



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E S2S Outlook: 3 Feb 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 (10–16 Feb):**

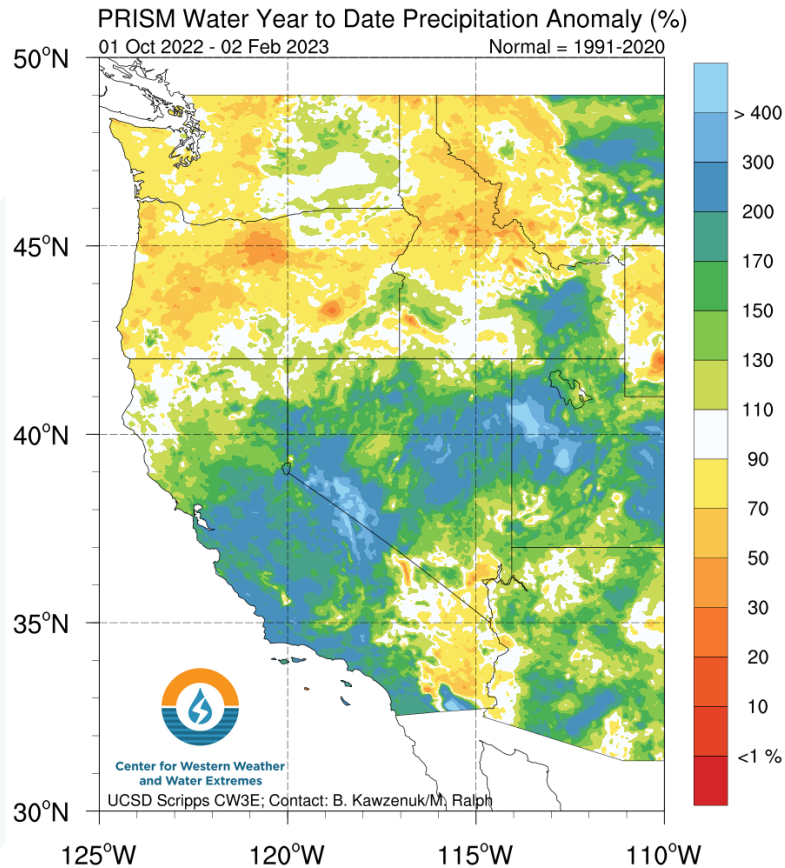
- Models agree on low likelihood (< 30% probability) of AR activity over California during Week 2
- NCEP and ECMWF are forecasting strong MJO activity over the Indian Ocean during Week 1, which is climatologically unfavorable for AR activity and precipitation in CA during Weeks 1–2
- Models agree on the high likelihood of above-normal ridging activity near CA (South- and West-Ridge types) during Weeks 1–2
 - South- and West-Ridge types are typically associated with dry conditions in Central and Southern California and wet conditions in the Pacific Northwest

➤ **Week 3 forecasts (17–23 Feb):**

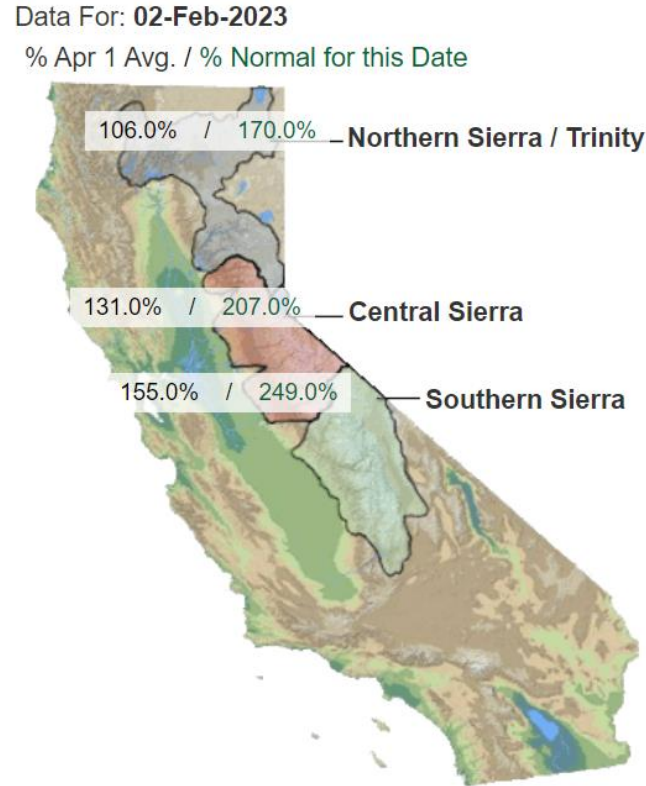
- Models are predicting low AR activity over CA, especially the ECMWF model which has high ensemble agreement
- Models show potential for above-normal ridging activity west of California during Weeks 3–4 with low-to-moderate confidence

Water Year Hydrologic Summary

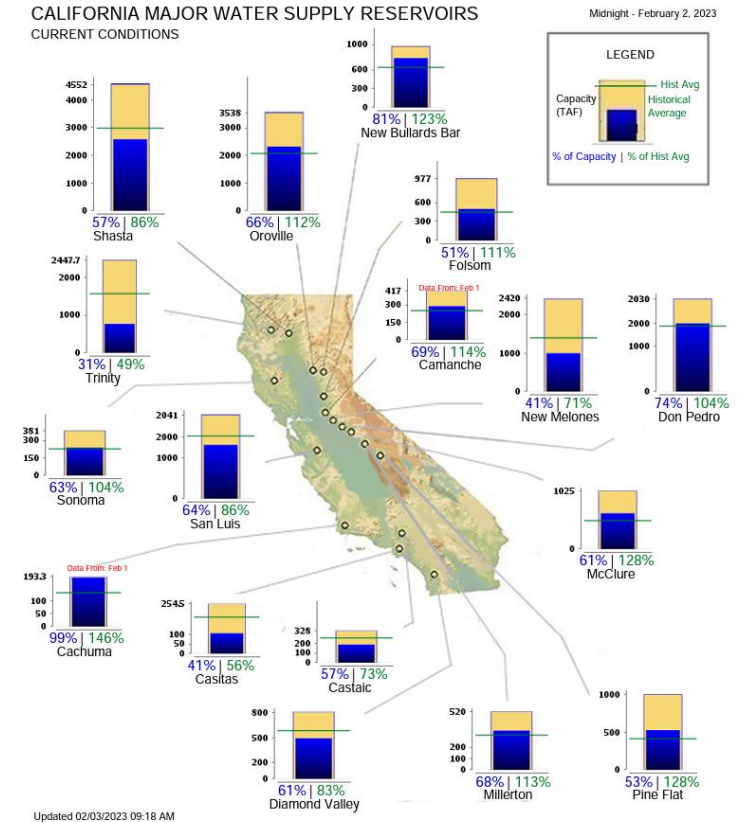
Precipitation



Snowpack Conditions



Reservoir Storage

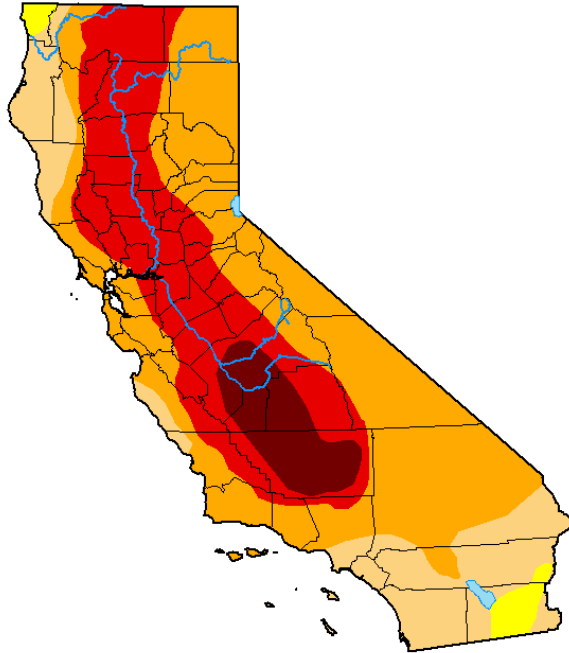


Source: California Department of Water Resources

- As of 2 Feb, 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 249% of normal for this date and 155% 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

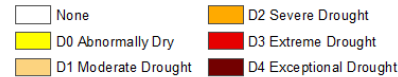
U.S. Drought Monitor California



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

	Drought Conditions (Percent Area)					
	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>

