CW3E Seasonal Outlook: 9 Jan 2024

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

CW3E Seasonal Forecasts: Glossary & Context

- **The outlooks are based on CW3E's and collaborating institutions' seasonal forecast products that can be found here: https://cw3e.ucsd.edu/s2s_forecasts/**

- **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)

- ***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.***

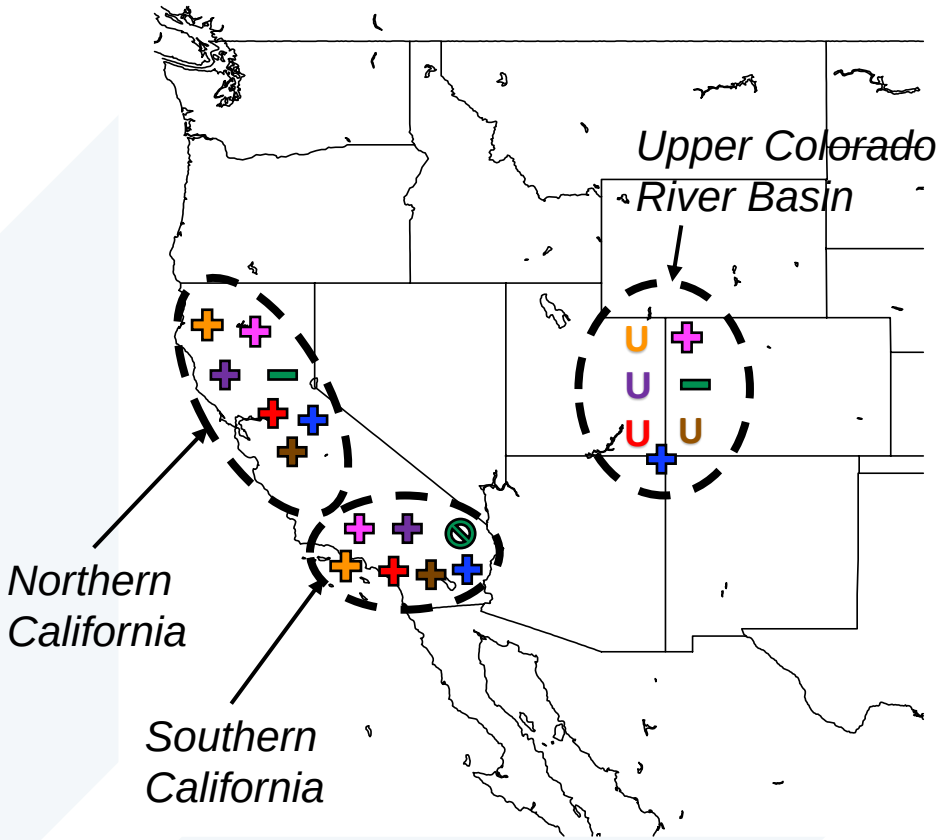
- ***The thresholds for below-normal, near-normal, and above-normal conditions are determined by forecast product and noted on each forecast product slide***

Summary: Jan–Mar 2024 Seasonal Forecasts

- Experimental seasonal forecast products generally agree on higher likelihood of above-normal precipitation over much of California
  - CW3E's CCA model based on Dec SST is predicting above-normal precipitation over Southern CA with high confidence and above-normal precipitation over Northern and Central CA with low confidence
  - Machine Learning (ML) model based on Dec SST and other atmospheric variables is suggesting above-normal precipitation conditions over much of CA
  - Most seasonal forecasts issued by other institutions are showing low confidence in above-normal precipitation over much of CA

- Odds of reaching normal water year precipitation have decreased over most of CA since the beginning of WY 2024

