



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E S2S Outlook: 27 Jan 2023

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UC San Diego



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CW3E S2S Forecasts: Glossary & Context

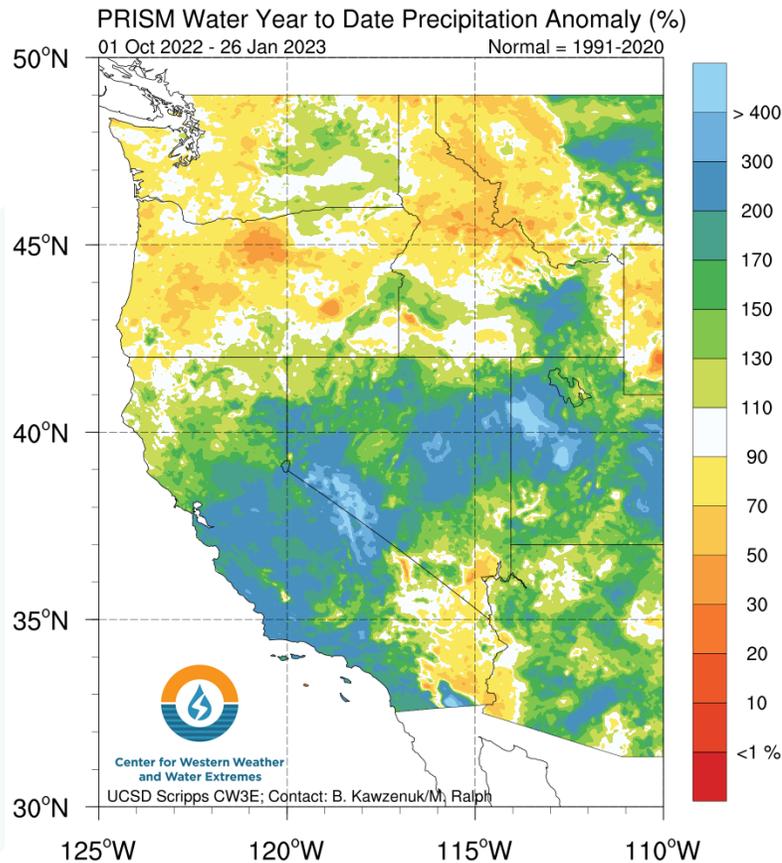
- The outlooks are based on CW3E subseasonal to seasonal forecast products that can be found here: https://cw3e.ucsd.edu/s2s_forecasts/
- **CW3E subseasonal (2–6 weeks lead time) atmospheric river, ridging, and circulation regime products use three different global ensemble prediction systems to create these products:**
 - NCEP GFS (US Model): Weeks 2–3
 - NCEP CFSv2 (US Model): Weeks 2–6
 - ECCO (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

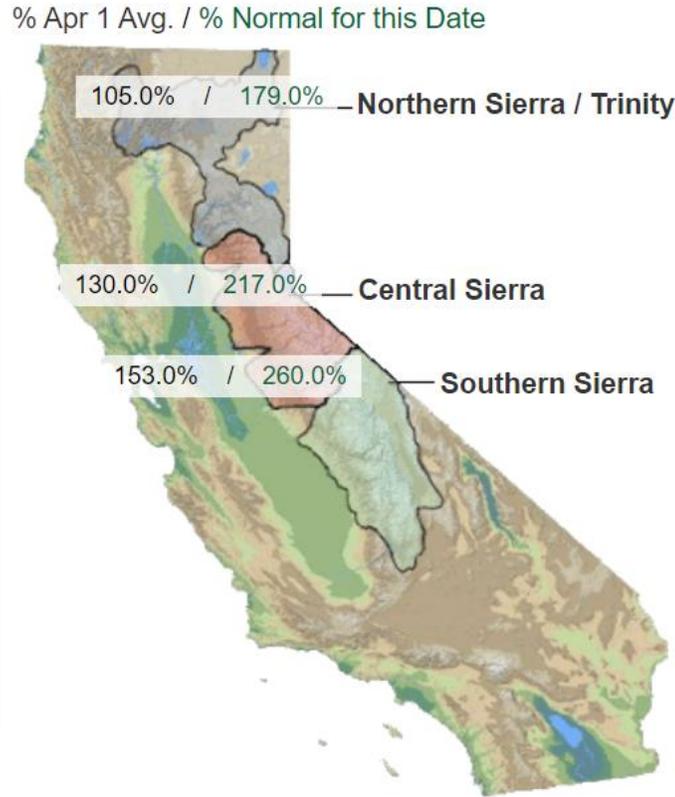
- **Week 2 forecasts (3–9 Feb):** Models generally agree on low likelihood (< 30% probability) of AR activity over most of California during Week 2
 - NCEP is showing higher probabilities (40–60%) of AR activity over far Northern CA and OR on 5 Feb compared to ECCO and ECMWF
- NCEP and ECMWF are forecasting strong MJO activity over the Indian Ocean during Week 1, which is climatologically unfavorable for AR activity in CA during Weeks 1–2
- Models disagree on predicted ridging activity near the US West Coast during Weeks 1–2, with NCEP showing higher likelihood of persistent ridging activity west of California
- **Week 3 forecasts (10–16 Feb):** All models are predicting below-normal AR activity over CA with high confidence
- Both NCEP and ECMWF both show potential for persistent ridging activity west of California during Weeks 3–4, but forecast confidence in this outcome is currently low
 - West-Ridge type is typically associated with wet conditions in the Pacific Northwest and dry conditions in Central and Southern CA

Water Year Hydrologic Summary

Precipitation

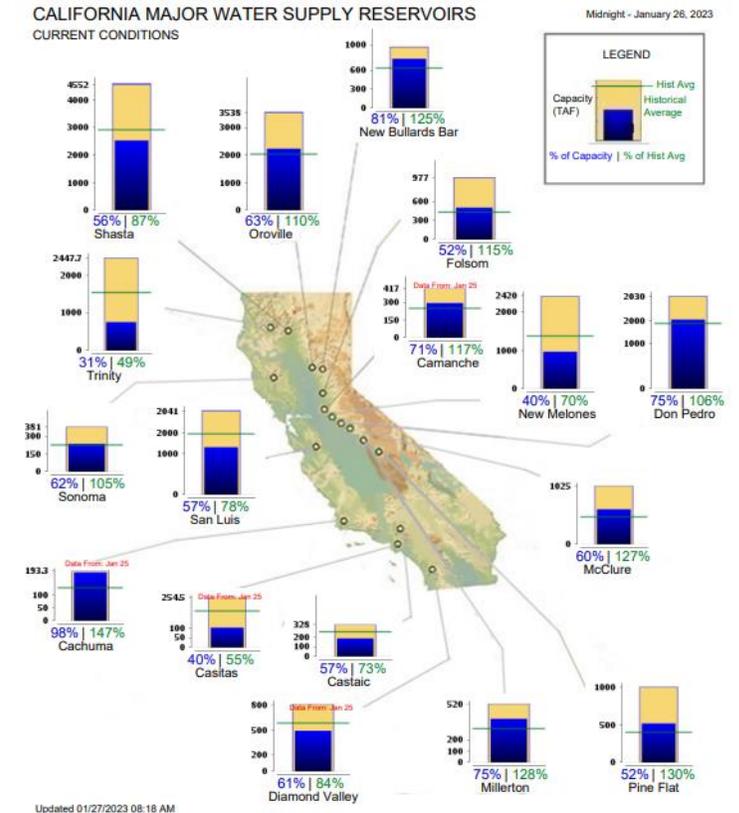


Snowpack Conditions



Source: California Department of Water Resources

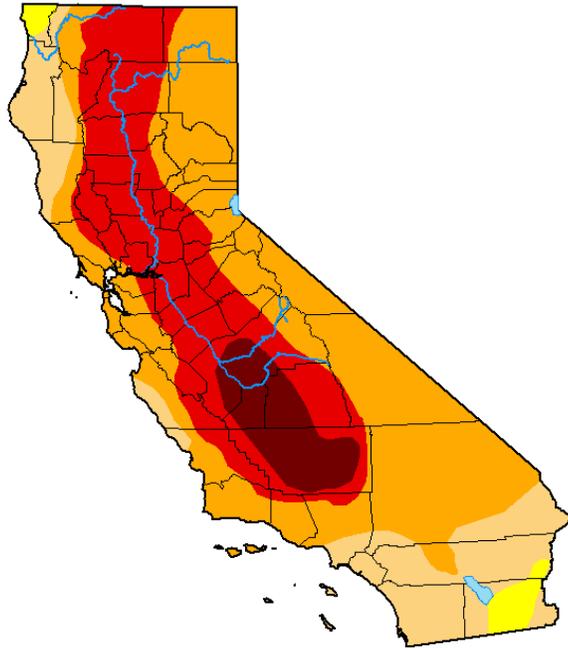
Reservoir Storage



- As of 26 Jan, water-year-to-date precipitation is above normal across much of the state
- Portions of Central CA and coastal Southern CA have received > 200% of normal precipitation since 1 Oct
- Statewide snowpack is well-above normal, especially in Southern Sierra Nevada where current snowpack is 260% of normal for this date and 153% of normal for 1 Apr
- Extremely wet conditions between late Dec and mid-Jan have replenished reservoirs throughout the state
- Most large reservoirs in California are now operating at > 50% of storage capacity

Drought Conditions

U.S. Drought Monitor California



December 20, 2022
(Released Thursday, Dec. 22, 2022)
Valid 7 a.m. EST

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	97.94	80.56	35.50	7.16
Last Week 12-13-2022	0.00	100.00	97.94	80.56	35.50	7.16
3 Months Ago 09-20-2022	0.00	100.00	99.76	94.06	40.91	16.57
Start of Calendar Year 01-04-2022	0.00	100.00	99.30	67.62	16.60	0.84
Start of Water Year 09-27-2022	0.00	100.00	99.76	94.01	40.91	16.57
One Year Ago 12-21-2021	0.00	100.00	100.00	92.44	79.44	23.11

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>

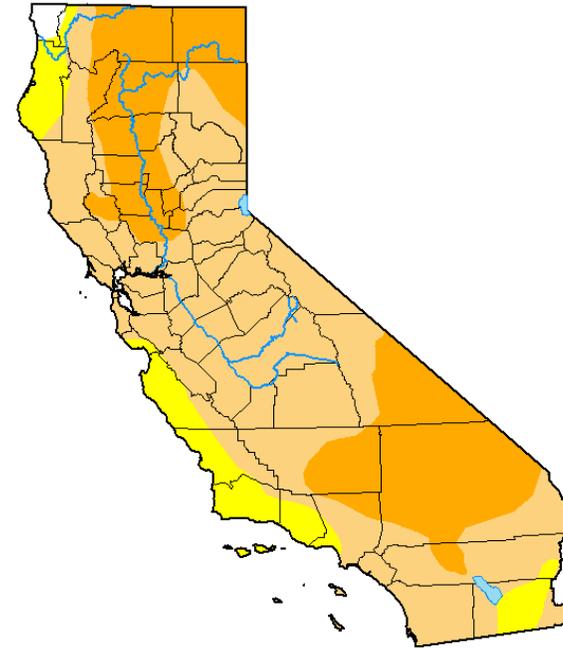
Author:

