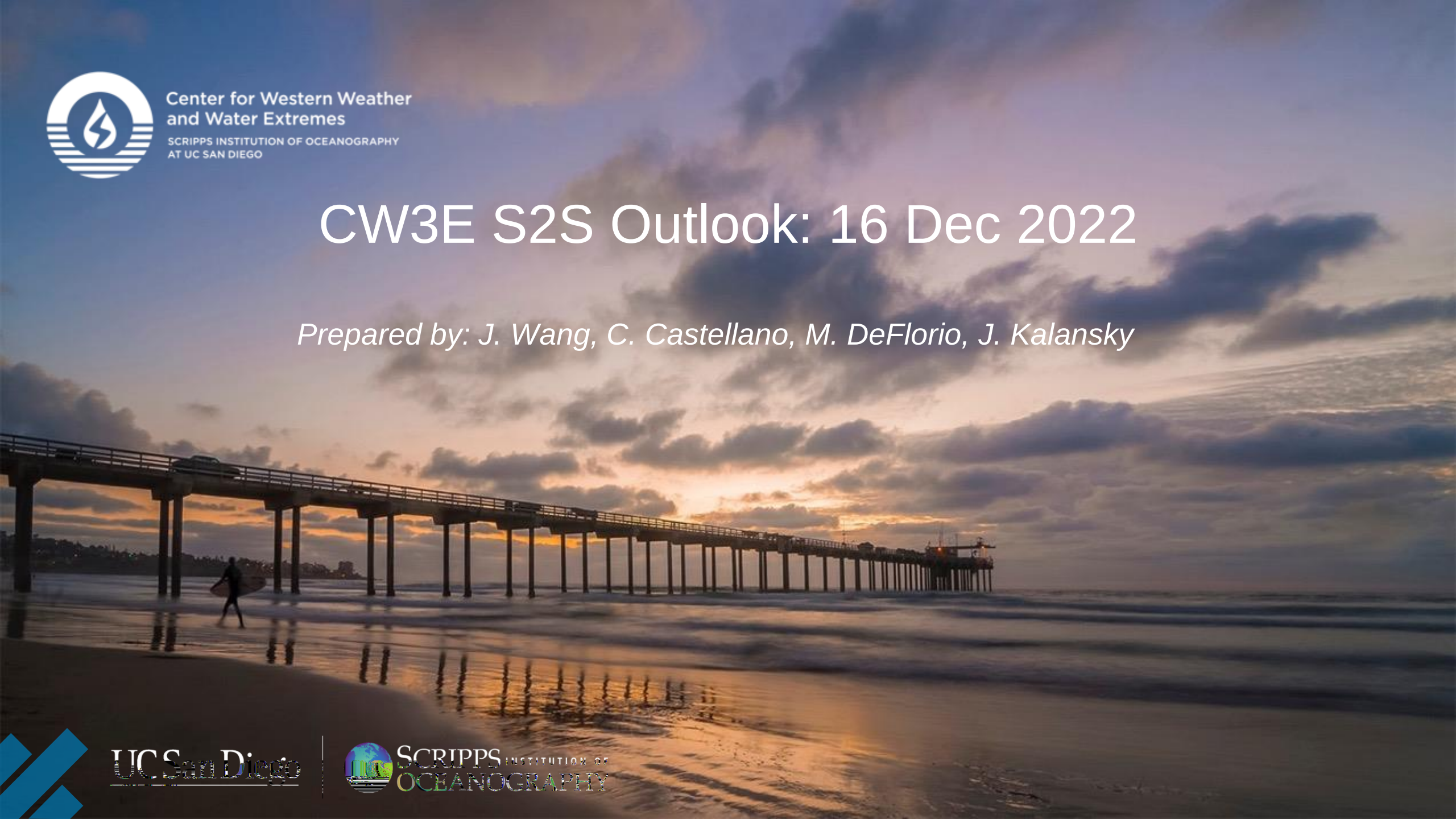

CW3E S2S Outlook: 16 Dec 2022

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

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 (23–29 Dec):** Models agree on the low likelihood (< 30% probability) of AR activity over California
- **Week 3 forecasts (30 Dec–5 Jan):** Models agree on the low amount of AR activity over Central and Southern California
  - NCEP is predicting higher AR activity over Northern California
- The MJO is predicted to be weak in the next two weeks and therefore is not a source of predictability on the subseasonal timescale
- NCEP shows moderate confidence in the occurrence of North-ridge type during weeks 1–2 and weeks 3–4 which is associated with dry conditions across the Western US
- CFSv2 suggests a moderate likelihood of West Coast Ridge during Week 2 and Greenland High during Weeks 3–4 which favor dry conditions over Northern California
- **Seasonal forecasts (Dec–Feb):** Statistical model is predicting significant drier than normal conditions over Central and Southern CA
- **Seasonal forecasts (Jan–Mar):** Statistical model predicts significant drier than normal conditions across CA, especially over Southern CA

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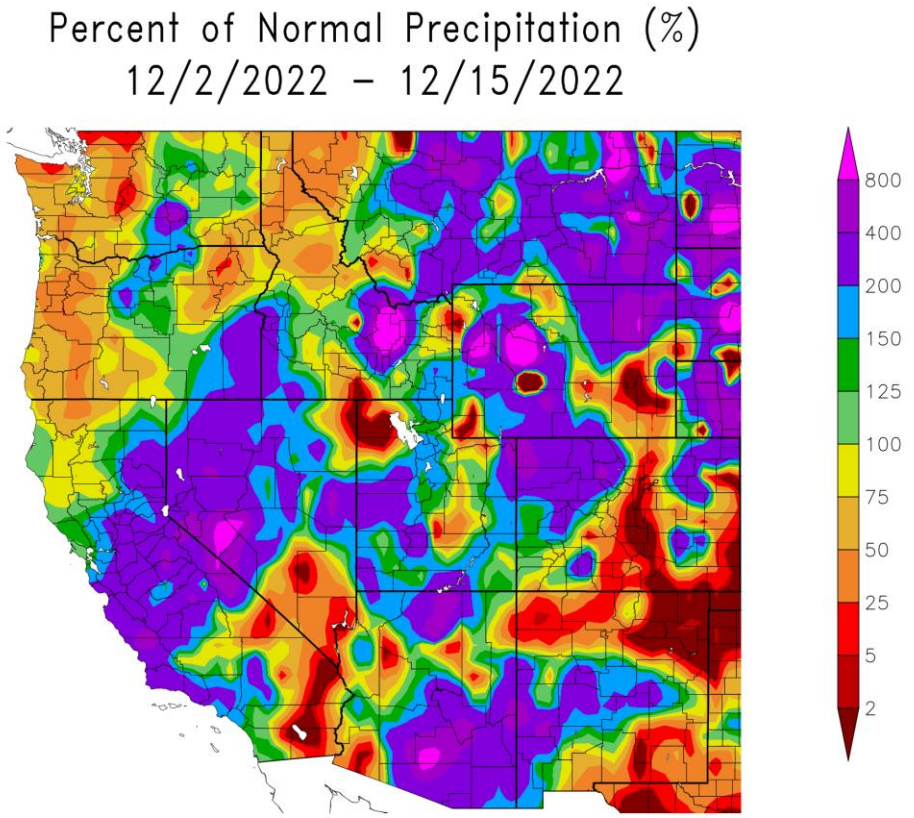
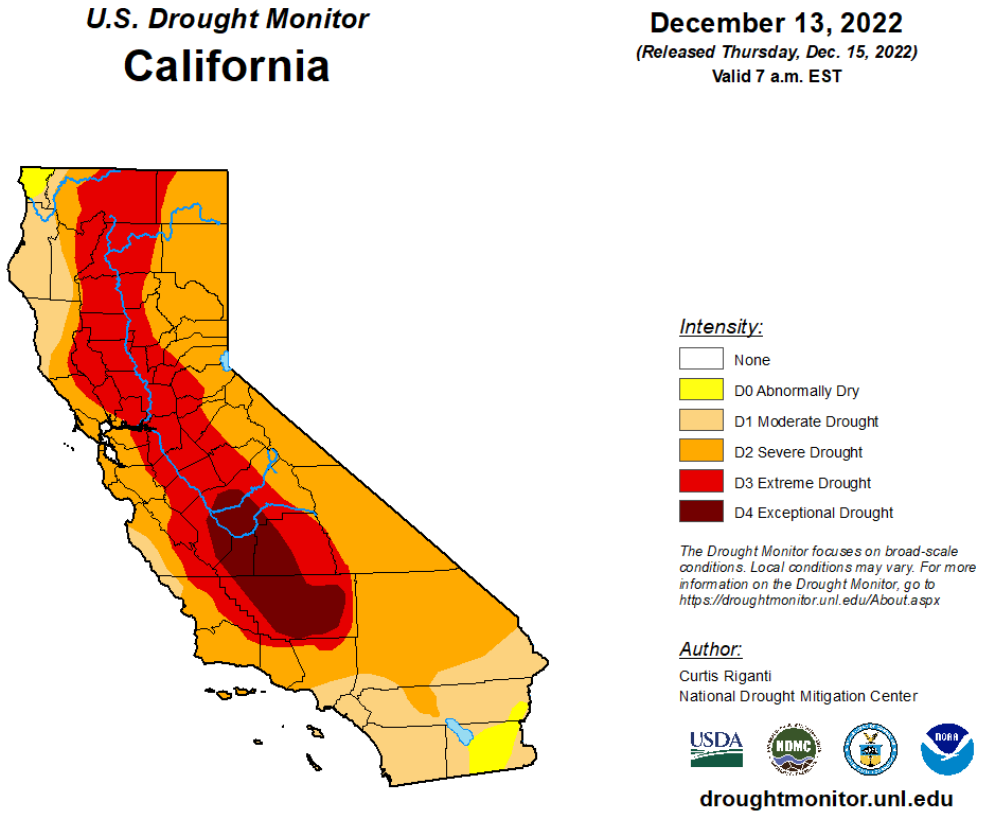
Looking Back: Recent Precipitation and Drought Conditions





- Central CA has experienced very wet conditions over the past two weeks while Southern CA was in very dry conditions
- Observed precipitation in California is consistent with a few ARs in the past two weeks that made landfall in Central CA
- As of 13 Dec, much of California remains in severe or extreme drought, with exceptional drought conditions over the southern San Joaquin Valley