Seasonal Synthesis Precipitation Outlook: Jan–Mar 2024



Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

Jet Propulsion Laboratory
California Institute of Technology

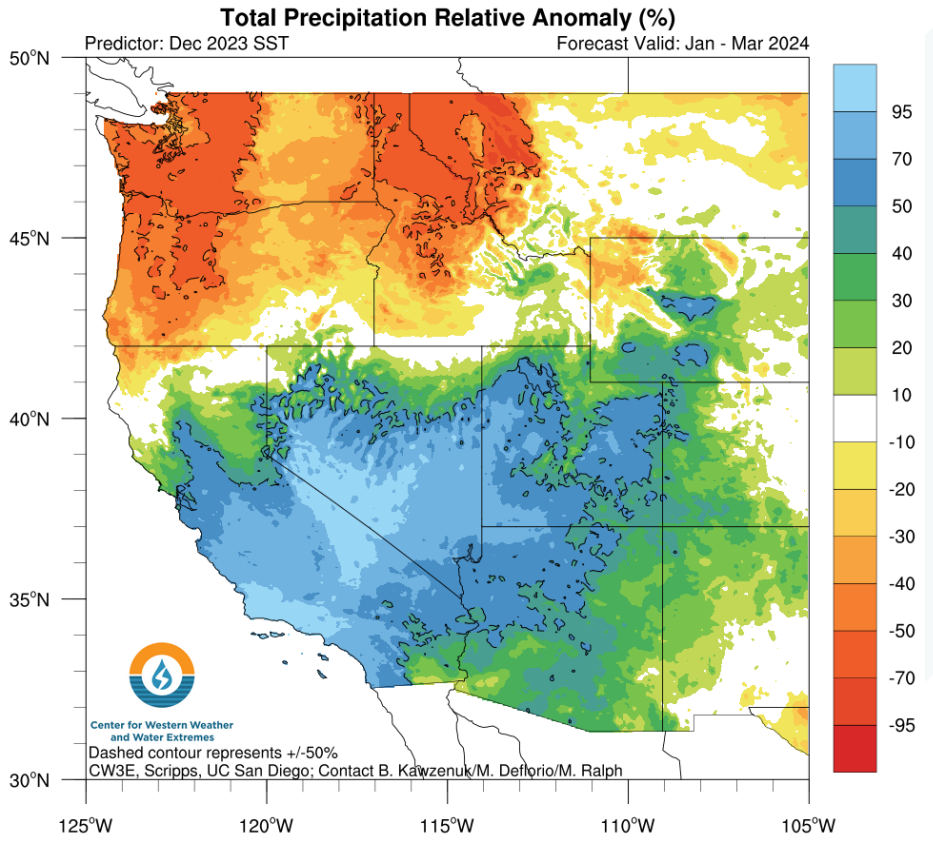
- Above Normal
- Below Normal
- Normal
- U Uncertain/Equal Chances

Methods	Forecast Period	Organization(s)	Nor Cal	So Cal	Upper Colo
Machine Learning based Forecast (Gibson et al.)	Nov-Jan	Jet Propulsion Laboratory, California Institute of Technology; Center for Western Weather and Water Extremes	+	+	+
CCA Seasonal Precipitation Forecast (Gershunov et al.)	Nov – Jan	Center for Western Weather and Water Extremes	+	+	+
Univ. of Arizona Hybrid Seasonal Forecast (Scheftic et al.)	Nov-Jan		+	+	U
IRI/CPC Forecast (Robertson et al.)	Nov-Jan	IRI	+	+	U
NOAA ESRL Seasonal Forecast (Switanek et al.)	Nov-Mar	NOAA	−	⊘	−
NMME Seasonal Forecast	Nov-Jan	The North American Multi-Model Ensemble	+	+	U
NOAA CPC Operational Outlook	Nov-Jan	NOAA	+	+	U

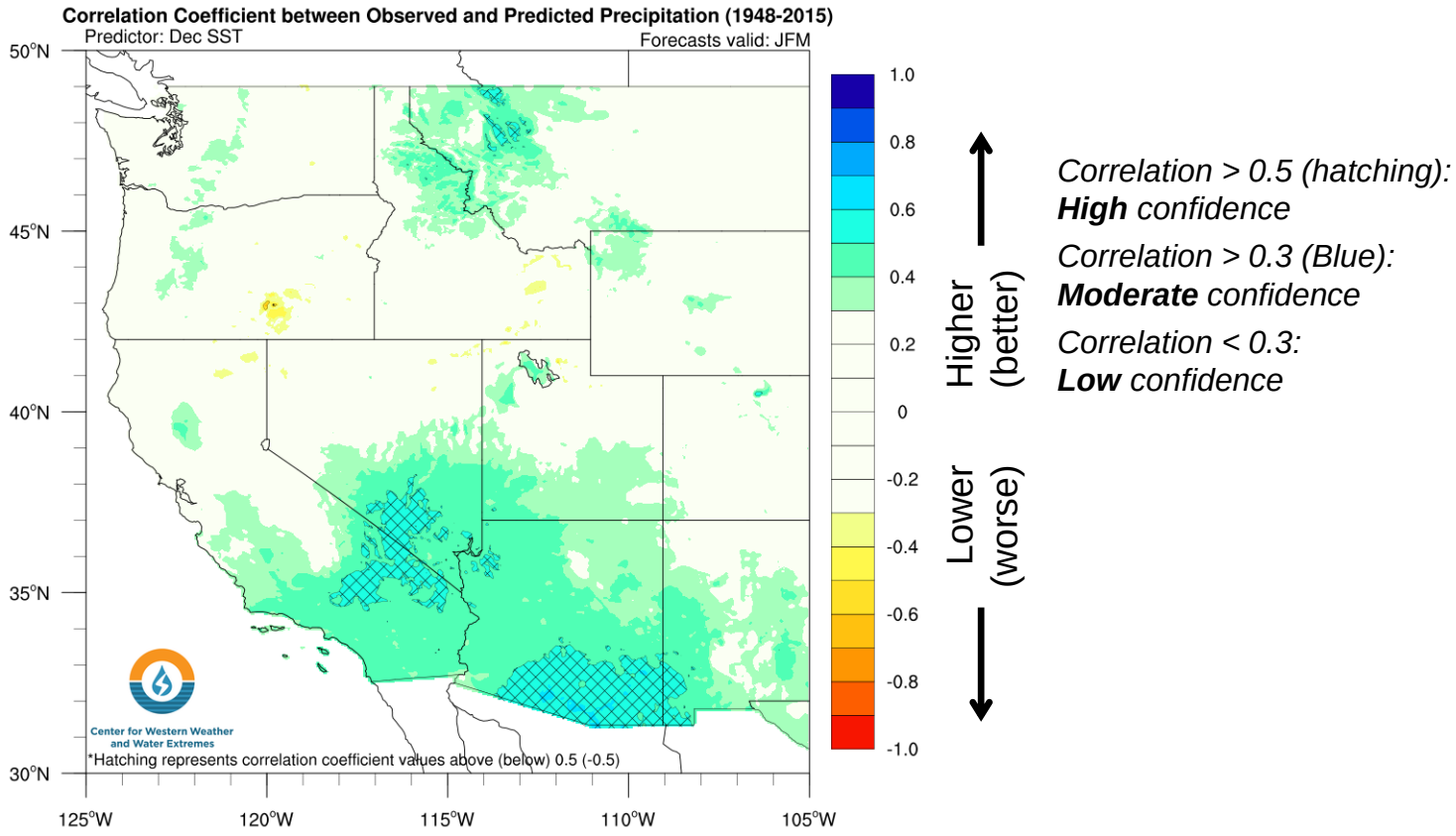
DeFlorio et al. (2023, BAMS)