Curtis Riganti
National Drought Mitigation Center



droughtmonitor.unl.edu

U.S. Drought Monitor California



January 24, 2023
(Released Thursday, Jan. 26, 2023)
Valid 7 a.m. EST

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.64	99.36	89.56	32.57	0.00	0.00
Last Week 01-17-2023	0.64	99.36	92.12	42.84	0.00	0.00
3 Months Ago 10-25-2022	0.00	100.00	99.77	91.83	43.06	16.57
Start of Calendar Year 01-03-2023	0.00	100.00	97.93	71.14	27.10	0.00
Start of Water Year 09-27-2022	0.00	100.00	99.76	94.01	40.91	16.57
One Year Ago 01-25-2022	0.00	100.00	99.25	66.39	1.39	0.00

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:

Rocky Billotta
NCEI/NOAA



droughtmonitor.unl.edu

- An extremely wet period from late December through mid-January brought substantial drought relief to much of California
- On 20 Dec, 81% of the state was experiencing severe or worse drought conditions, and 36% of the state was experiencing extreme or exceptional drought
- As of 24 Jan, only 33% of the state is experiencing severe drought conditions, and no areas are experiencing extreme or exceptional drought
- The greatest improvement in drought conditions has occurred over Central California

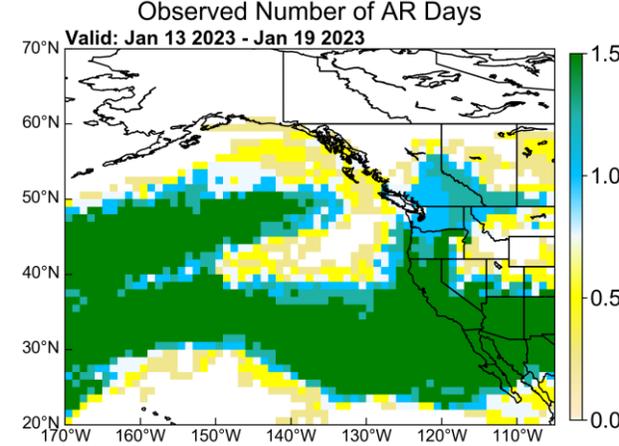
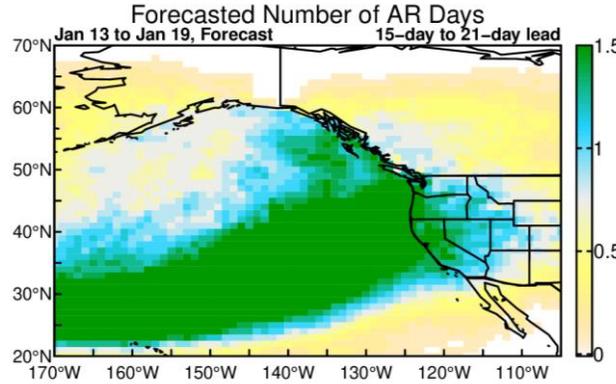
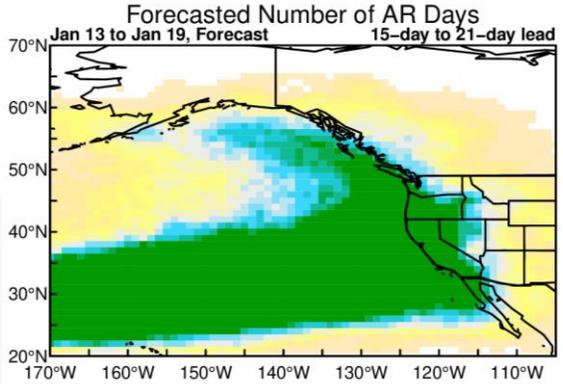
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 29 Dec 2022; Valid: 13–19 Jan 2023

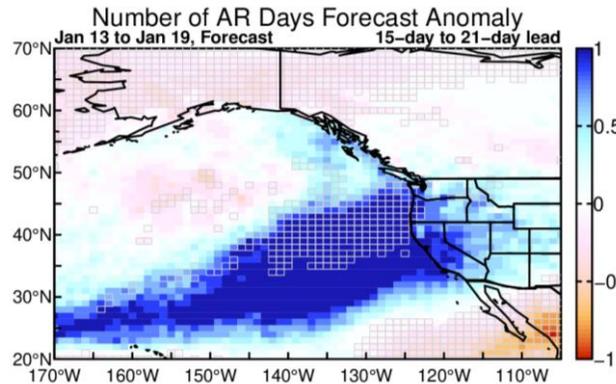
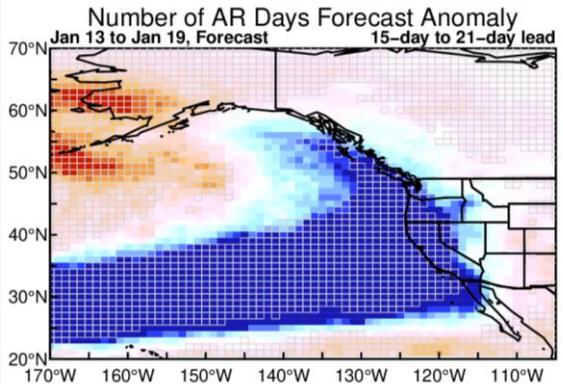
NCEP

EC3C

Observed (GFS Analysis)

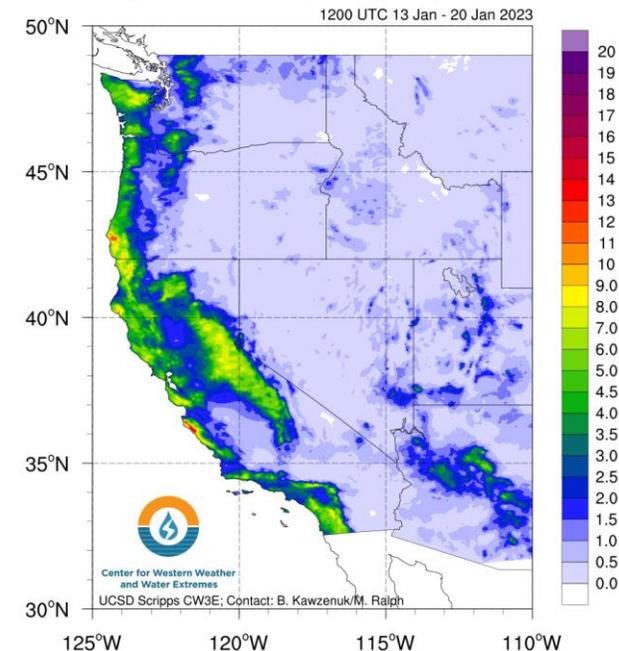


**ECMWF
Unavailable**



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

GFS verified over CA; EC3C verified over Northern and Central CA but predicted too little AR activity over Southern CA

- Multiple landfalling ARs brought at least 5–10 inches of precipitation to coastal CA, OR, and WA, as well as the Sierra Nevada

Looking Back: Week 3 AR Activity Forecasts

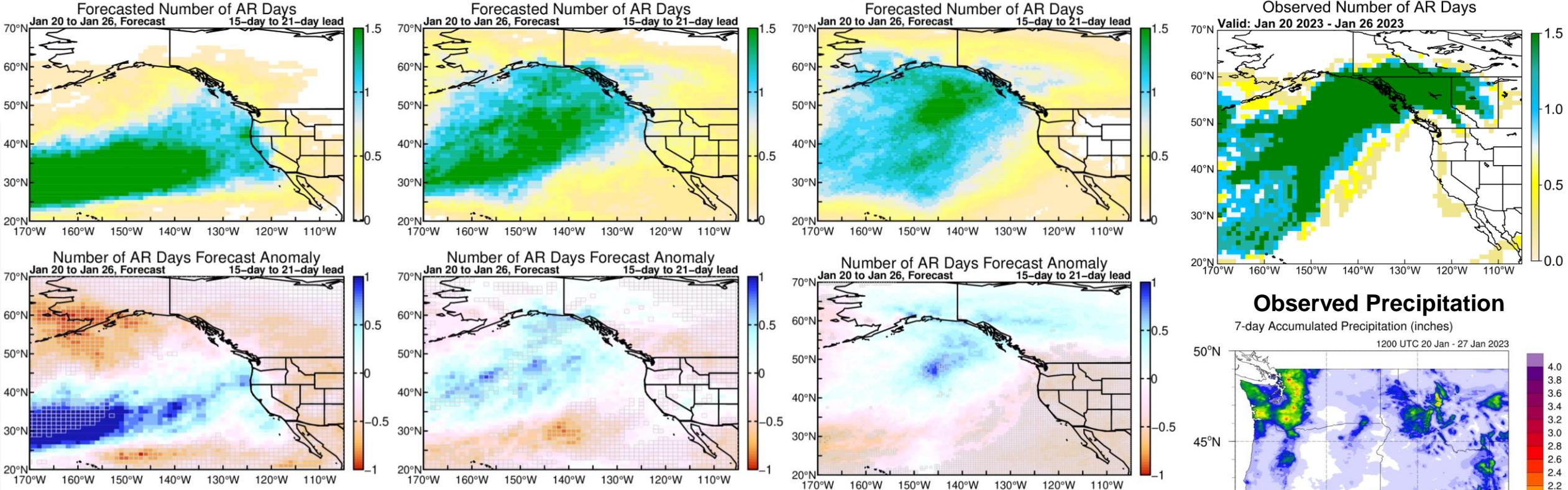
Forecasts Initialized 5 Jan 2023; Valid: 20–26 Jan 2023