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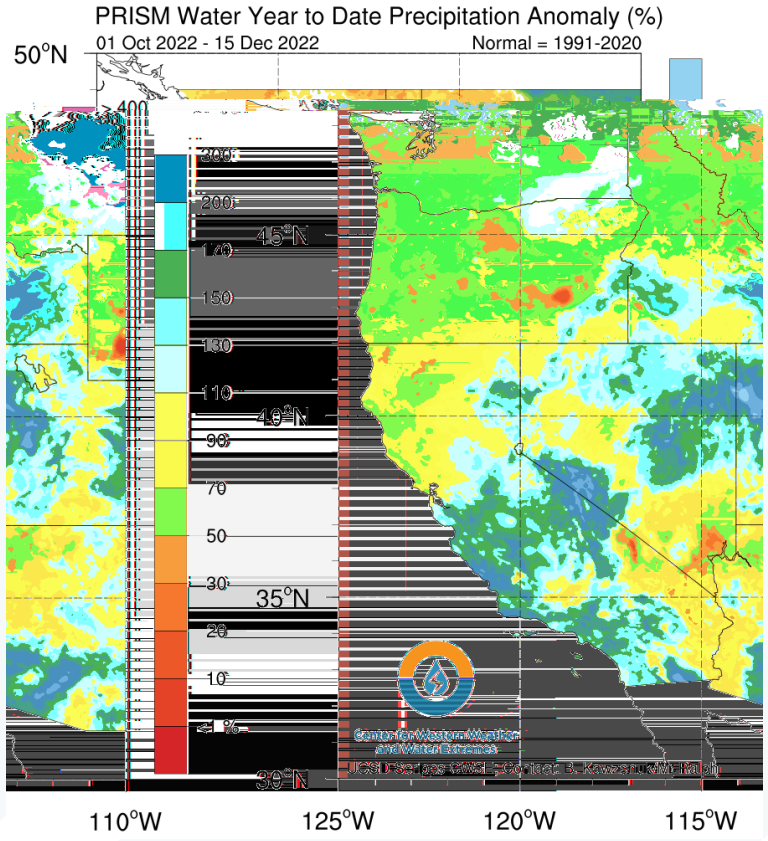
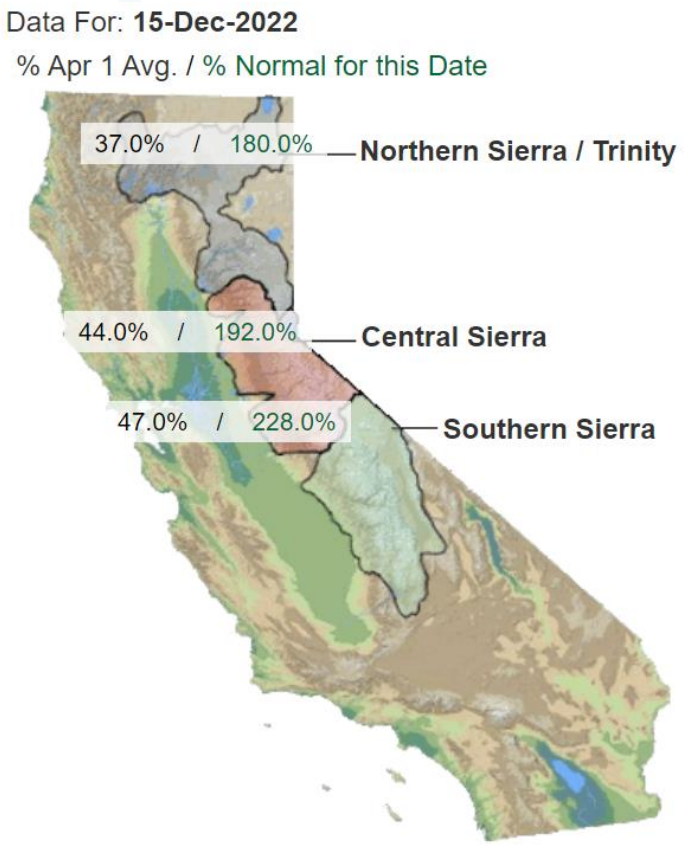
Water Year Hydrologic Summary

Precipitation

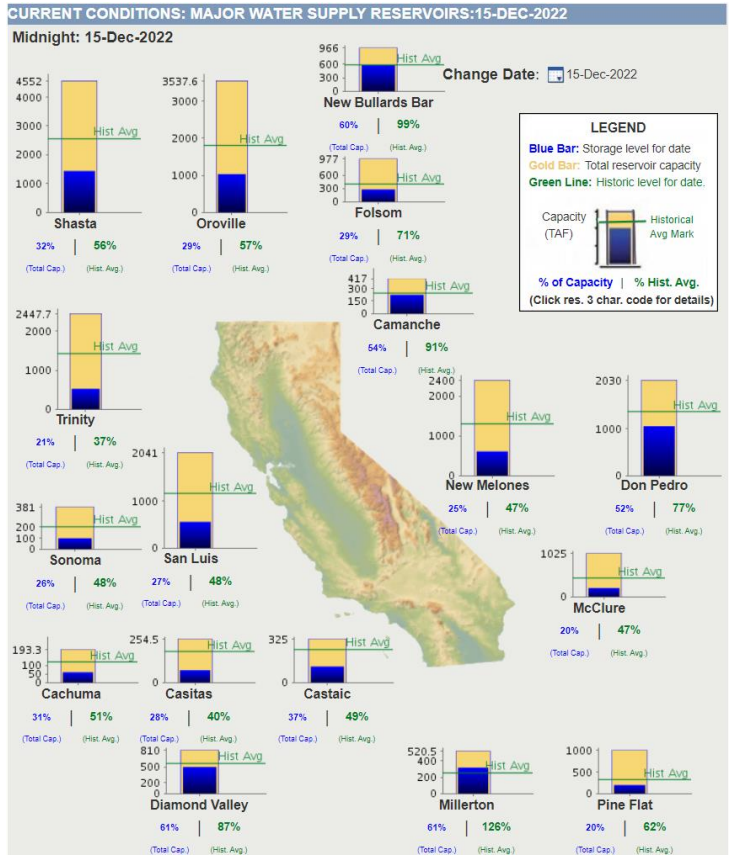


Above-normal: >150%; Below-normal: <50%

Snowpack Conditions



Reservoir Storage



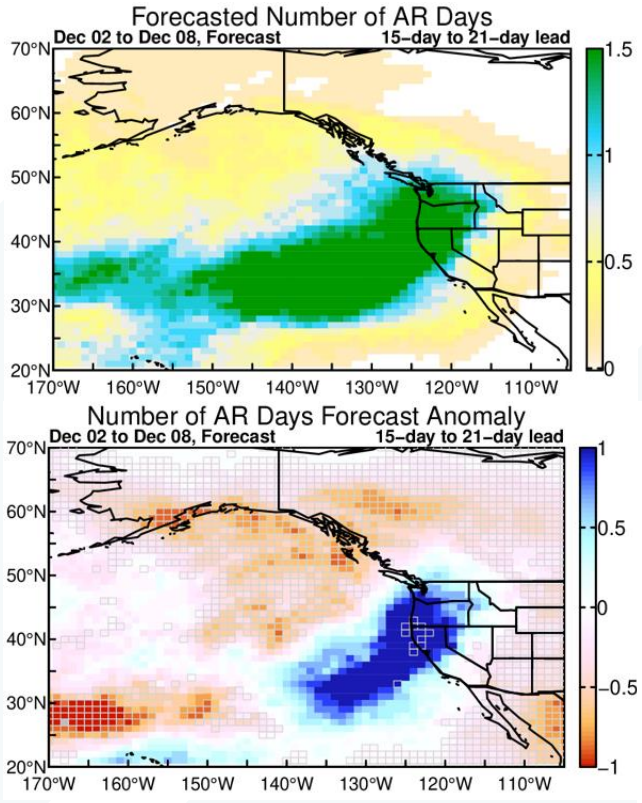
Source: California Department of Water Resources

- As of 15 Dec, water-year-to-date precipitation is above-normal across much of Central and Southern CA and near-normal over Northern CA
- Snowpack is largely above normal for this date in the Sierra Nevada and was mainly provided by two storms during 2–5 Dec and another storm during 9–12 Dec
- Most major reservoirs in California are operating at below-normal (<50% of capacity) storage

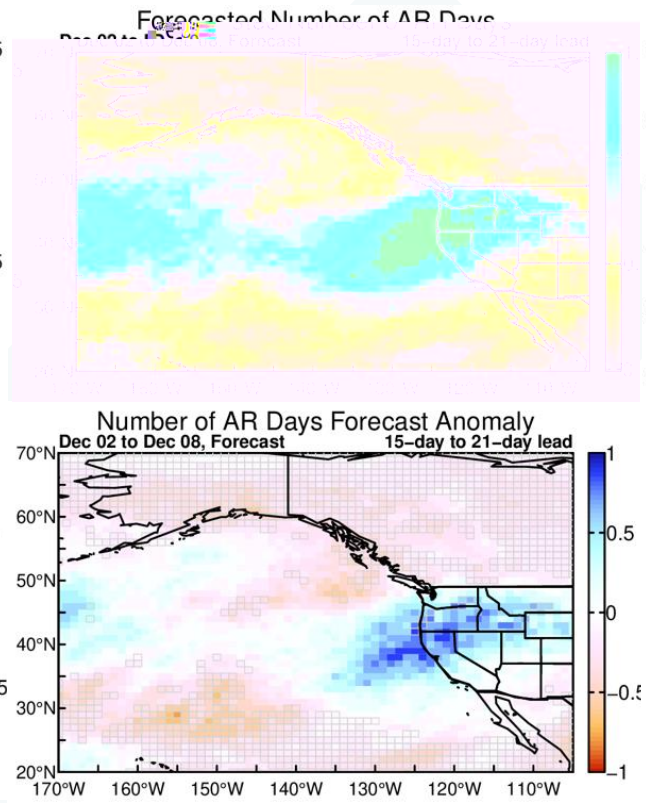
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 17 Nov; Valid: 2–8 Dec 2022