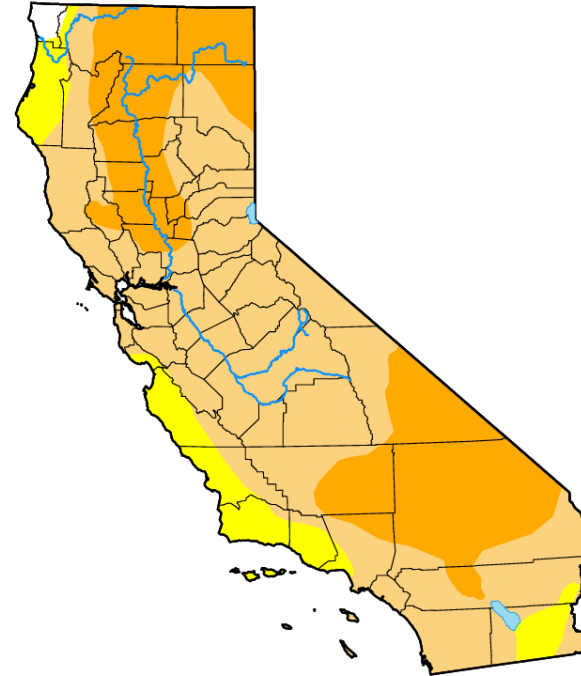
Author:

Curtis Riganti
National Drought Mitigation Center



droughtmonitor.unl.edu

U.S. Drought Monitor California



January 31, 2023
(Released Thursday, Feb. 2, 2023)
Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	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 01-24-2023	0.64	99.36	89.56	32.57	0.00	0.00
3 Months Ago 11-01-2022	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 02-01-2022	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 Bilotta
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 31 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

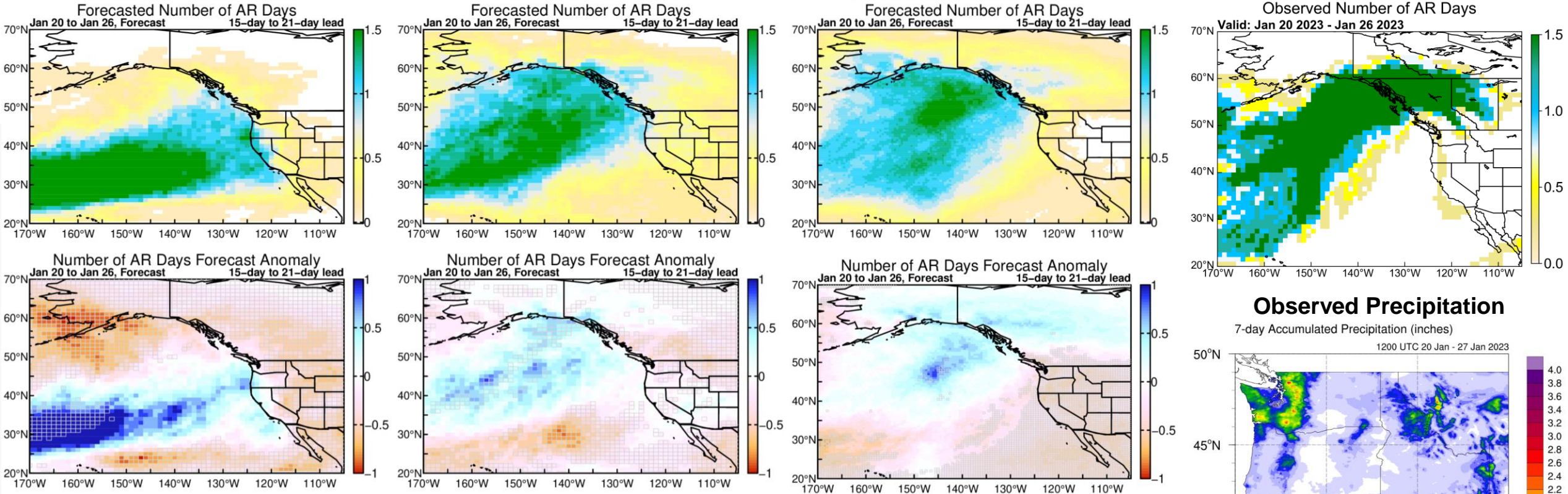
Forecasts Initialized 5 Jan 2023; Valid: 20–26 Jan 2023

NCEP

ECCE

ECMWF

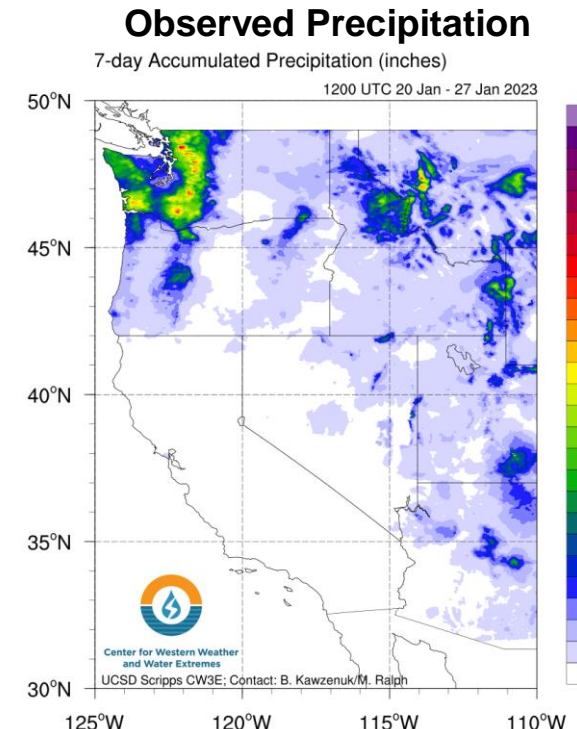
Observed (GFS Analysis)



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

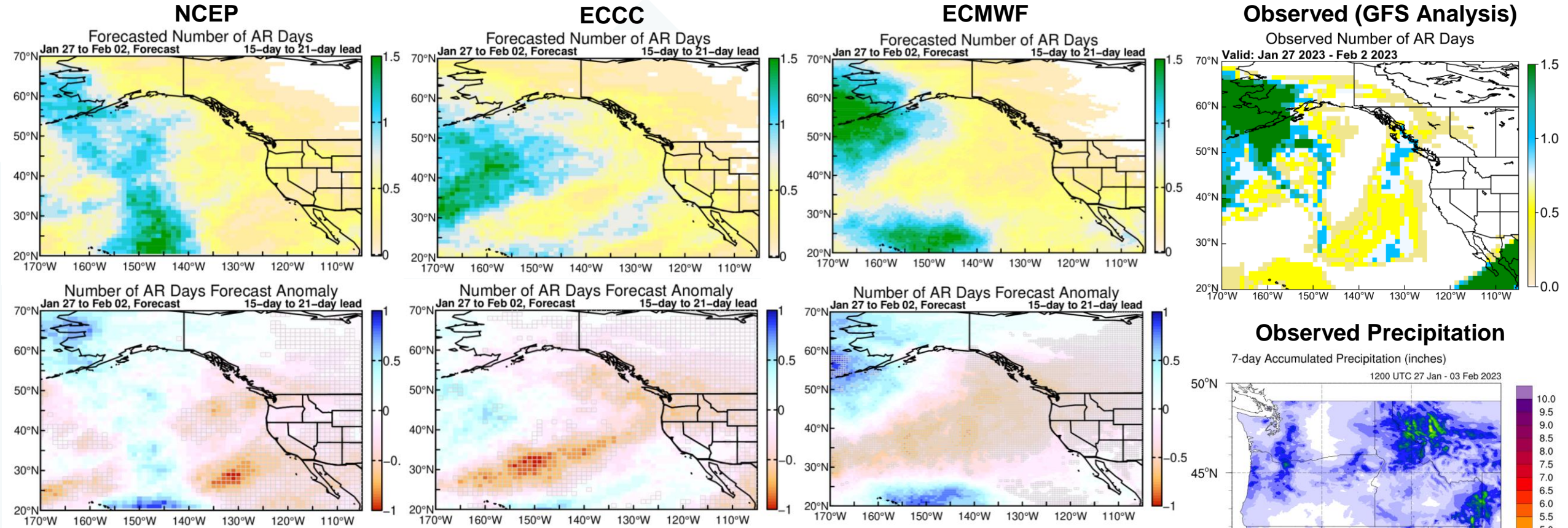
NCEP predicted too much AR activity over CA; ECCE and ECMWF verified over CA and correctly forecasted AR activity over the Alaska Panhandle

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



Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 12 Jan 2023; Valid: 27 Jan – 2 Feb 2023