NCEP

ECCE

ECMWF

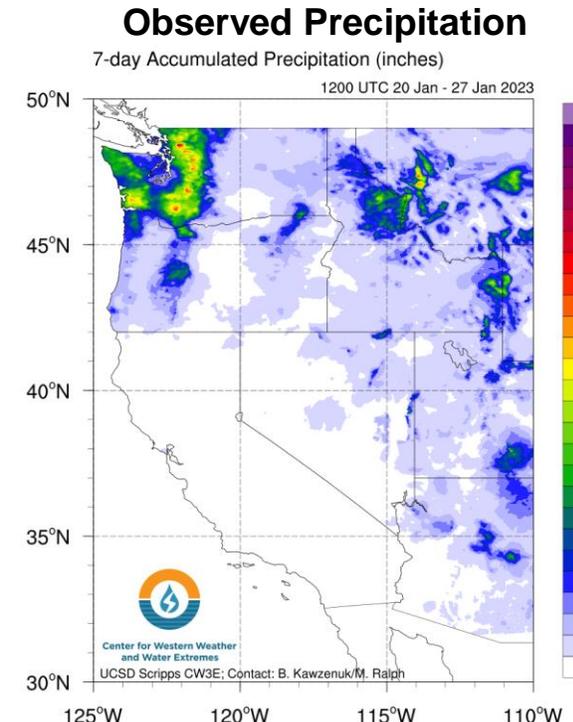
Observed (GFS Analysis)



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

NCEP predicted too much AR activity over CA; ECCE and ECMWF verified over CA and correctly forecasted AR activity over the Alaska Panhandle

- Multiple weak systems brought light precipitation to Western WA
- No precipitation was observed over CA during this period



Dynamical Model MJO Forecasts (NCEP vs. ECMWF)

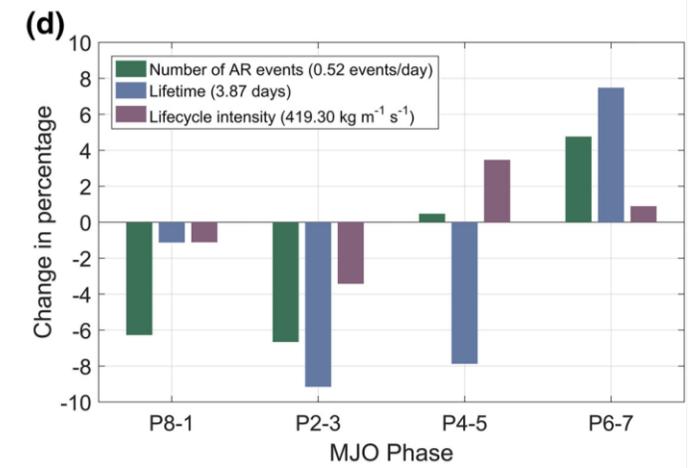
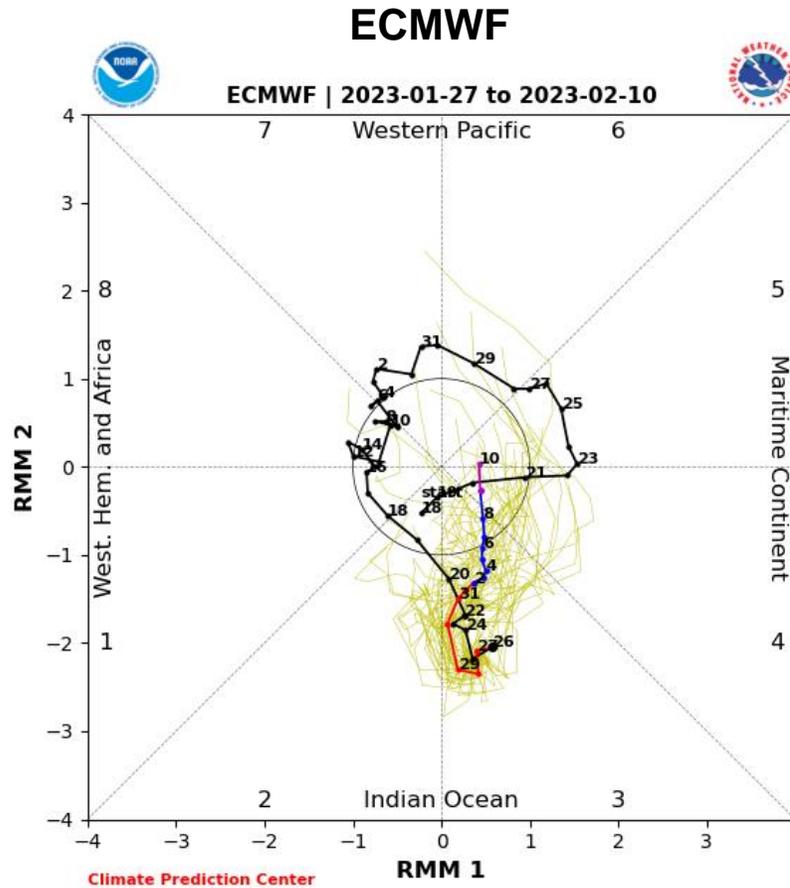
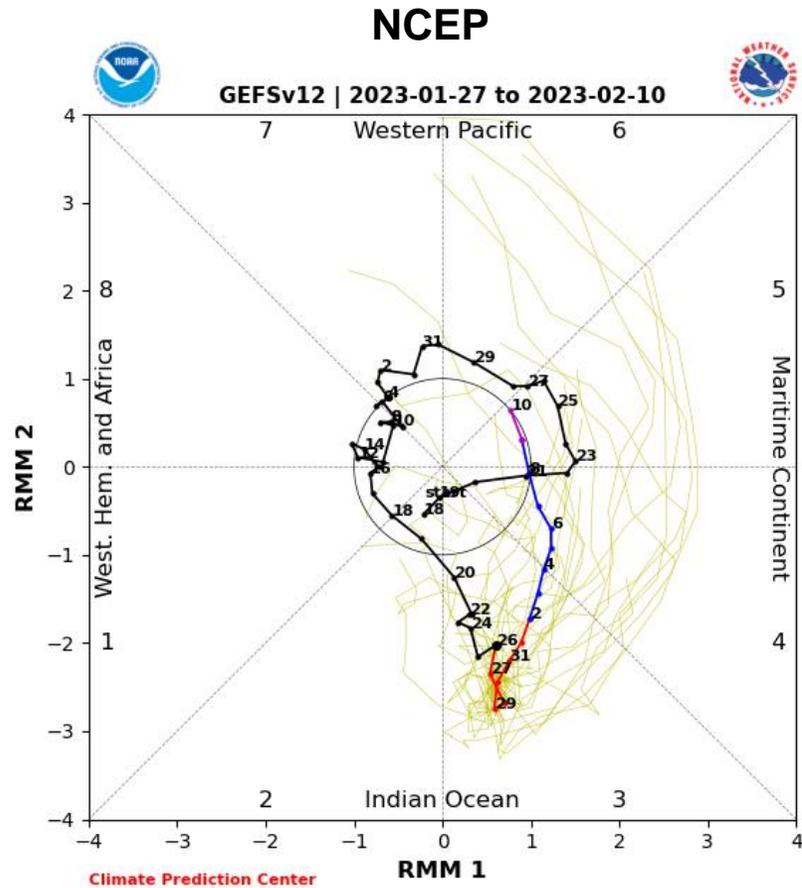
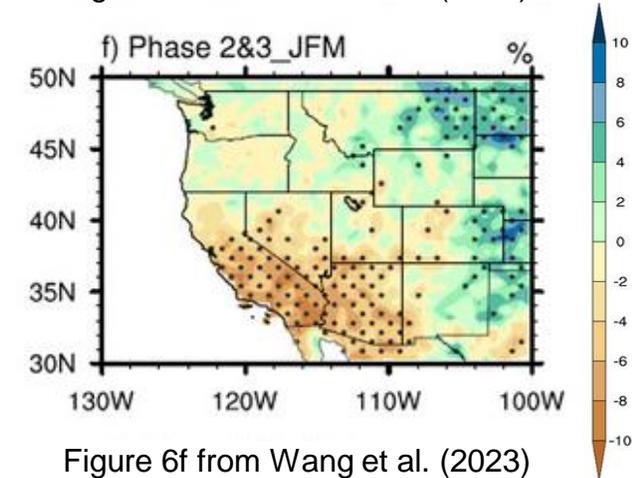