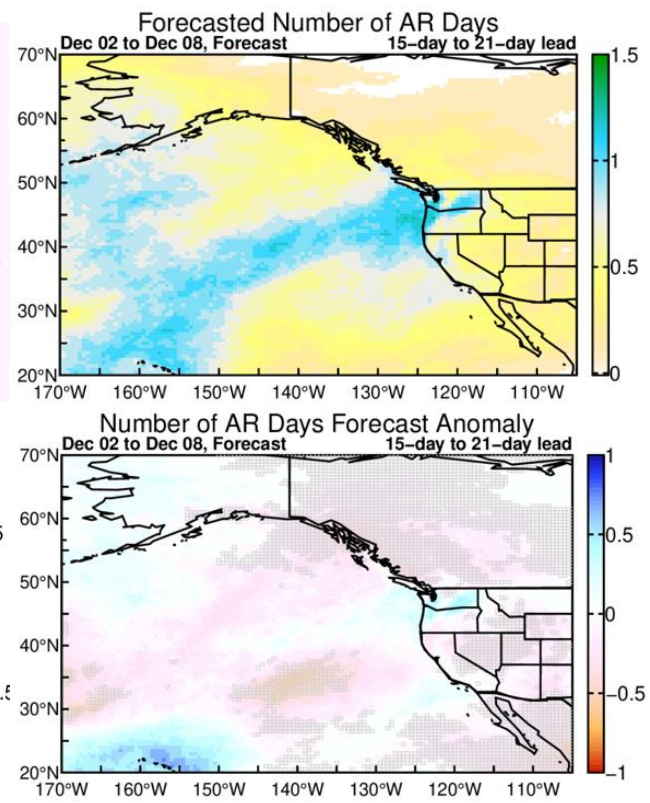
NCEP



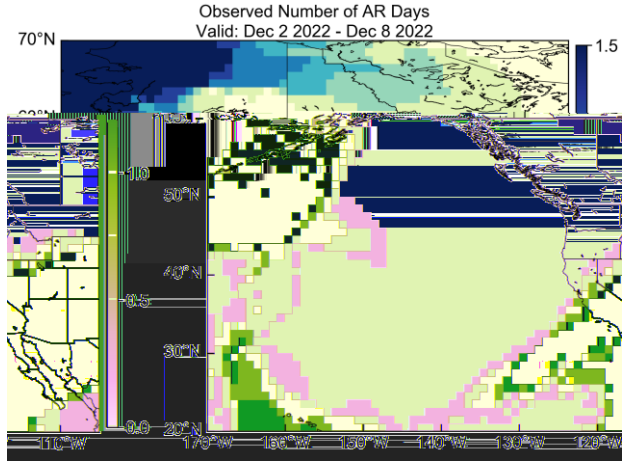
ECCC



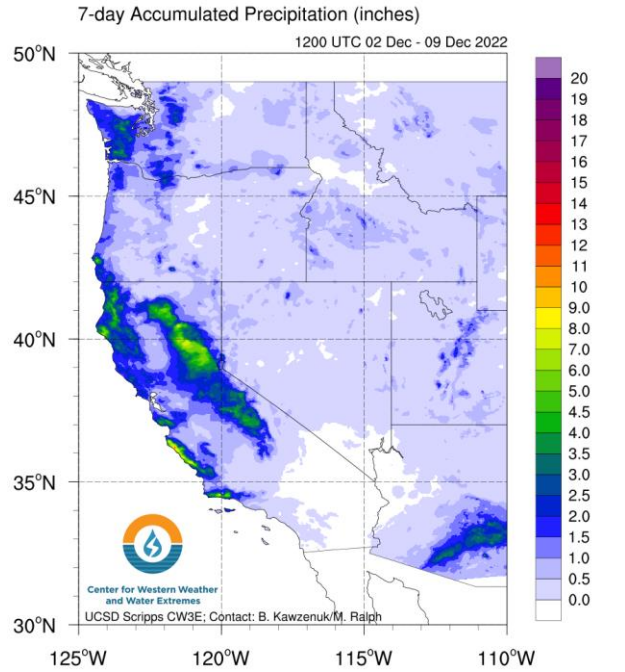
ECMWF



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

No models verified over CA

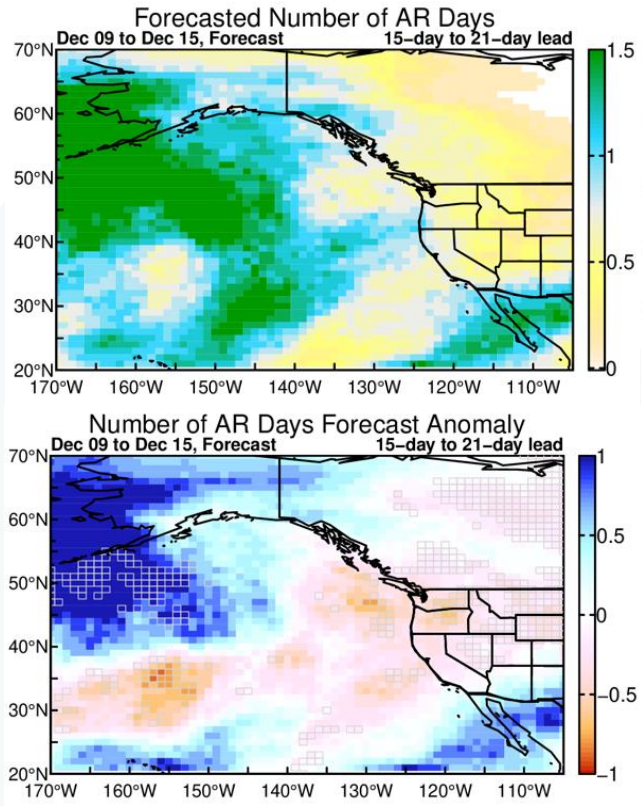
NCEP and ECCC predicted AR activity over the US West Coast, but too far north compared to observed AR activity

- Multiple storms and ARs produced > 5 inches of rain over the Big Sur coast and > 3 feet of snow in the higher terrain of the Sierra Nevada on 2–5 Dec

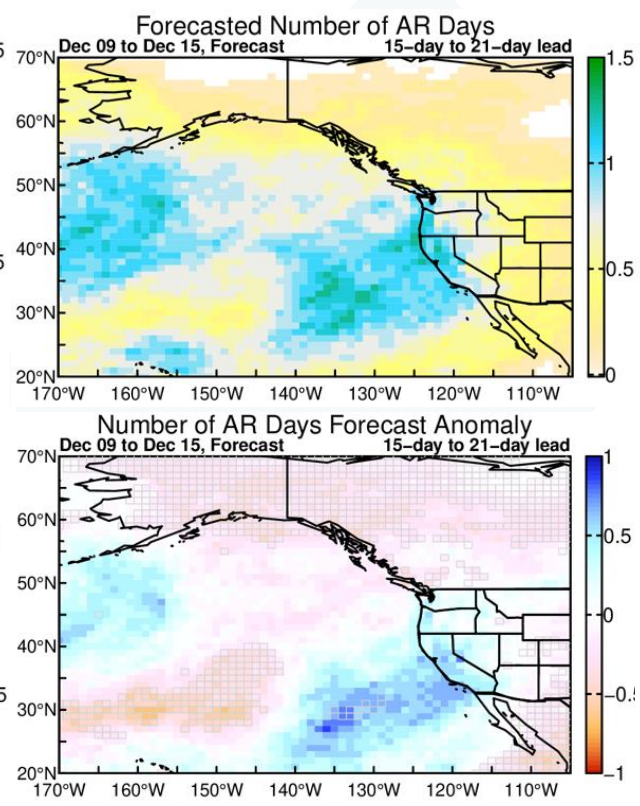
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 24 Nov; Valid: 9–15 Dec 2022

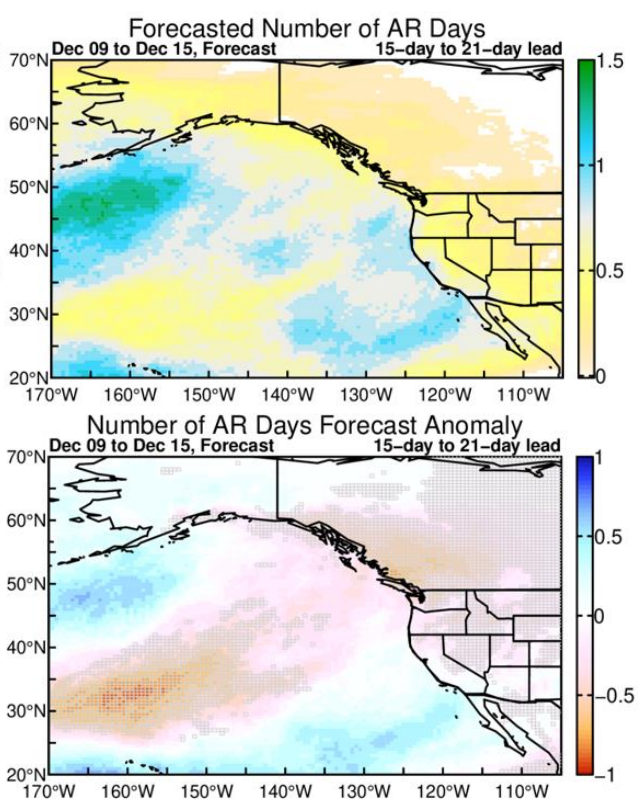
NCEP



ECCC

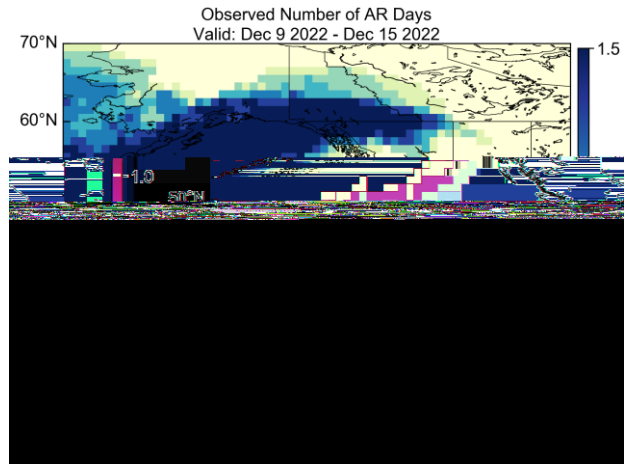


ECMWF

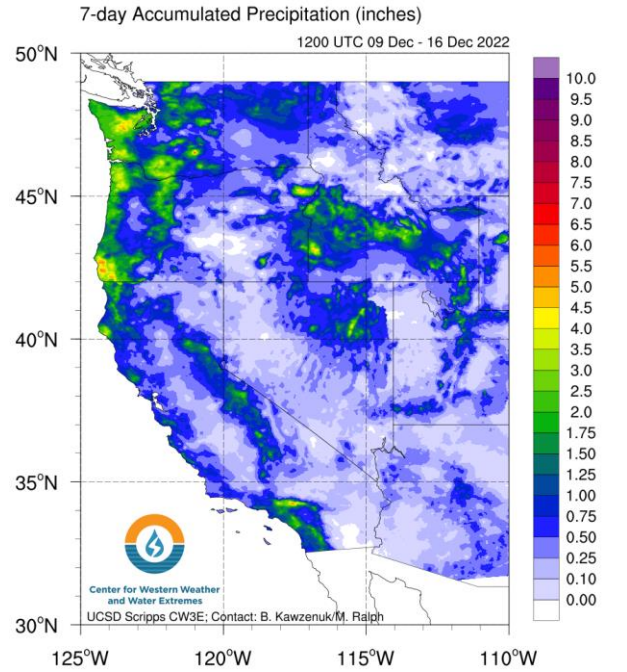


Shading: Fractional # of AR days over a 7-day period (top) and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

Observed (GFS Analysis)