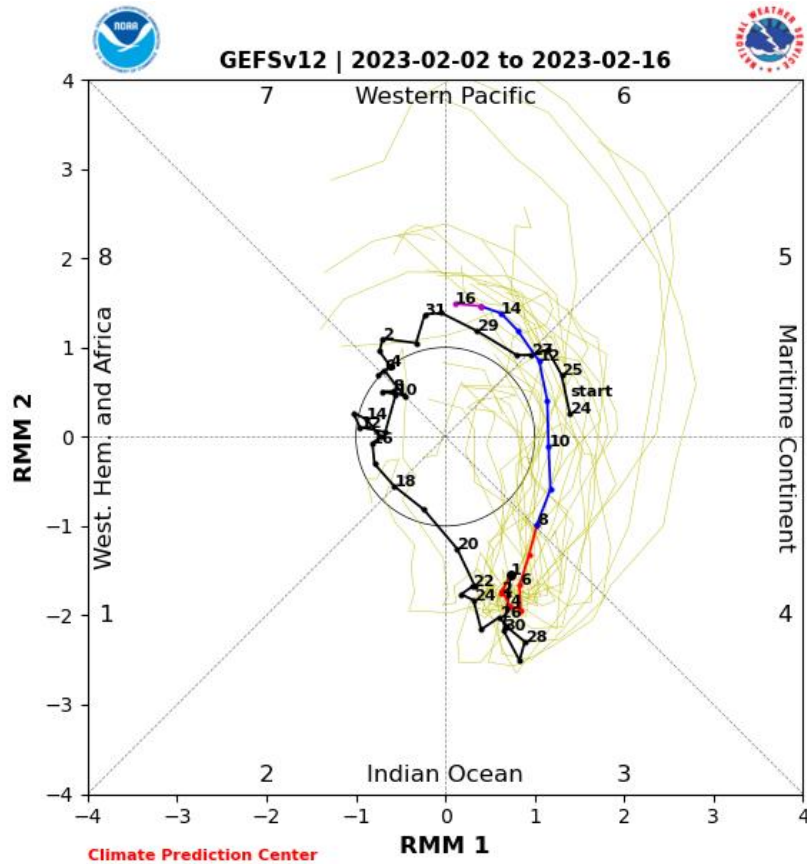
Shading: Fractional # of AR days over a 7-day period (top) and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

All models verified over CA

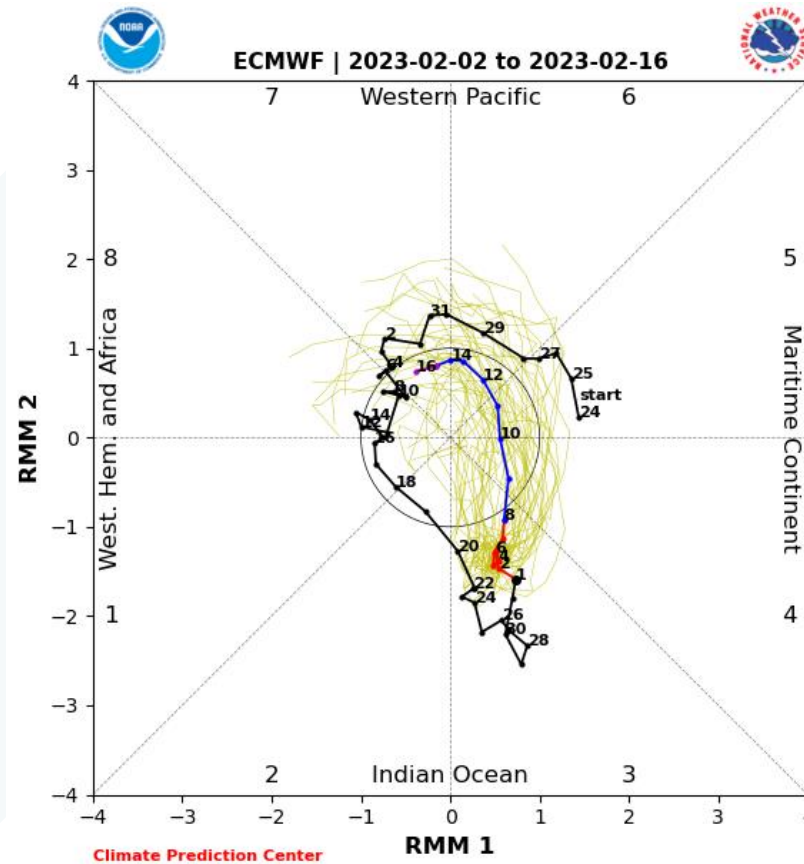
- Very little precipitation was observed over CA during this period

Dynamical Model MJO Forecasts (NCEP vs. ECMWF)

NCEP



ECMWF



Black line: Last 40 days of observations; Yellow lines: Ensemble members
Forecast: (red: week 1, blue: week 2, purple: > week 2)

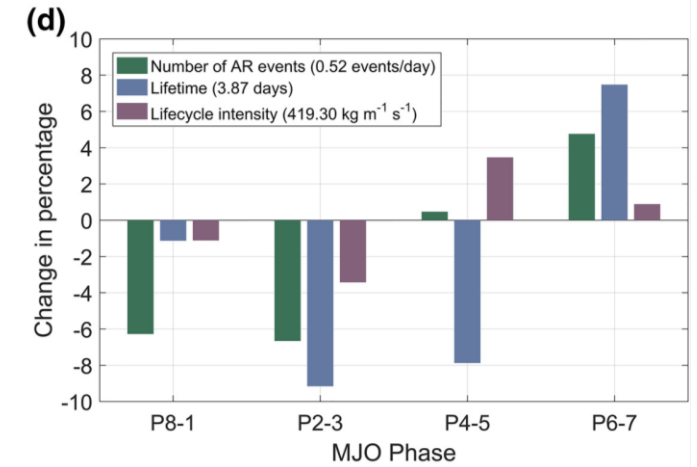
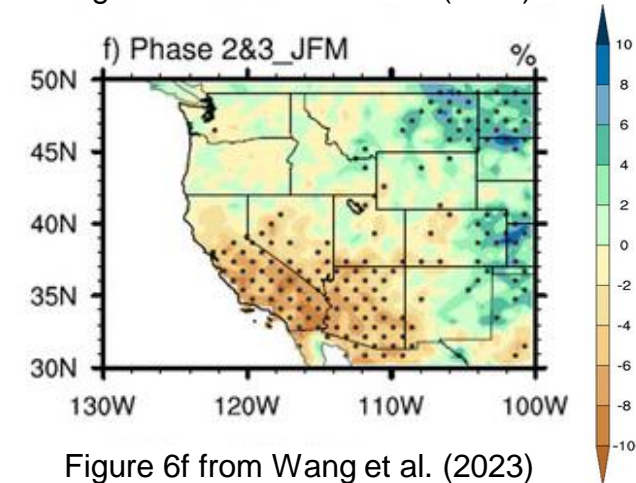


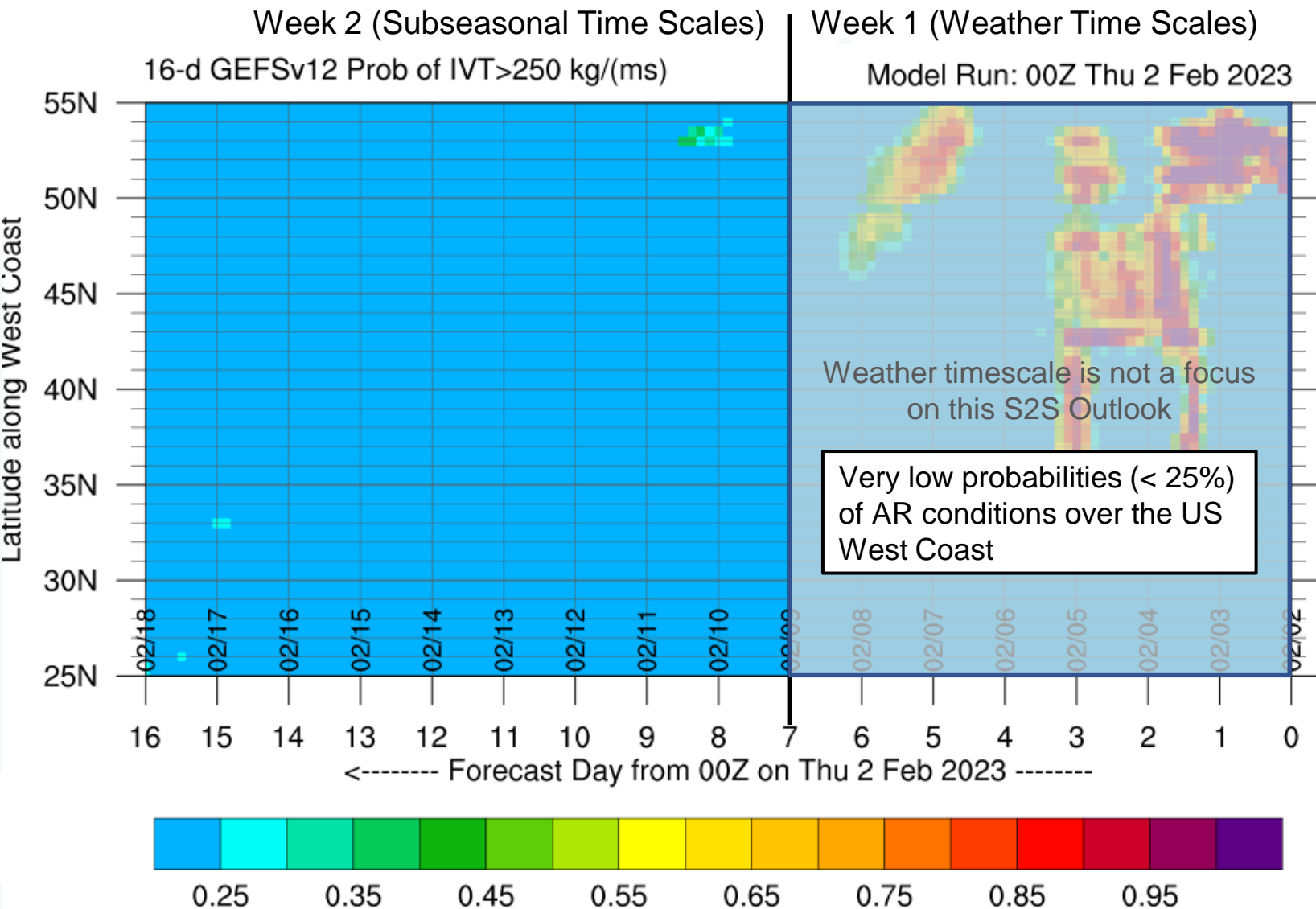
Figure 2d from Zhou et al. (2021)