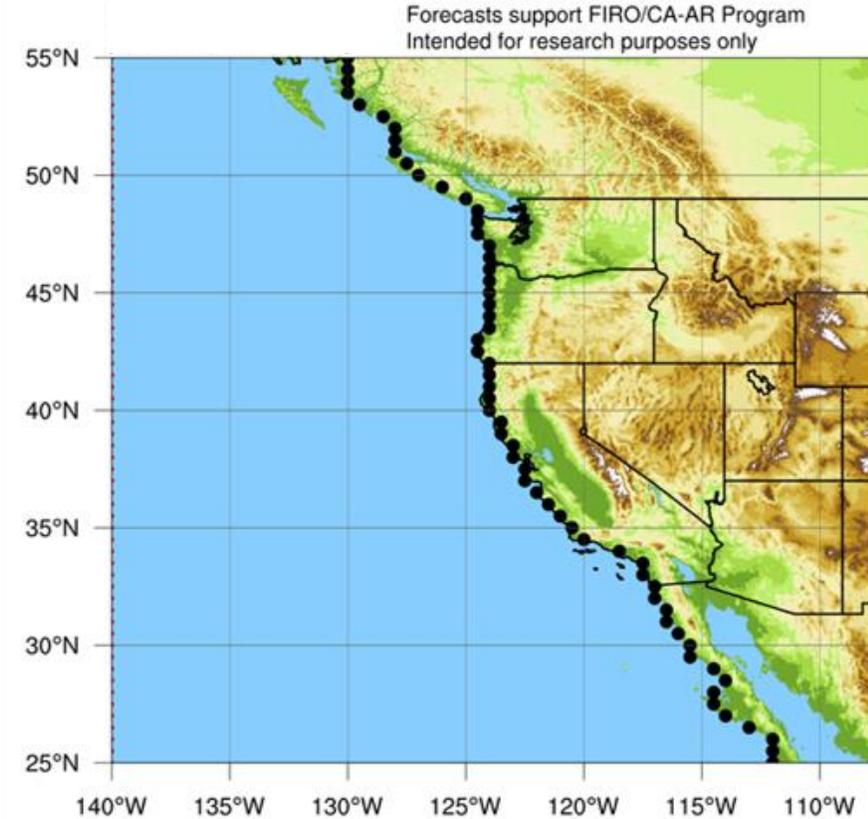
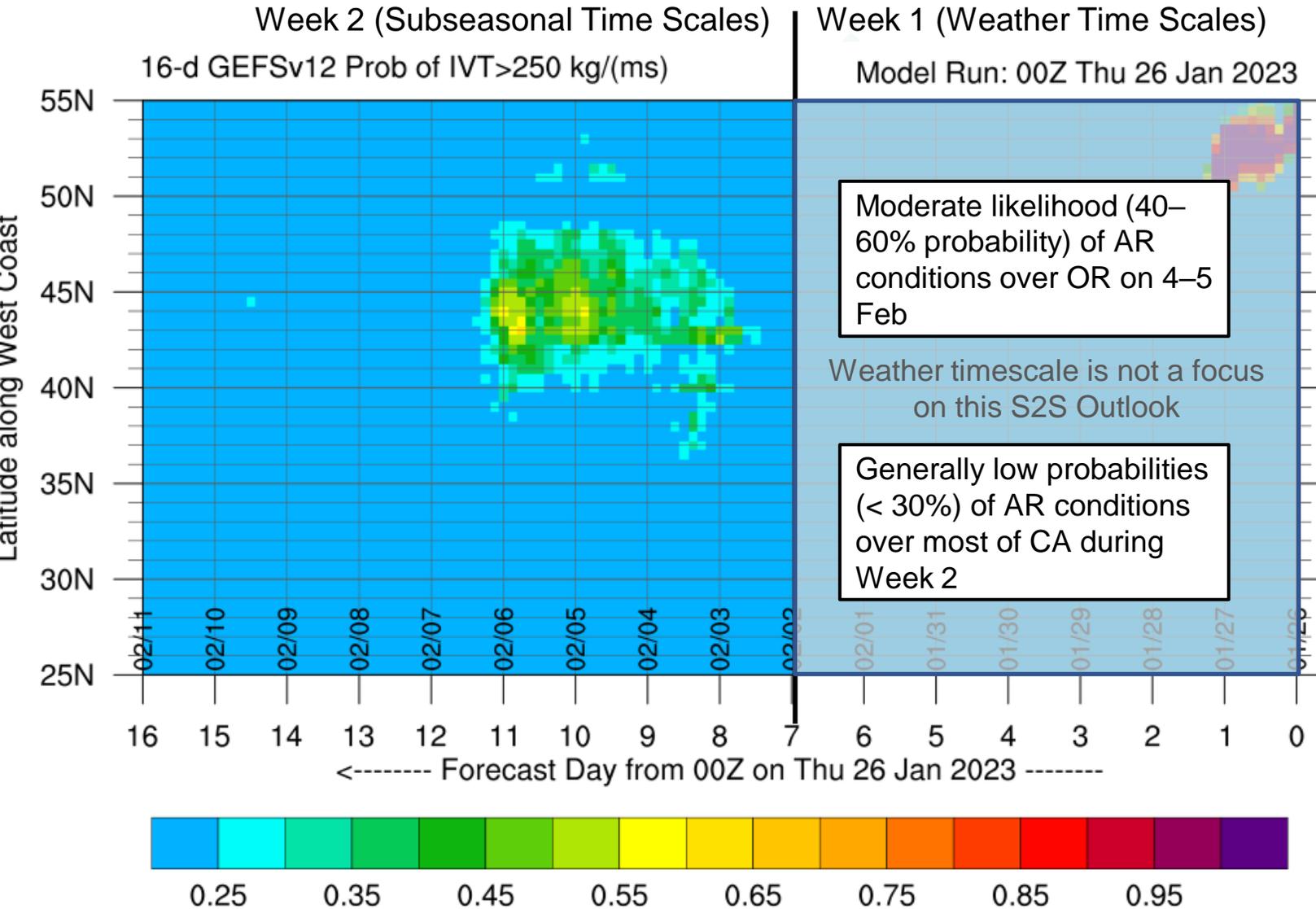
Figure 2d from Zhou et al. (2021)



- Both NCEP and ECMWF are forecasting strong MJO activity over the Indian Ocean during Week 1
- NCEP is forecasting strong MJO activity to propagate over the Maritime Continent during Week 2, but ECMWF is forecasting MJO activity to weaken
- MJO activity over the Indian Ocean is associated with decreases in AR activity over the subtropical North Pacific and extreme precipitation over California

NCEP GEFS AR Landfall Tool: Valid 00Z 26 Jan – 00Z 11 Feb

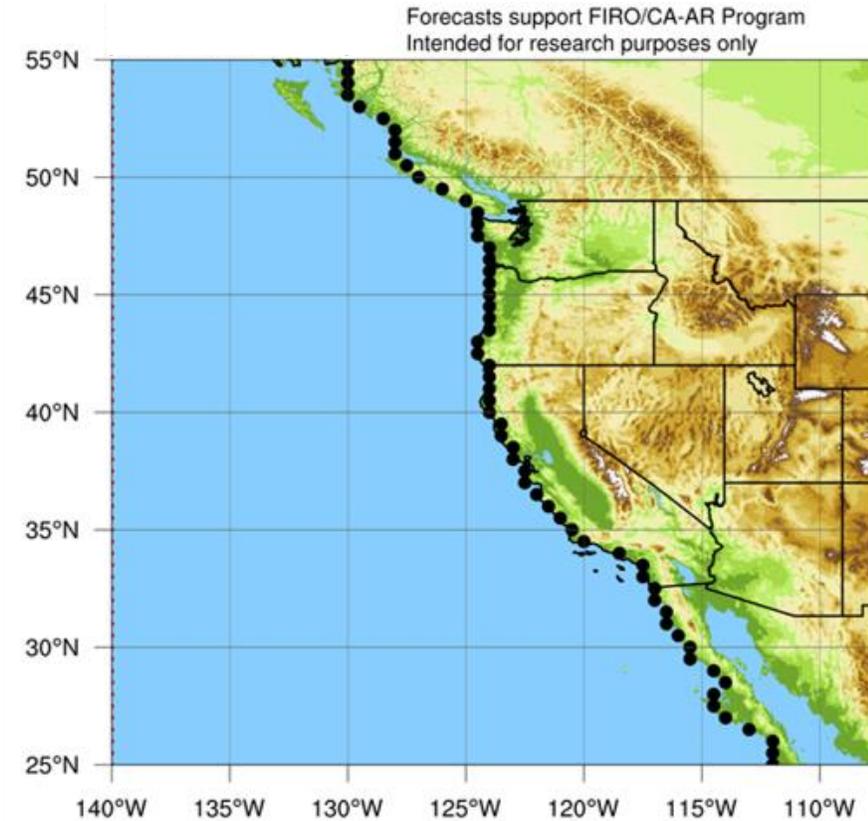
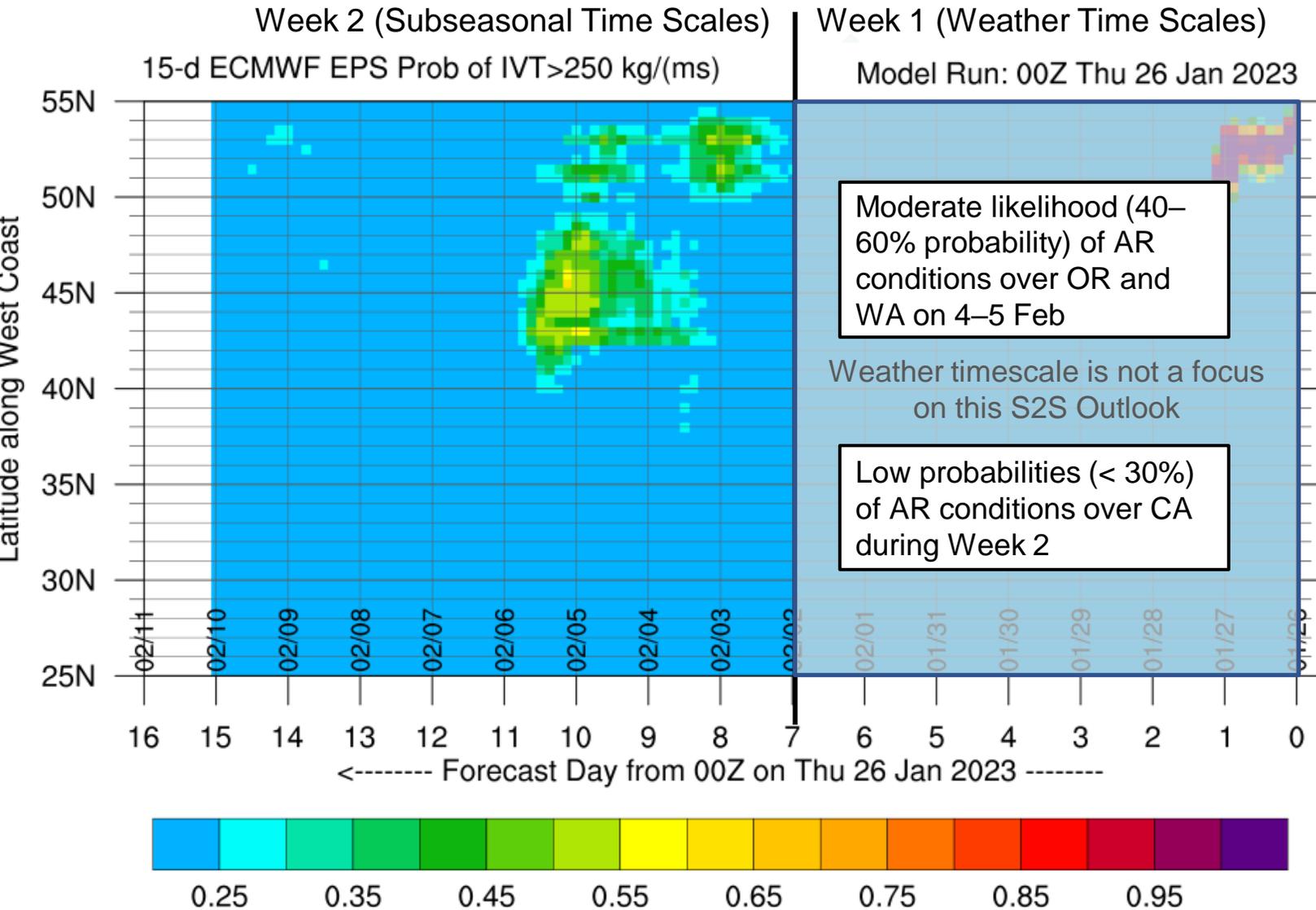
Forecasts Initialized 26 Jan 2023



- NCEP is forecasting low likelihood of AR conditions over California in Week 2, with strong MJO activity over the Indian Ocean and Maritime Continent during Weeks 1–2

