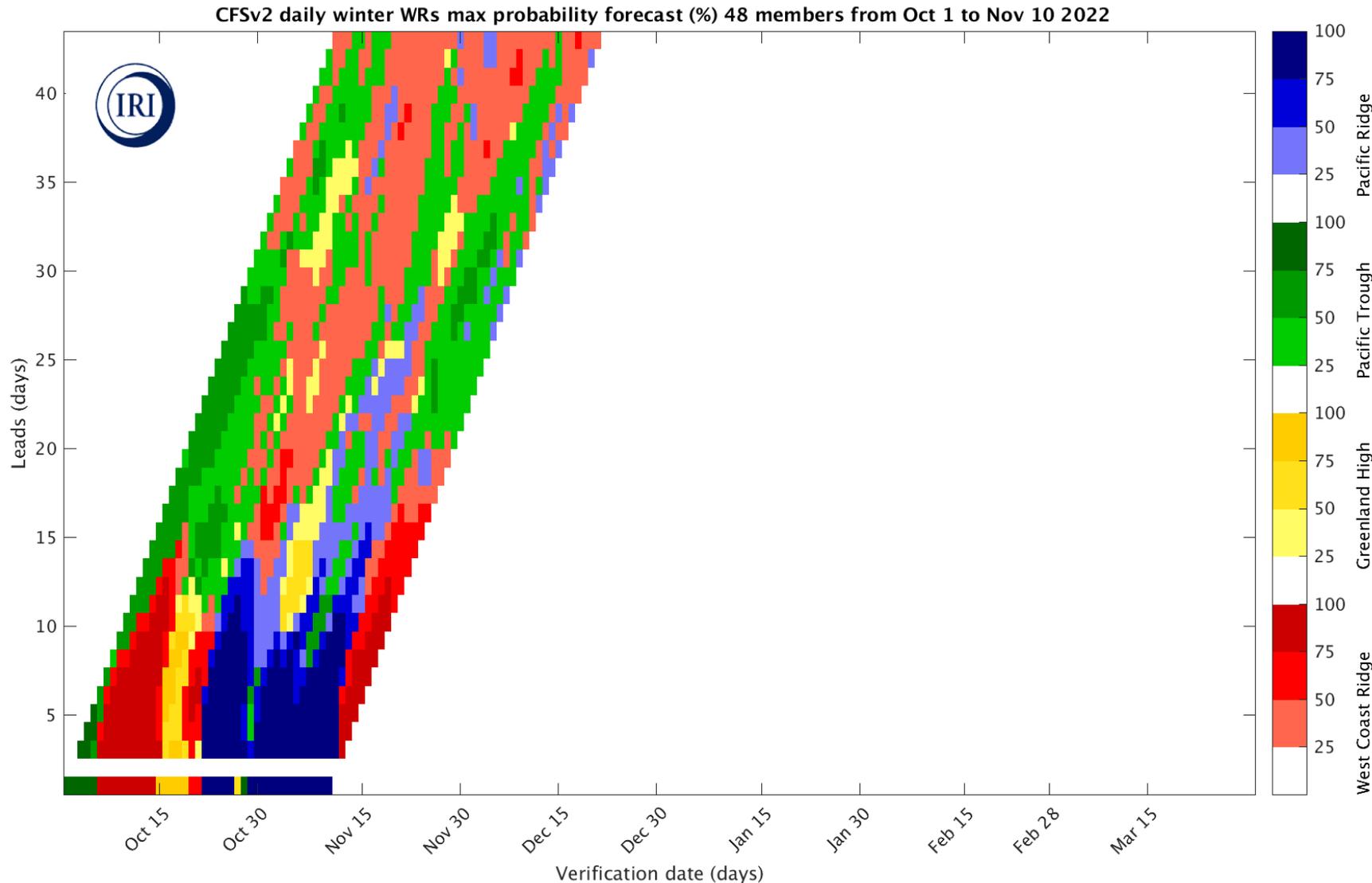


west-ridge signal, <50% agreement]

- Both models show moderate confidence (54% and 62% ensemble agreement) in the occurrence of the South-Ridge type during Weeks 3–4 (24 Nov – 8 Dec)
- 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
- Both models show low confidence (< 50% ensemble agreement) in the occurrence of the North- and West-Ridge types

There is moderate confidence between models in the South-Ridge type during 24 Nov – 8 Dec which is typically associated with dry conditions in Southern CA