- 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 historically associated with decreases in AR activity over the subtropical North Pacific and extreme precipitation over California

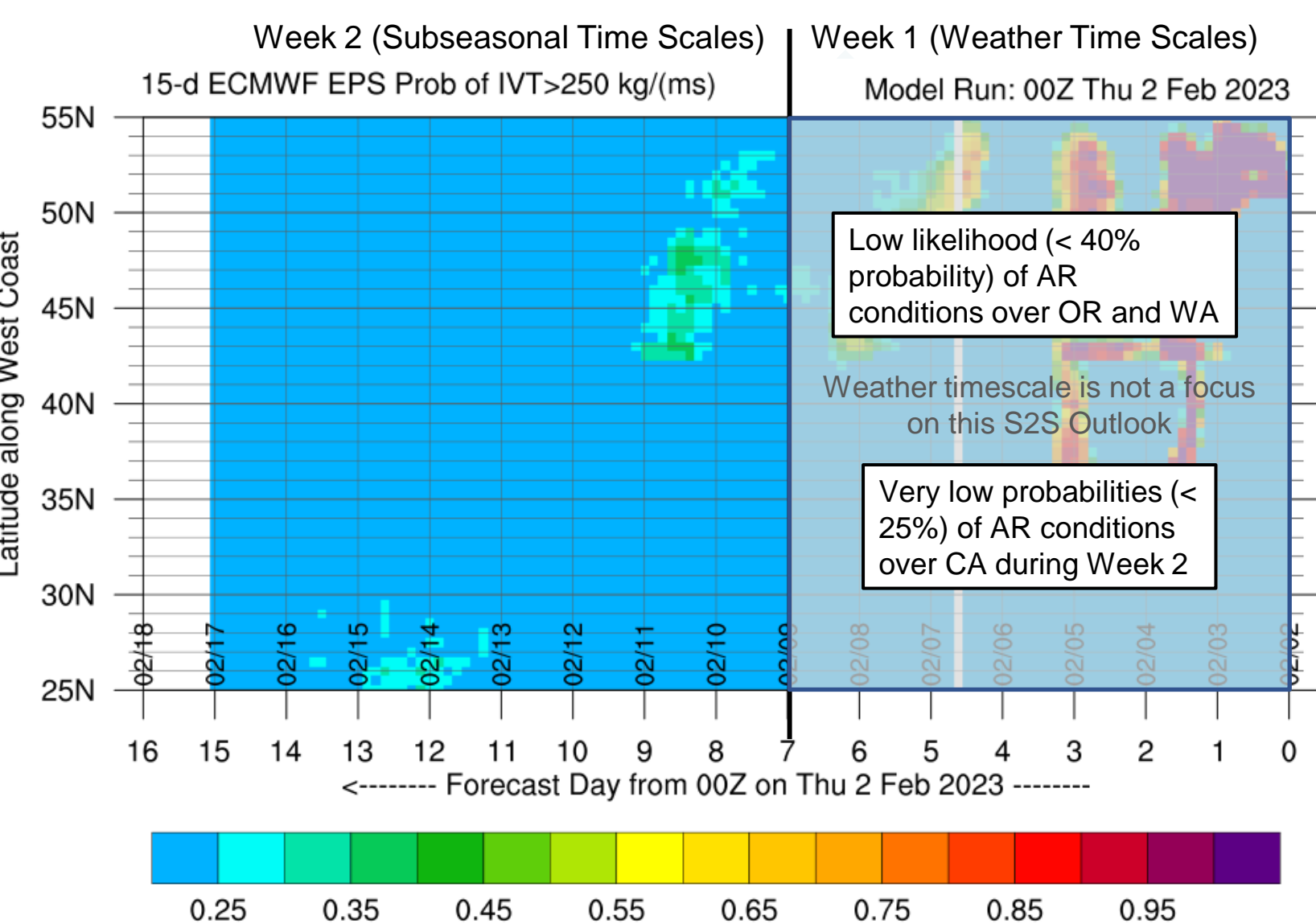
NCEP GEFS AR Landfall Tool: Valid 00Z 2 Feb – 00Z 18 Feb

Forecasts Initialized 2 Feb 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 2 Feb – 00Z 17 Feb



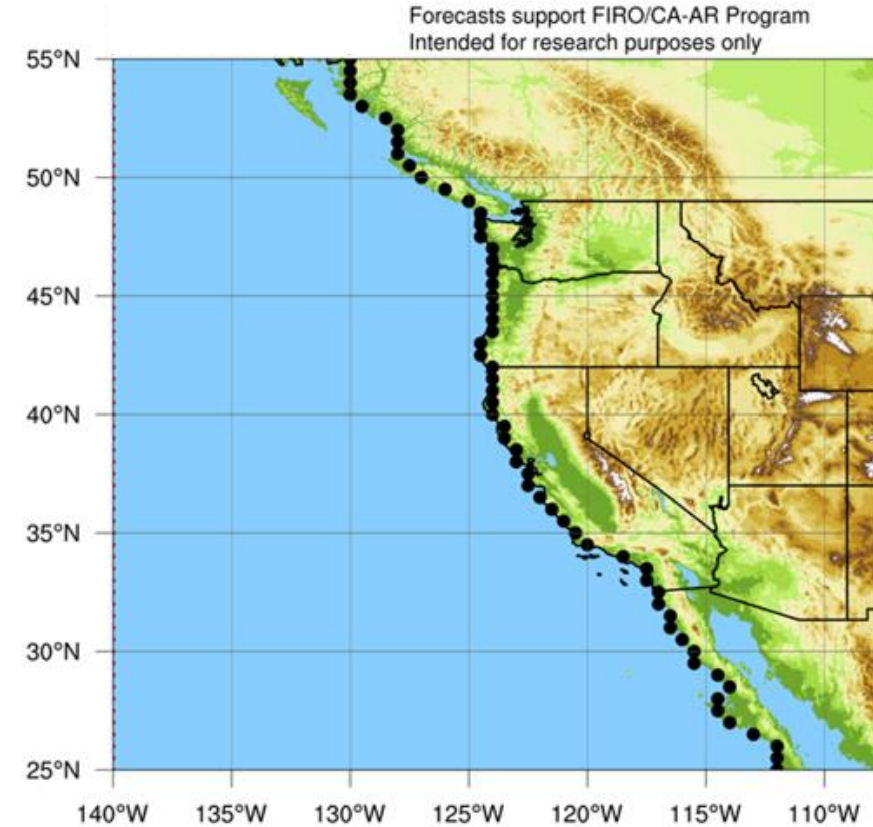
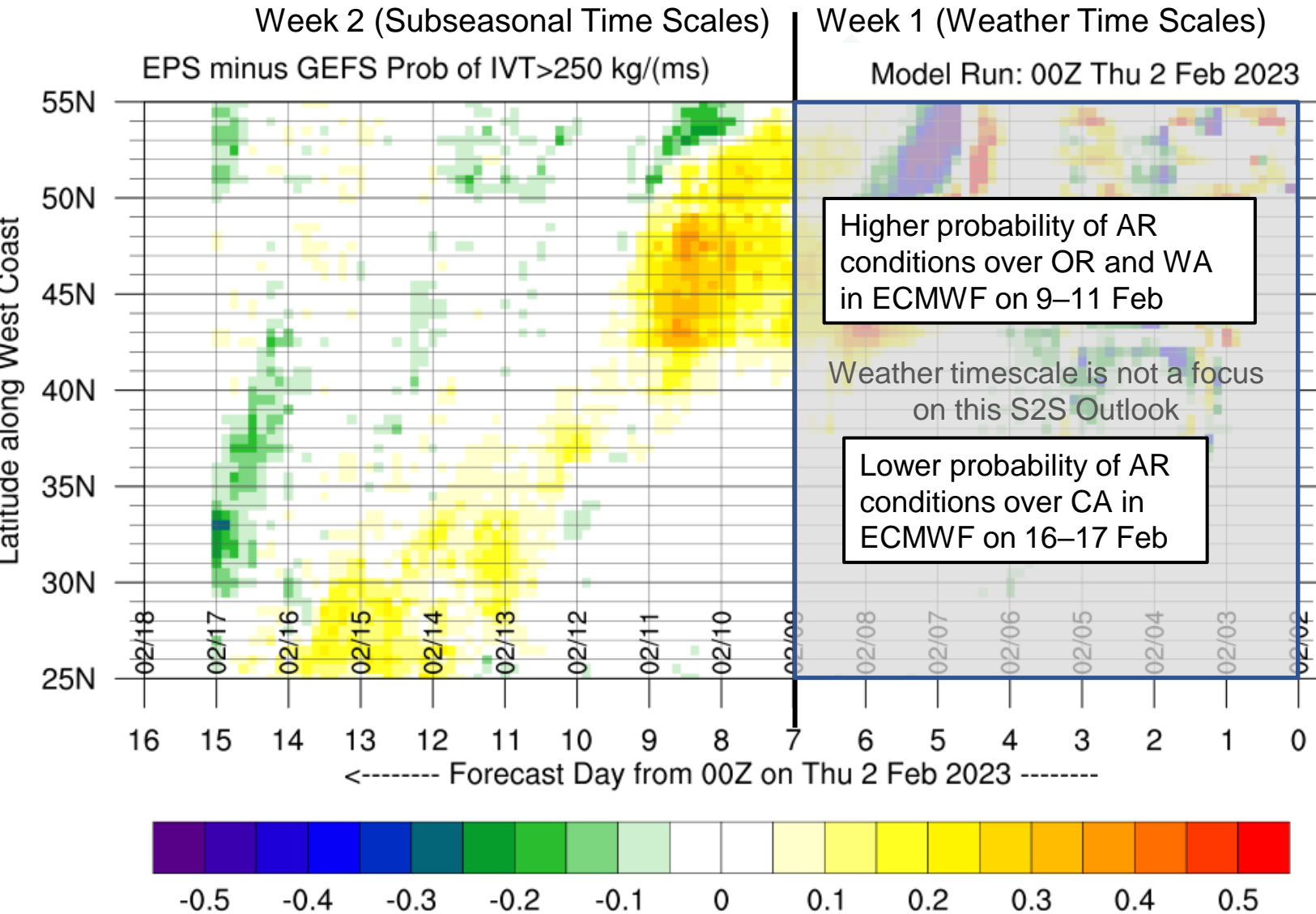
Forecasts Initialized 2 Feb 2023