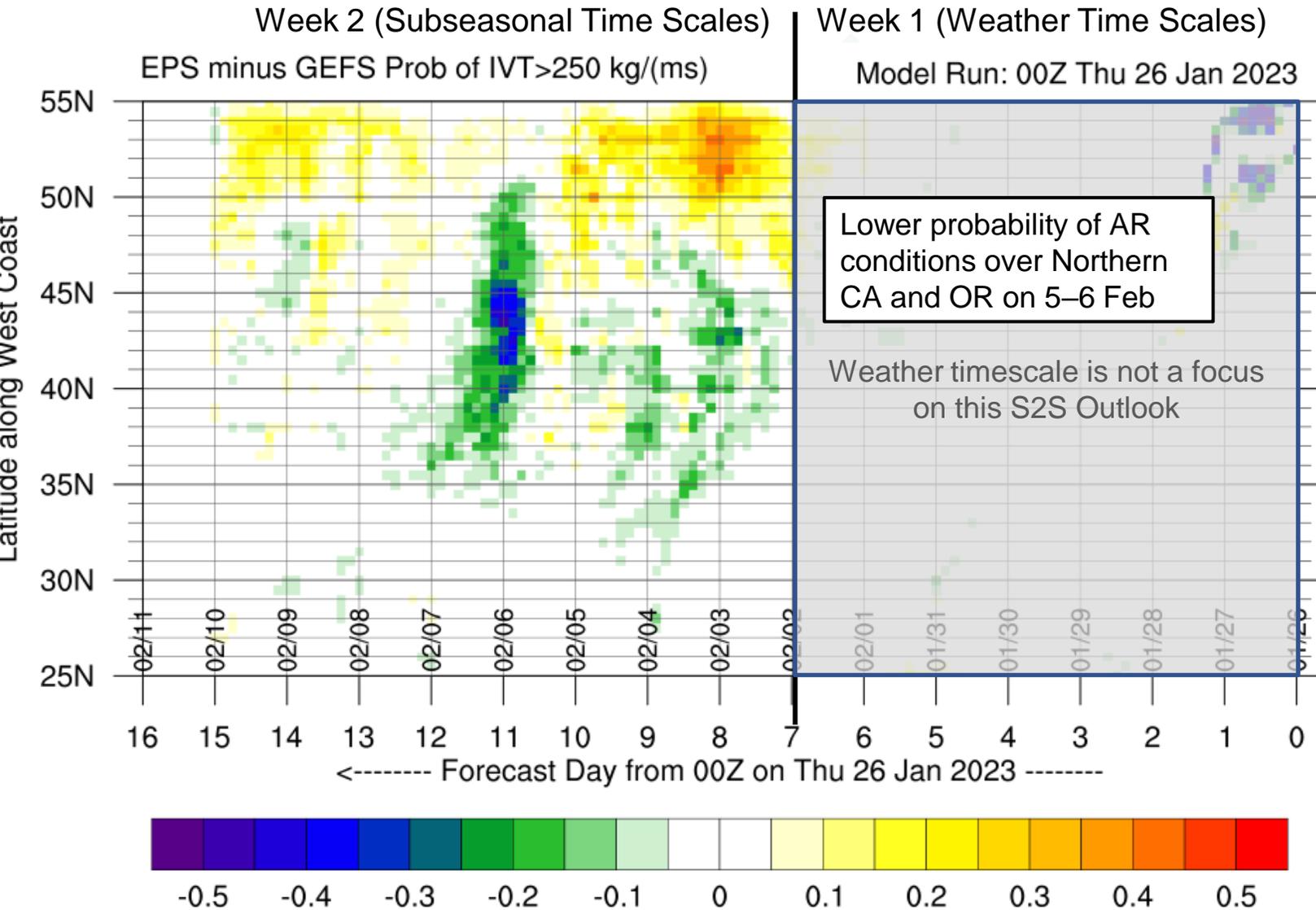
ECMWF EPS AR Landfall Tool: Valid 00Z 26 Jan – 00Z 10 Feb

Forecasts Initialized 26 Jan 2023

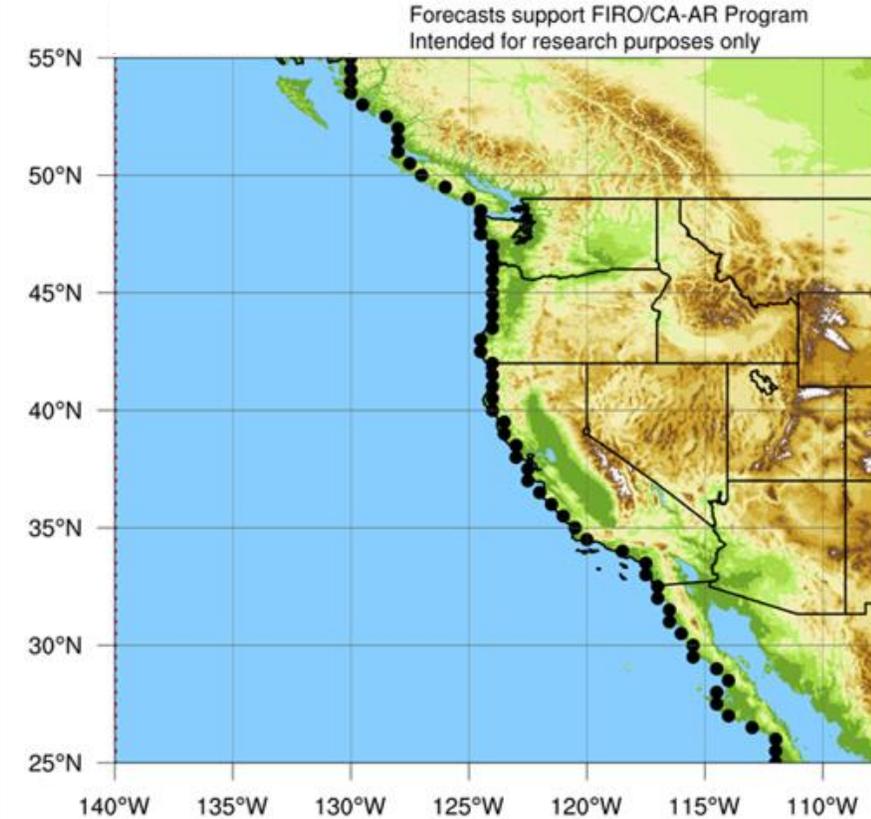


- ECMWF is forecasting low likelihood of AR conditions over California during Week 2, with strong MJO activity over the Indian Ocean during Week 1

EPS Minus GEFS AR Landfall Tool: Valid 00Z 26 Jan – 00Z 10 Feb



Forecasts Initialized 26 Jan 2023



- ECMWF is forecasting lower likelihood of AR conditions over Northern CA and Oregon on 5-6 Feb compared to NCEP

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

Forecasts Initialized 26 Jan 2023

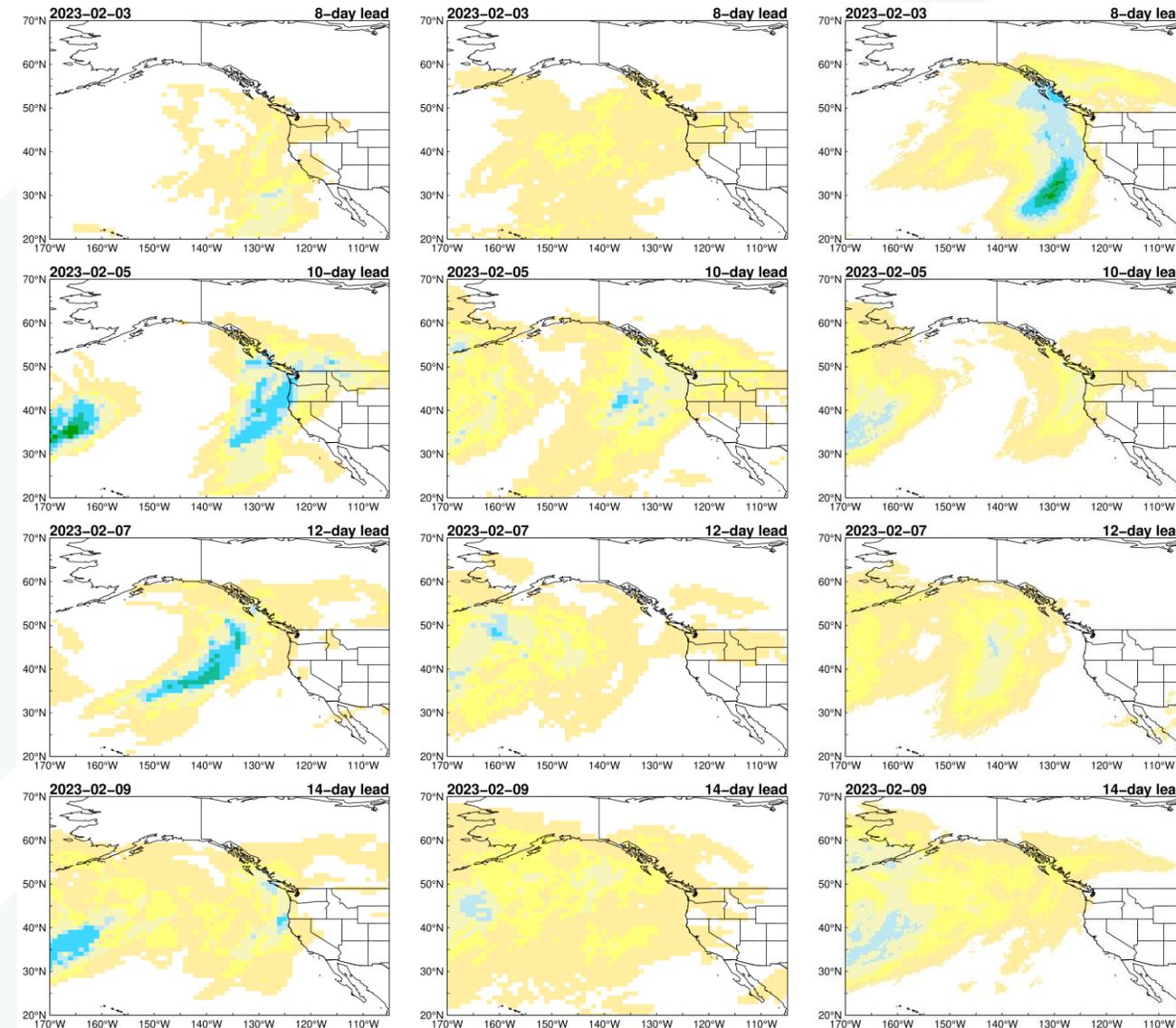
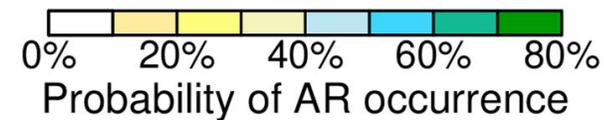
NCEP