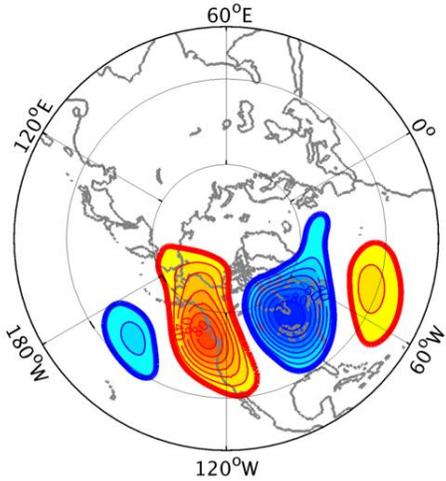
New tool: IRI Subseasonal Weather Regime Forecast



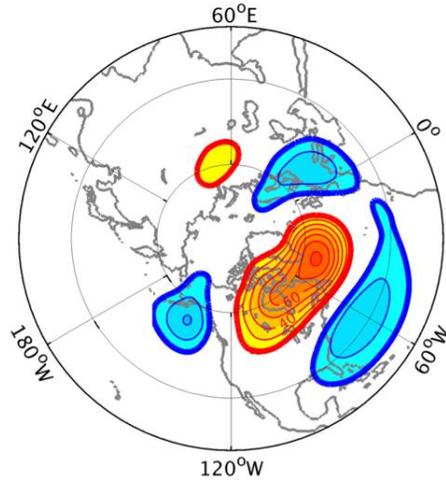
- Daily forecast out to 45-day lead time shown on CW3E S2S website
- Uses NCEP CFSv2 ensemble
- Latest forecast favors West Coast Ridge conditions for weeks 1-3, then Pacific Trough into mid-December and West Coast Ridge in late December

New tool: IRI Subseasonal Weather Regime Forecasts

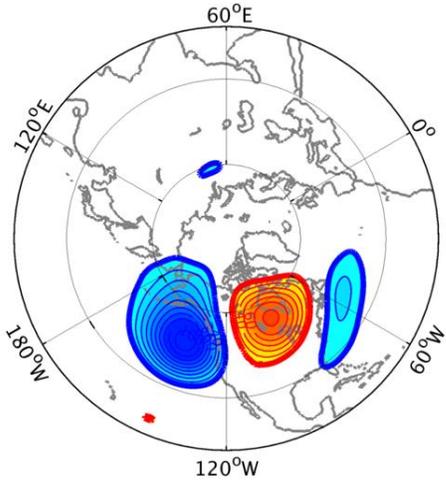
a) WR 1: West Coast Ridge



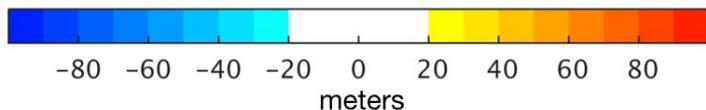
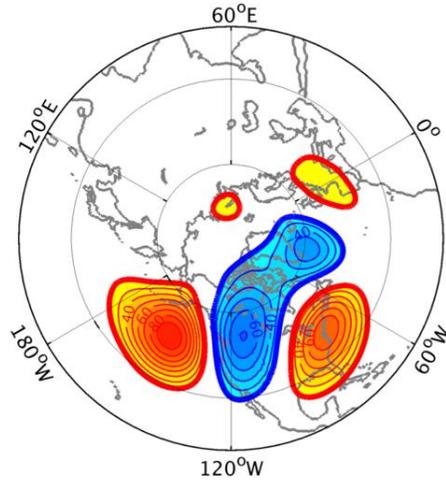
b) WR 2: Greenland High