Seasonal Outlook: Jan–Mar 2024 Precipitation (CCA Model)

JFM Precipitation Anomaly (% of Normal)



JFM Historical Forecast Skill



Correlation > 0.5 (hatching): ***High*** *confidence*

Correlation > 0.3 (Blue): ***Moderate*** *confidence*

Correlation < 0.3: ***Low*** *confidence*

- CW3E statistical model based on December SST is predicting above-normal precipitation in Northern and Central CA with low confidence, and above-normal precipitation in Southern CA with high confidence during Jan–Mar

CCA: Canonical correlation analysis relating seasonal precipitation anomalies to observed monthly Pacific SST anomalies (click here for more information)
Above-normal: >+30%; Below-normal: <−30%

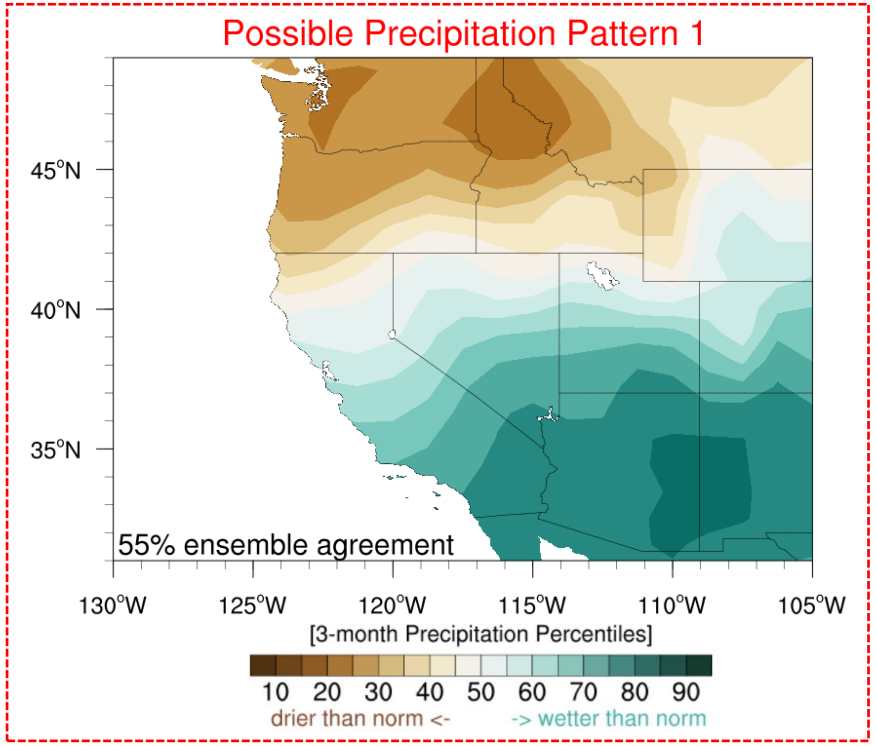
Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

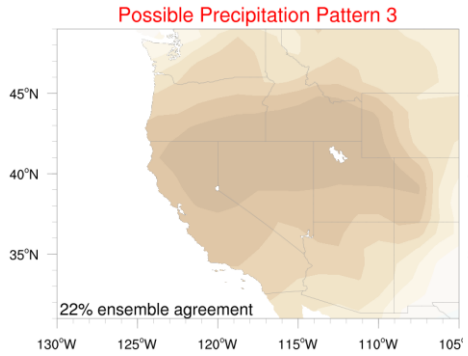
Seasonal Outlook: Jan–Mar 2024 Precipitation (ML Model)