ECCC

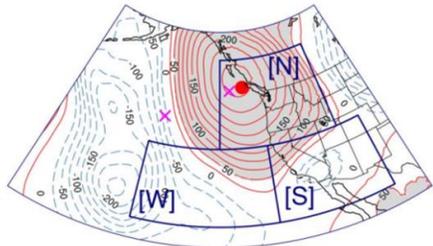
ECMWF

- All models are showing low probabilities (< 30%) of AR activity over Central and Southern CA during Week 2 (3–9 Feb)
- NCEP is showing the highest probabilities (40–60%) of AR activity over far Northern CA, OR, and WA on 5 Feb

Models agree on low likelihood of AR activity over most of California during Week 2 (3–9 Feb)

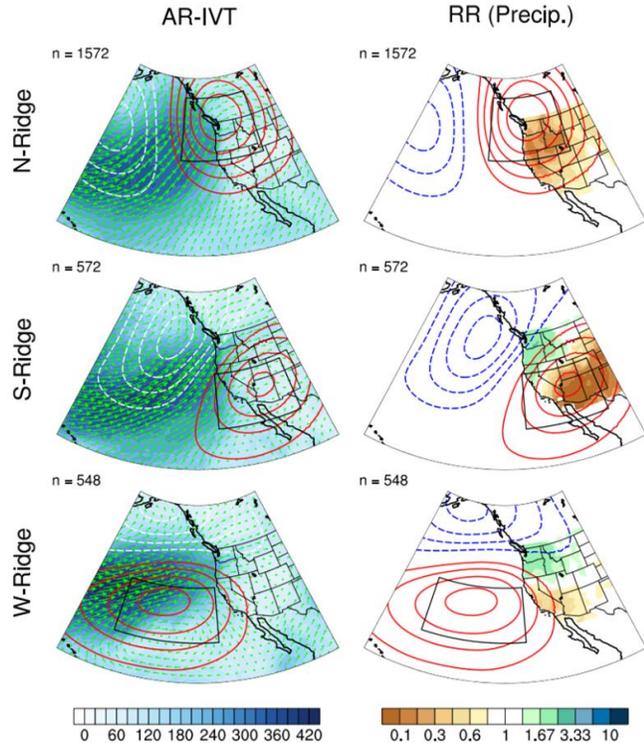


Background Info: Subseasonal Ridging Outlooks



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 Central and Southern California and wet conditions over the Pacific Northwest



Jet Propulsion Laboratory
California Institute of Technology



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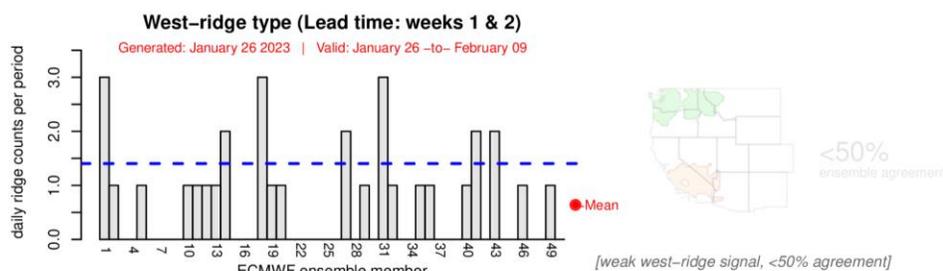
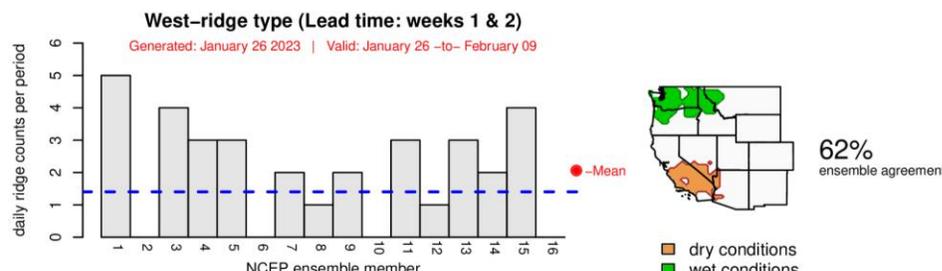
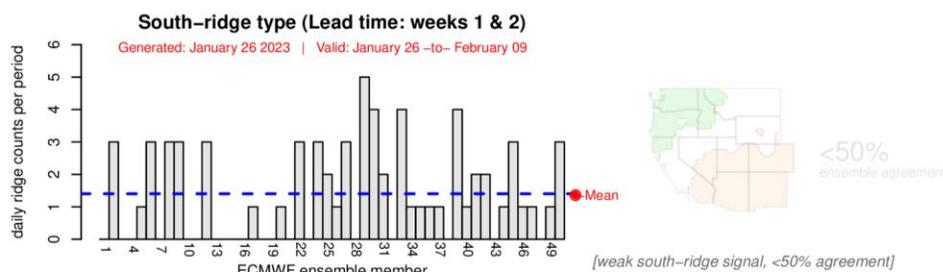
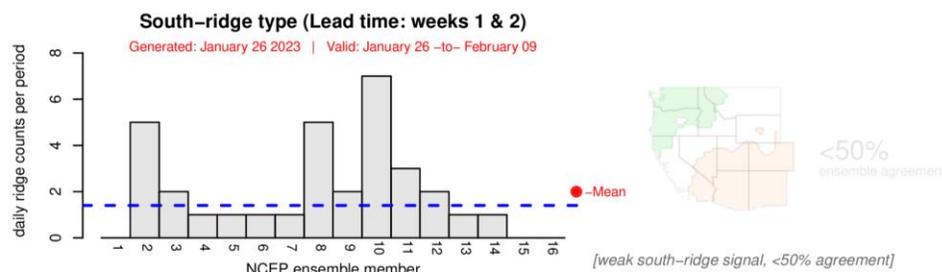
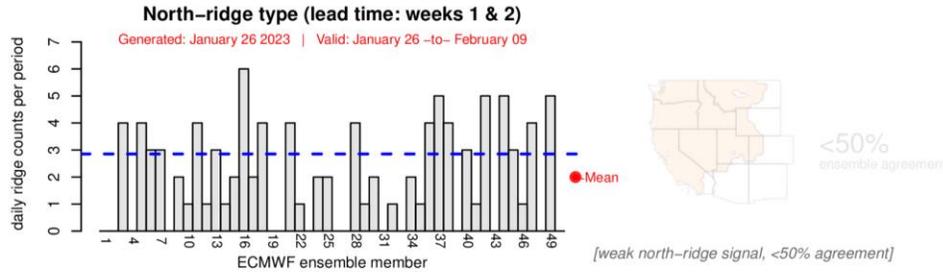
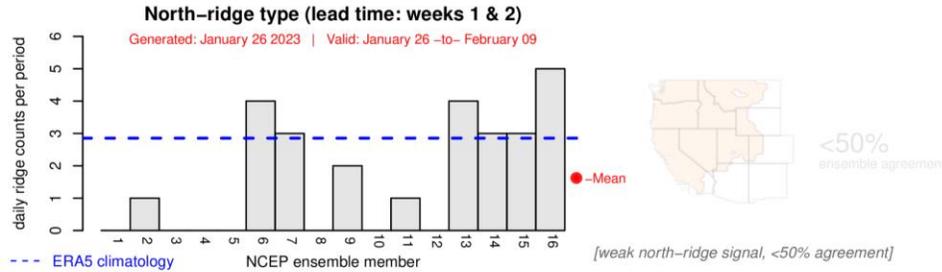
Contact: pgibson@ucsd.edu
Reference: Gibson et al. (2020)
Journal of Climate

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

Forecasts Initialized 26 Jan 2023

NCEP

ECMWF



- NCEP is showing moderate likelihood (< 62% ensemble agreement) of above-normal ridging activity west of CA during Weeks 1–2 (26 Jan – 9 Feb)
- ECMWF is showing low likelihood of above-normal ridging activity west of CA
- Both NCEP and ECMWF are predicting near-normal ridging activity over the southwestern US



There is considerable uncertainty in ridging activity near the US West Coast during Weeks 1–2

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

Forecasts Initialized 26 Jan 2023

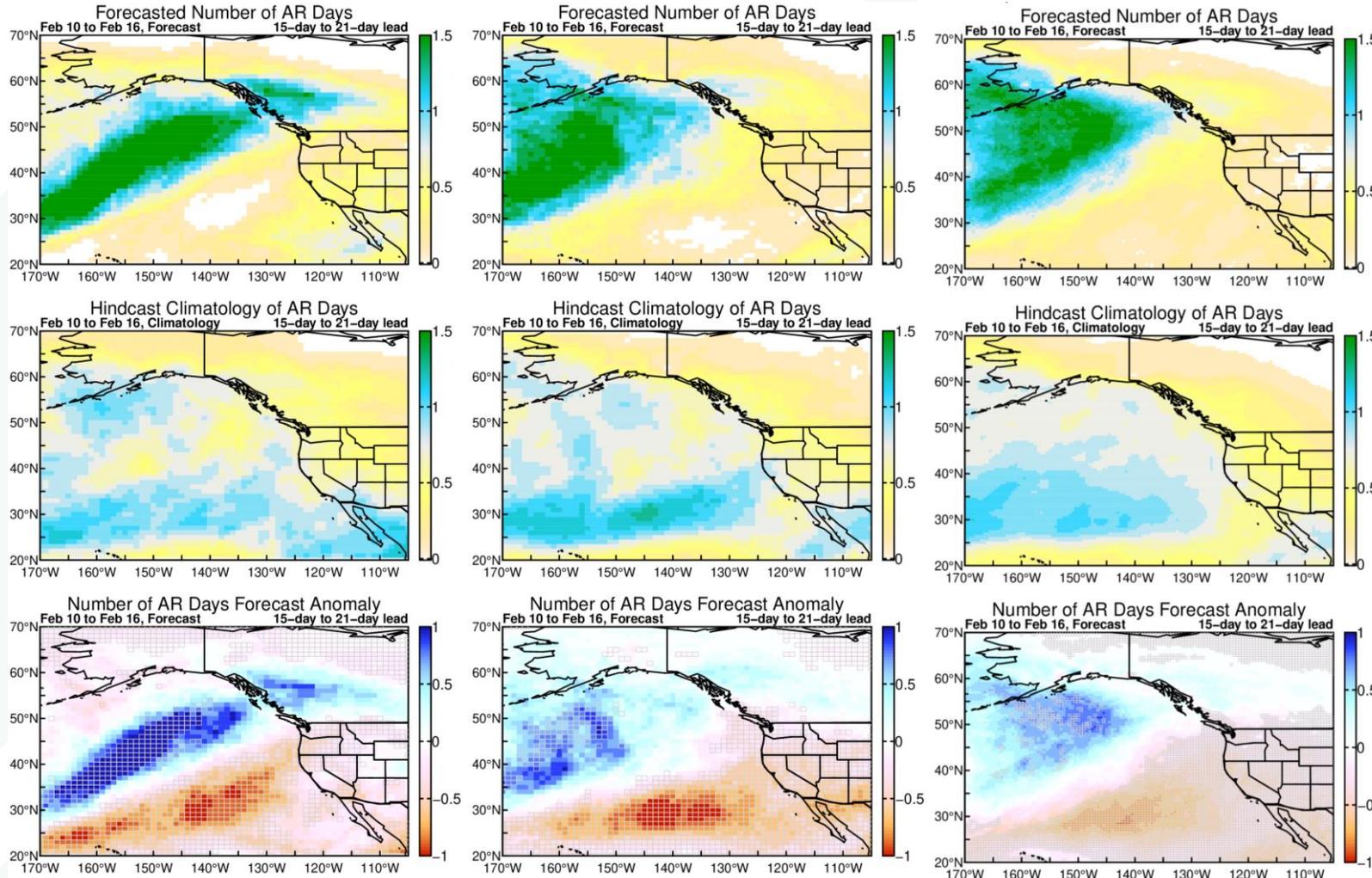
NCEP

ECCC

ECMWF

- All models are predicting little AR activity over CA during Week 3 (10–16 Feb)
- Each model's ensemble members are in strong agreement in forecasting below-normal AR activity over CA

