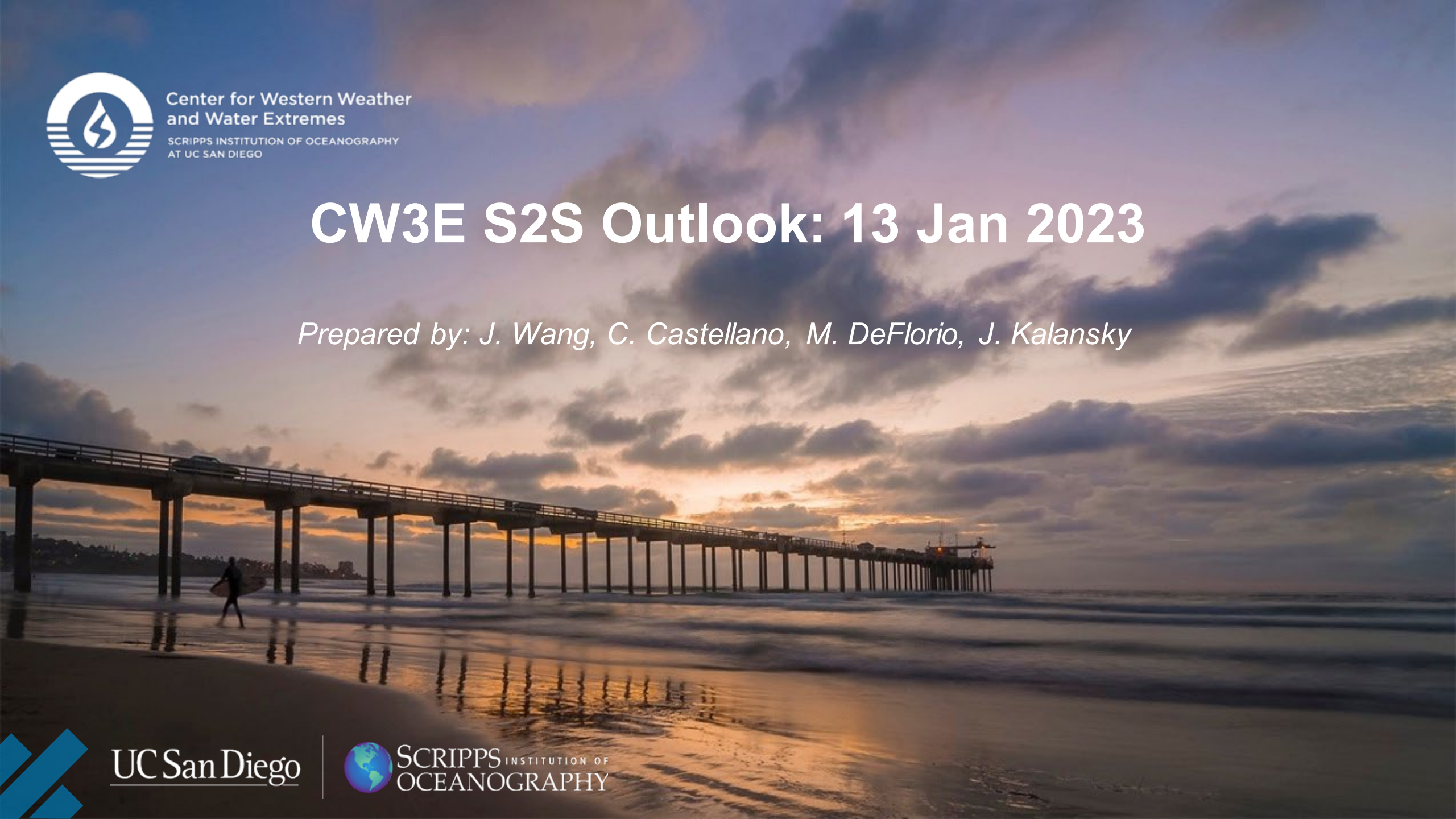

CW3E S2S Outlook: 13 Jan 2023

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 (20–26 Jan):** Models agree on low likelihood of AR activity over the US West Coast
- **Week 3 forecasts (27 Jan–2 Feb):** Models agree on low likelihood of AR activity over the US West Coast
- NCEP and ECMWF both show low confidence of above-normal ridge activity in any one particular ridge type during Weeks 1–2 (12–26 Jan) but ECMWF predicts near-normal occurrence of the North-ridge type, consistent with below-normal AR activity in Week 2
- NCEP and ECMWF both show potential for above normal ridging activity during Weeks 3–4, but there is uncertainty in the location of ridging
  - NCEP is showing high confidence in the occurrence of West-ridge type, which is typically associated with dry conditions in Central and Southern CA and wet conditions in the Pacific Northwest
  - ECMWF is showing near-normal/slightly above-normal occurrence in every ridge type, suggesting a strong signal for ridging conditions, but with uncertainty regarding the centroid location of ridging activity
- NCEP and ECMWF are predicting strong MJO activity in the Indian Ocean during Week 2, which is historically associated with decreased AR activity in Week 3, consistent with the current Week 3 AR forecast

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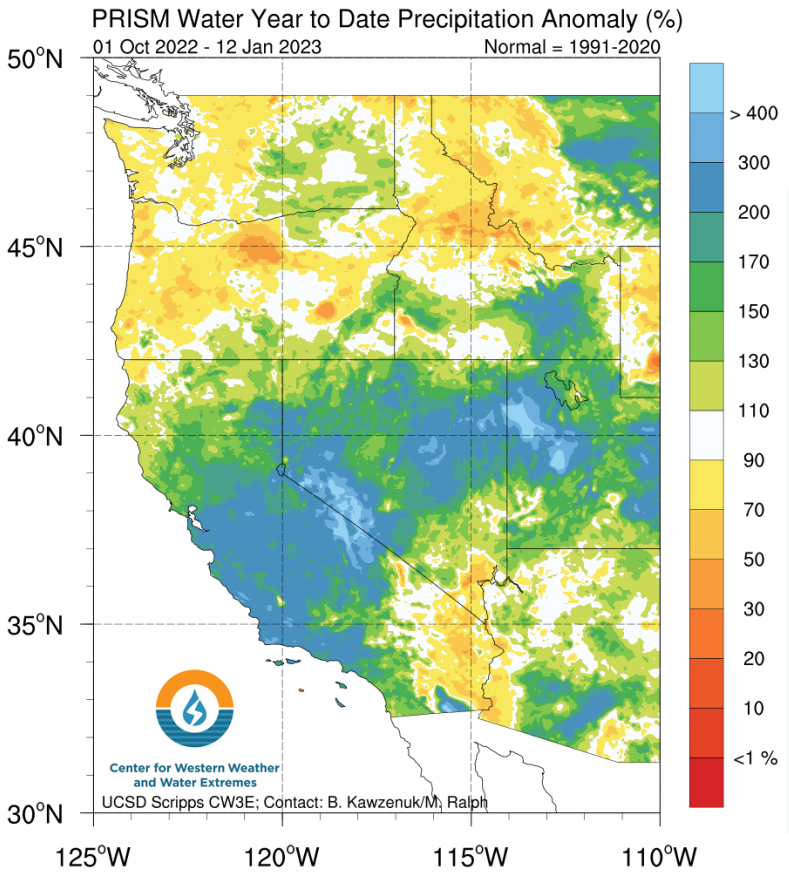
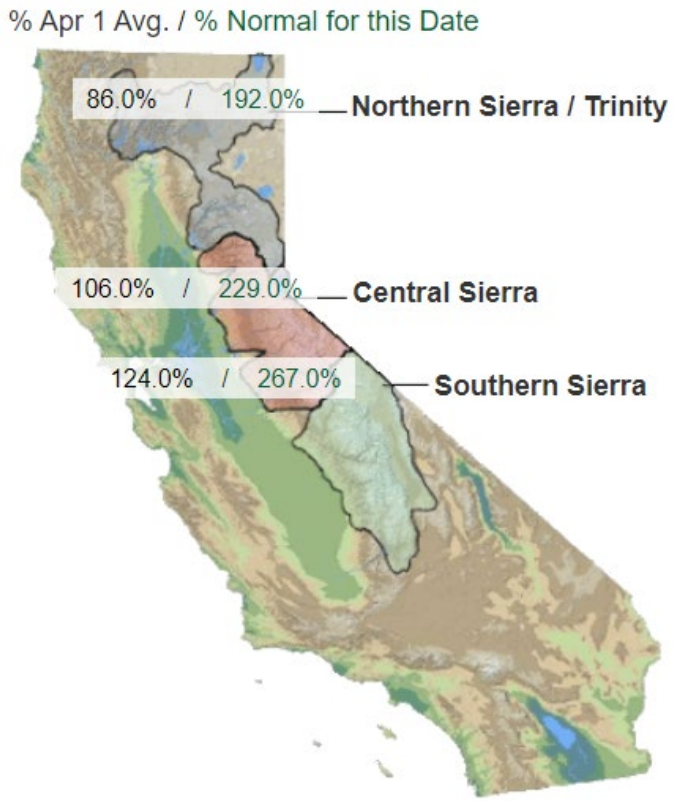
Water Year Hydrologic Summary

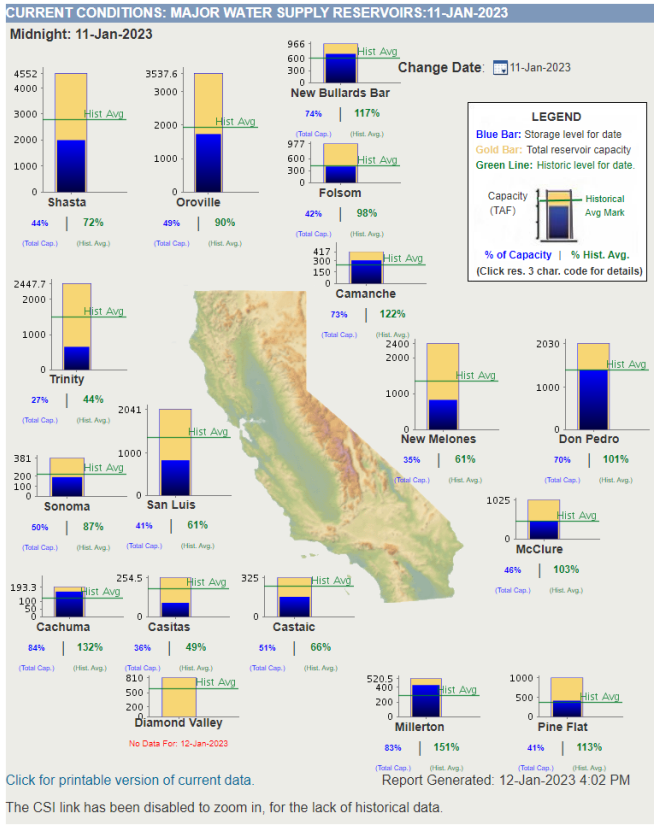
Precipitation



Snowpack Conditions



Reservoir Storage

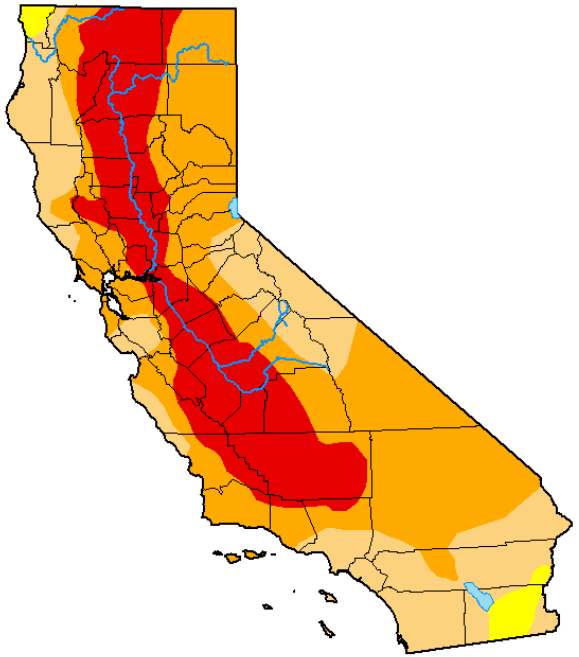


Source: California Department of Water Resources

- As of 12 Jan, water-year-to-date precipitation is well above normal across much of the state, especially Central California, where some areas have received > 200% of normal precipitation since 1 Oct
- Statewide snowpack is also well above normal, especially in the Central and Southern Sierra Nevada
- Water storage has continuously increased in almost all reservoirs due to substantial precipitation in recent weeks, but half of them still remain below the historical average
- Storage levels in several major reservoirs, including New Bullards Bar, Camanche, Cachuma, Millerton, and Pine Flat, are now above the historical average for this time of year