c) WR 3: Pacific Trough



d) WR 4: Pacific Ridge

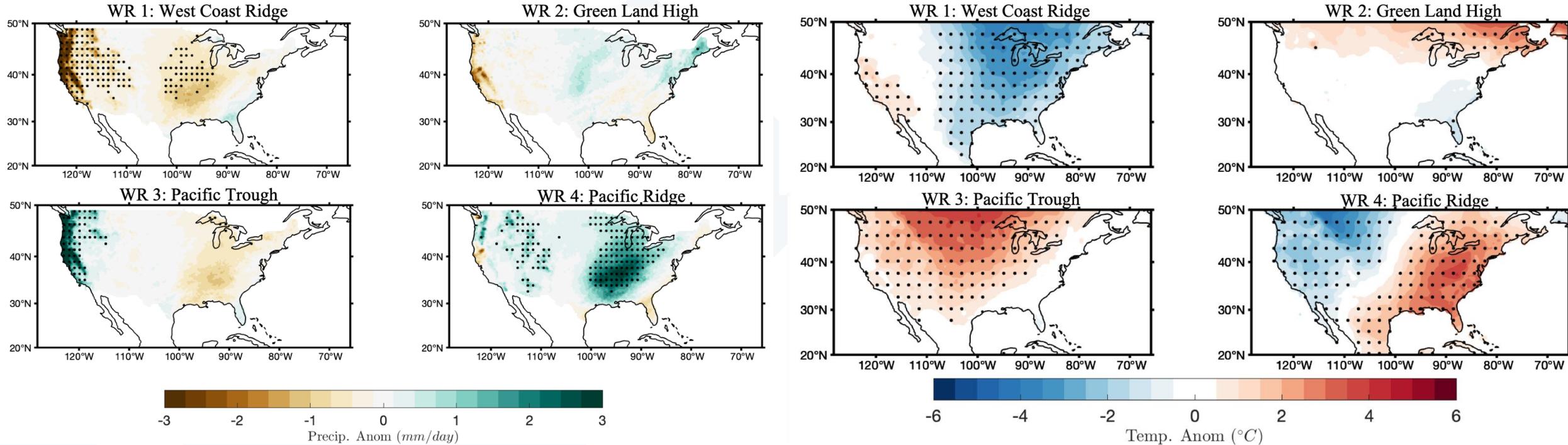


- Four dominant weather regimes identified using k-means cluster analysis on daily Z500 anomalies from MERRA data (1981-2015)

New tool: IRI Subseasonal Weather Regime Forecasts

Precipitation

Temperature



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

- Dry and warm conditions over CA are predicted in late November with high confidence and late December with low confidence
- Wet and warm conditions over CA are predicted in early December with low confidence

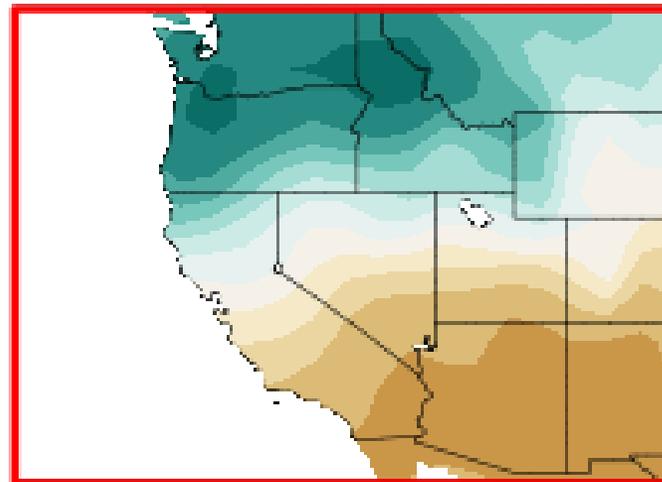
Seasonal Machine Learning Outlooks: Nov 2022–Jan 2023 Precipitation

- The North American Multi-Model Ensemble and CW3E machine learning models based on October SST/global weather patterns are predicting drier than normal conditions for Southern CA and wetter than normal conditions for Northern CA during Nov–Jan with moderate confidence

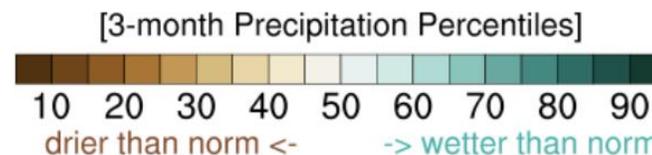
CW3E Machine Learning Models: Nov–Jan Forecast