Models agree on low AR activity over CA during Week 3 (10–16 Feb)



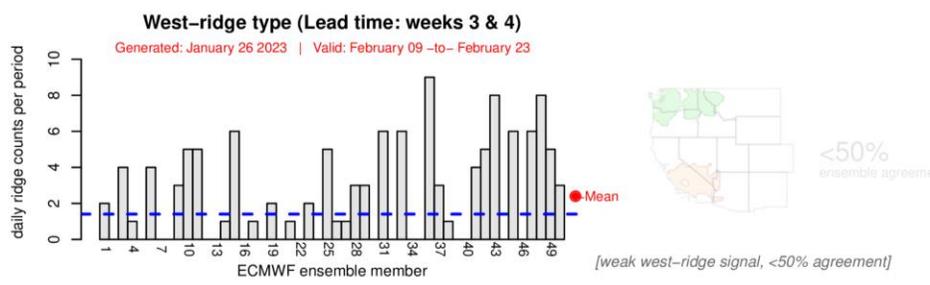
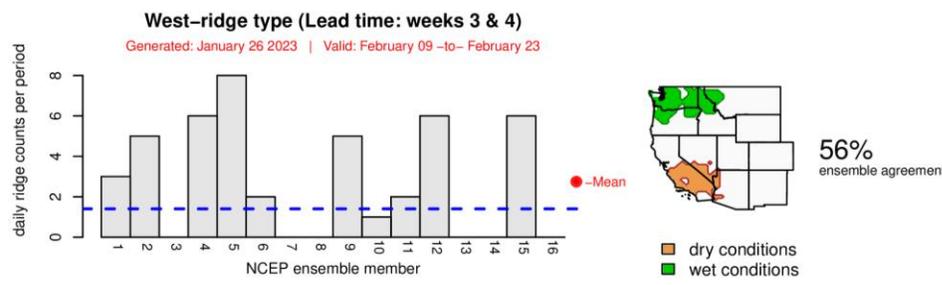
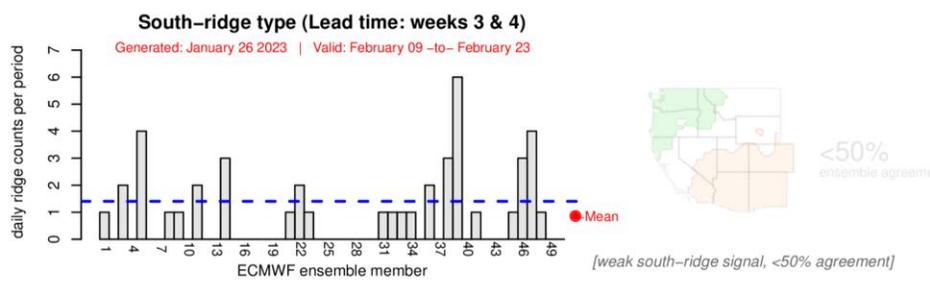
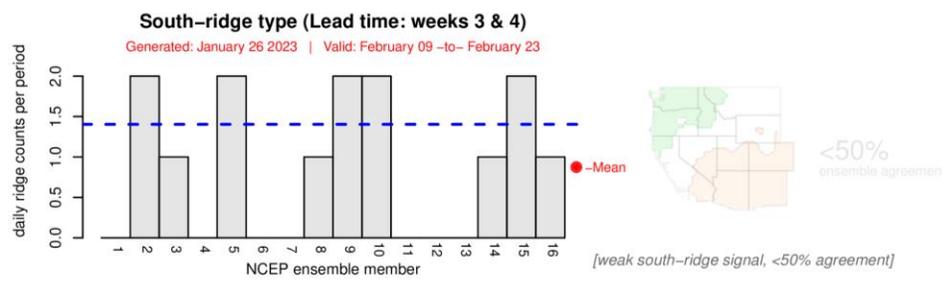
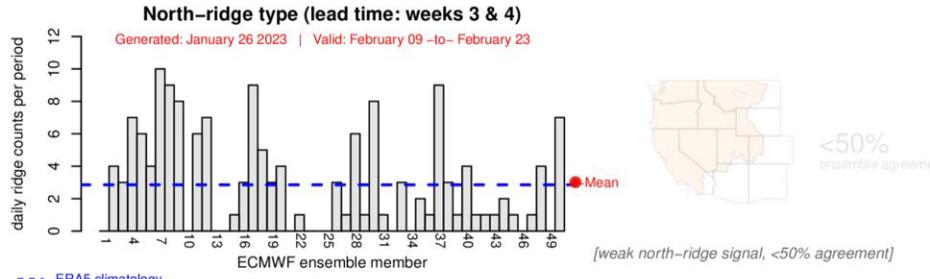
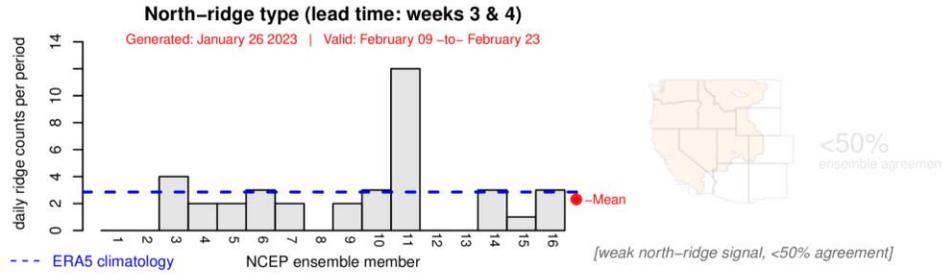
Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

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

Forecasts Initialized 26 Jan 2023

NCEP

ECMWF



- NCEP shows moderate likelihood (56% ensemble agreement) in above-normal ridging activity west of California during Weeks 3–4 (9–23 Feb)
- ECMWF is predicting slightly above-normal ridging activity west of California and near-normal ridging activity over the Pacific Northwest, but there is low ensemble agreement

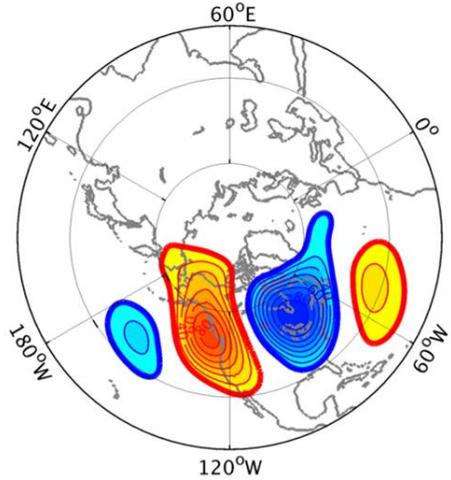


Both models are showing potential for above-normal ridging activity west of California during Weeks 3–4 (9–23 Feb)

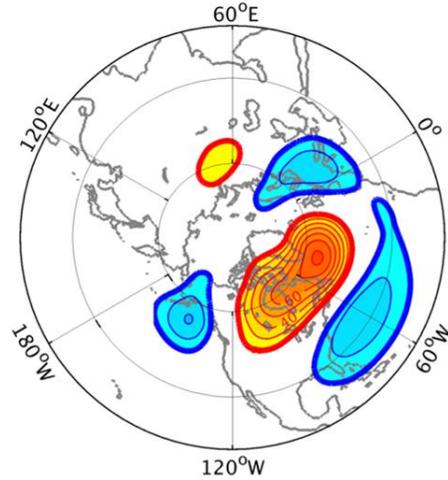


Background Info: IRI Subseasonal Weather Regime Forecasts

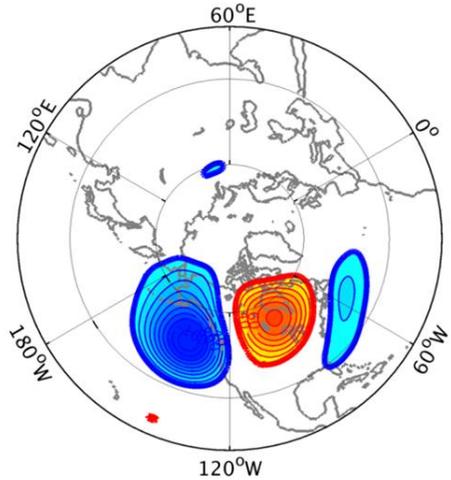
a) WR 1: West Coast Ridge



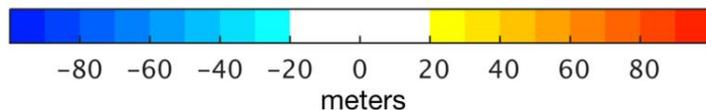
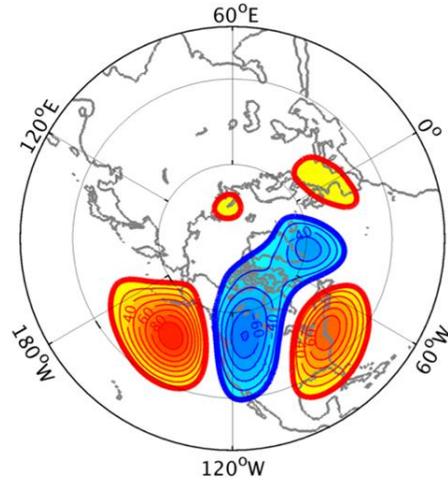
b) WR 2: Greenland High