Drought Conditions

U.S. Drought Monitor
California



January 3, 2023
(Released Thursday, Jan. 5, 2023)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	97.93	71.14	27.10	0.00
Last Week 12-27-2022	0.00	100.00	97.94	80.56	35.50	7.16
3 Months Ago 10-04-2022	0.00	100.00	99.77	94.02	40.91	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 01-04-2022	0.00	100.00	99.30	67.62	16.60	0.84

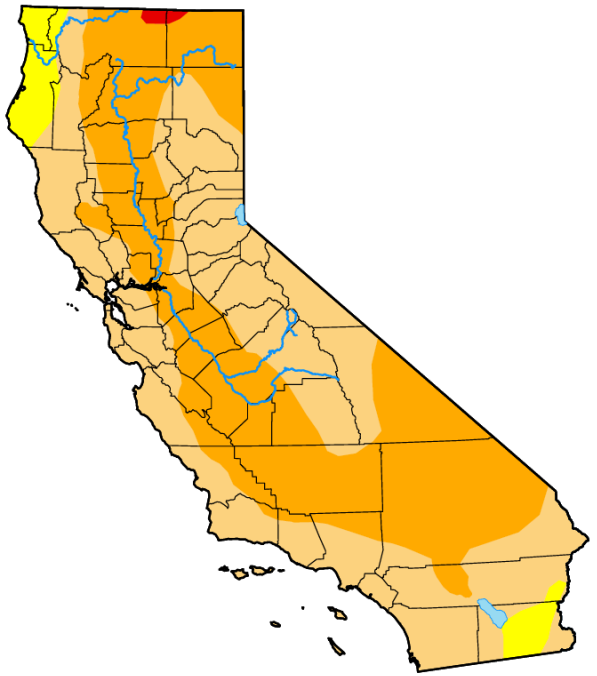
Intensity:
- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

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:
Brad Pugh
CPC/NOAA

droughtmonitor.unl.edu

U.S. Drought Monitor
California



January 10, 2023
(Released Thursday, Jan. 12, 2023)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	95.38	46.00	0.32	0.00
Last Week 01-03-2023	0.00	100.00	97.93	71.14	27.10	0.00
3 Months Ago 10-11-2022	0.00	100.00	99.77	93.99	40.91	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 01-11-2022	0.00	100.00	99.25	66.39	1.39	0.00

Intensity:
- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

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:
Richard Tinker
CPC/NOAA/NWS/NCEP

droughtmonitor.unl.edu

- The drought condition is further relieved in much of California due to heavy precipitation associated with multiple landfalling ARs in recent weeks
- On 3 Jan, 27% of the state is experiencing extreme drought
- As of 10 Jan, nearly no areas are experiencing extreme and exceptional drought

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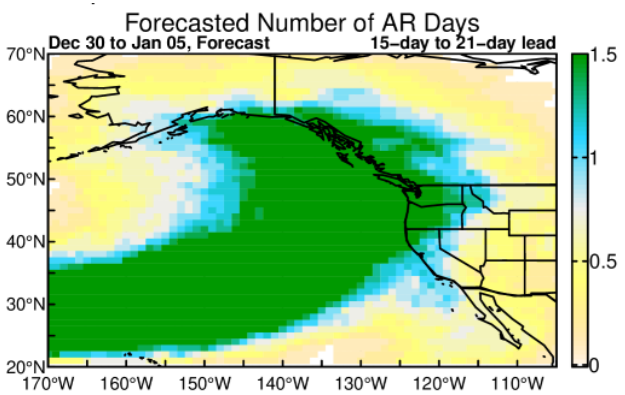
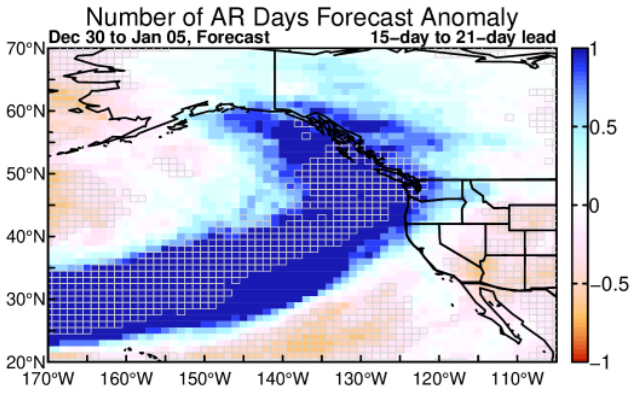
Looking Back: Week 3 AR Activity Forecasts

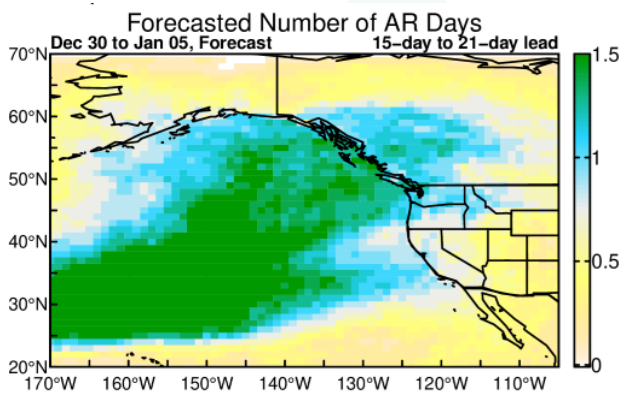
Forecasts Initialized 15 Dec; Valid: 30 Dec 2022 – 5 Jan 2023

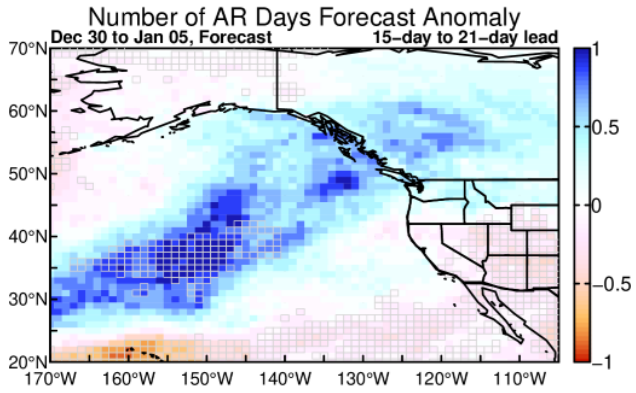
NCEP





ECCC

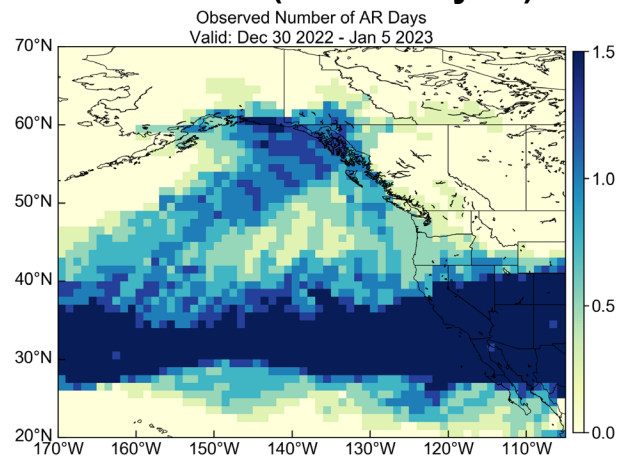




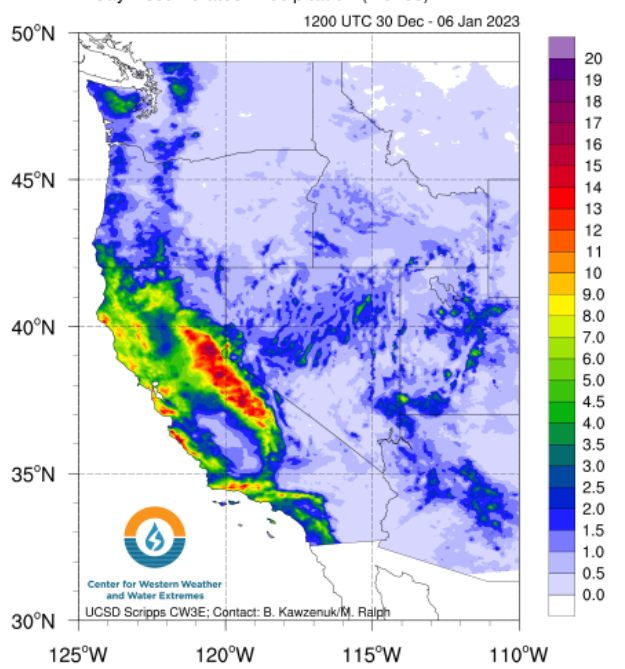
Shading: Fractional # of AR days over a 7-day period (top) and forecast minus model climatology (bottom)
Grey cells: >75% of ensemble members agree on sign of anomaly

ECMWF Unavailable

Observed (GFS Analysis)



Observed Precipitation



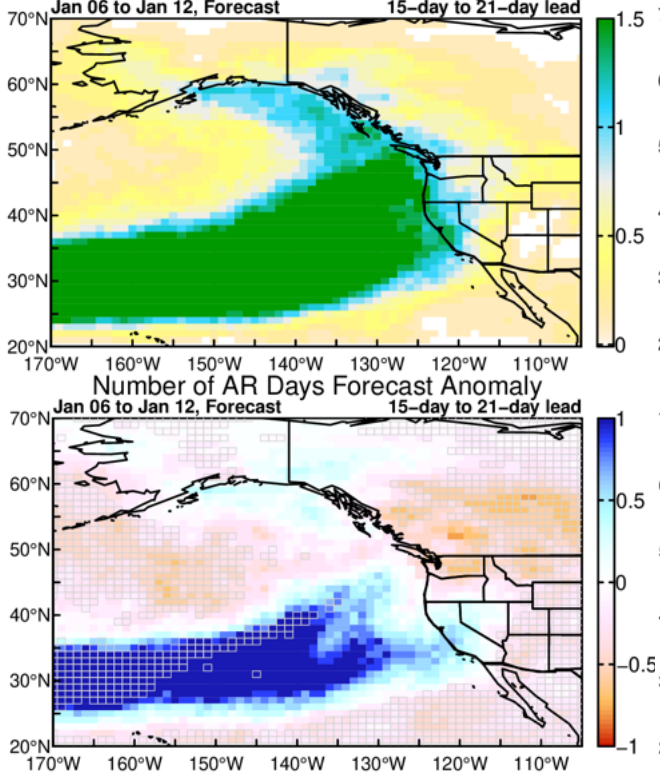
NCEP and ECCC correctly forecasted AR activity over the Alaska Panhandle, but failed to forecast the pronounced AR activity in CA, especially over Southern and Central CA