55% chance for wet North and dry South

Pattern 4

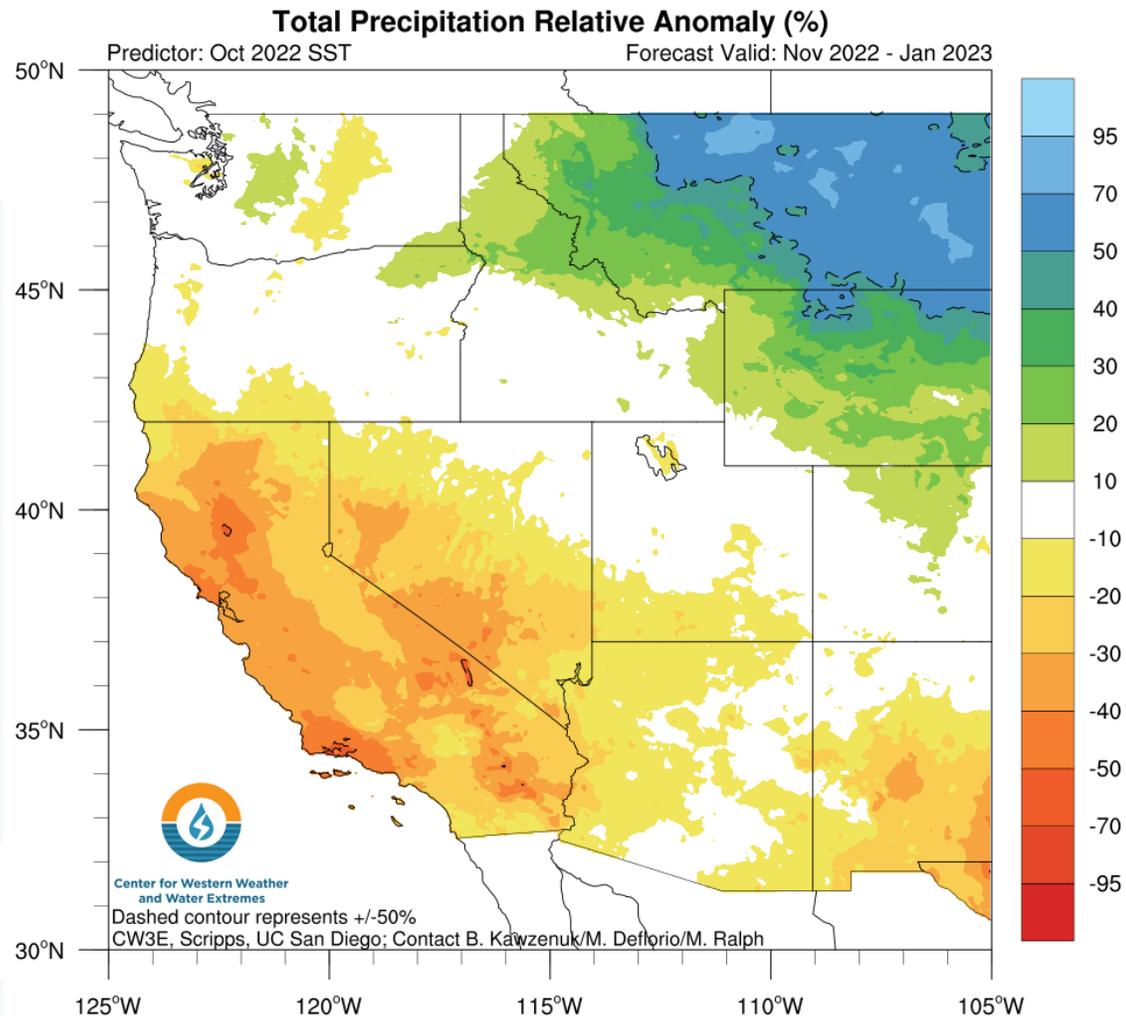


55% ensemble agreement



Skill assessment: Gibson et al. 2021

Seasonal CCA Outlooks: Nov 2022 – Jan 2023 Precipitation



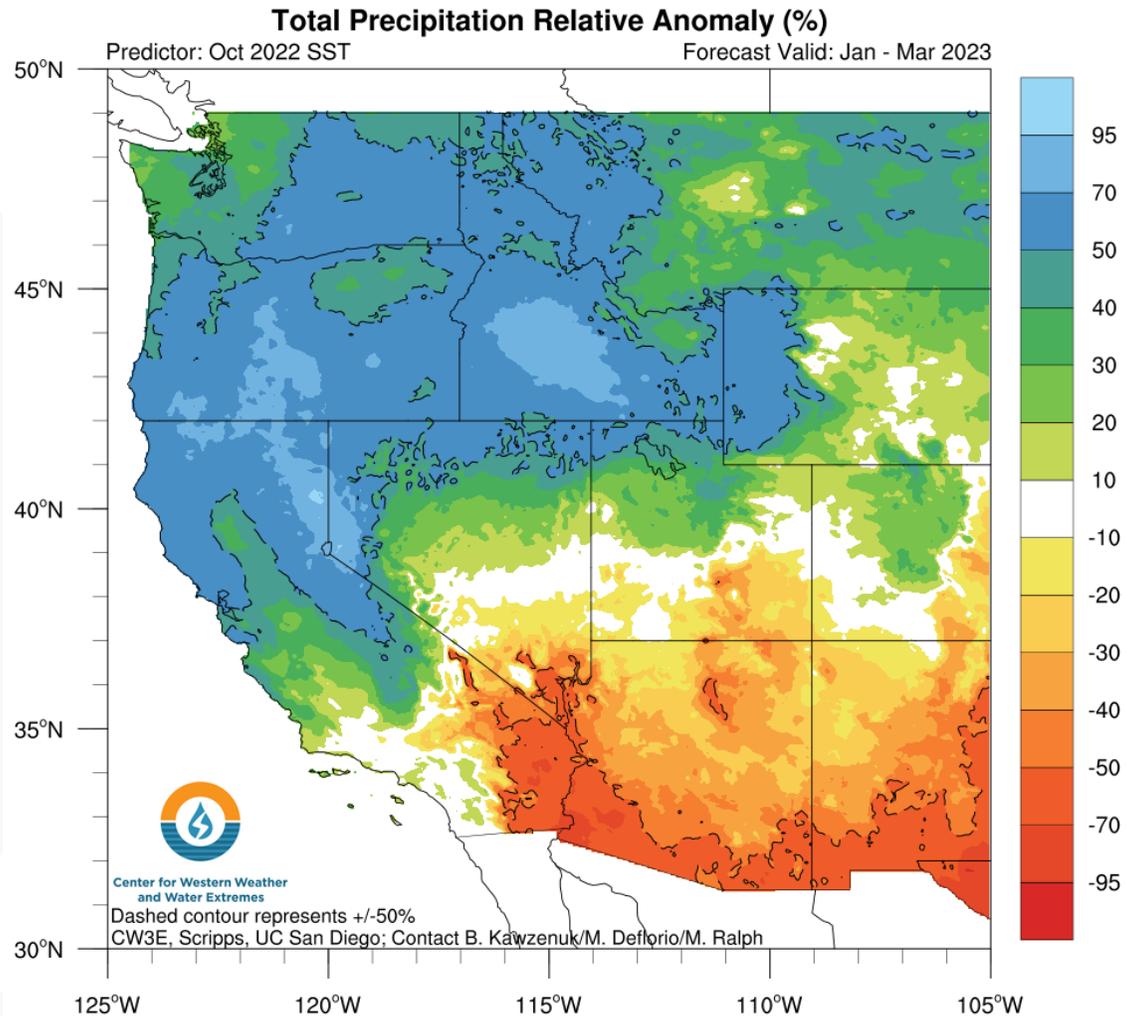
- CW3E statistical model based on October SST is predicting below-normal Nov–Jan precipitation over CA
- La Niña conditions are expected to continue into winter

Context regarding historical skill:

- For both the NDJ and JFM forecasts, skill is highest over the desert SW and Sothern CA compared to Northern and Central CA
- The domain-averaged skill for the JFM forecast is generally higher than that of the NDJ forecast

CCA: Canonical correlation analysis relating seasonal precipitation anomalies to observed monthly Pacific SST anomalies (click [here](#) for more background information)