- 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 2 Feb – 00Z 17 Feb

Forecasts Initialized 2 Feb 2023



- ECMWF is forecasting higher likelihood of AR conditions over Oregon and Washington on 9–11 Feb compared to NCEP and lower likelihood of AR conditions over California on 16–17 Feb

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

Forecasts Initialized 2 Feb 2023

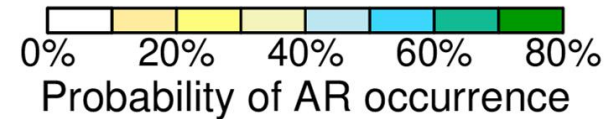
NCEP

ECMWF

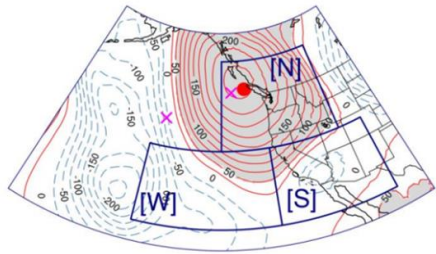
ECCC
Unavailable

- Both NCEP and ECMWF models are showing low probabilities (< 30%) of AR activity over the US West Coast during Week 2 (10–16 Feb)

Models agree on low likelihood of AR activity over California during Week 2 (10–16 Feb)

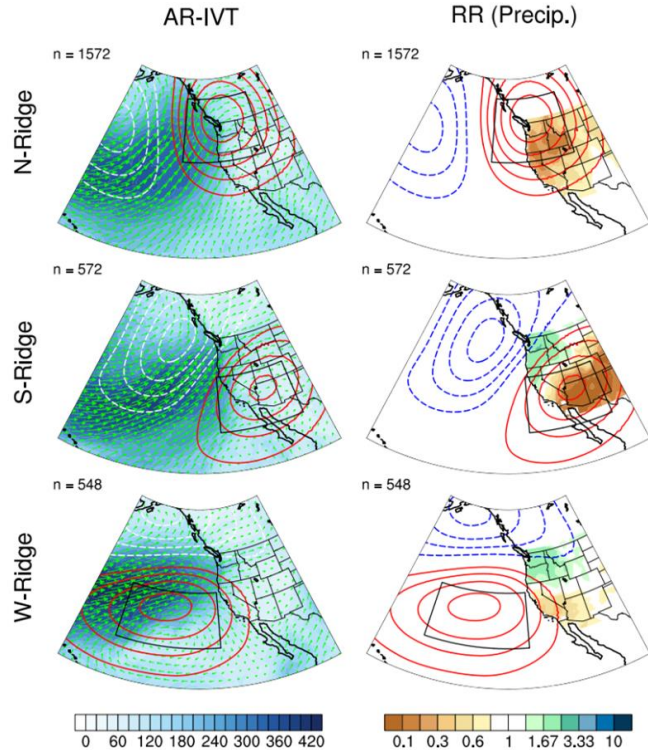


Background Info: Subseasonal Ridging Outlooks



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 2 Feb 2023

NCEP

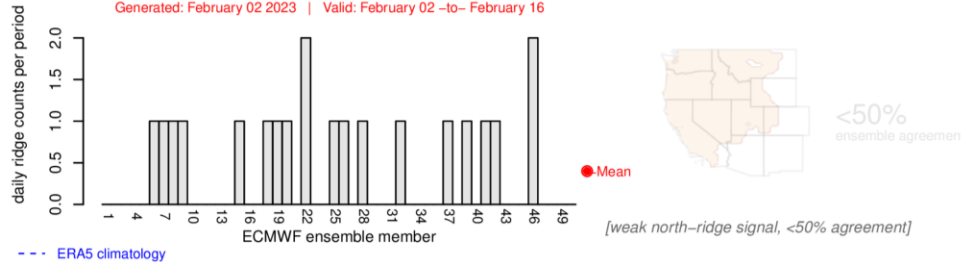
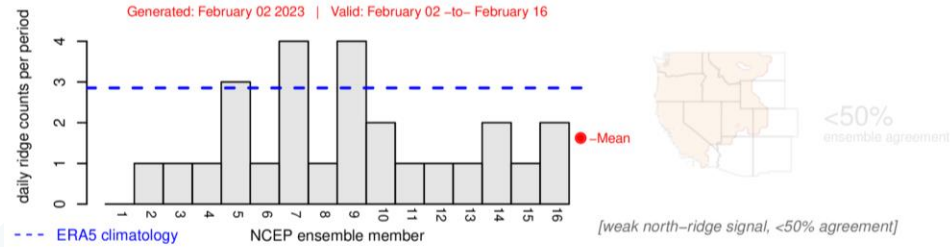
ECMWF

North-ridge type (lead time: weeks 1 & 2)

North-ridge type (lead time: weeks 1 & 2)

Generated: February 02 2023 | Valid: February 02 –to– February 16

Generated: February 02 2023 | Valid: February 02 –to– February 16

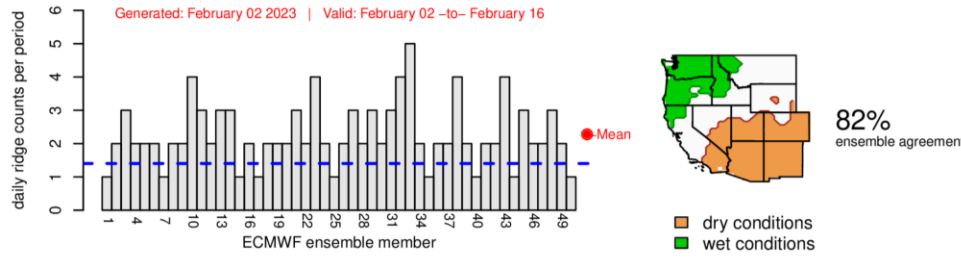
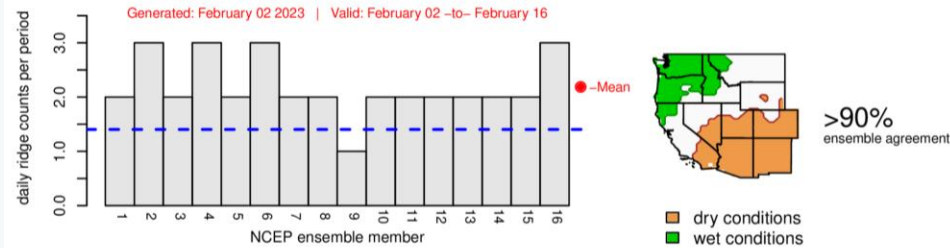