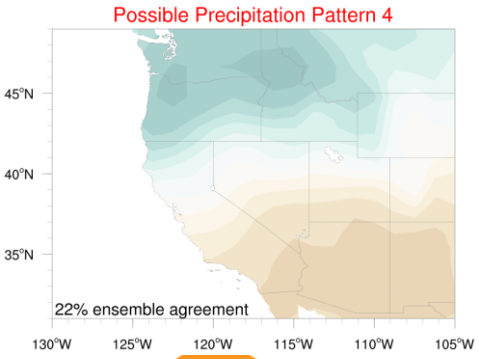
- A majority of the machine learning (ML) + North American Multi-Model Ensemble (NMME) forecasts are predicting patterns consistent with wetter than normal conditions in much of CA during the JFM period (55% ensemble agreement; 5/9 members)

A majority of combined ML + NMME ensemble members tilt the odds towards wetter than normal conditions across much of CA

55% chance for Wet South/Dry North







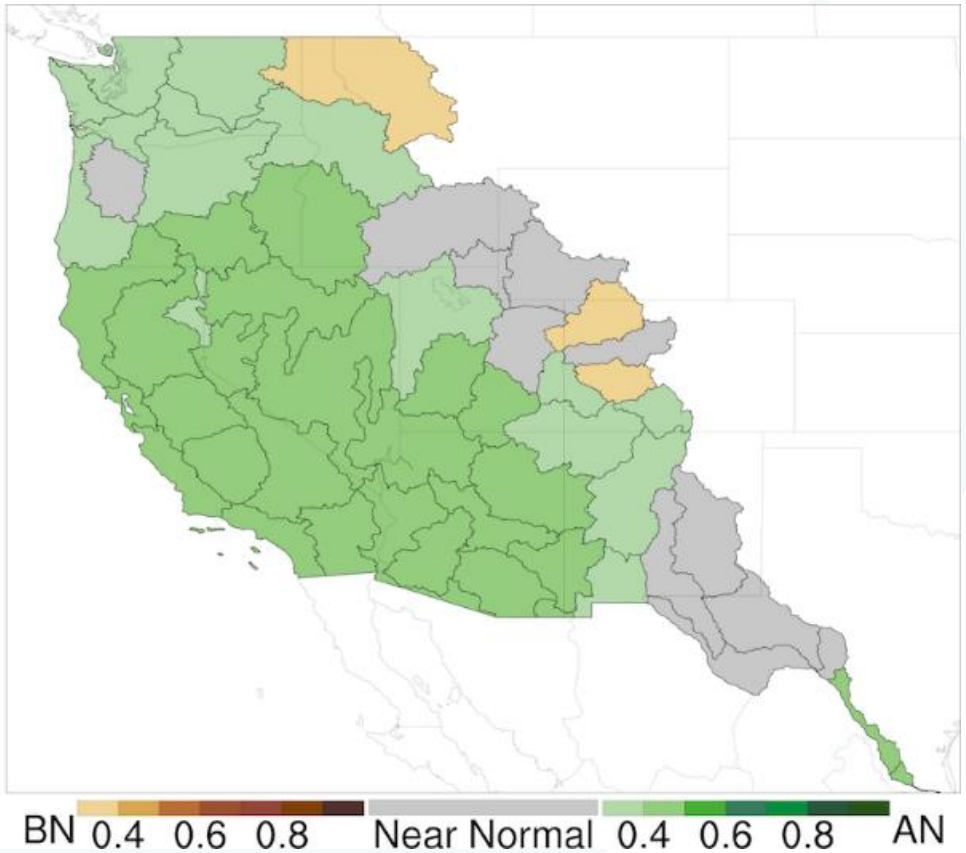
The ensemble is comprised of both CW3E ML models (4 ensembles) and NOAA NMME models (5 ensembles). See Gibson et al. (2021) for methodology and skill assessment.

Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

Seasonal Outlook: University of Arizona 3-Month Precipitation Outlook

Forecast Issued Dec 2023

JFM Precipitation Forecast

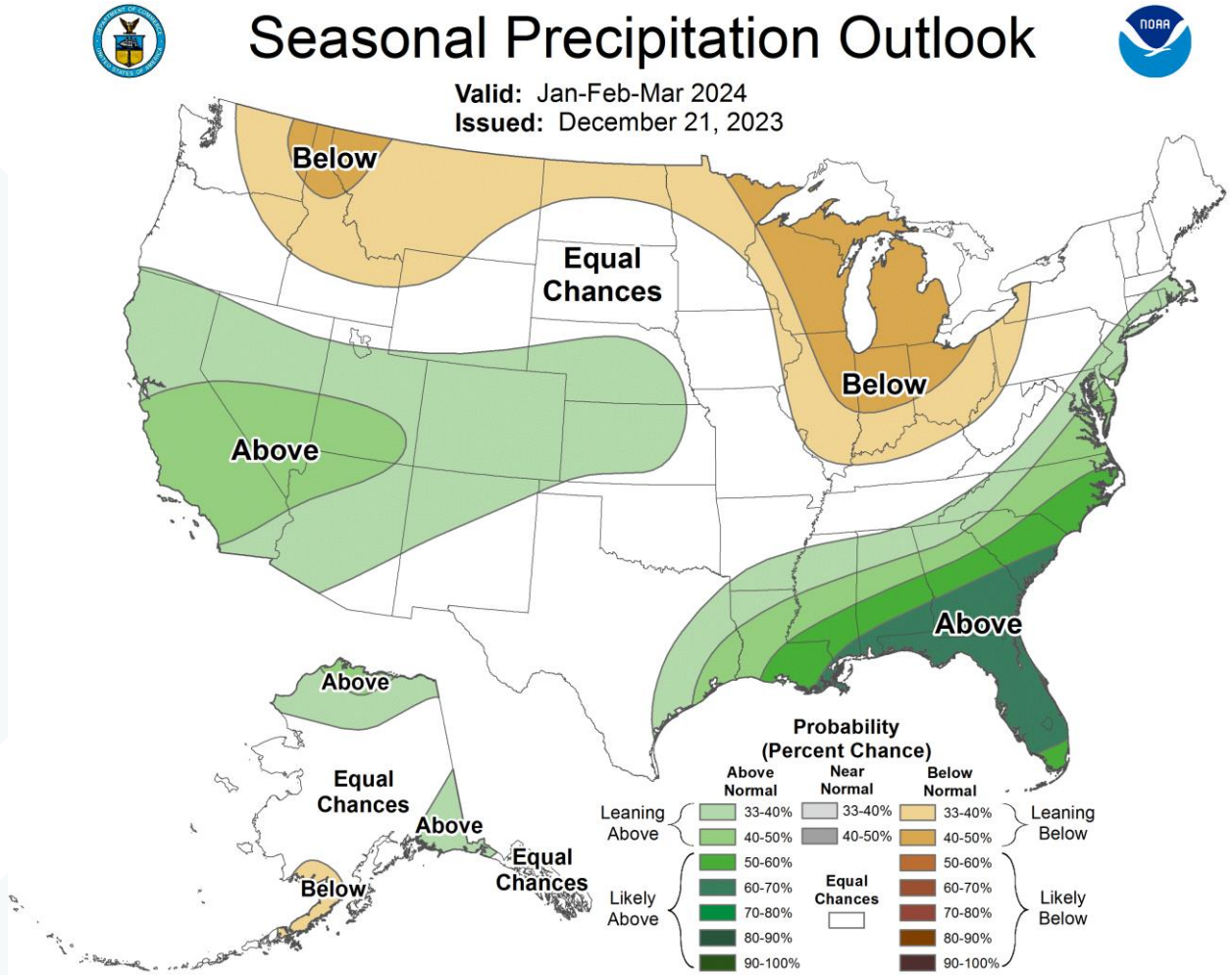


- The University of Arizona produces probabilistic 3-month precipitation forecasts every month based on ensemble seasonal predictions from NCEP and ECMWF. These forecasts incorporate bias correction and climatological information to improve the prediction skill.
- The forecast issued in December is showing above-normal precipitation in CA during Jan–Mar 2024, but with low confidence (< 50% probability)

This graphic shows the probability of 3-month precipitation being in the below-normal (bottom third), near-normal (middle third), or above-normal (top third) category, with only the dominant category shown for each basin.

Graphics provided by the Bill Scheftic and Xubin Zeng at the University of Arizona. See Scheftic et al. (2023) for more information about these seasonal forecasts.