Seasonal CCA Outlooks: Jan – Mar 2023 Precipitation



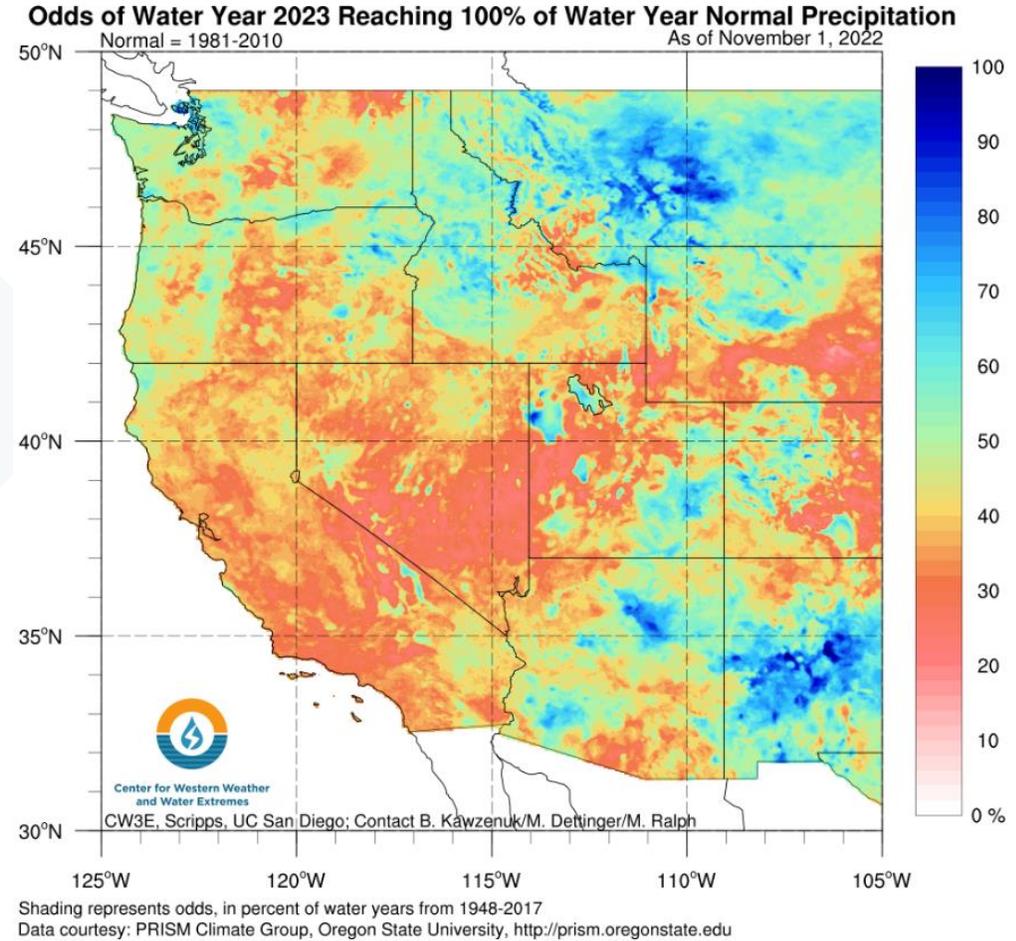
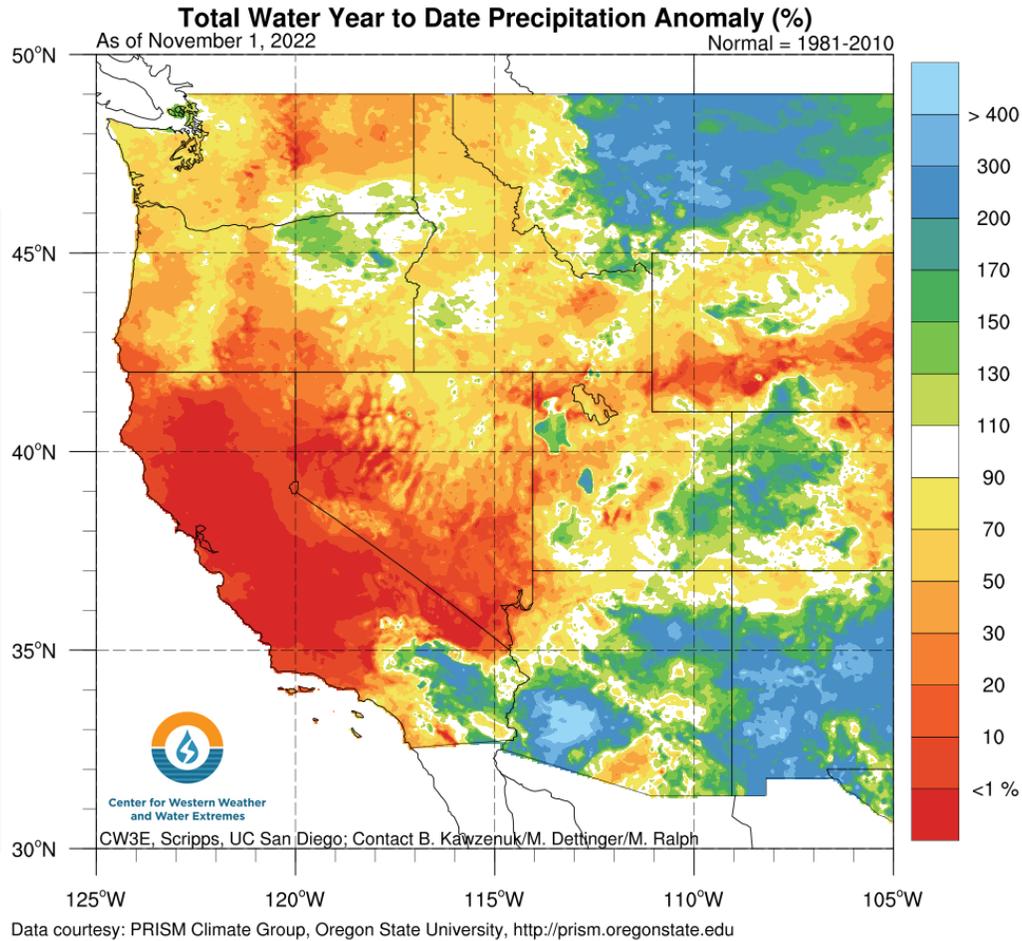
- CW3E statistical model based on October SST is predicting significantly above-normal precipitation over Northern CA and below-normal precipitation over CA during Jan - Mar 2023
- La Niña conditions are expected to continue into spring