South-ridge type (Lead time: weeks 1 & 2)

South-ridge type (Lead time: weeks 1 & 2)

Generated: February 02 2023 | Valid: February 02 –to– February 16

Generated: February 02 2023 | Valid: February 02 –to– February 16

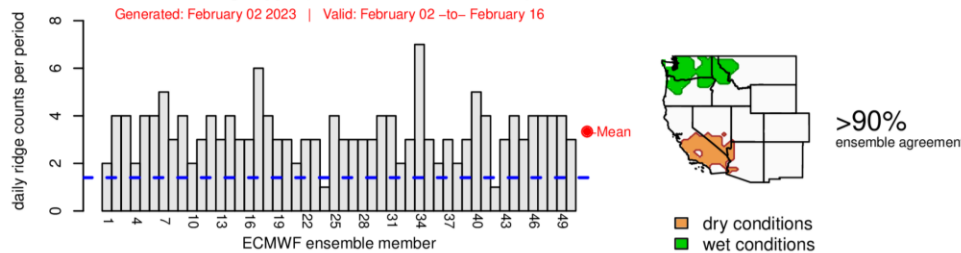
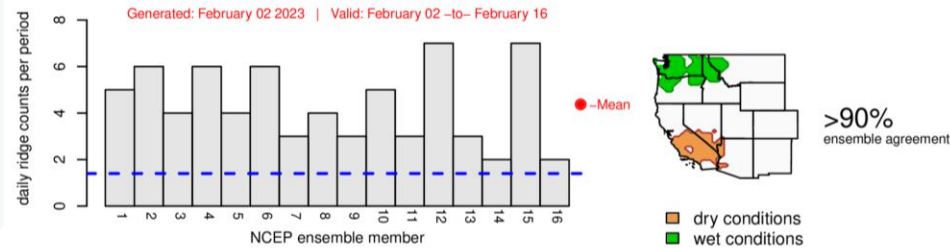


West-ridge type (Lead time: weeks 1 & 2)

West-ridge type (Lead time: weeks 1 & 2)

Generated: February 02 2023 | Valid: February 02 –to– February 16

Generated: February 02 2023 | Valid: February 02 –to– February 16



- Both models are showing high likelihood (>80% ensemble agreement) of above-normal ridging activity near CA during Weeks 1–2 (02 – 16 Feb)

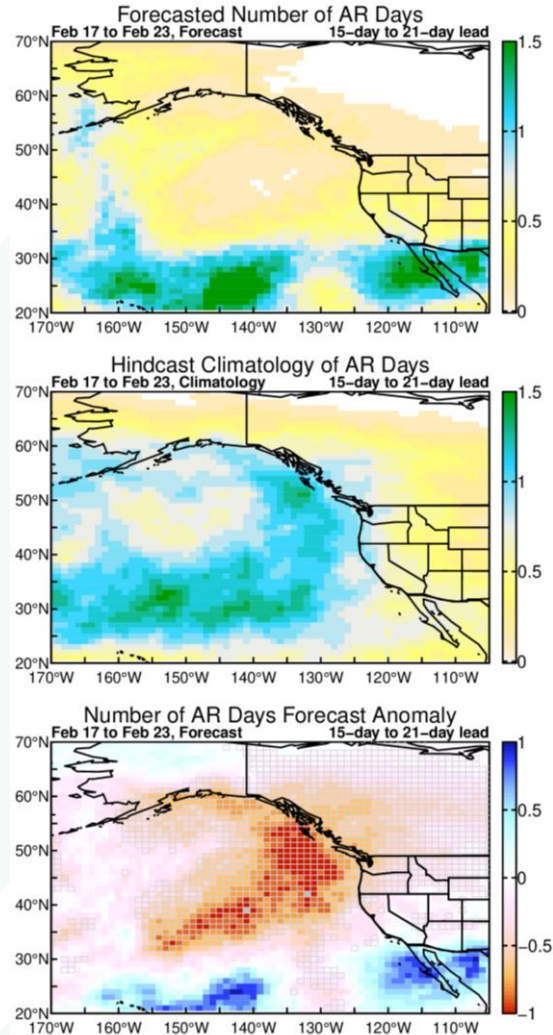
- The ridge types are typically associated with dry conditions in Central and Southern California and wet conditions in the Pacific Northwest

Models agree on the high likelihood of above-normal ridging activity near CA during Weeks 1–2 (02 – 16 Feb)

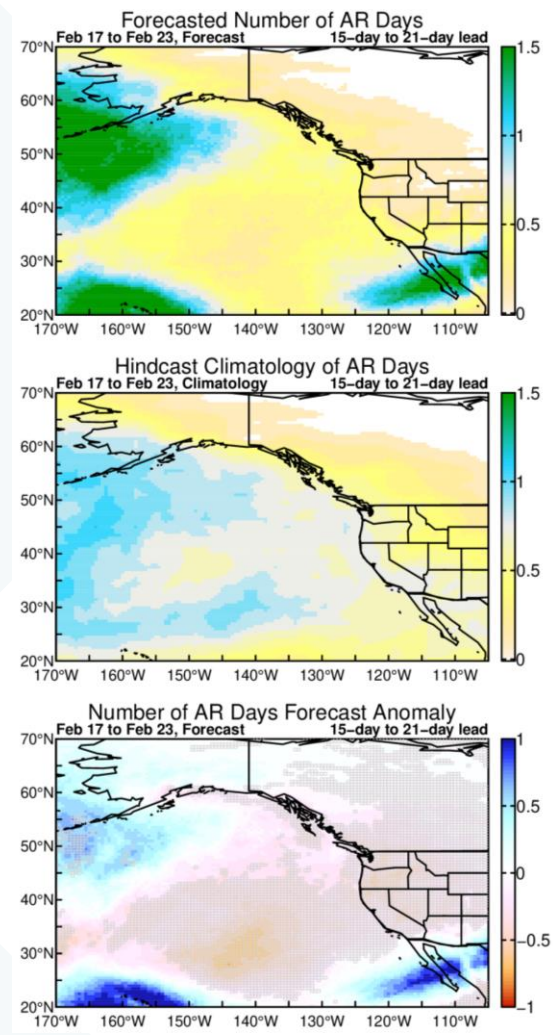
Subseasonal Outlooks: Week 3 AR Activity (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 2 Feb 2023

NCEP



ECMWF



**ECCC
Unavailable**

- Both NCEP and ECMWF models are predicting little AR activity over the US West Coast during Week 3 (17–23 Feb)
- ECMWF 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 (17–23 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 2 Feb 2023

NCEP

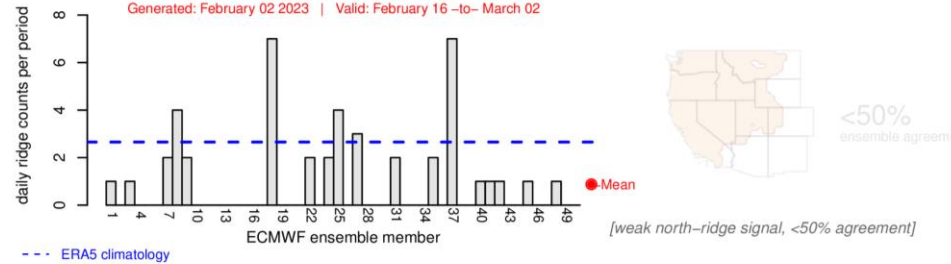
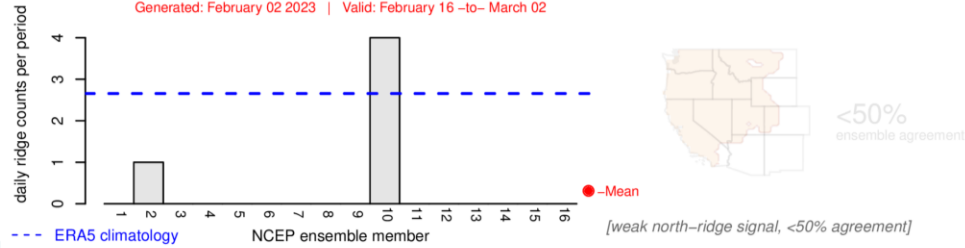
ECMWF