c) WR 3: Pacific Trough



d) WR 4: Pacific Ridge



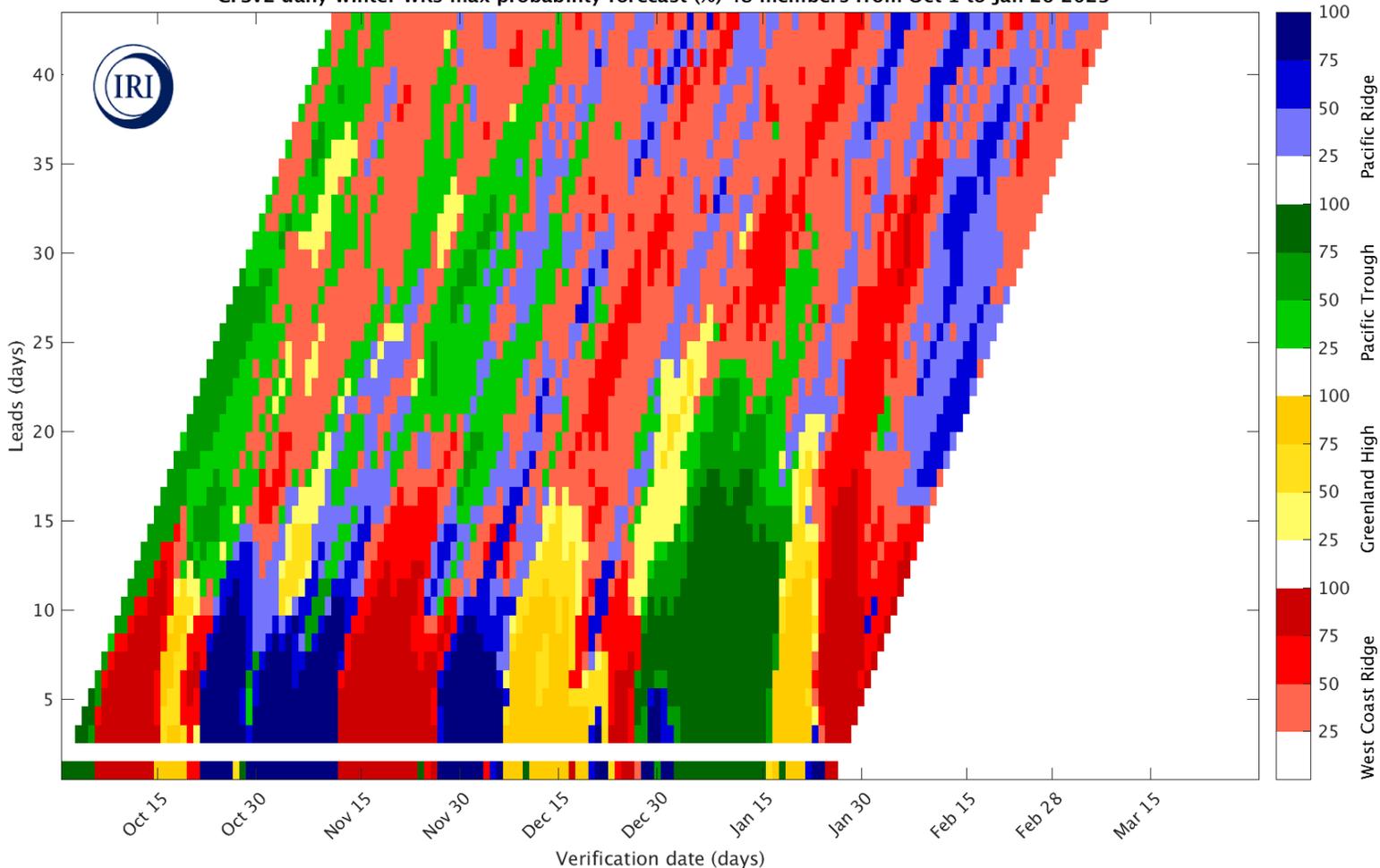
This slide contains background information about IRI's North American weather regime forecast product

- 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

CFSv2 daily winter WRs max probability forecast (%) 48 members from Oct 1 to Jan 26 2023



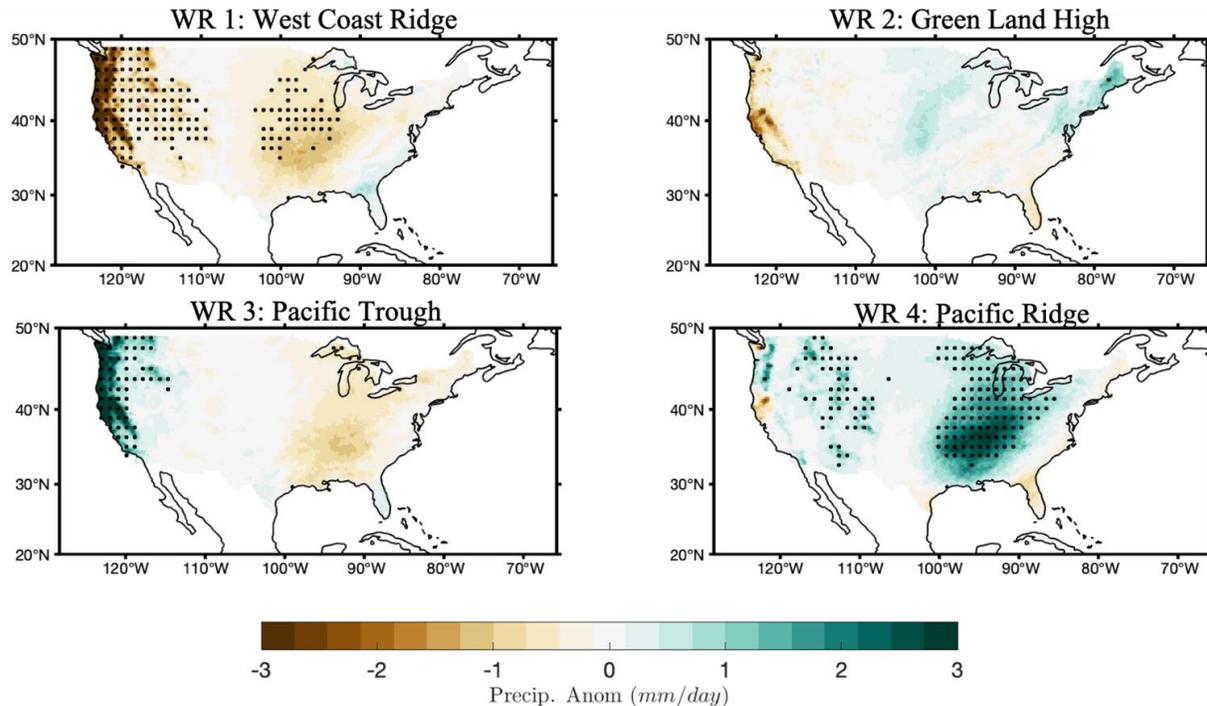
Latest Forecast Initialized 26 Jan 2023

- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- High likelihood (> 75%) of West Coast Ridge conditions continuing through Weeks 1–2
- Possible transition to Pacific Ridge in Weeks 3–4 and back to West Coast Ridge in Weeks 5–6, but lack of strong ensemble agreement (< 50%) in either regime
- Despite uncertainty in center of action of ridging, a plurality of CFSv2 members are forecasting ridging over the US West Coast or the Northeast Pacific during the next 6 weeks

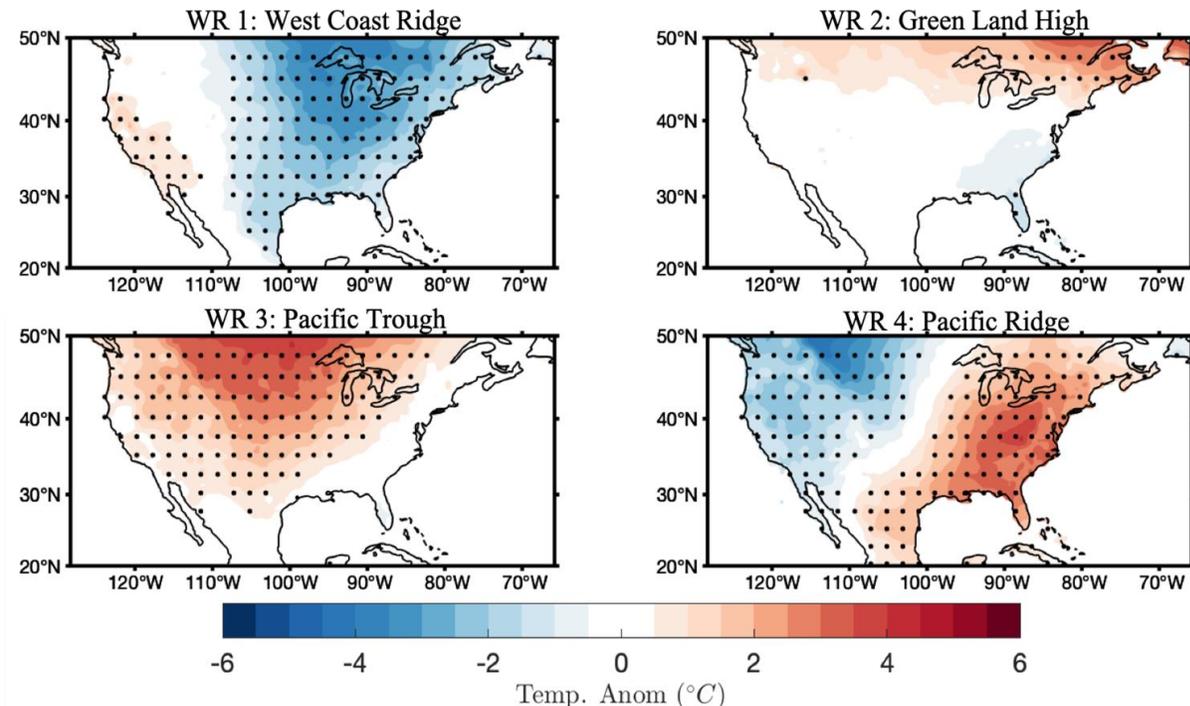
This graphic shows the which of the four North American weather regimes (different colors) is most likely to occur over the next 45 days. Darker (lighter) shading denotes higher (lower) probability of a particular regime.

Subseasonal Outlooks: IRI North American Weather Regime Forecasts

Precipitation



Temperature



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

- Anomalously warm and dry conditions are predicted over California in late January/early February with high confidence
- Anomalously cold conditions and near-normal precipitation are predicted over California in mid-February with low confidence
- Anomalously warm and dry conditions are predicted over California in late February/early March with low confidence