CCA: Canonical correlation analysis relating seasonal precipitation anomalies to observed monthly Pacific SST anomalies (click [here](#) for more background information)

Context regarding historical skill:

- For both the NDJ and JFM forecasts, skill is highest over the desert SW and Southern CA compared to Northern and Central CA
- The domain-averaged skill for the JFM forecast is generally higher than that of the NDJ forecast

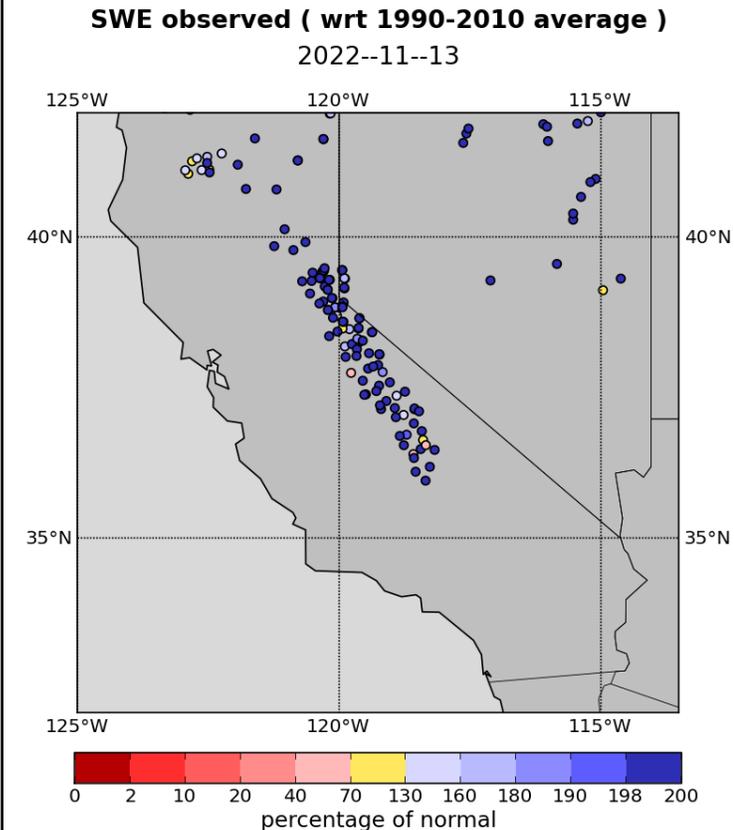
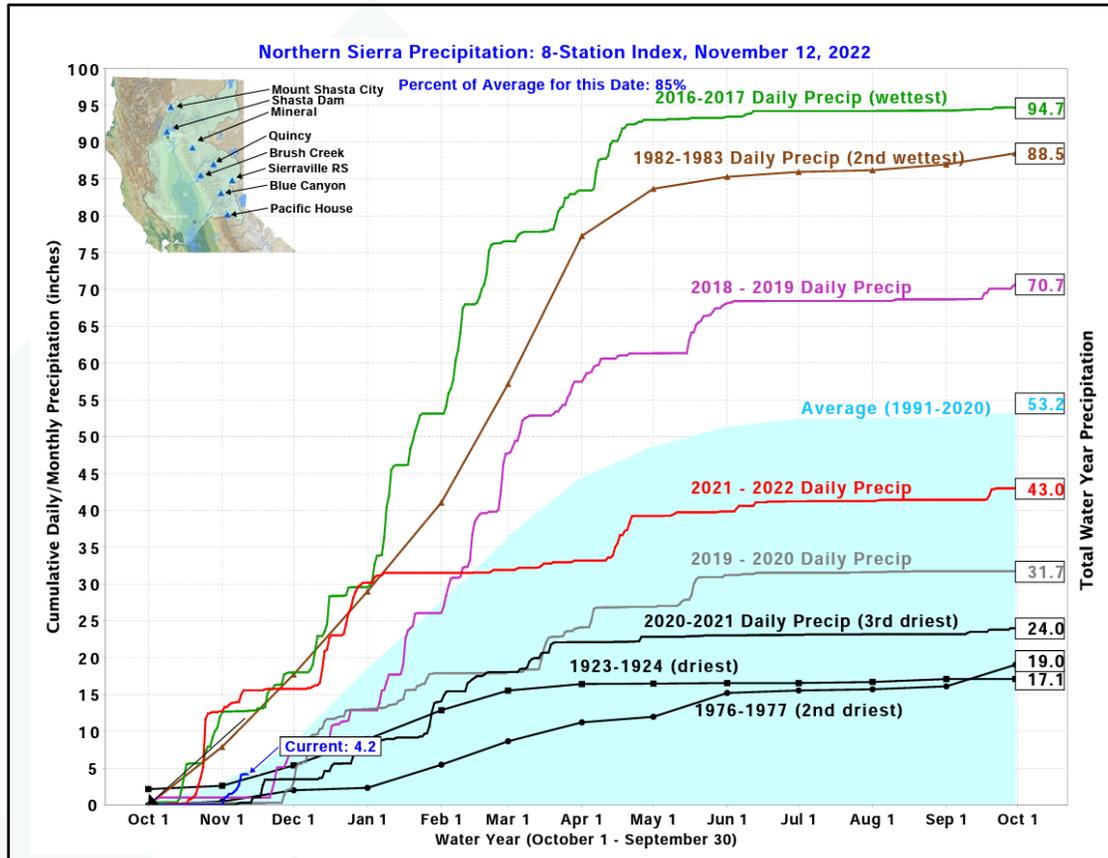
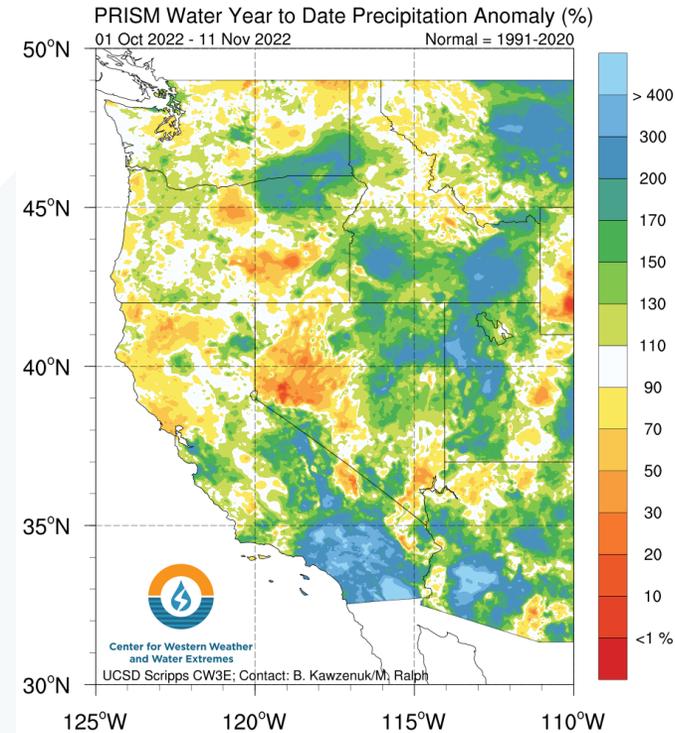
Seasonal Outlooks: Odds of Reaching Normal Water Year Precipitation



Note: Map is based on historical data rather than forecast data

- As of 1 Nov 2022, total water-year-to-date (WYTD) precipitation was running below the climatological normal in Northern and Central CA, and running well above the climatological normal in Southern CA
- Based on historical precipitation data, the probability of reaching normal WY precipitation by the end of Sep 2023 is less than 50% in CA
- The observed precipitation anomalies are largely the result of persistent North-Ridge or West-Ridge type during October that lead to dry conditions across much of the western US

Water Year Precipitation Summary



- As of 11 Nov, water-year-to-date precipitation is above normal across Southern CA
- Total water year precipitation in the Northern Sierra Nevada is now 85% of normal for this date (12 Nov) which is currently below average
- As of 13 Nov, Sierra Nevada snowpack is well above of normal