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

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

Generated: February 02 2023 | Valid: February 16 –to– March 02

Generated: February 02 2023 | Valid: February 16 –to– March 02

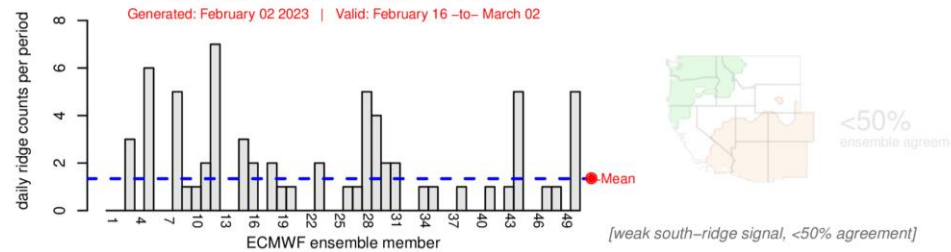
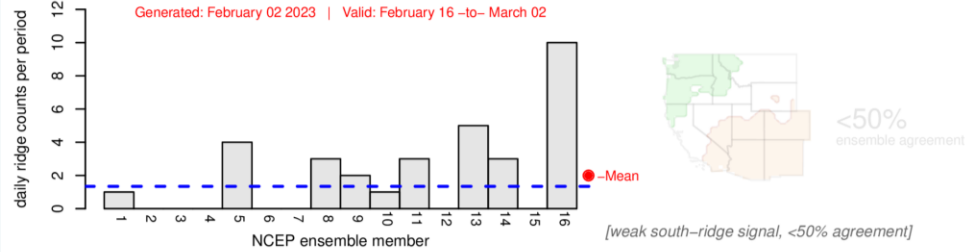


South-ridge type (Lead time: weeks 3 & 4)

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

Generated: February 02 2023 | Valid: February 16 –to– March 02

Generated: February 02 2023 | Valid: February 16 –to– March 02

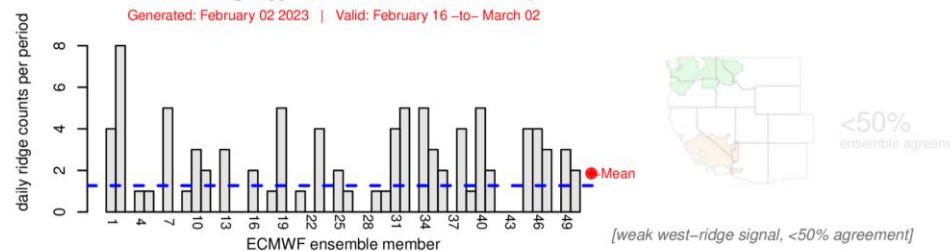
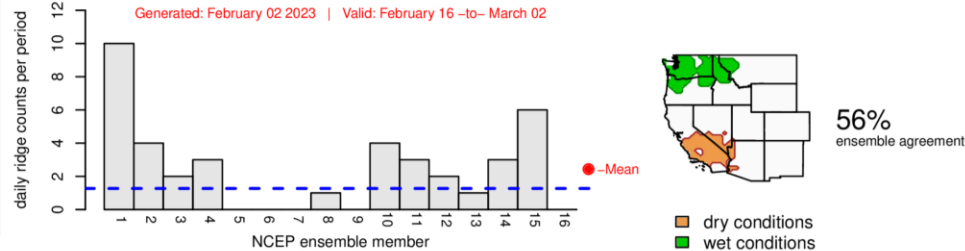


West-ridge type (Lead time: weeks 3 & 4)

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

Generated: February 02 2023 | Valid: February 16 –to– March 02

Generated: February 02 2023 | Valid: February 16 –to– March 02



- NCEP shows moderate likelihood (56% ensemble agreement) in above-normal ridging activity west of California during Weeks 3–4 (16 Feb – 2 Mar)
- ECMWF is predicting slightly above-normal ridging activity west of California with low ensemble agreement
- Both models are predicting near-normal South-ridge type ridging activity

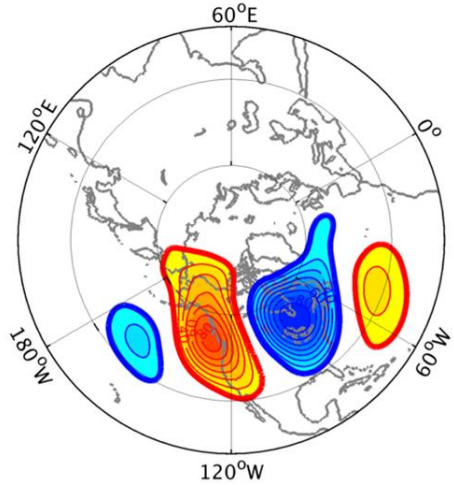


Both models are showing potential for above-normal ridging activity west of California during Weeks 3–4 (16 Feb – 2 Mar)

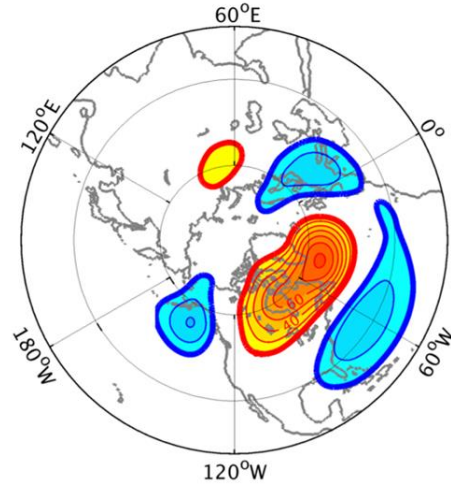


Background Info: IRI Subseasonal Weather Regime Forecasts

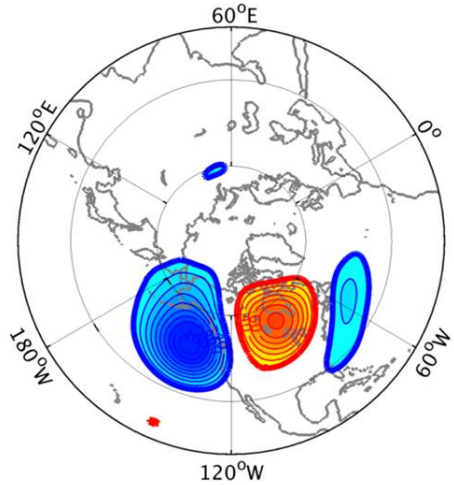
a) WR 1: West Coast Ridge



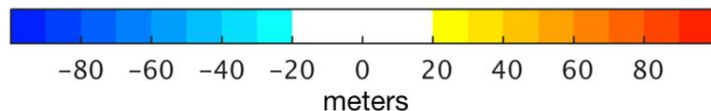
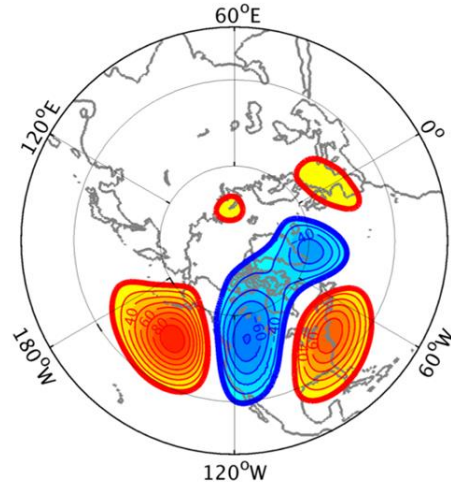
b) WR 2: Greenland High