Seasonal Outlooks: CPC 3-Month Precipitation Outlook



Forecast Issued Dec 2023

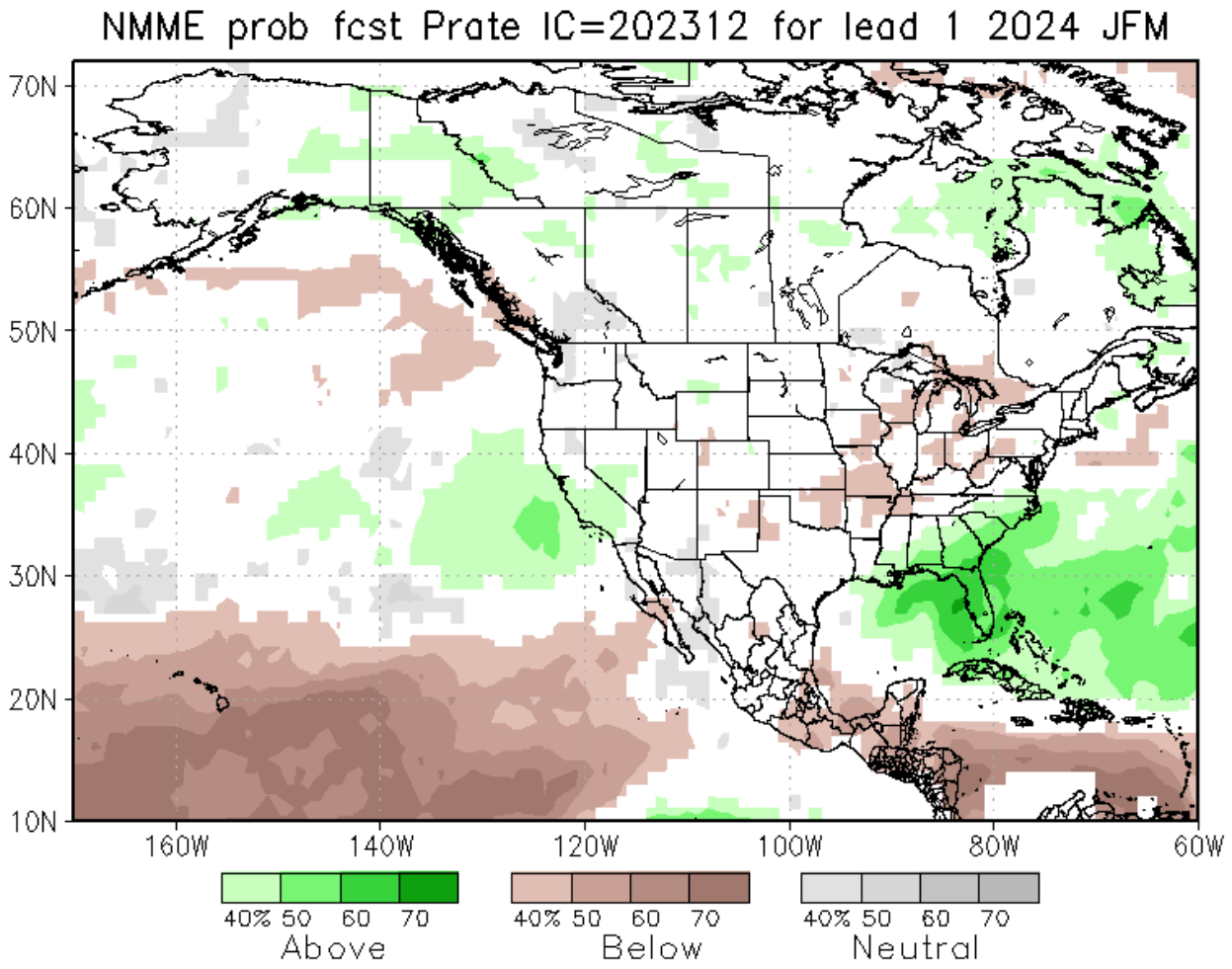
- The NOAA Climate Prediction Center (CPC) issues probabilistic 3-month precipitation outlooks for the CONUS and Alaska every month
- These outlooks are based on a combination of dynamical and statistical models
- The forecast issued in December tilts the odds towards above-normal precipitation in CA during Jan–Mar 2024, but with low confidence (< 50% probability)

This graphic shows the probability of below-normal (brown), near-normal (grey), and above-normal (green) precipitation during a 3-month period. Regions without shading indicate where the forecasts are more uncertain.

Graphics provided by the NOAA NWS Climate Prediction Center. For more information about this forecast product: https://www.cpc.ncep.noaa.gov/products/predictions/long_range/seasonal_info.php.