Observed Precipitation

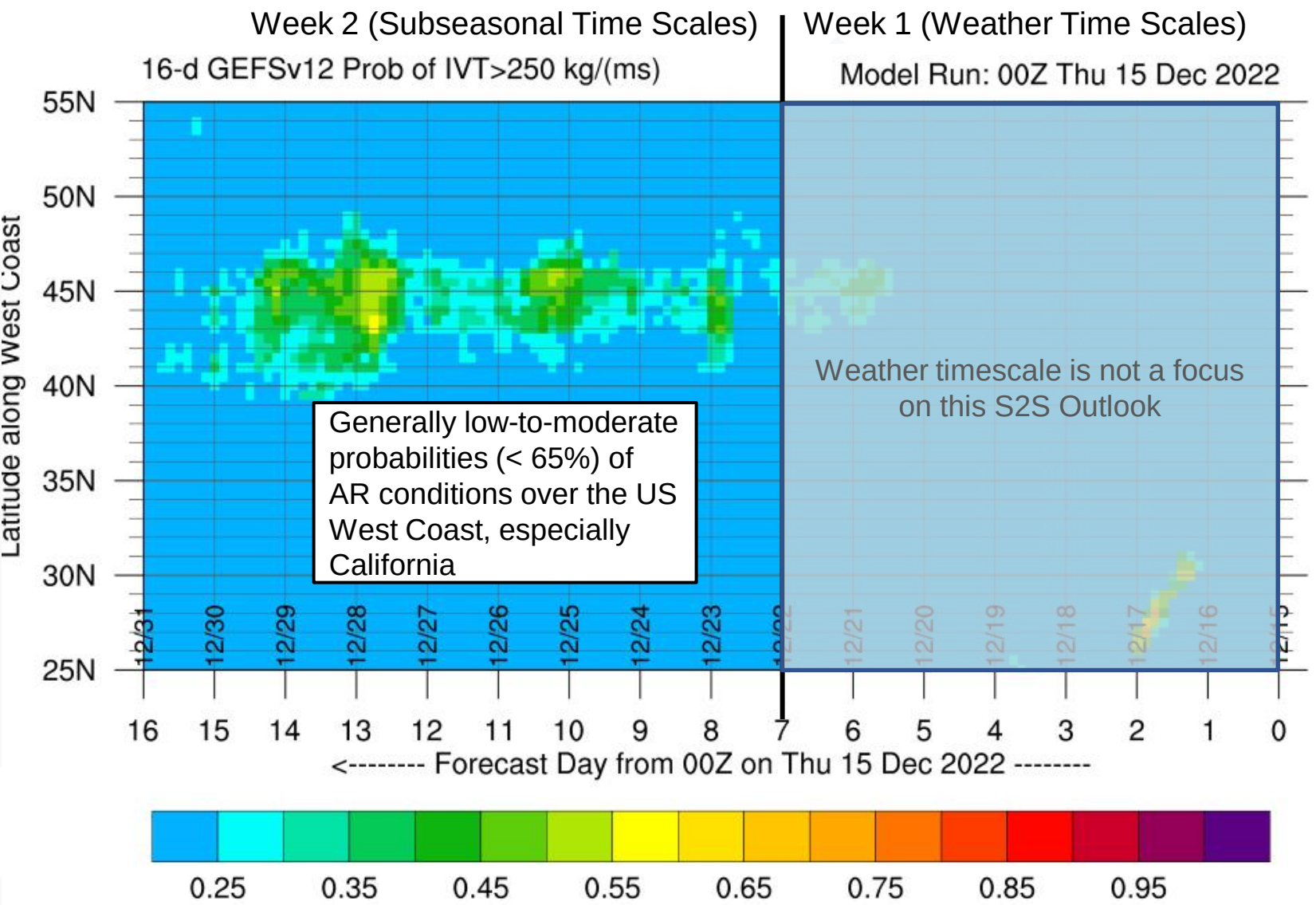


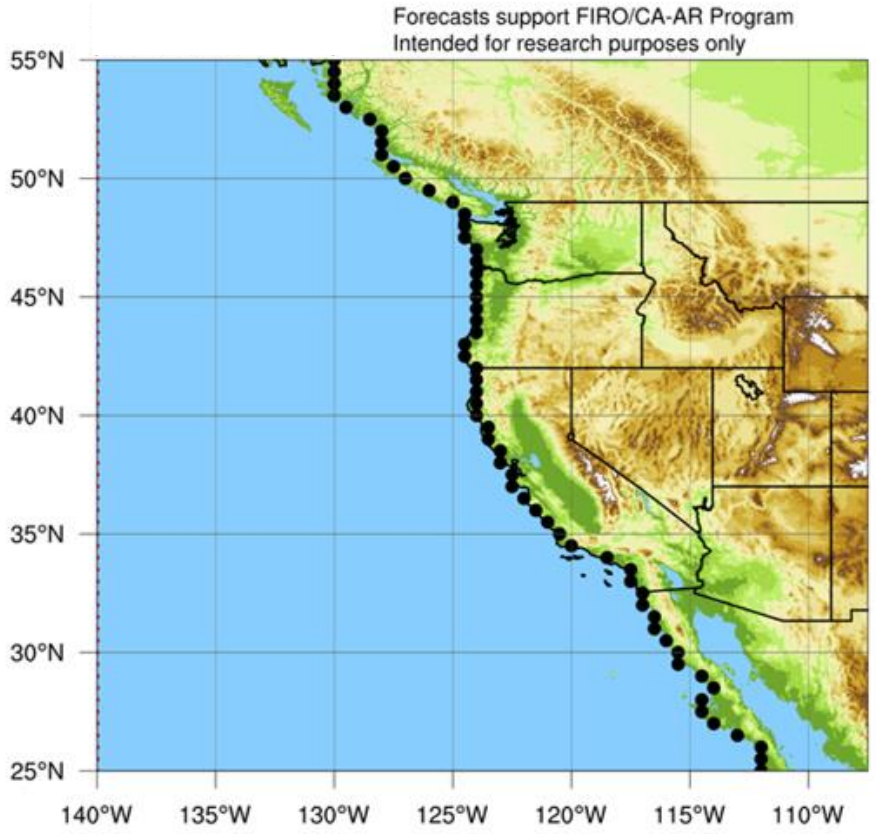
Only ECCC verified over Central CA

- An AR produced heavy precipitation along the Central California coast between the San Francisco Bay area and Santa Barbara on 9–12 Dec
- The largest snowfall totals (> 6 feet) were observed across the higher terrain of the Sierra Nevada with the Klamath mountains receiving 1–3 feet of snowfall

NCEP GEFS AR Landfall Tool: Valid 00Z 15 Dec – 00Z 31 Dec

Forecasts Initialized 15 Dec 2022





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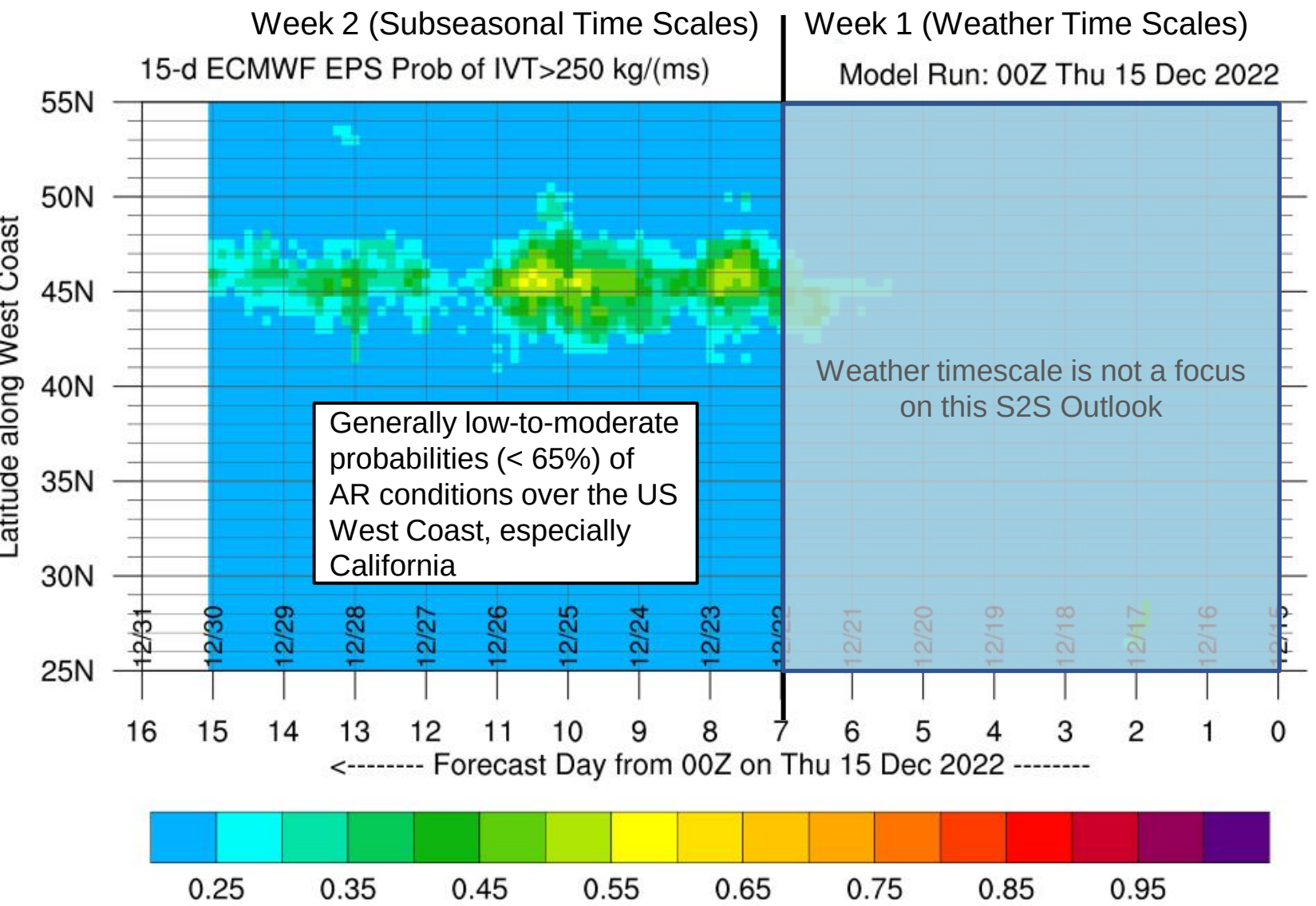
PLYMOUTH STATE METEOROLOGY

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

ECMWF EPS AR Landfall Tool: Valid 00Z 15 Dec – 00Z 30 Dec

Forecasts Initialized 15 Dec 2022



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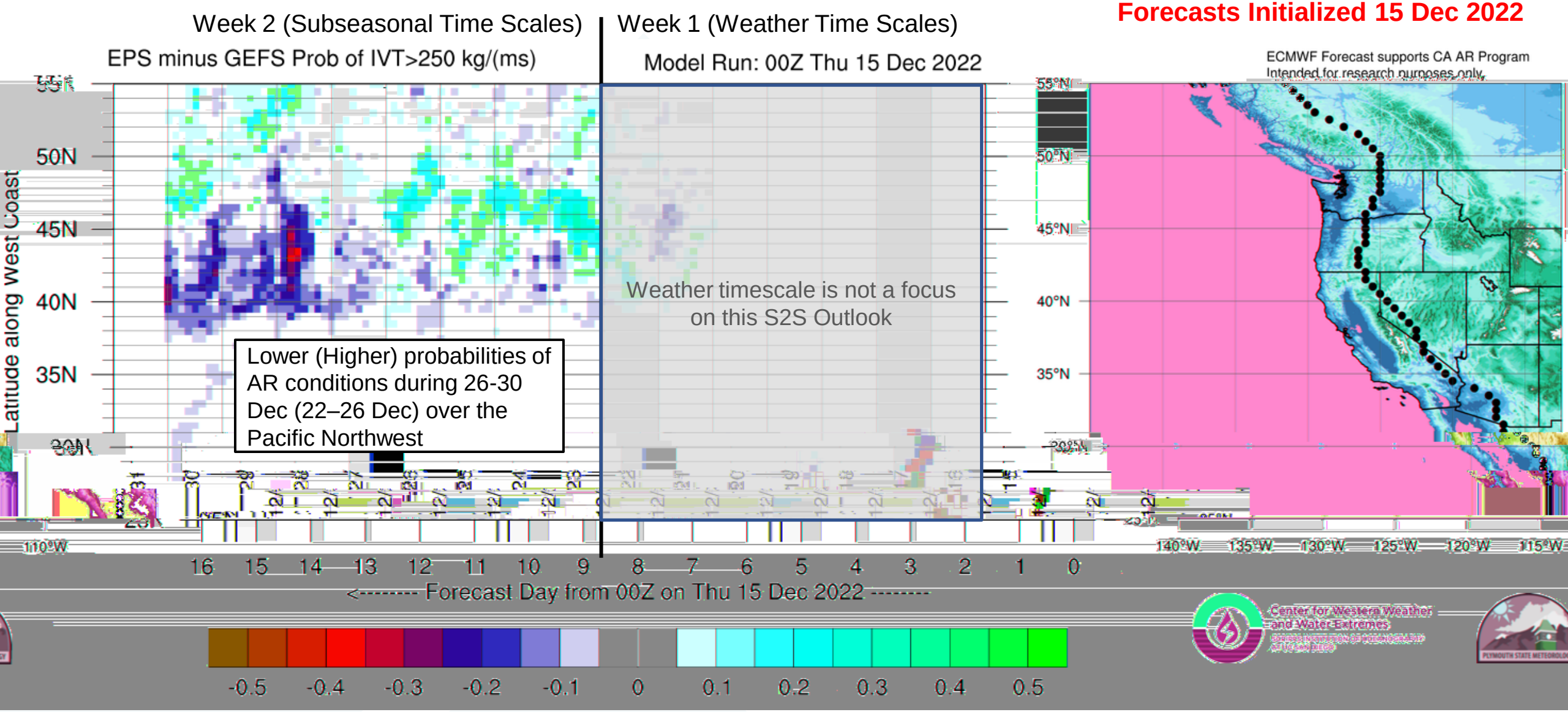
PLYMOUTH STATE METEOROLOGY

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

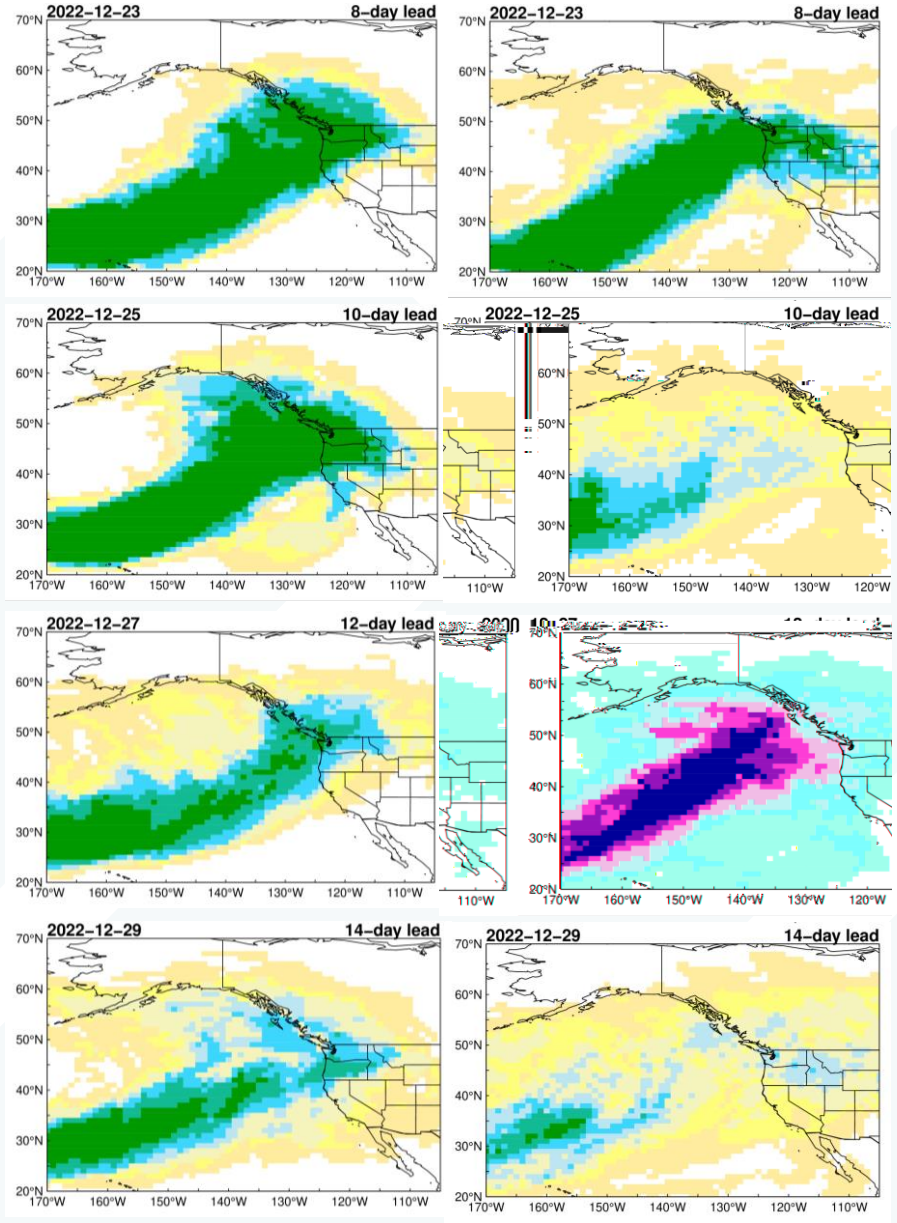
EPS Minus GEFS AR Landfall Tool: Valid 00Z 15 Dec – 00Z 30 Dec

Forecasts Initialized 15 Dec 2022



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

NCEP | **ECCC** | **ECMWF**



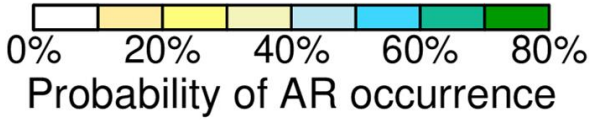
Unavailable

Forecasts Initialized 15 Dec 2022

- NCEP and ECCC models are showing generally low probabilities (< 30%) of AR activity in California during Week 2 (23–29 Dec), with slightly higher probability (>50%) of AR activity in Northern CA on 23 Dec

- NCEP model is predicting much higher probabilities (>60%) of AR activity in OR/WA during week 2

All models agree on the low likelihood of AR activity over California in Week 2 (23–29 Dec)



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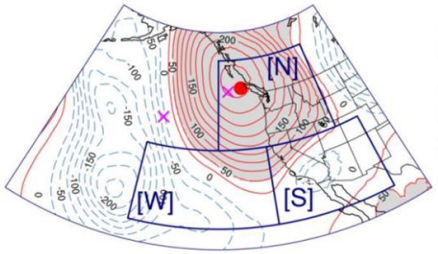
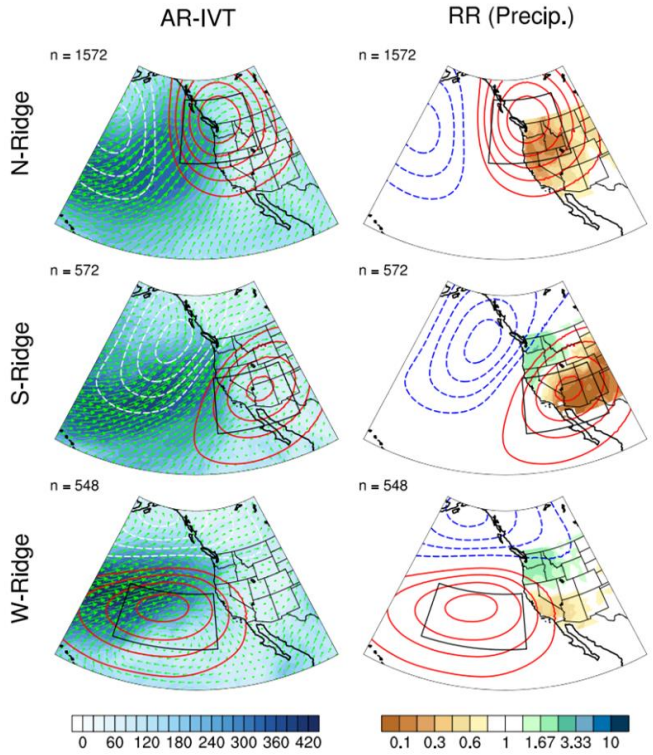
AMBASSADOR™ WRN WEATHER-READY NATION

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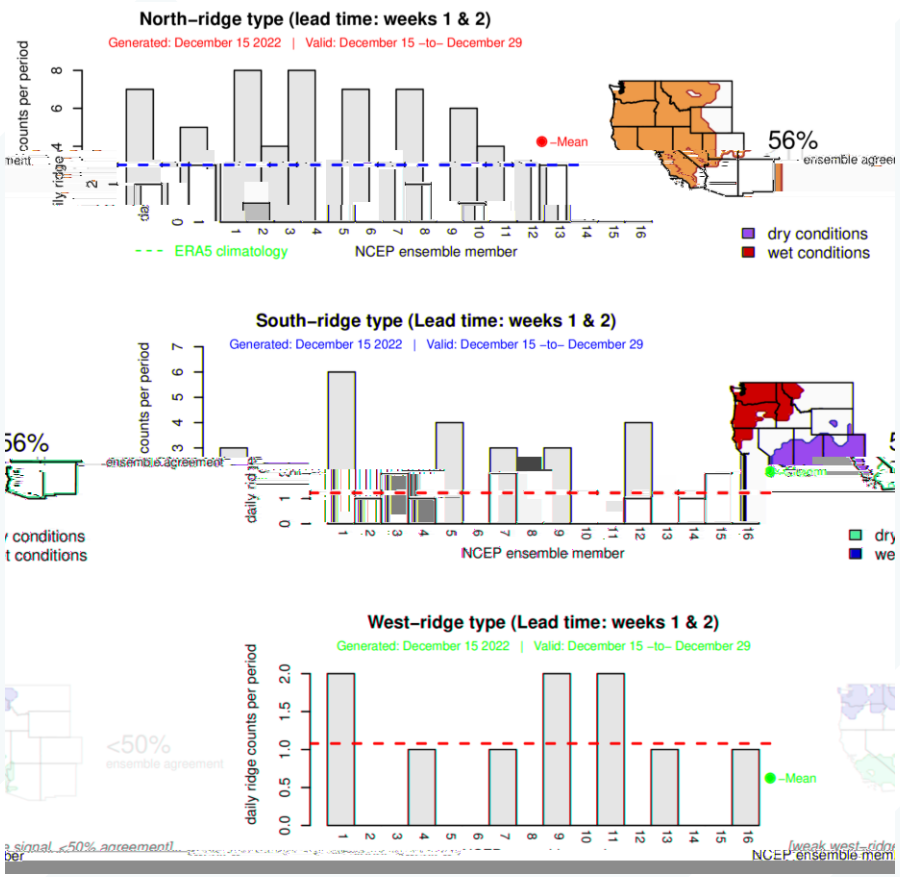
Contact: pgibson@ucsd.edu
Reference: Gibson et al. (2020) Journal of Climate

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

Forecasts Initialized 15 Dec 2022

NCEP



ECMWF
Unavailable

- NCEP shows moderate confidence (56% ensemble agreement) in the occurrence of North-ridge and South-ridge types during weeks 1–2 (15–29 Dec)

There is a moderate likelihood of the occurrence of North-ridge or South-ridge types during 15–29 Dec

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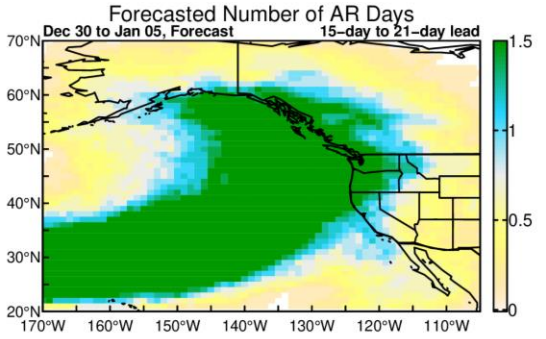
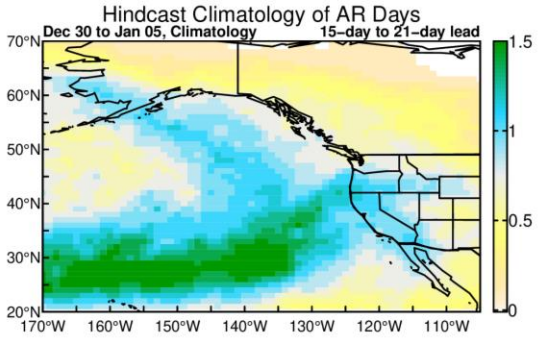
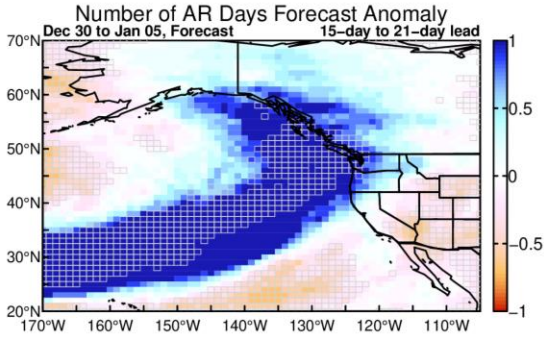
Subseasonal Outlooks: Week 3 AR Activity (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 15 Dec 2022

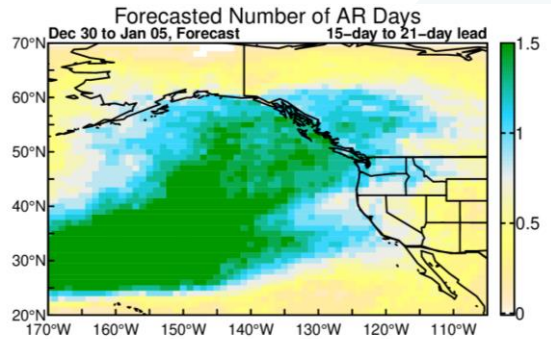
NCEP

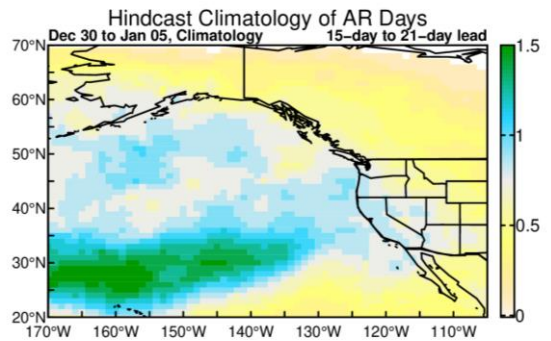


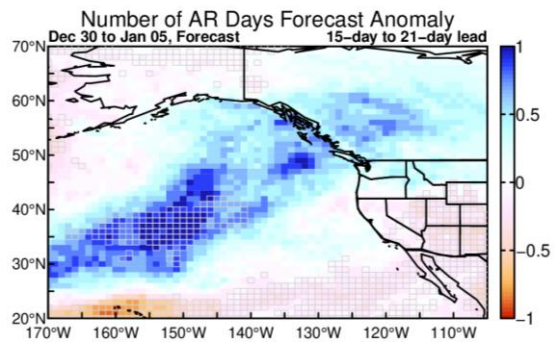




ECCC







ECMWF

Unavailable

- NCEP and ECCC models are predicting near-to-below-normal AR activity over CA during Week 3 (30 Dec-5 Jan)
- NCEP is predicting higher AR activity over Northern CA

Little AR activity is predicted over Central and Southern California during Week 3 (30 Dec – 5 Jan)
Some AR activities are predicted over Northern CA by the NCEP model

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 the sign of anomaly
Above-normal: >0.5; Below-normal: <-0.5

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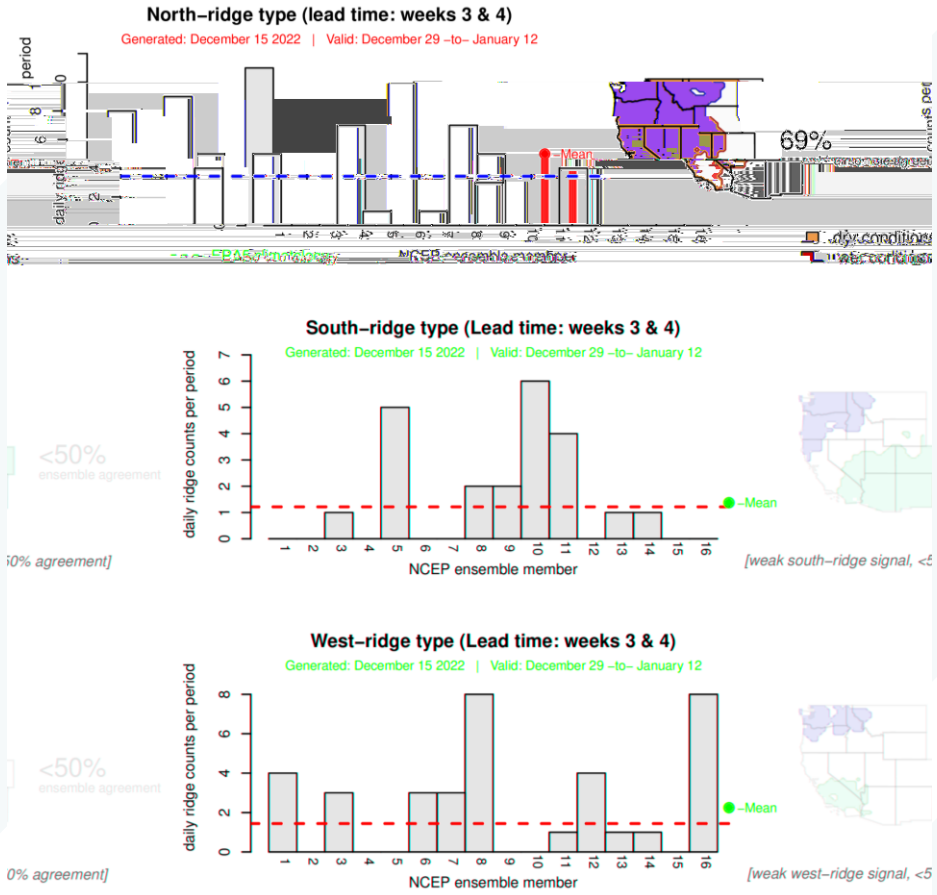
Subseasonal Outlooks: Weeks 3–4 Ridging Forecasts (NCEP vs. ECMWF)

Forecasts Initialized 15 Dec 2022

NCEP



ECMWF
Unavailable

- NCEP shows moderate confidence (69% ensemble agreement) in the occurrence of North-ridge type during Weeks 3–4 (29 Dec – 12 Jan)
- NCEP is predicting near-normal occurrence (ensemble mean close to climatology) of the South-ridge type

There is a moderate likelihood of the occurrence of North-ridge type during 29 Dec – 12 Jan which is typically associated with dry conditions across the Western US

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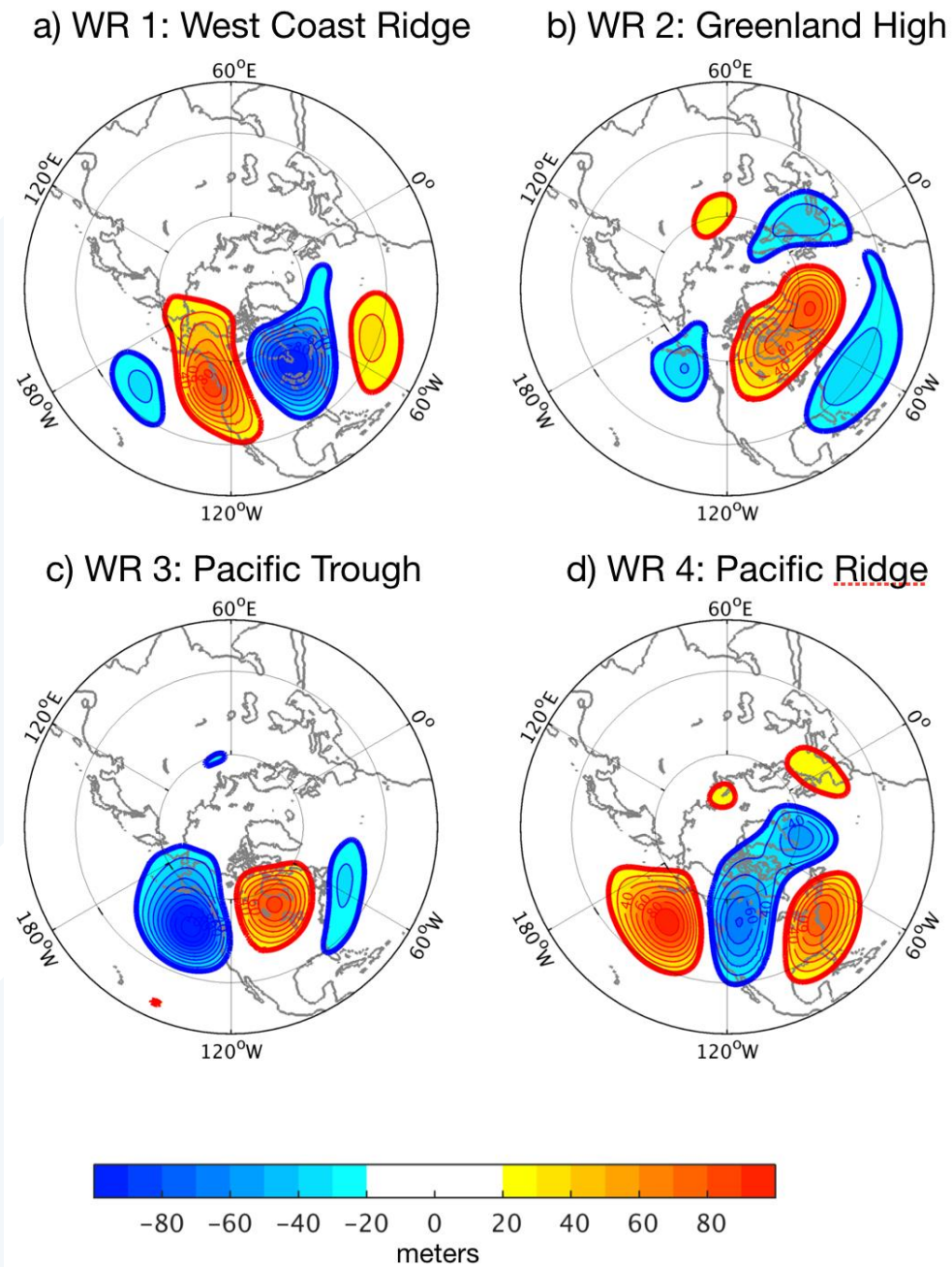
Background Info: IRI Subseasonal Weather Regime Forecasts



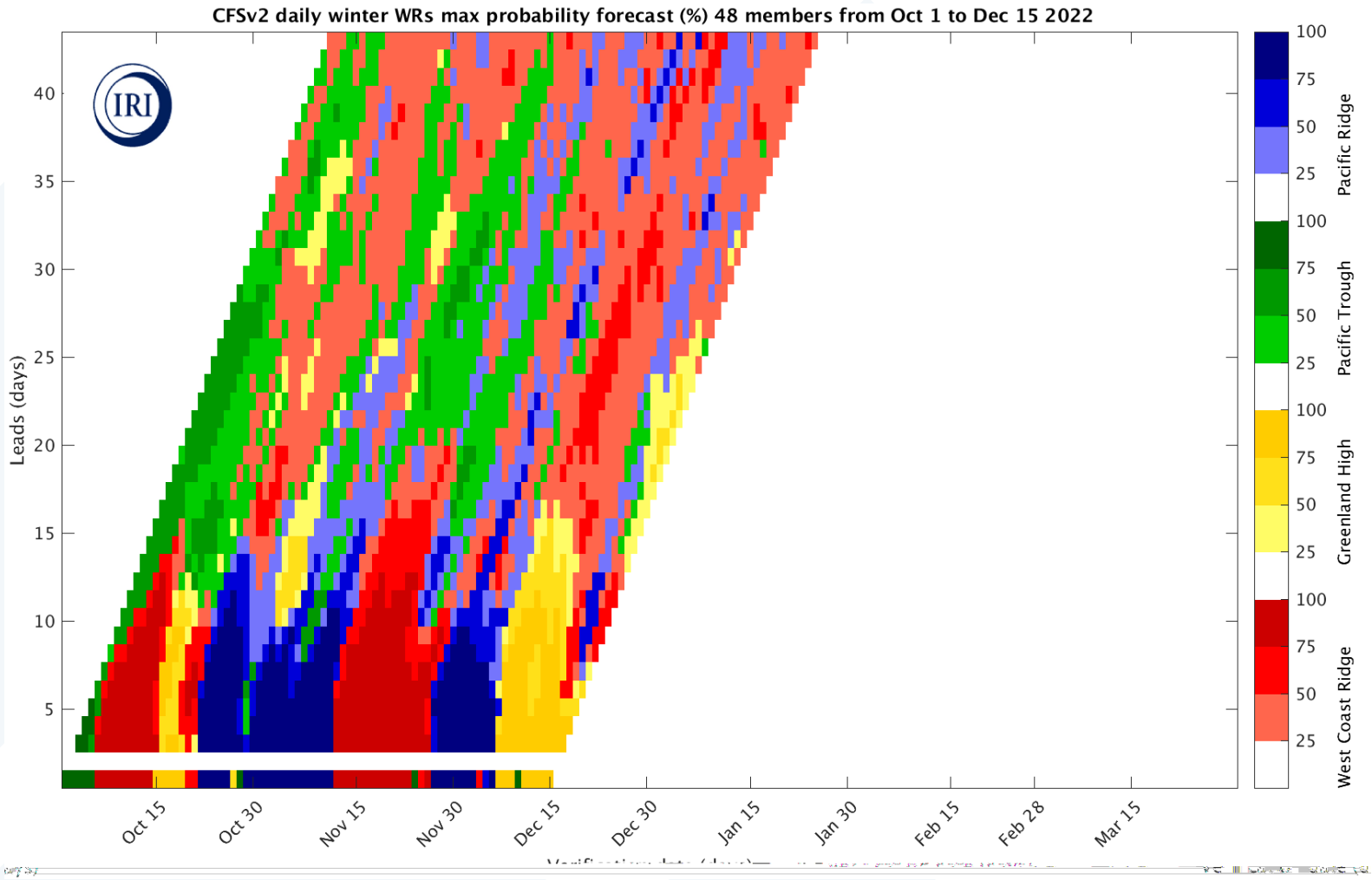
This slide contains background information about IRI's North American weather regime forecast product

- 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 15 Dec 2022



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

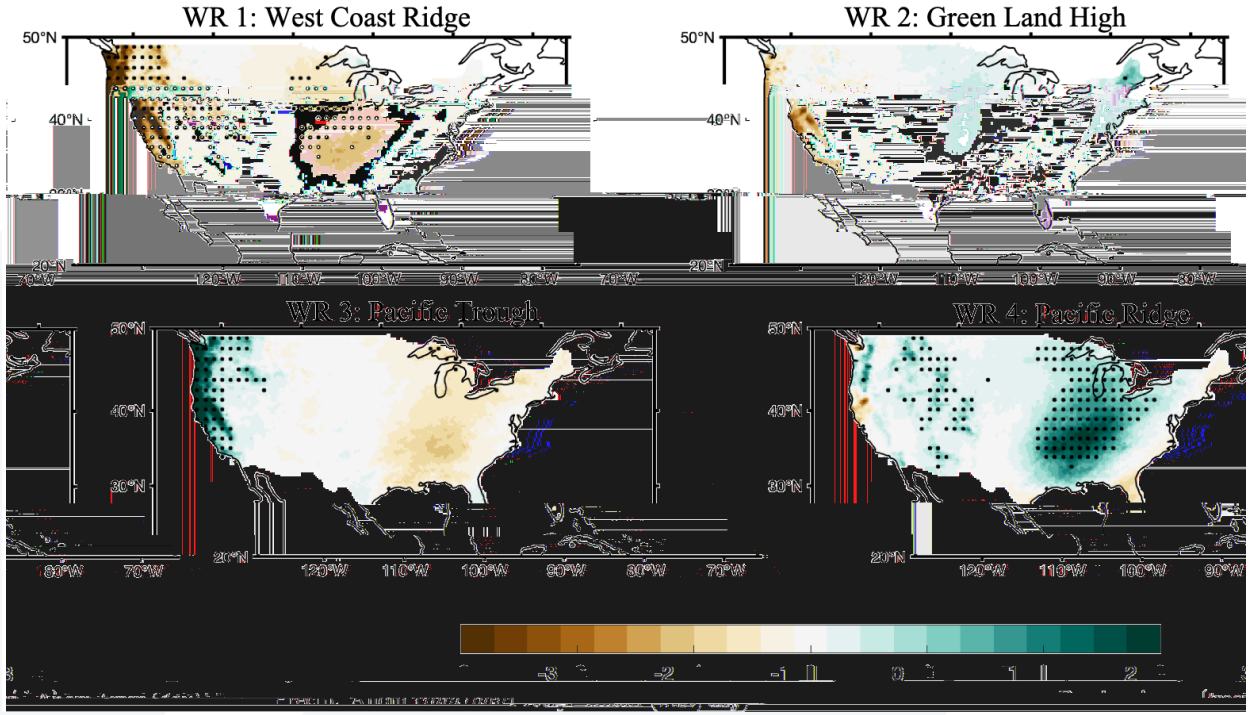
- Daily forecast out to 45-day lead time shown on CW3E S2S website
- Uses NCEP CFSv2 ensemble
- High likelihood (> 75%) of Greenland High during Week 1
- Moderate likelihood (> 50%) of West Coast Ridge during Week 2
- Moderate likelihood of Greenland High during Weeks 3–4

Both ridge types suggest dry conditions over Northern CA

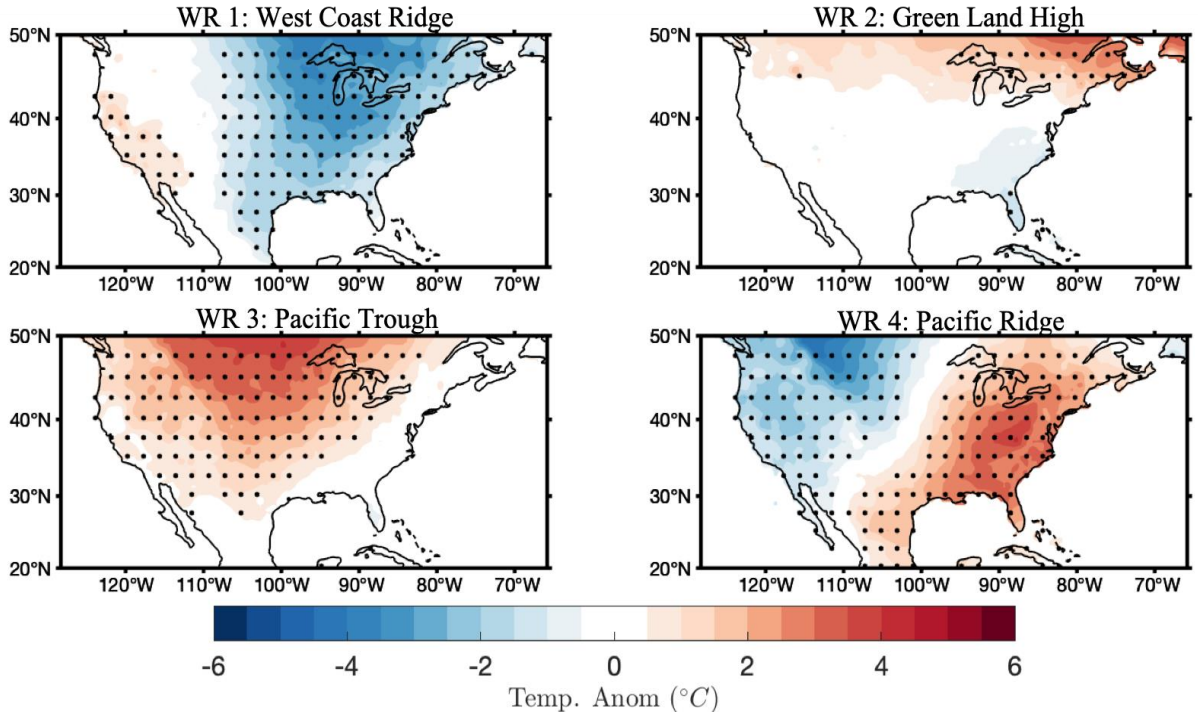
For more information about the forecast product: https://wiki.iri.columbia.edu/index.php?n=Climate.S2S-WRs

Subseasonal Outlooks: IRI North American Weather Regime Forecasts

Precipitation



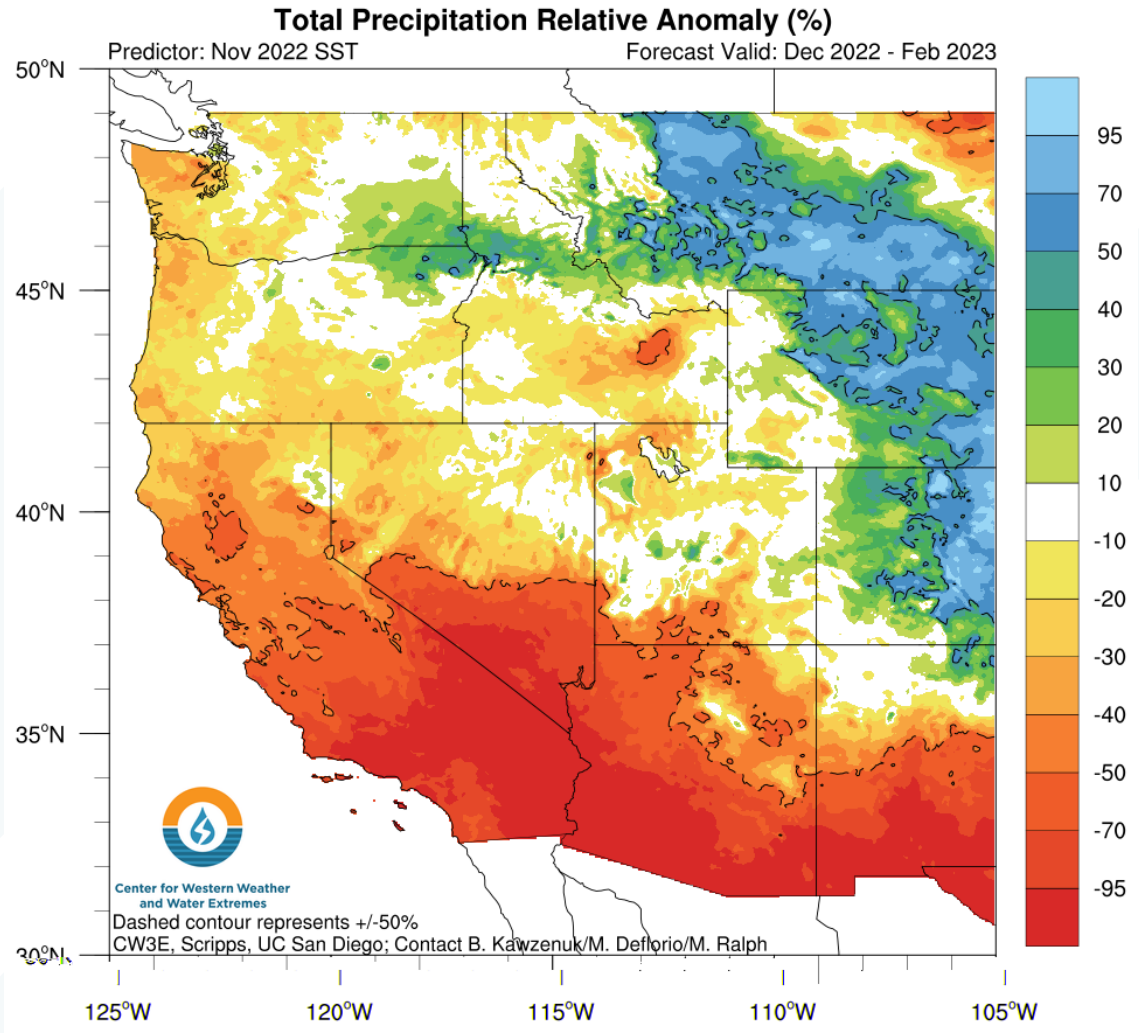
Precipitation



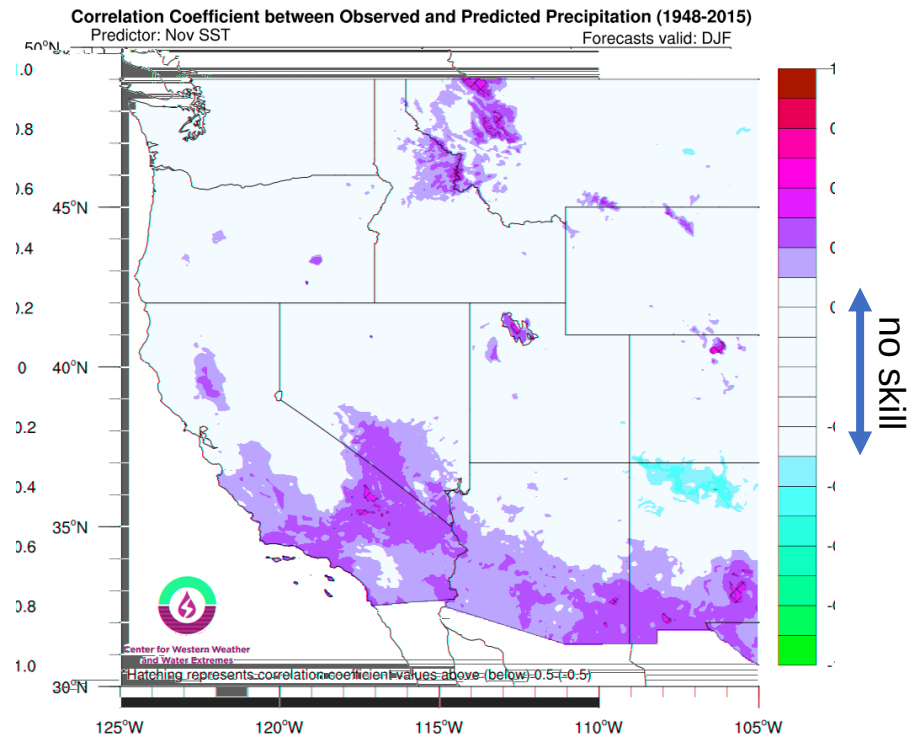
Historical precipitation (left) and temperature (right) composites associated with each regime

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

Seasonal CCA Outlooks: Dec 2022 – Feb 2023 Precipitation



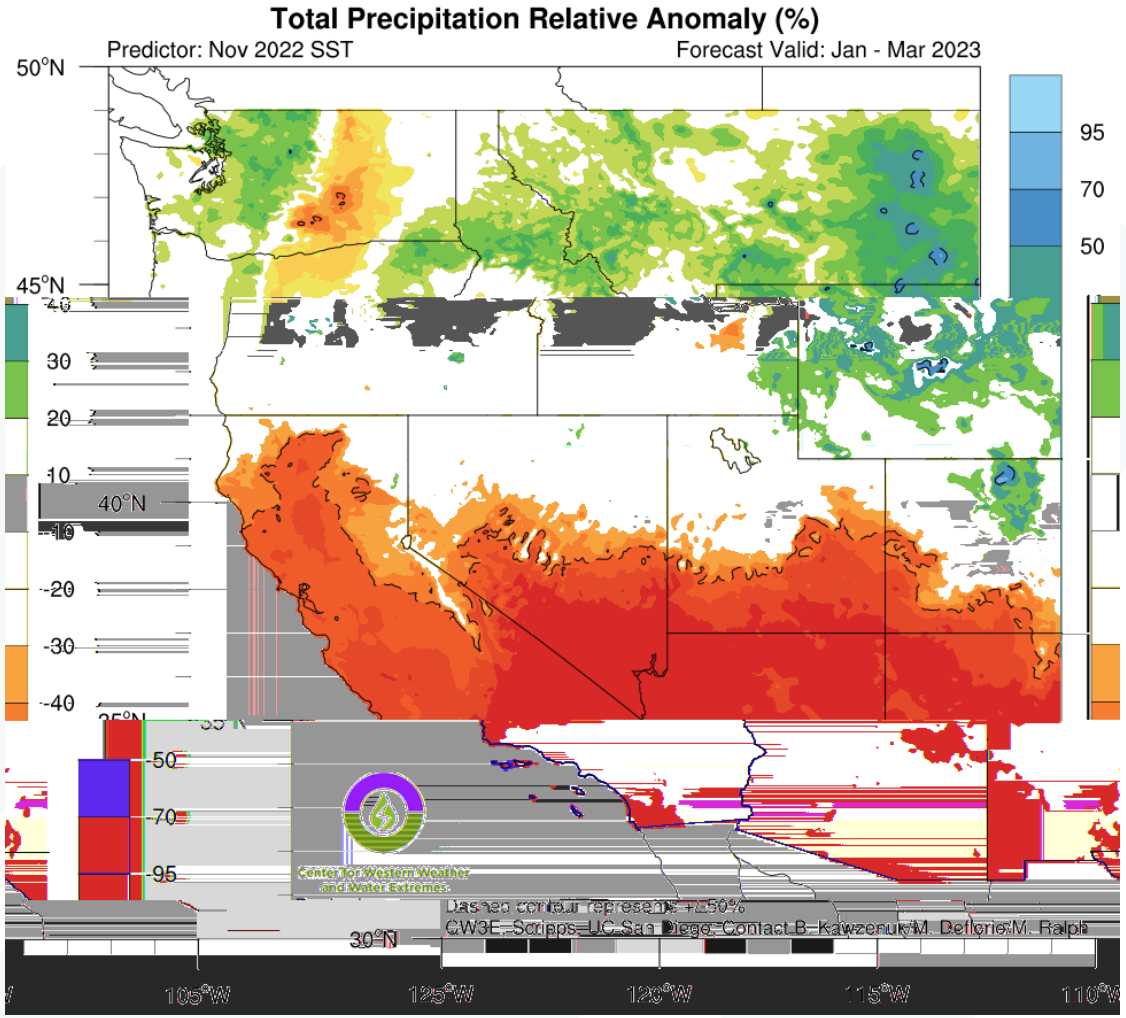
Skill Assessment



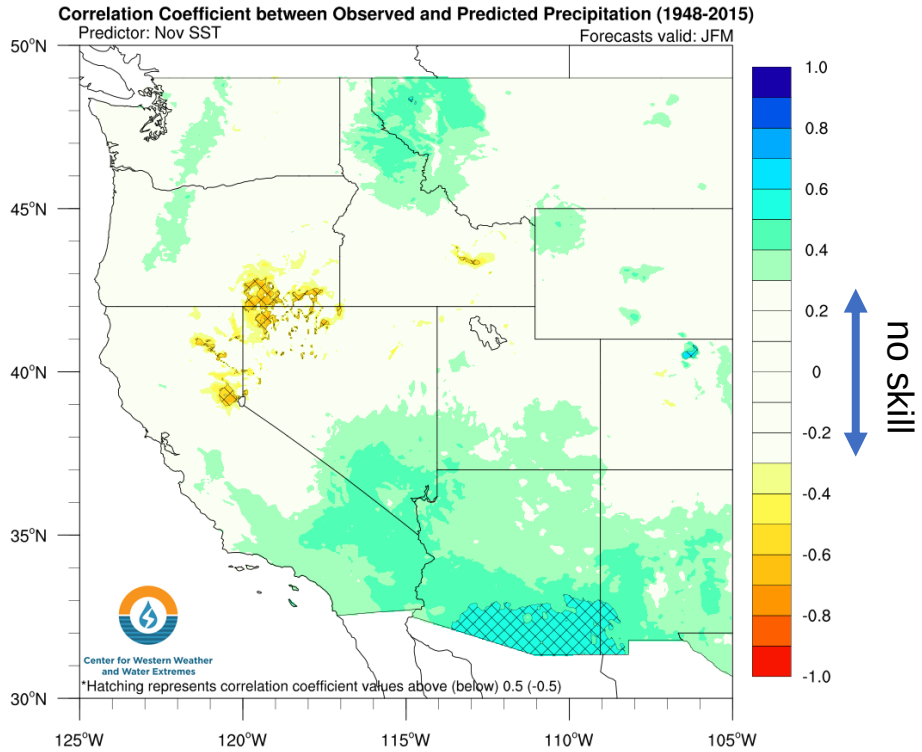
- CW3E statistical model based on Nov SST is predicting significantly below-normal Dec 2022 – Feb 2023 precipitation over southern CA which has a skill at ~0.5 correlation coefficient.

CCA: Canonical correlation analysis relating seasonal precipitation anomalies to observed monthly Pacific SST anomalies (click here for more background information)
Above-normal: >50%; Below-normal: <-50%

Seasonal CCA Outlooks: Jan–Mar 2023 Precipitation



Skill Assessment



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