c) WR 3: Pacific Trough



d) WR 4: Pacific Ridge



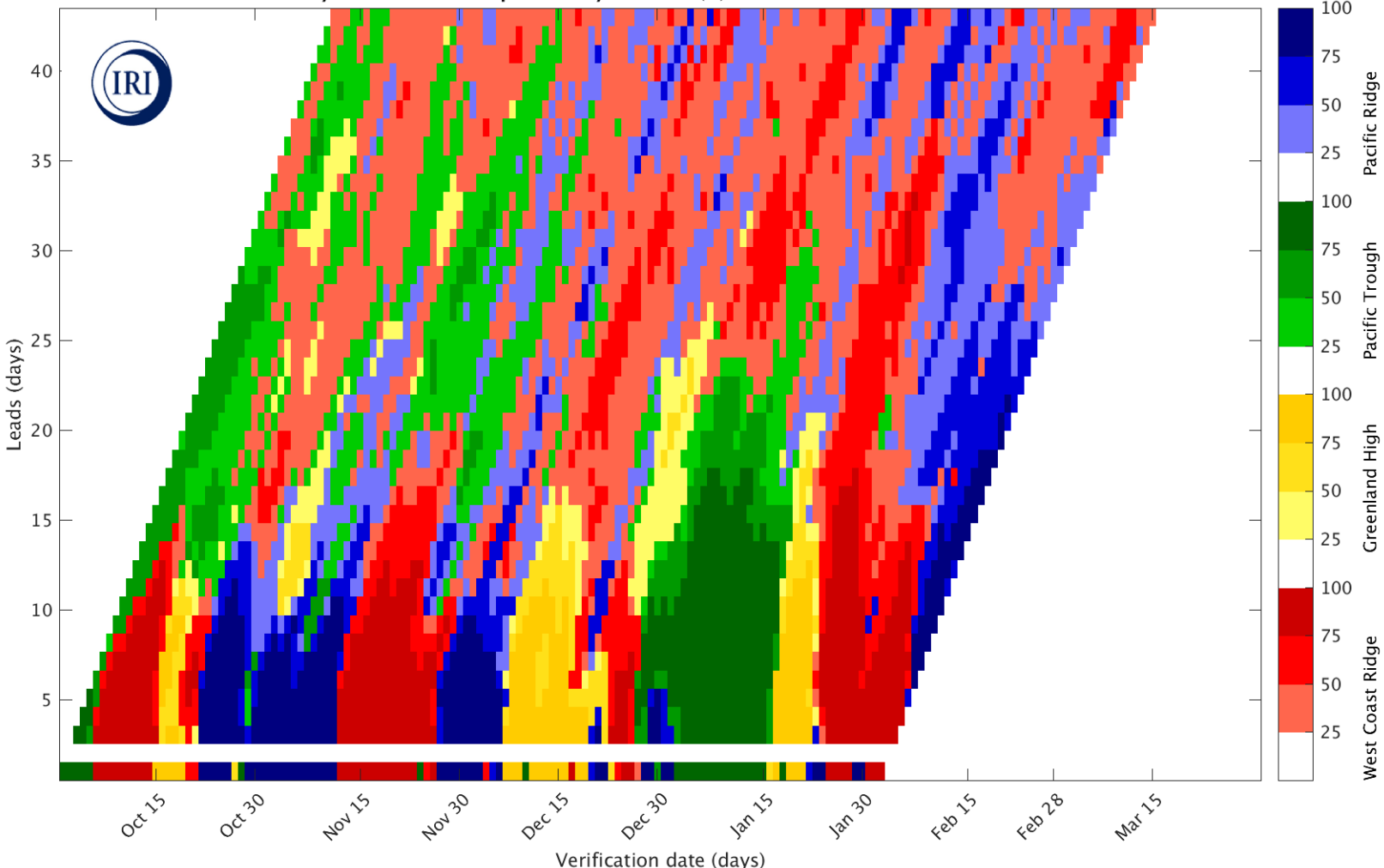
This slide contains background information about IRI's North American weather regime forecast product

- 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 Feb 2 2023



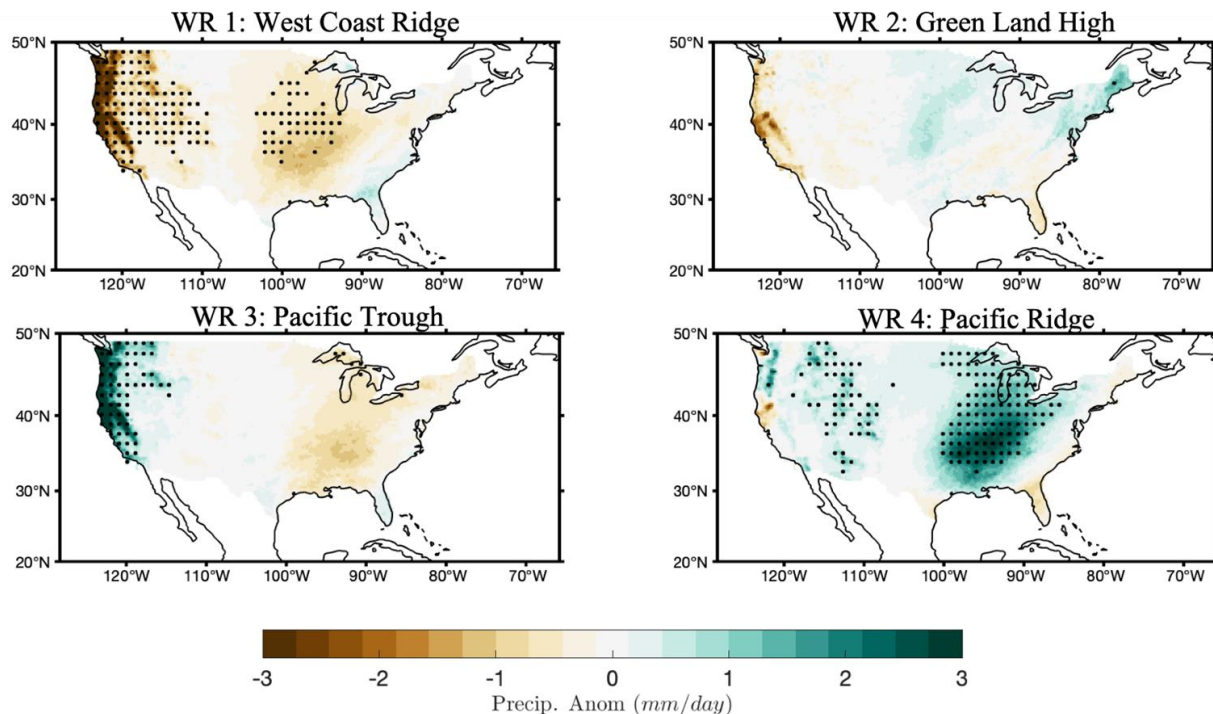
Latest Forecast Initialized 2 Feb 2023

- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- High likelihood (> 75%) of West Coast Ridge condition during Week 1
- High likelihood (> 75%) of Pacific Ridge condition during Weeks 2-3 which continues through Week 4 with lower probability

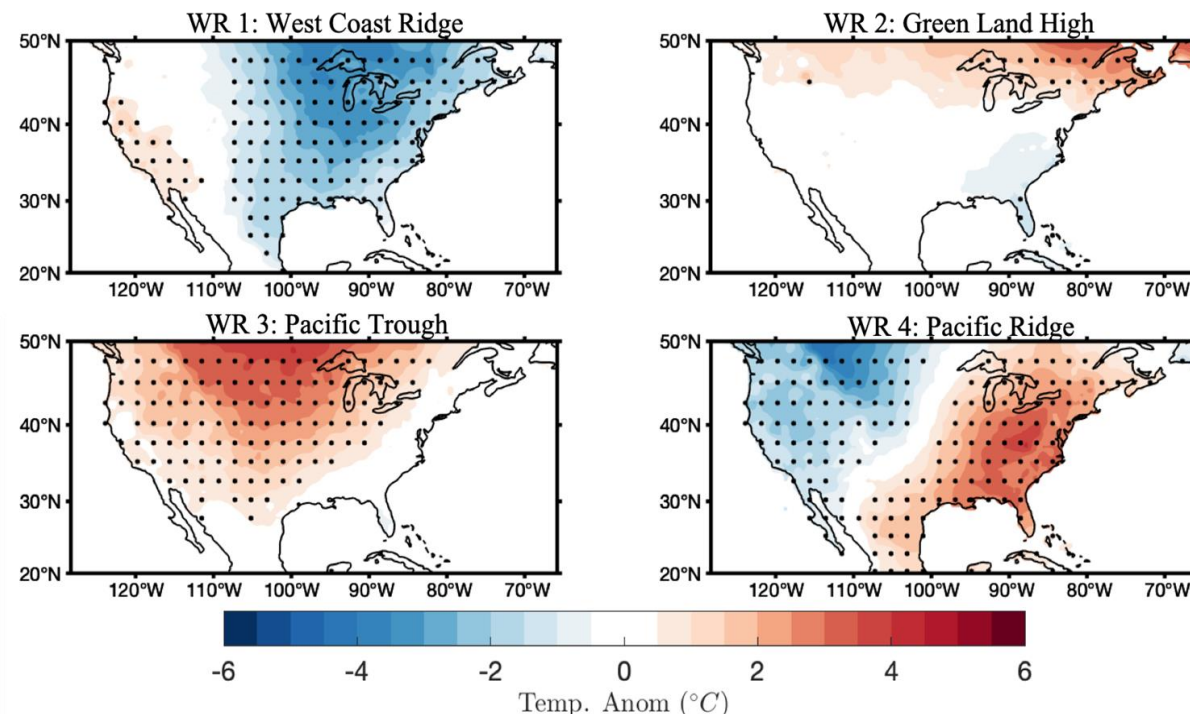
This graphic shows the which of the four North American weather regimes (different colors) is most likely to occur over the next 45 days. Darker (lighter) shading denotes higher (lower) probability of a particular regime.

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 early February with high confidence
- Anomalously cold conditions and near-normal precipitation are predicted over California in mid-to-late February with high confidence