Seasonal Outlooks: NMME 3-Month Precipitation Outlook

Forecast Issued Dec 2023

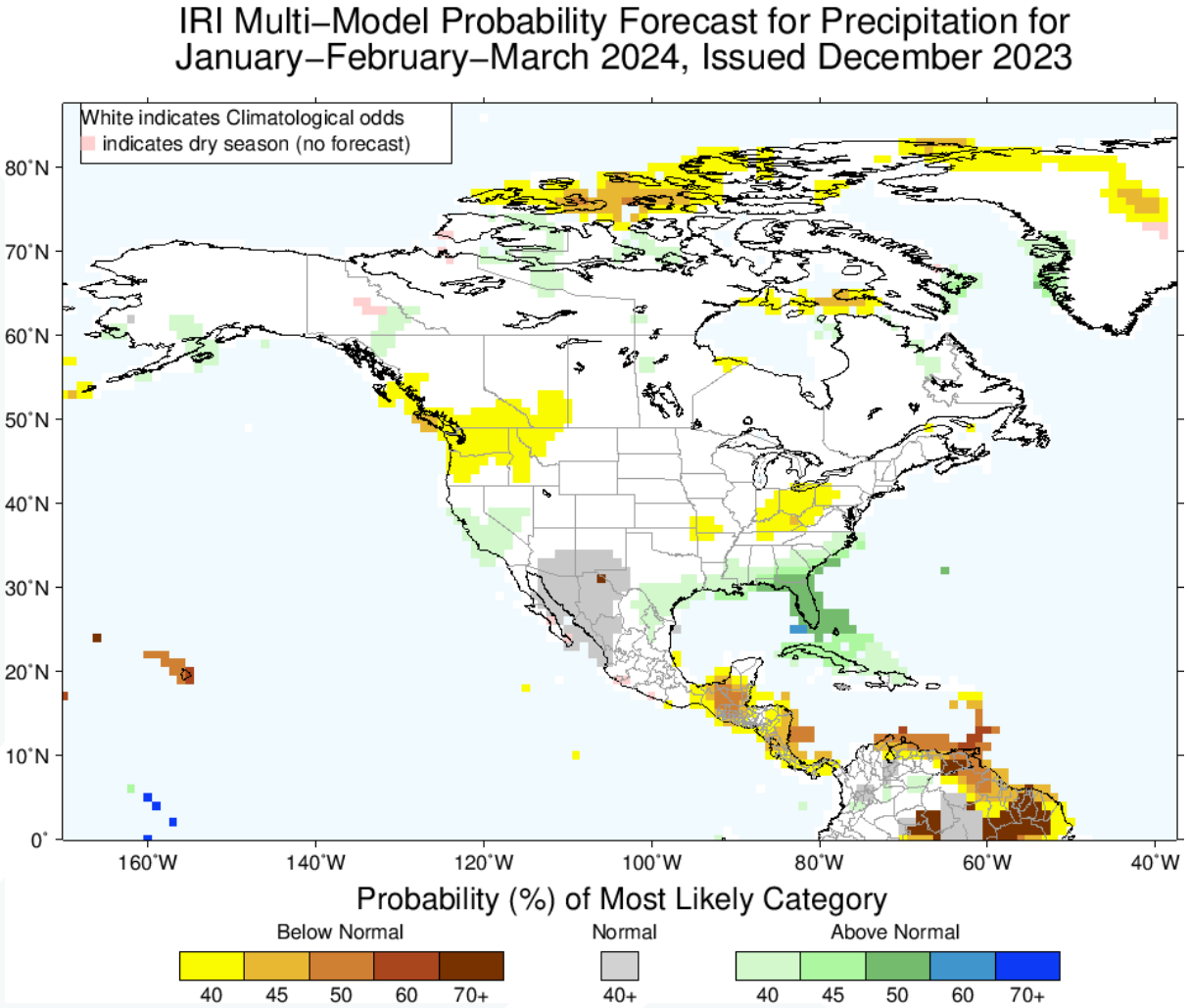


- The CPC also issues probabilistic 3-month precipitation products every month using precipitation output from the North American Multi-Model Ensemble (NMME)
- The forecast issued in December shows above-normal precipitation in Central and Southern CA during Jan–Mar 2024, but with low confidence (< 50% probability)

This graphic shows the probability of below-normal (brown), near-normal (grey), and above-normal (green) precipitation during a 3-month period. Regions without shading indicate where the forecasts are more uncertain.

Graphics provided by the NOAA NWS Climate Prediction Center. For more information about the forecast product: https://www.cpc.ncep.noaa.gov/products/NMME/about.html.

Seasonal Outlooks: IRI/CPC 3-Month Precipitation Forecast



Forecast Issued Dec 2023

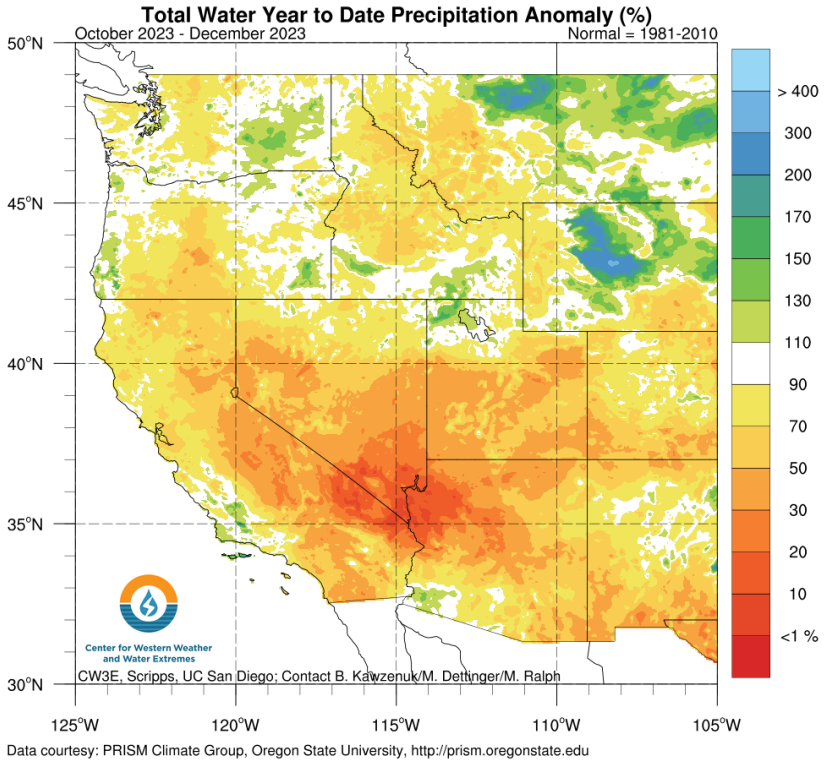
- The International Research Institute (IRI) issues probabilistic 3-month precipitation forecasts every month based on calibrated forecasts from the NMME
- The forecast issued in December is showing above-normal precipitation in Central CA and portions of Southern CA during Jan–Mar 2024, but with low confidence (< 50% probability)

This graphic shows the probability of below-normal (yellow/brown), near-normal (grey), and below-normal (green/blue) precipitation during a 3-month period. Regions without shading indicate where the forecasts are more uncertain.