- Multiple ARs brought heavy precipitation to California on 30 Dec – 1 Jan and 4–5 Jan
- More than 8 inches of precipitation fell over the California Coast Ranges, the Bay Area, and the Transverse Ranges, with more than 12 inches over the Sierra Nevada

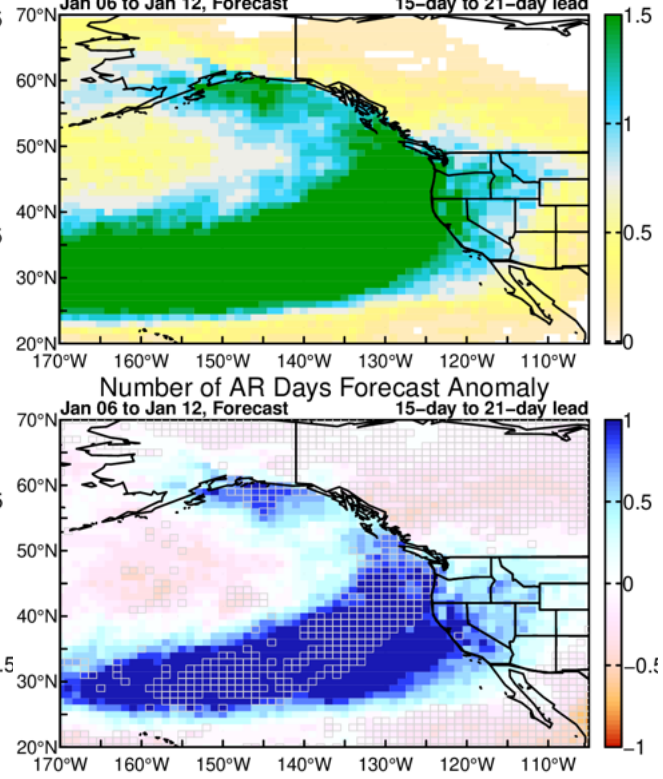
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 22 Dec 2022; Valid: 06 Jan – 12 Jan 2023

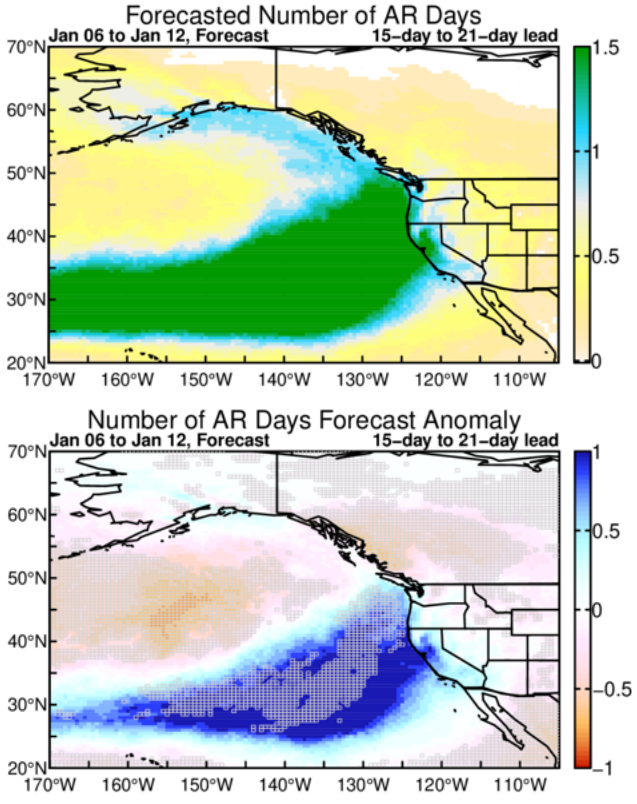
NCEP



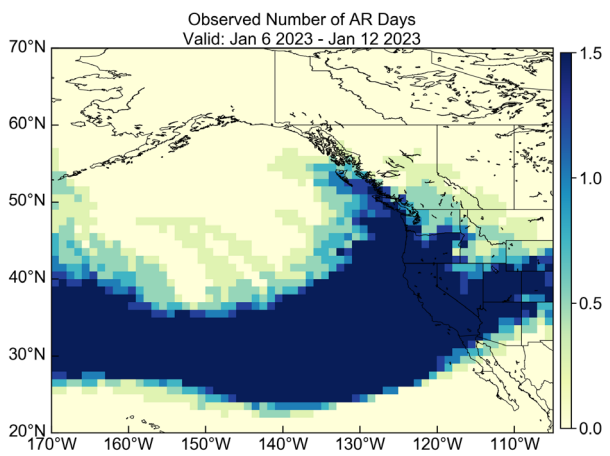
ECCC



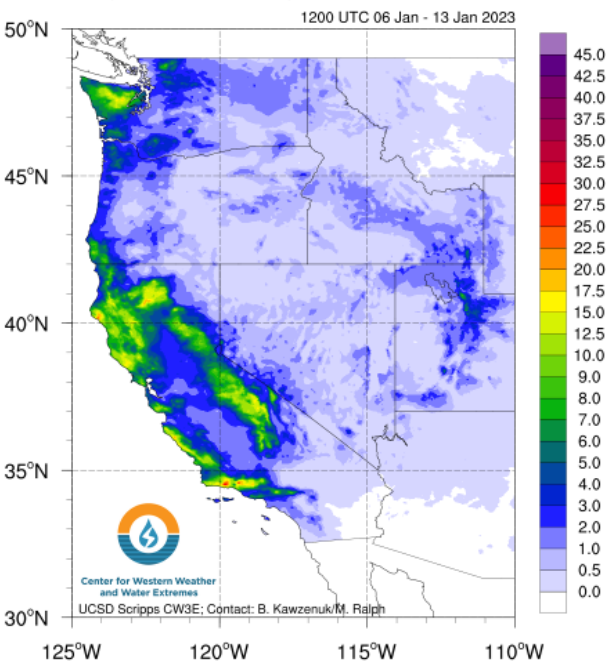
ECMWF



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

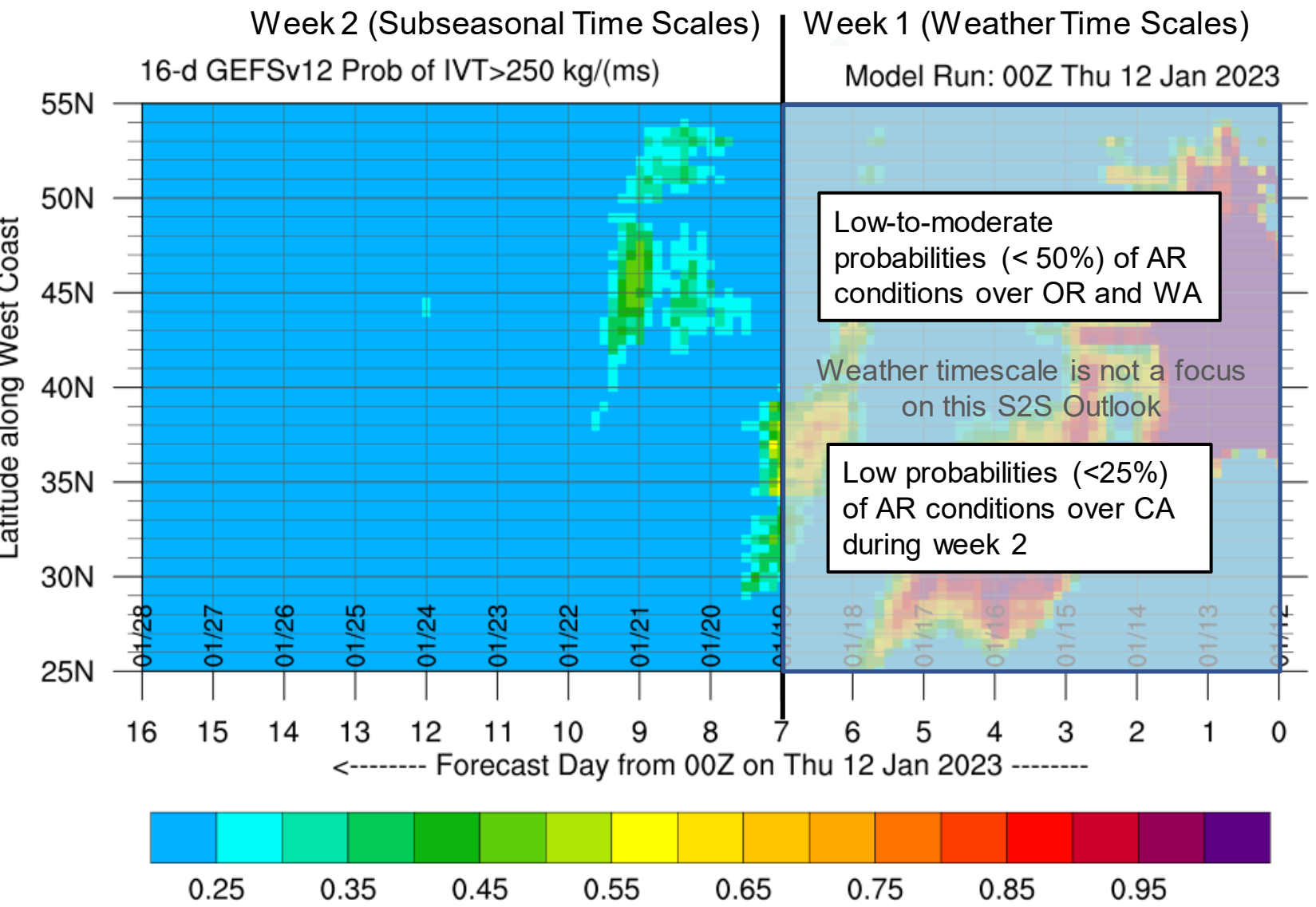
ECCC and ECMWF correctly forecasted AR activity over CA; NCEP verified over Northern and Central CA but failed to predict the AR activity over Southern CA

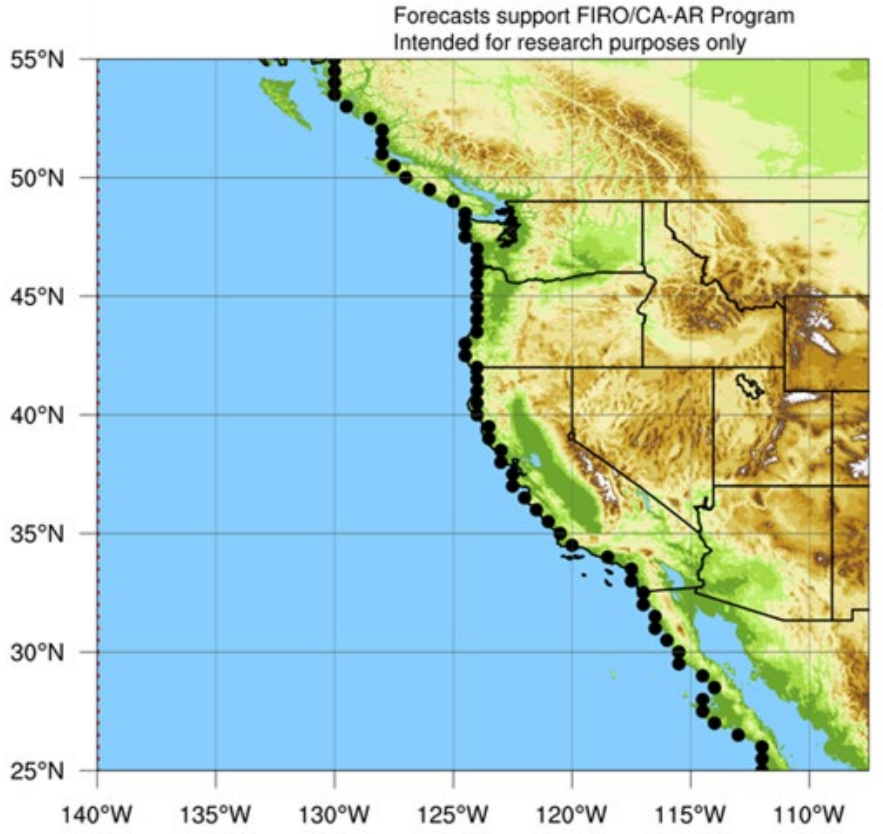
Generally, AR activity over the US West Coast during 6 – 12 Jan is better predicted by ECCC

- Multiple ARs made landfall during 6-8 Jan and 11 Jan, resulting in very heavy rainfall and flooding in portions of California
- At least 4-8 inches of precipitation fell over Southern Sierra Nevada, Central California Coast Ranges, and eastern Transverse Ranges

NCEP GEFS AR Landfall Tool: Valid 00Z 12 Jan – 00Z 28 Jan

Forecasts Initialized 12 Jan 2023





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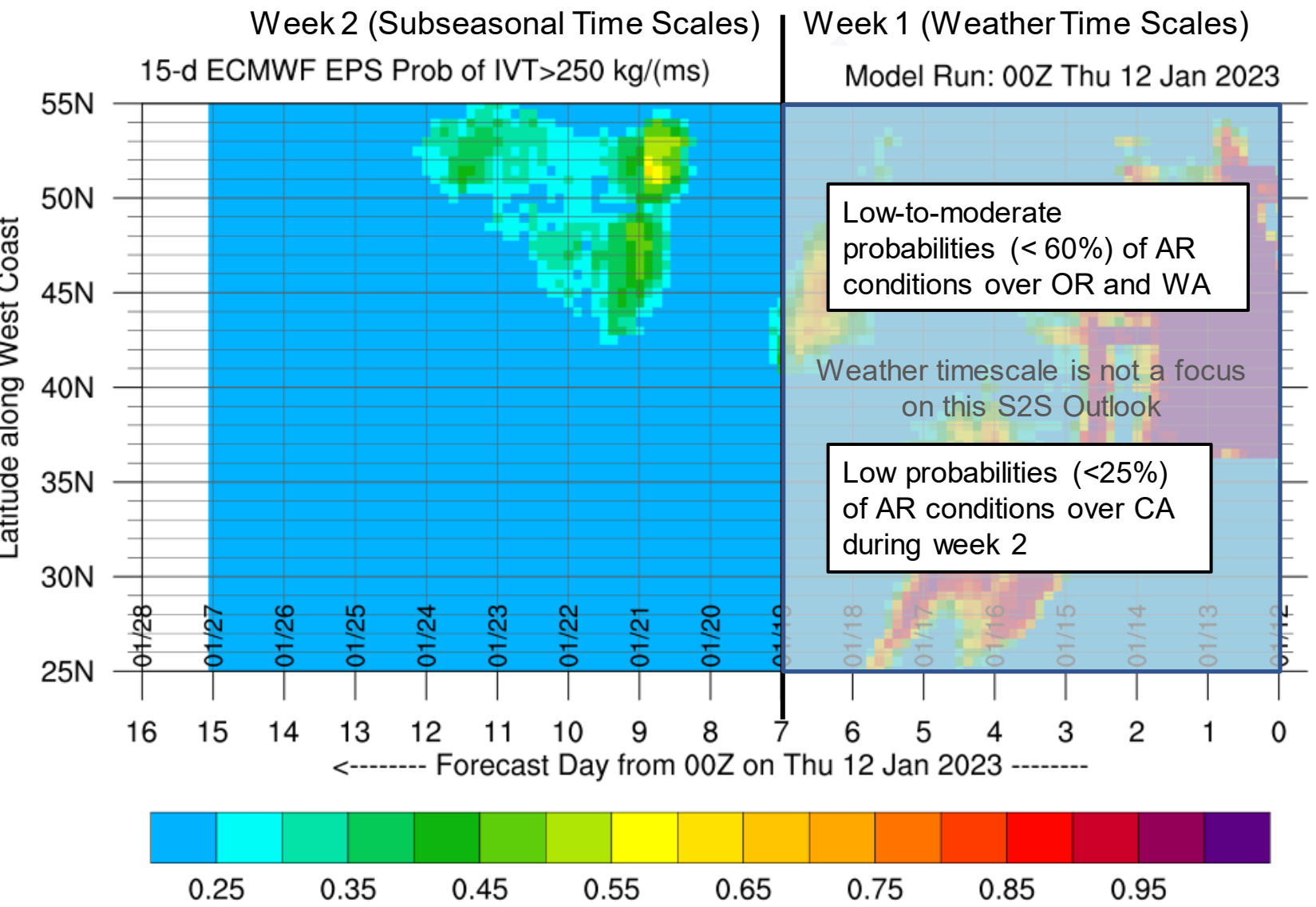
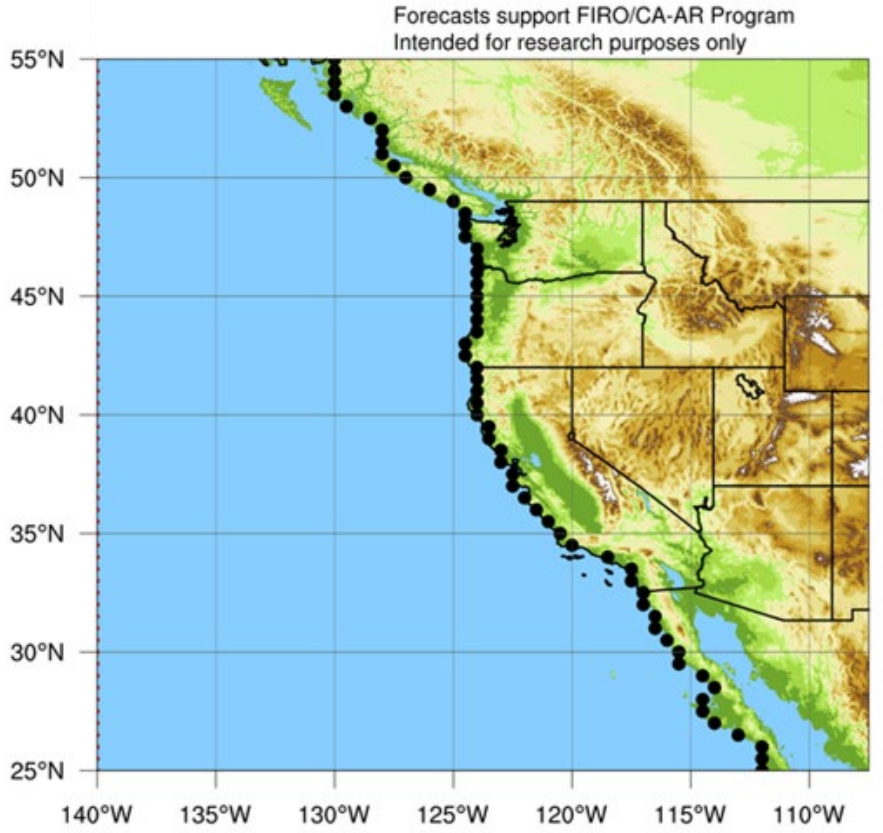
PLYMOUTH STATE METEOROLOGY

- NCEP is forecasting low likelihood of AR conditions over California in Week 2

ECMWF EPS AR Landfall Tool: Valid 00Z 12 Jan – 00Z 27 Jan

Forecasts Initialized 12 Jan 2023





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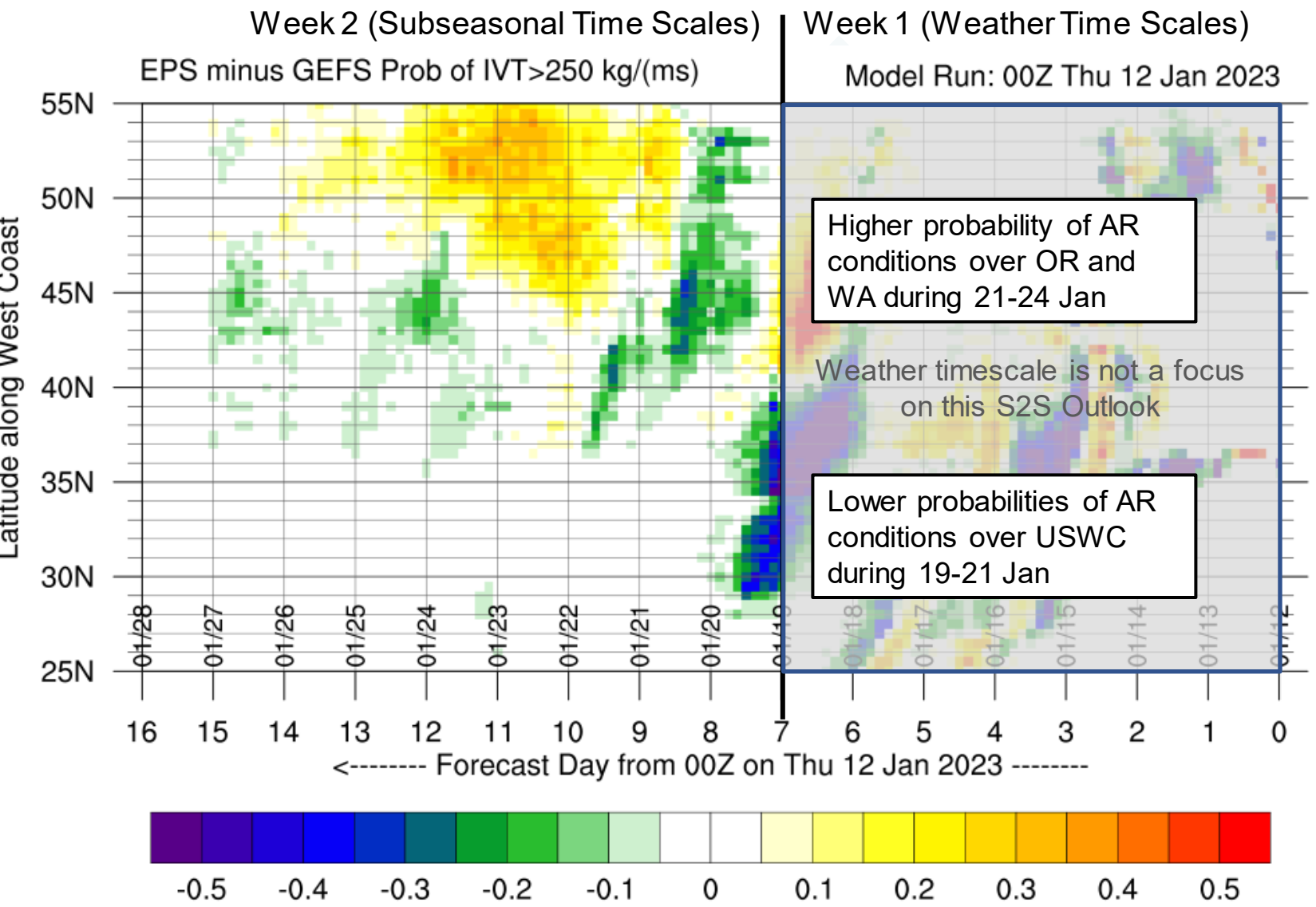
PLYMOUTH STATE METEOROLOGY

- ECMWF is also forecasting low likelihood of AR conditions over California in Week 2 with some ridging activity predicted during Weeks 1–2 over the US West Coast

EPS Minus GEFS AR Landfall Tool: Valid 00Z 12 Jan – 00Z 27 Jan

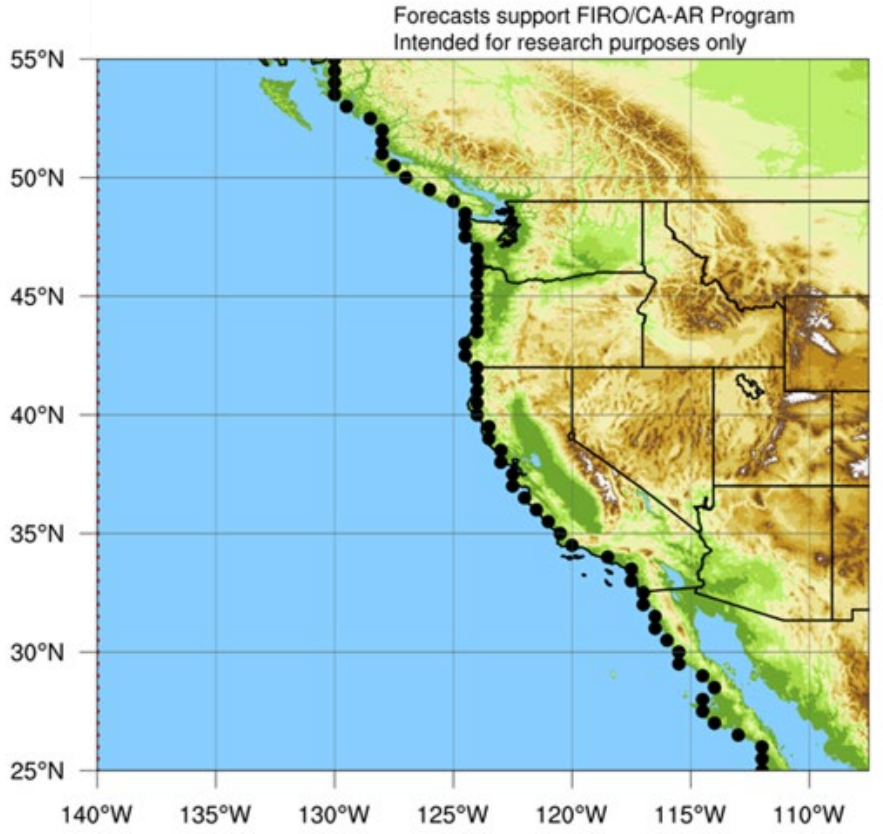
Forecasts Initialized 12 Jan 2023



Higher probability of AR conditions over OR and WA during 21-24 Jan

Weather timescale is not a focus on this S2S Outlook

Lower probabilities of AR conditions over USWC during 19-21 Jan



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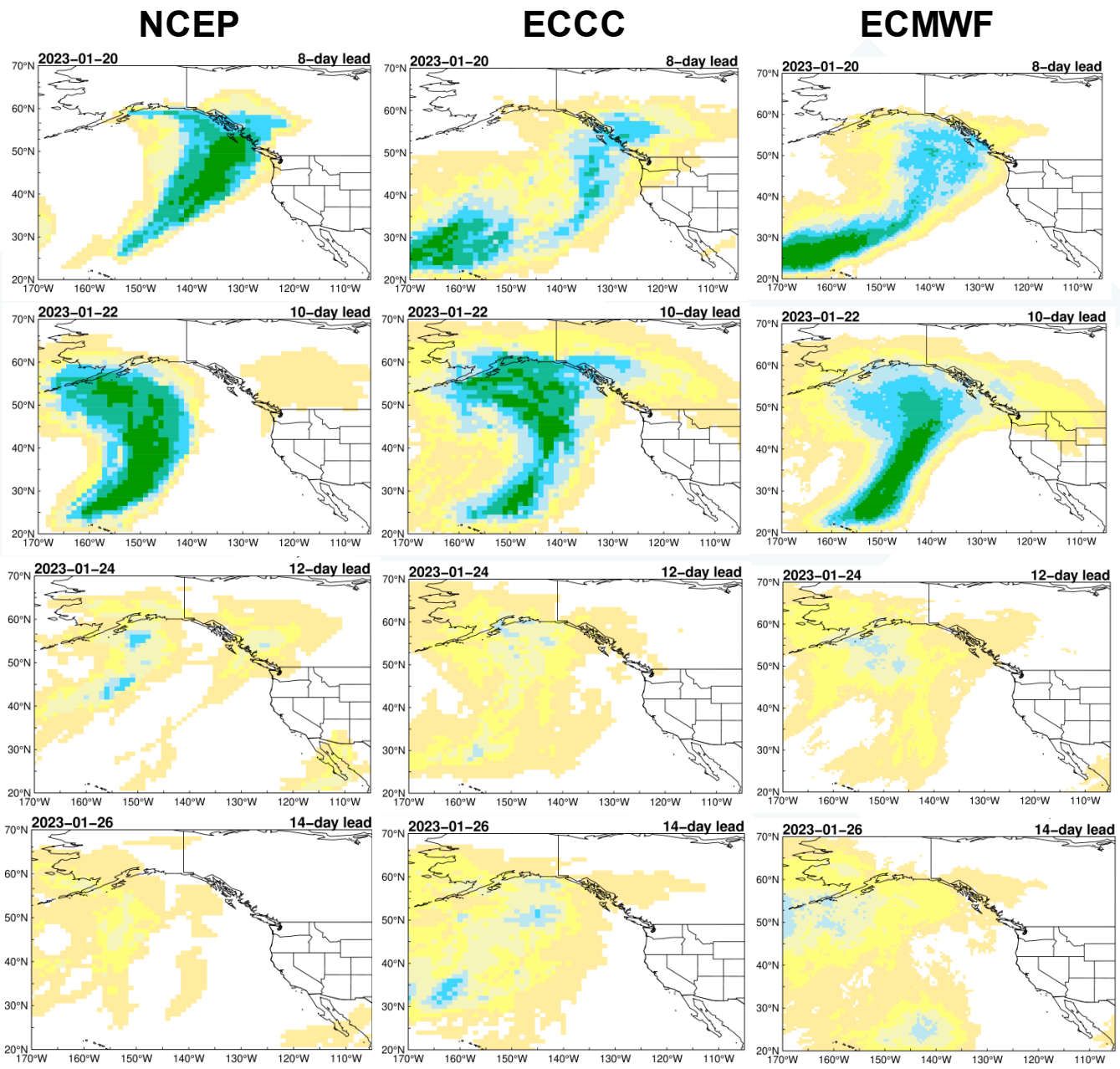
PLYMOUTH STATE METEOROLOGY

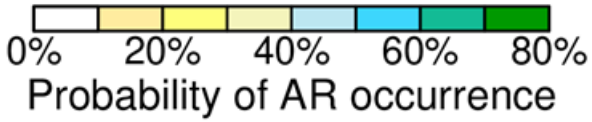
Subseasonal Outlooks: Week 2 AR Activity (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 12 Jan 2023



- All models are showing very low probabilities (<10%) of AR activity over CA during 20-26 Jan

All models agree on low likelihood of AR activity over the US West Coast during 20-26 Jan



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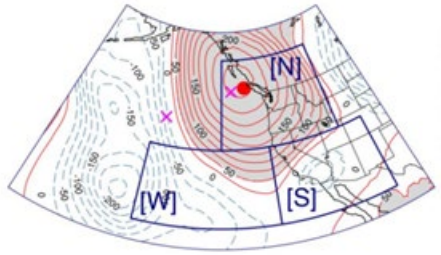
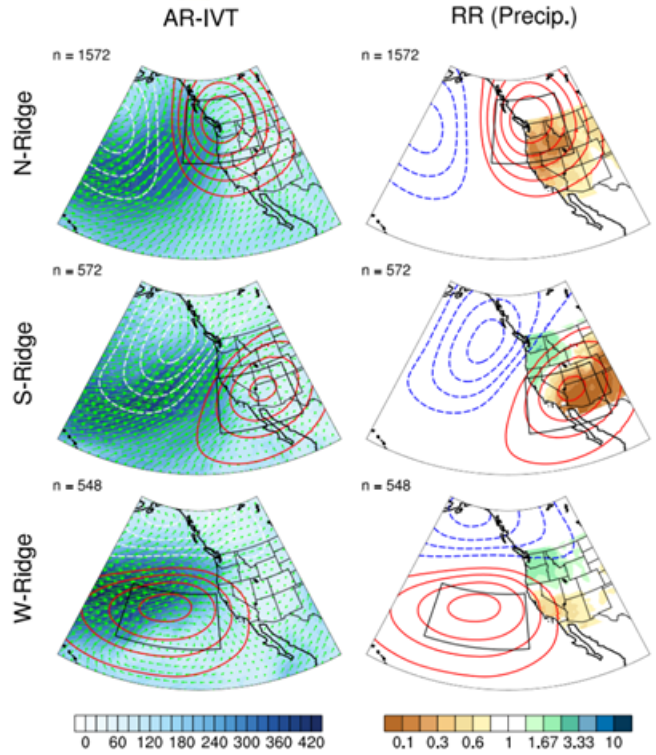
Background Info: Subseasonal Ridging Outlooks



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

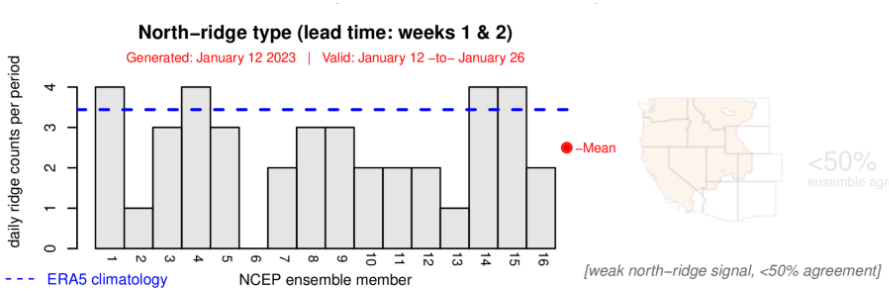
Jet Propulsion Laboratory
California Institute of Technology

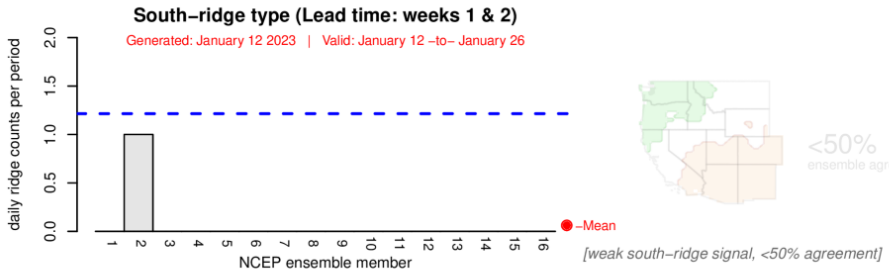
Center for Western Weather and Water Extremes
Scripps Institution of Oceanography at UC San Diego

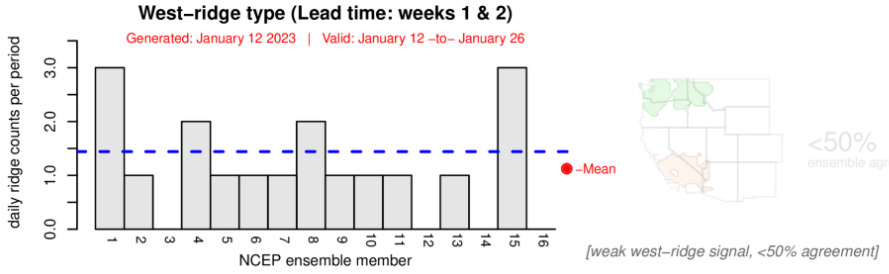
Contact: pgibson@ucsd.edu
Reference: Gibson et al. (2020) Journal of Climate

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

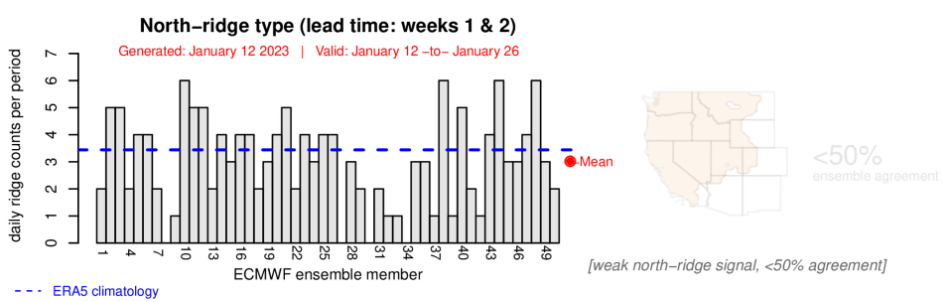
NCEP

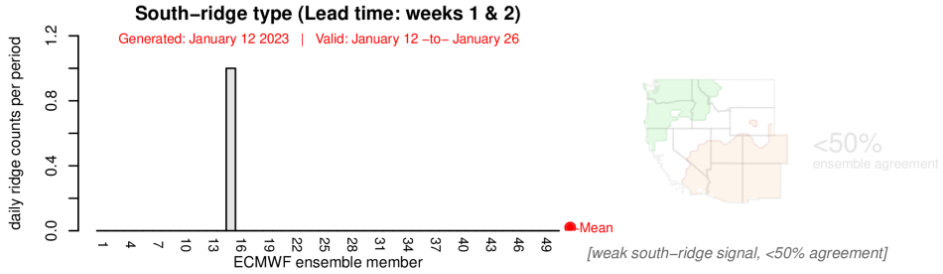


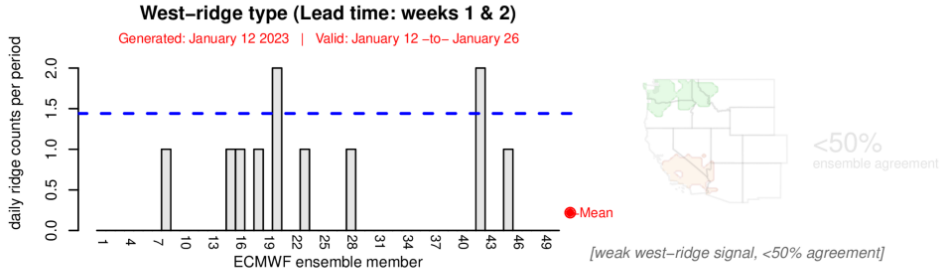




ECMWF







Forecasts Initialized 12 Jan 2023

- Both models are showing low confidence (< 50% ensemble agreement) in any one particular ridge type during Weeks 1–2 (12–26 Jan)
- ECMWF is predicting near-normal occurrence (ensemble mean close to climatology) of the North-ridge type

There is low confidence in any one particular ridge type over the US West Coast during Weeks 1–2 (12-26 Jan) but patterns in ECMWF ensemble more resemble the North-ridge type

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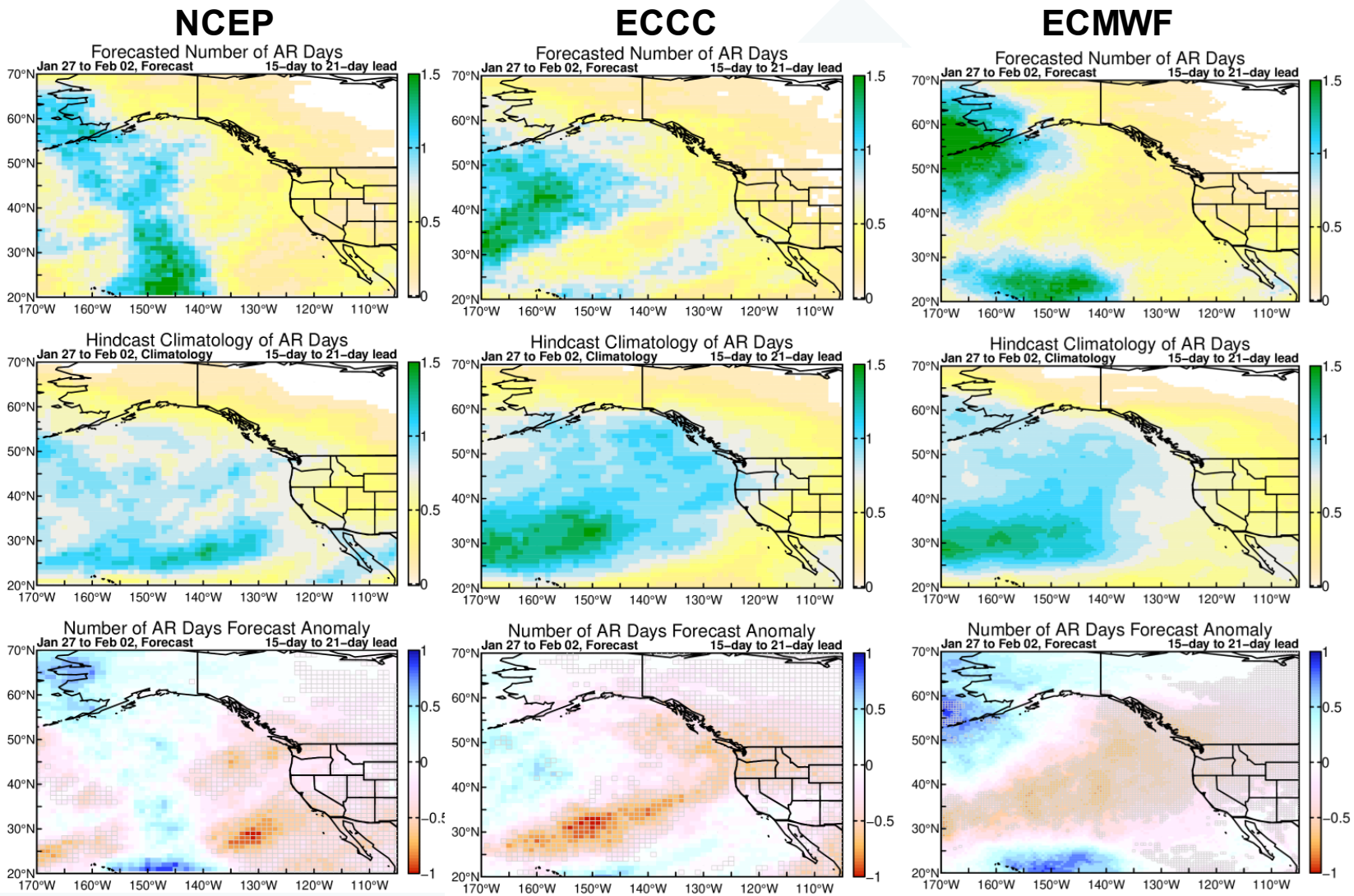
Subseasonal Outlooks: Week 3 AR Activity (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 12 Jan 2023



- All models are predicting little AR activity over US West Coast during Week 3 (27 Jan–2 Feb)

All models agree on low likelihood of AR activity over US West Coast during 27 Jan-2 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

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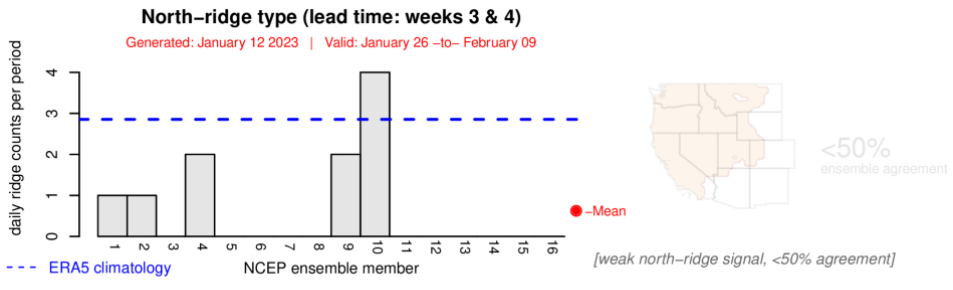
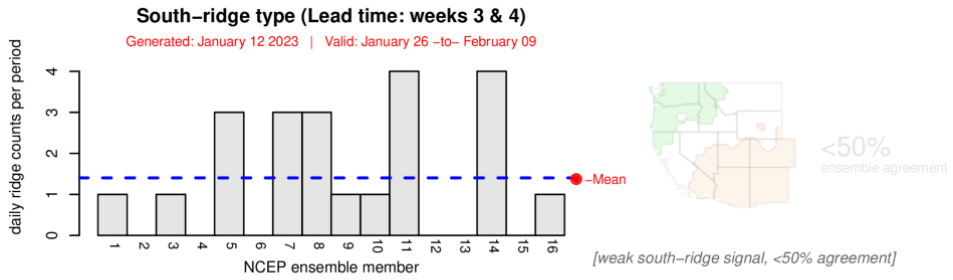
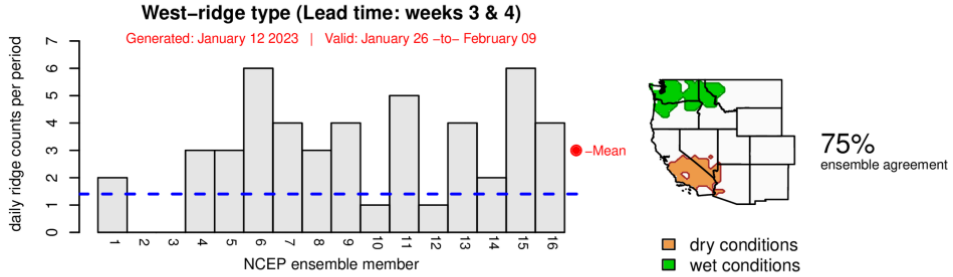
Subseasonal Outlooks: Weeks 3–4 Ridging Forecasts (NCEP vs. ECMWF)

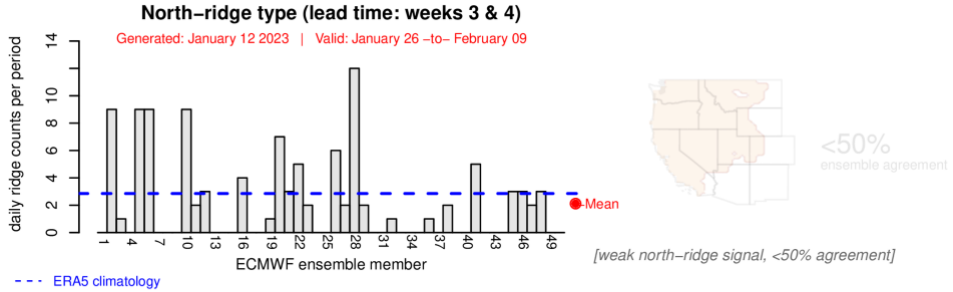
NCEP

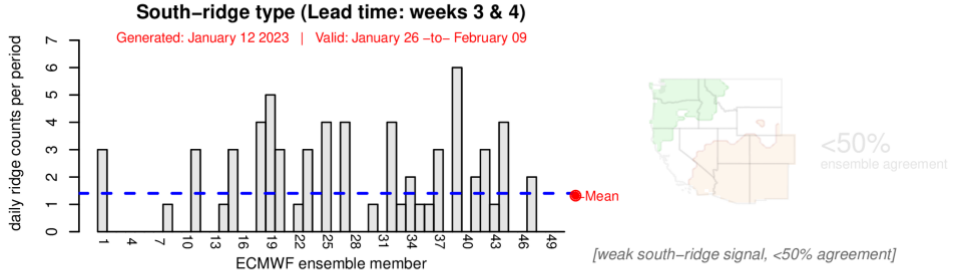


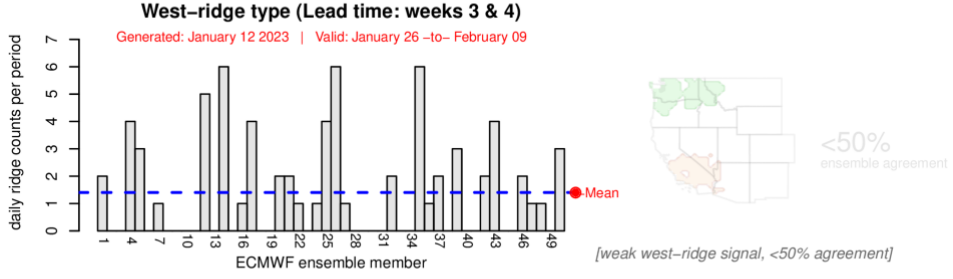




ECMWF







Forecasts Initialized 12 Jan 2023

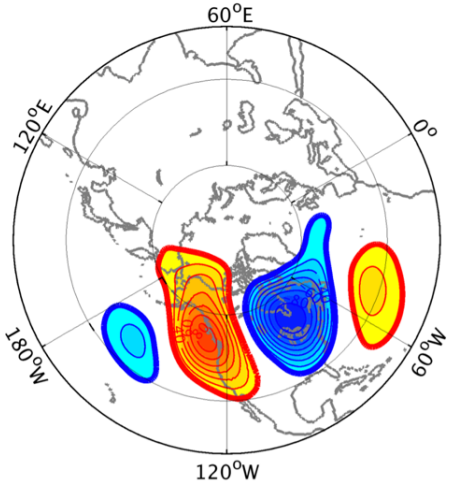
- NCEP shows high confidence (75% ensemble agreement) in the occurrence of West-ridge type during Weeks 3-4 (26 Jan–9 Feb); NCEP also predicts near-normal occurrence of the South-ridge type
- ECMWF is showing near-normal/slightly above-normal occurrence in every ridge type, suggesting a strong signal for ridging conditions, but large disagreement between ensemble members on the exact ridge type

There is a moderate-to-high likelihood of above-normal ridging activity near the US West Coast during Weeks 3–4 (26 Jan – 9 Feb)

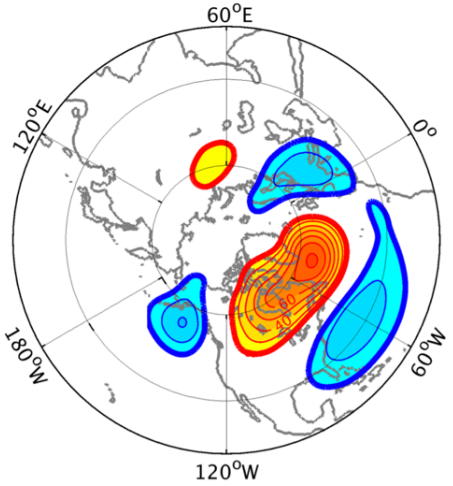
Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

Background Info: IRI Subseasonal Weather Regime Forecasts

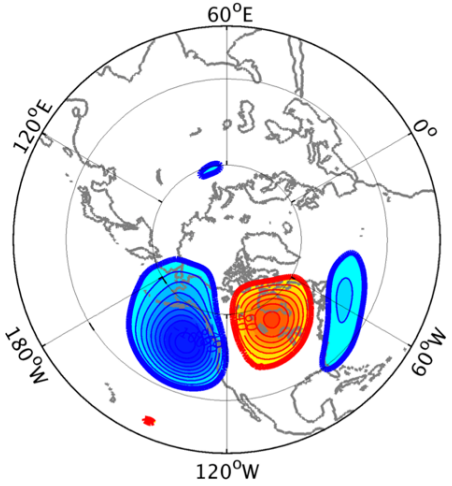
a) WR 1: West Coast Ridge



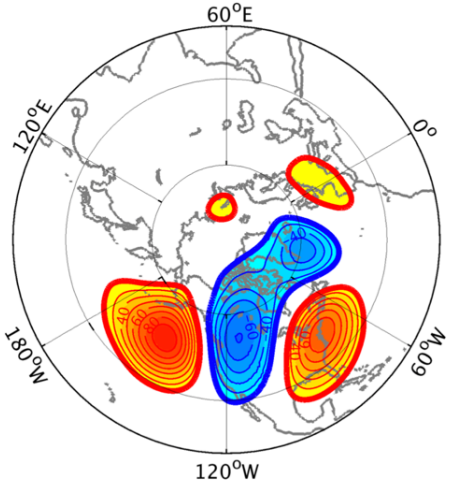
b) WR 2: Greenland High

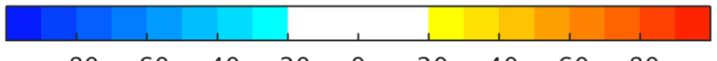


c) WR 3: Pacific Trough



d) WR 4: Pacific Ridge



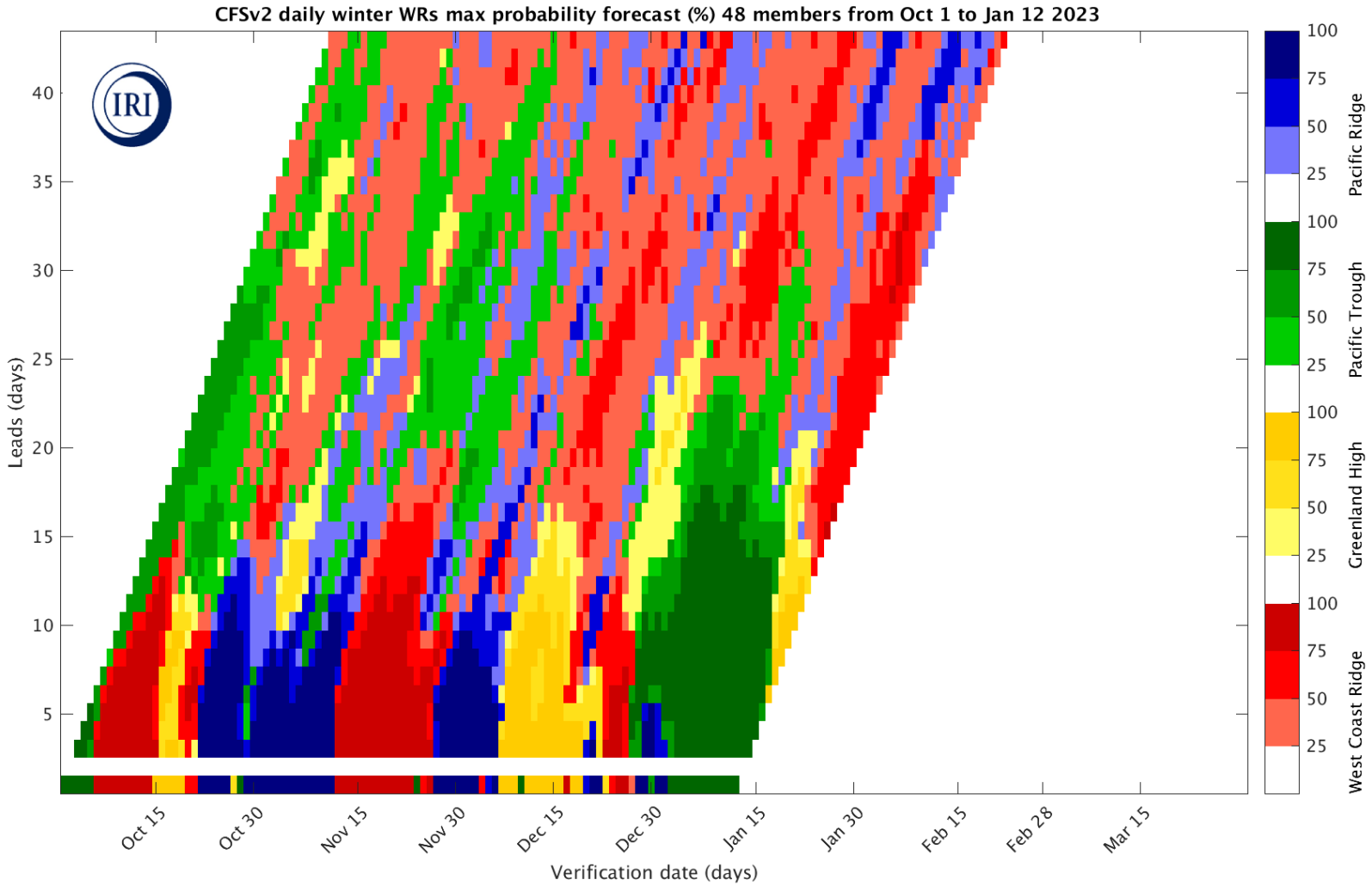


This slide contains background information about IRI's North American weather regime forecast product

- 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 Forecast



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.

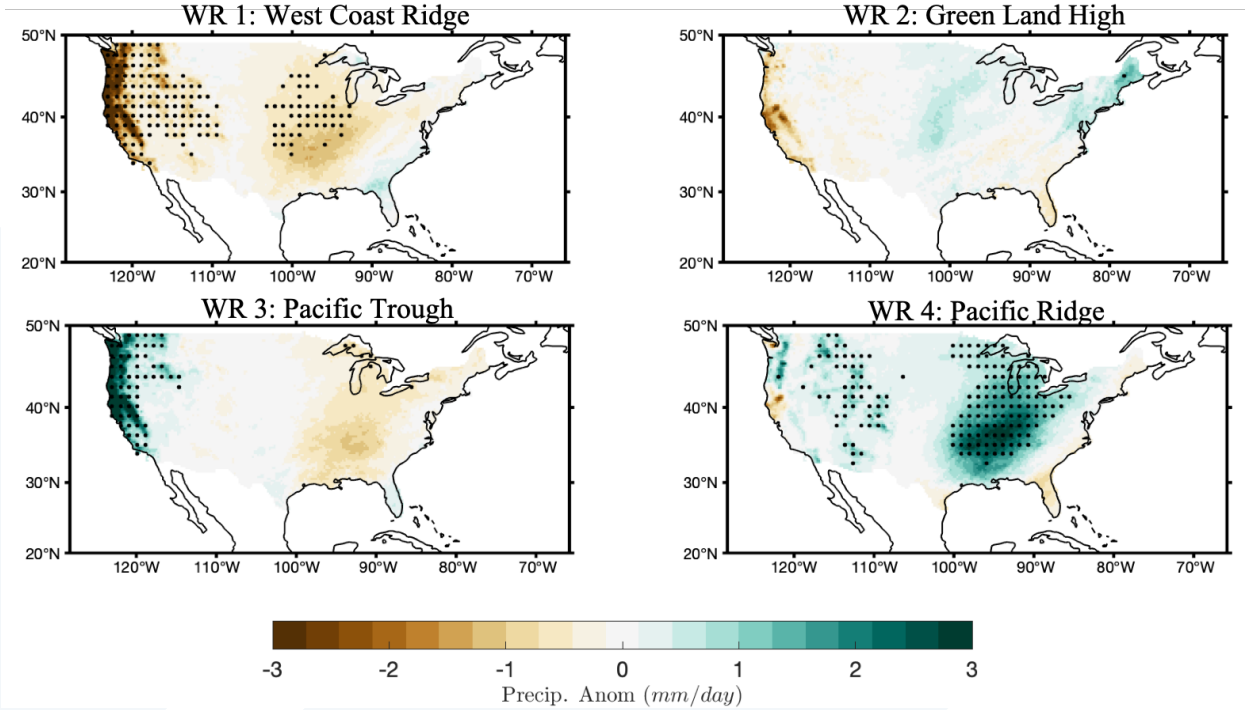
Latest Forecast Initialized 12 Jan 2023

- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- High likelihood (> 75%) of Pacific Trough during Week 1
- High likelihood (>75%) of Greenland High during Week 2
- Moderate likelihood (50–75%) of West Coast Ridge during Weeks 3-4
- Low likelihood (25–50%) of Pacific Ridge and West Coast Ridge during Weeks 5-6

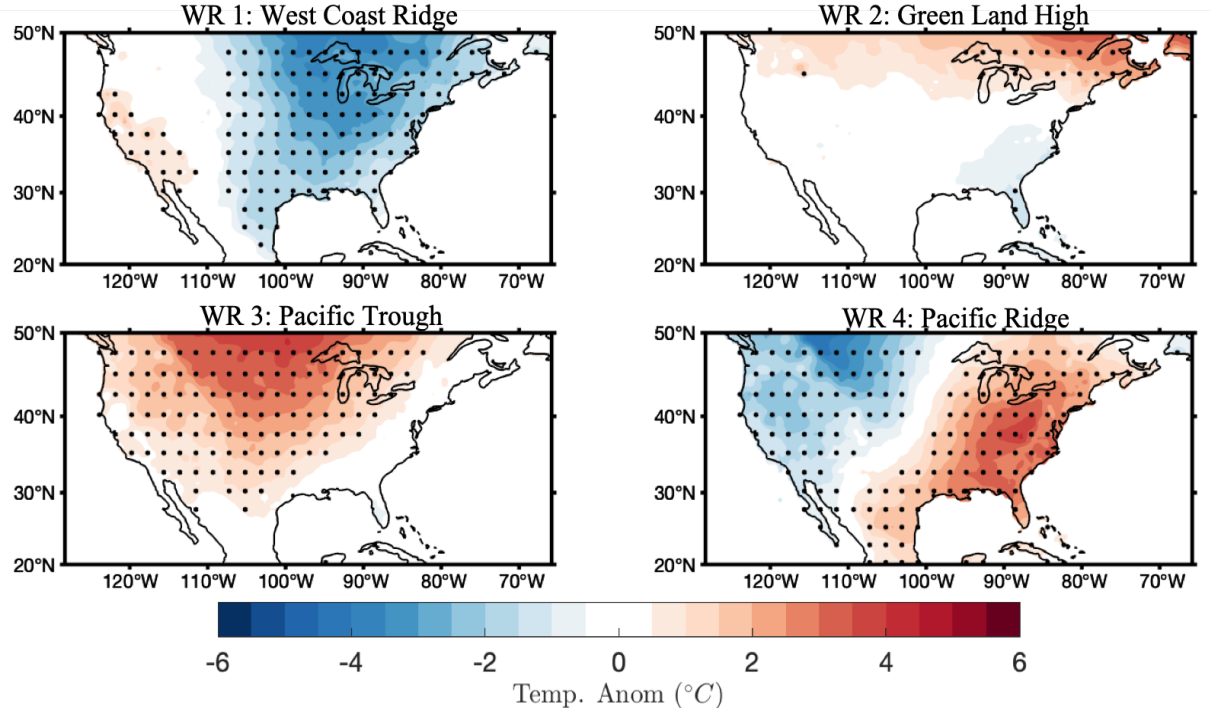
For more information about the forecast product: https://wiki.iri.columbia.edu/index.php?n=Climate.S2S-WRs

Subseasonal Outlooks: IRI North American Weather Regime Forecasts

Precipitation



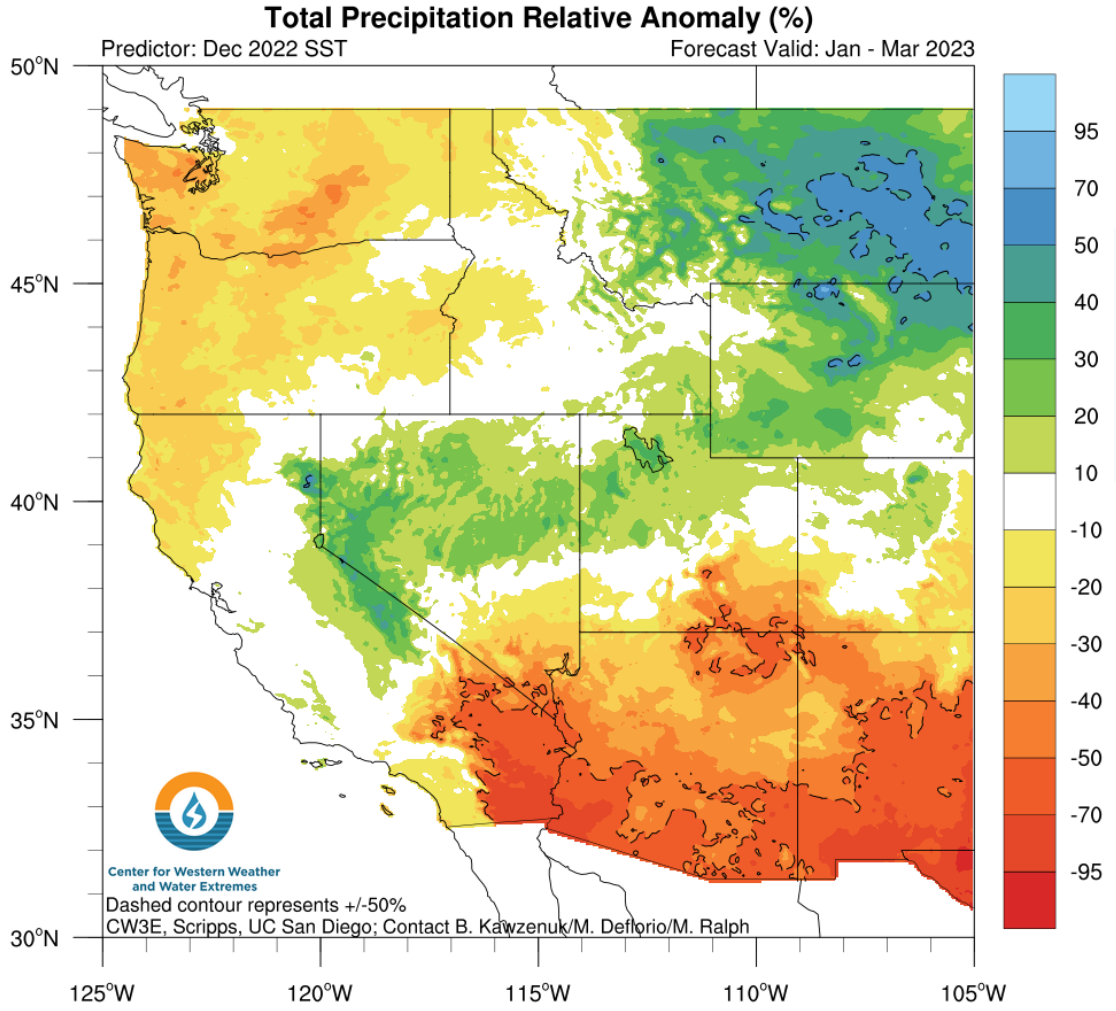
Temperature



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

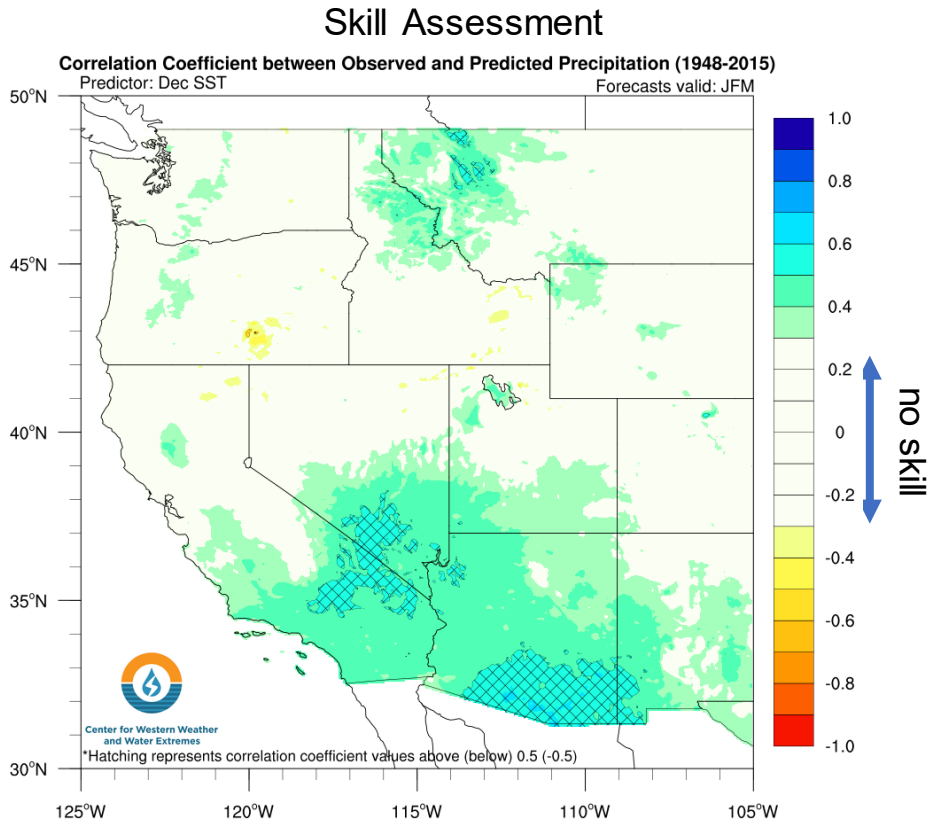
- Anomalously wet and warm conditions are predicted over California in mid-January with high confidence; Anomalously dry conditions are predicted over California in late January with high confidence
- Anomalously warm and dry conditions are predicted over California in early February with moderate confidence

Seasonal CCA Outlooks: Jan – Mar 2023 Precipitation



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

Above-normal: >30%; Below-normal: <-30%



- CW3E statistical model based on Dec SST is predicting significantly below-normal Jan–Mar 2023 precipitation over Southern CA which has anomaly correlation coefficient historical skill values near 0.5