Graphics provided by the International Research Institute for Climate and Society, Columbia University, https://iri.columbia.edu. See Kirtman et al. (2014) for more information about the NMME.

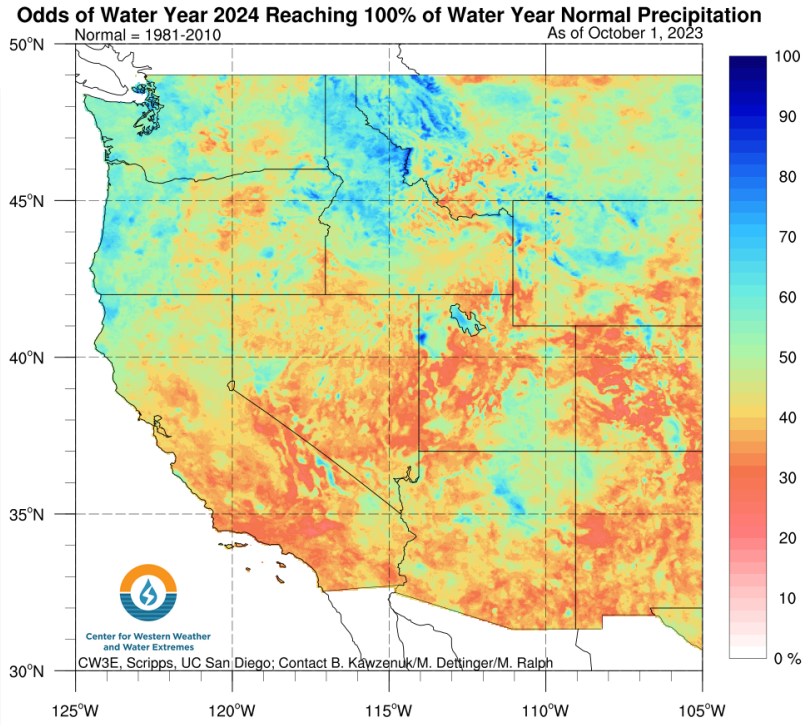
Seasonal Outlook: Odds of Reaching Normal Water Year Precipitation

WY-to-Date Precipitation Anomaly (% of Normal): Start of Jan 2024



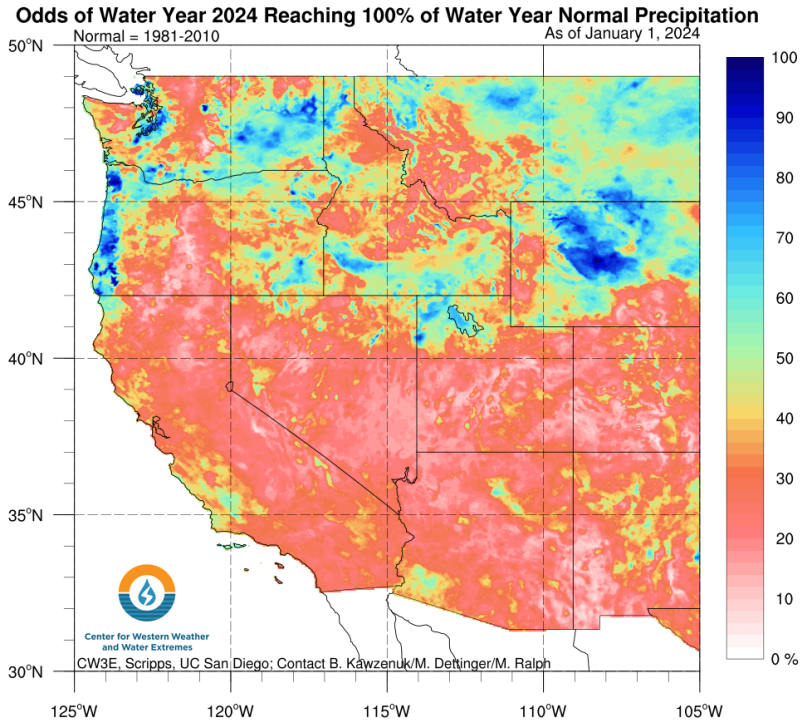
Data courtesy: PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu

Start of WY 2024 Odds



Shading represents odds, in percent of water years from 1948-2017
Data courtesy: PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu

Start of Jan 2024 Odds



Shading represents odds, in percent of water years from 1948-2017
Data courtesy: PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu

- WY 2024 is off to a dry start in much of California
- Odds of reaching normal WY precipitation have decreased throughout the state and were < 30% at the start of Jan

Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO