STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47600, Olympia, WA 98504-7600 • 360-407-6000

Water Supply Availability Committee (WSAC)

Thursday, December 12, 2024, 10 a.m. – 11:30 a.m.
Zoom: Click to join. (Call-in: 253.205.0468; Meeting ID: 816 5686 6078; Passcode: 038972)

Meeting Objectives – December:

- Share pertinent info and assess water supply conditions in Washington for fall.
- Learn and discuss snowpack research from the Desert Research Institute.

Agenda

Time	Agenda item	Responsible
10:00 a.m.	Welcome and agenda review Recap: Drought Declaration and implications	Caroline Mellor, Ecology
10:05 a.m.	Snowpack research presentation (Guest Speaker)	Dan McEvoy, Desert Research Institute
10:30 a.m.	Regional Climate Setting/ ENSO	Karin Bumbaco, OWSC
10:45 a.m.	Water Supply Forecasts	Amy Burke, NWRFC
11:00 a.m.	Mountain Conditions	Matt Warbritton, NRCS
11:10 a.m.	Streamflow and Groundwater	Nick Sutfin, USGS
11:25 a.m.	Discussion: What concerns do folks have for drought recovery and Water Year 2025?	All participants Ecology facilitates
11:30 a.m.	Wrap-up	Caroline Mellor, Ecology

Committee Purpose

WSAC provides an important consultative and advisory role to Ecology related to current and forecasted water supply conditions and whether the hydrologic drought threshold has been met or is forecasted to be met: seventy-five percent of normal water supply within a geographic area (RCW 43.83B.405 and WAC 173-166-050).

Resources

WSAC Website: Water Supply Availability Committee - WA State Department of Ecology
Ecology Drought homepage: Drought response - WA State Department of Ecology

Contact

Committee Chair: Caroline Mellor, Statewide Drought Lead, WA Department of Ecology
Caroline.Mellor@ecy.wa.gov | (c) 360.628.4666

Snow Science Research Overview and Updates

Dan McEvoy, Desert Research Institute, Western Regional Climate Center

State of Washington Water Supply Availability Committee
December 12, 2024

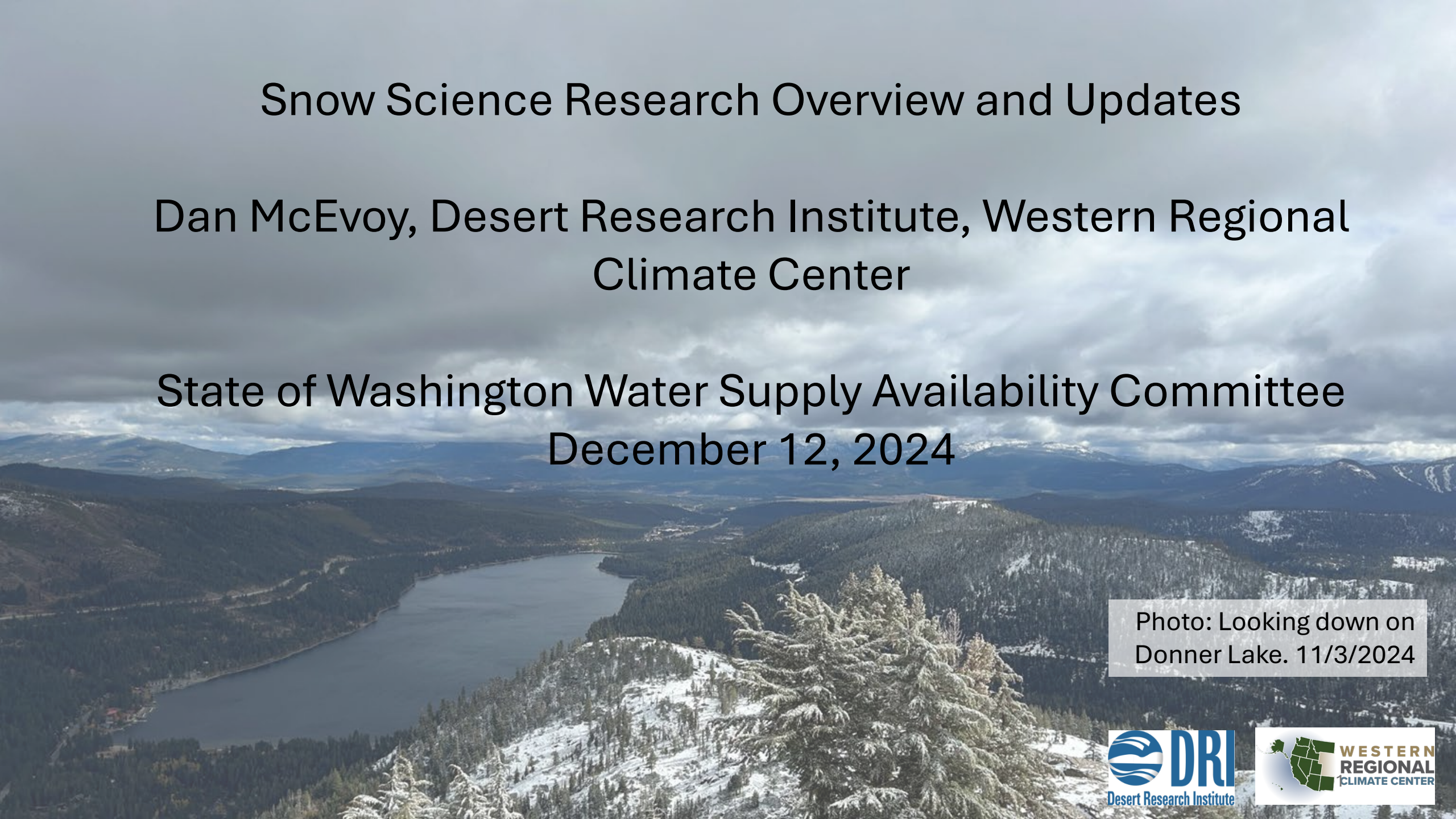


Photo: Looking down on Donner Lake. 11/3/2024

Outline

Lyngen Alps, Norway
September 2024

- Snow drought
  - Overview, past research, and state of the science
- Heatwave-snow drought relationships (ongoing NOAA-funded project)
- Developing a cooperative snow temperature survey (ongoing USBR-funded project)

Dr. James Church 1906
Photo: NRCS

Snow, water supply, and drought in the West have been linked for over a century.

Snow survey in the 1940s.
Photo: NRCS

Snow Survey on Mt Rose, NV in 2023. Photo: KOLO8

Defining Snow Drought and Why It Matters

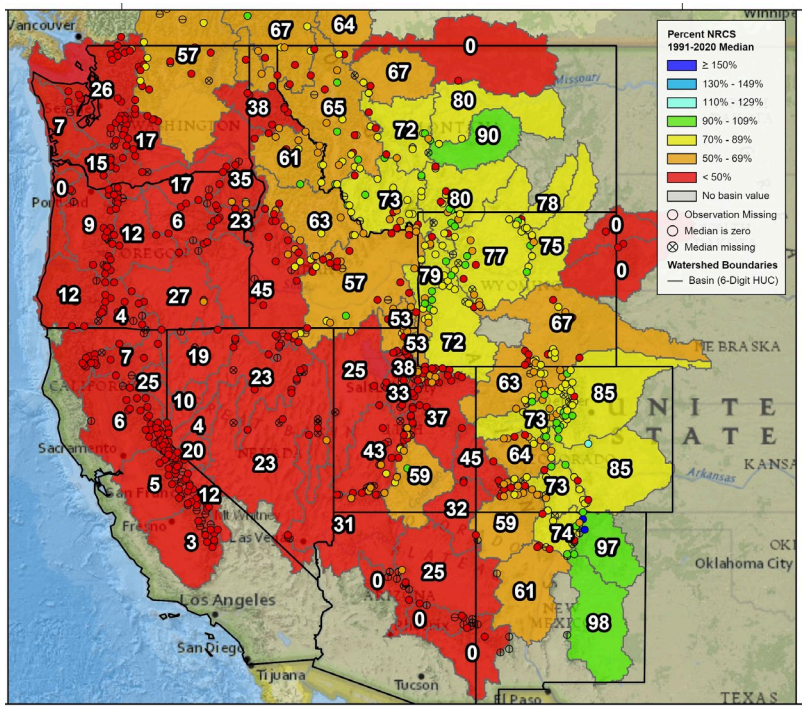
Harpold et al., 2017 Eos

Swings from snow drought to extreme winter rainfall make managing reservoirs, like the Oroville Dam, incredibly difficult. But what exactly is "snow drought"?

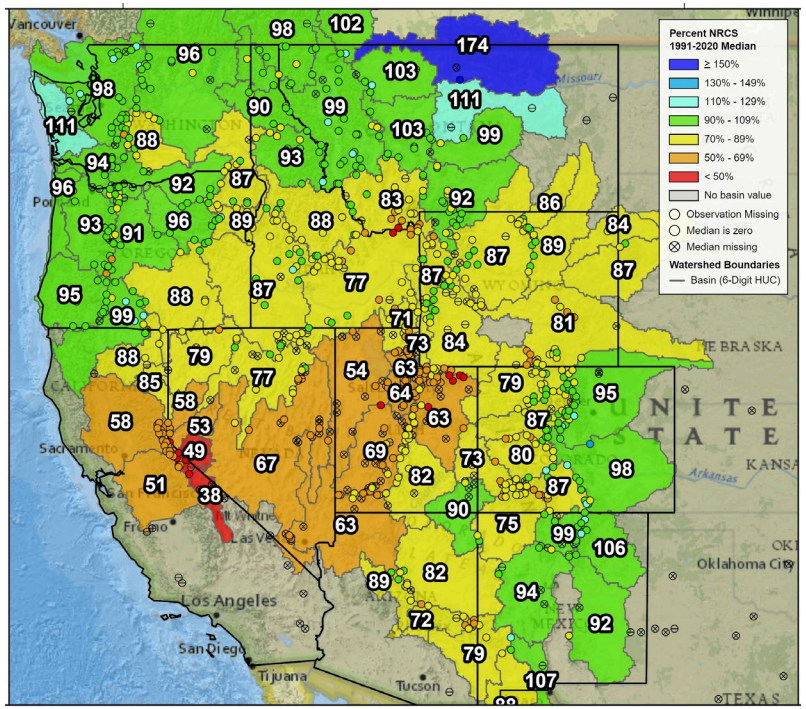
Mountain snowpack, water cycle, and associated drought impacts in the West have been changing.

Snow drought definitions have been evolving

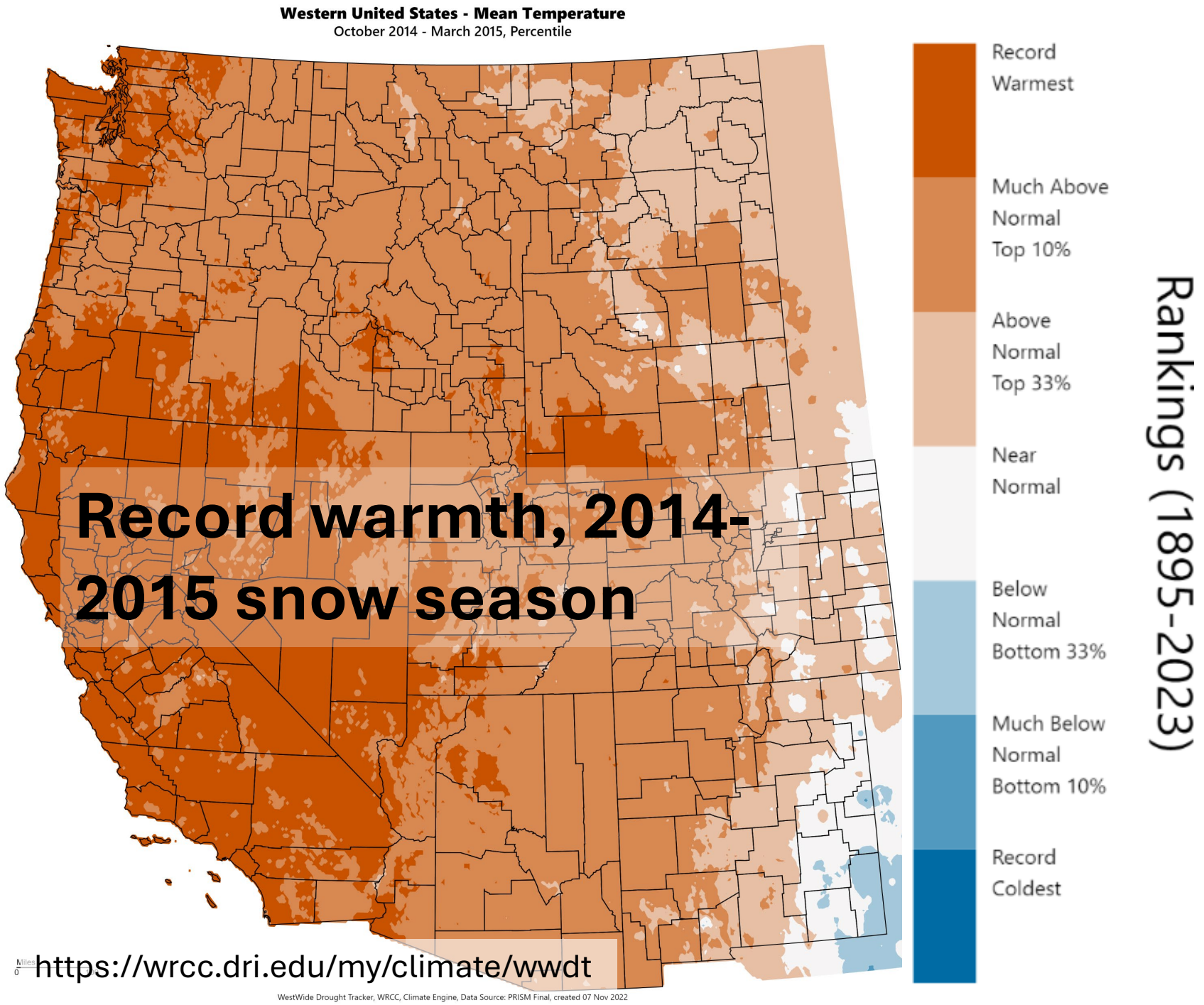
April 1, 2015, Snow Water Equivalent % of Normal



Oct-Mar 2015 Precipitation % of Normal



https://www.nrcs.usda.gov

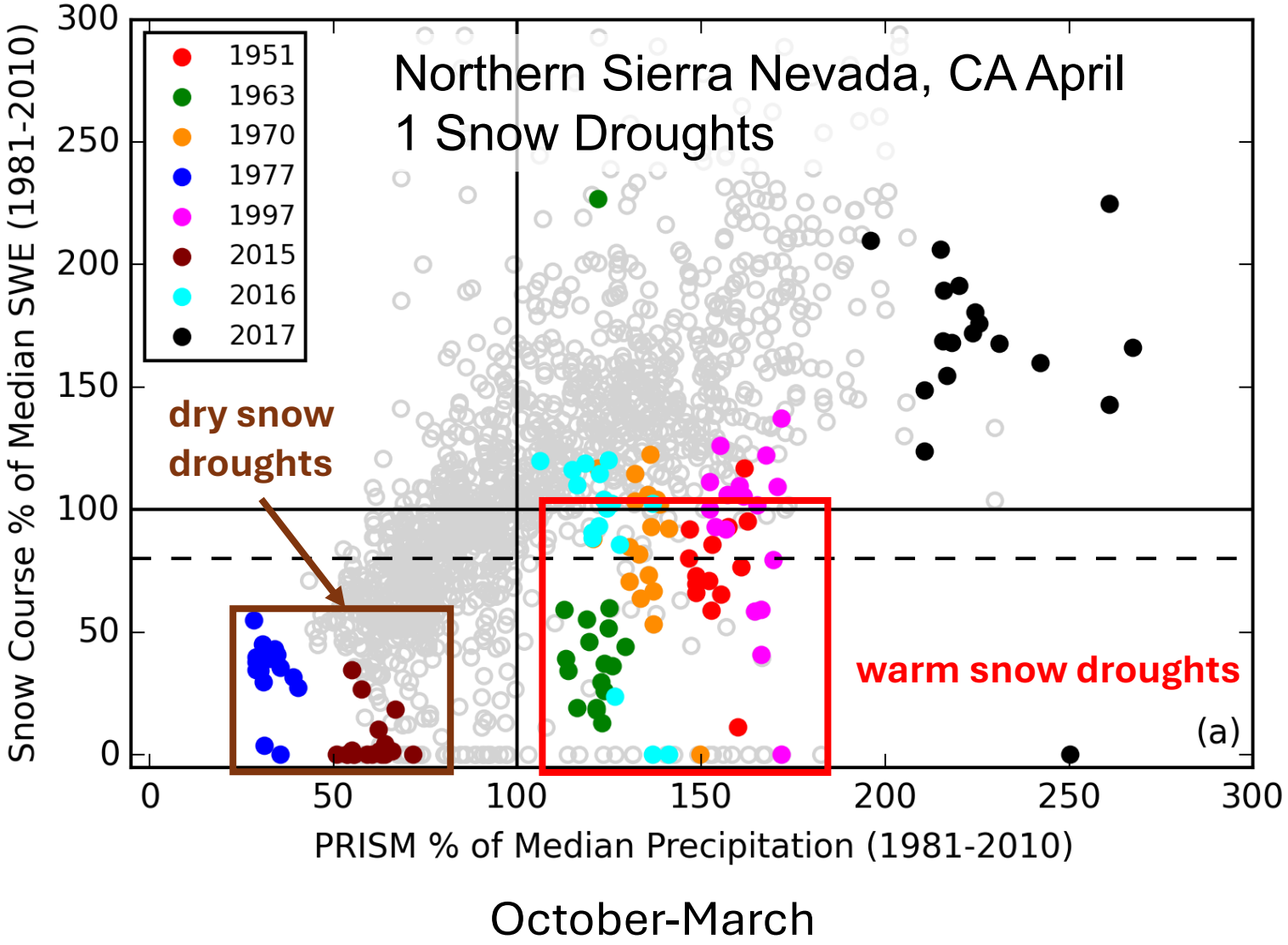


Record warmth, 2014-2015 snow season

https://wrcc.dri.edu/my/climate/wwdt

2015 was eye opening:

Snow drought can be much more than lack of precipitation during winter.



October-March

Framework for tracking tracking snow drought types

- Snow drought quadrants
- Dry and warm type snow drought separated by above or below normal precipitation

- Can be “dry and warm” like 2015

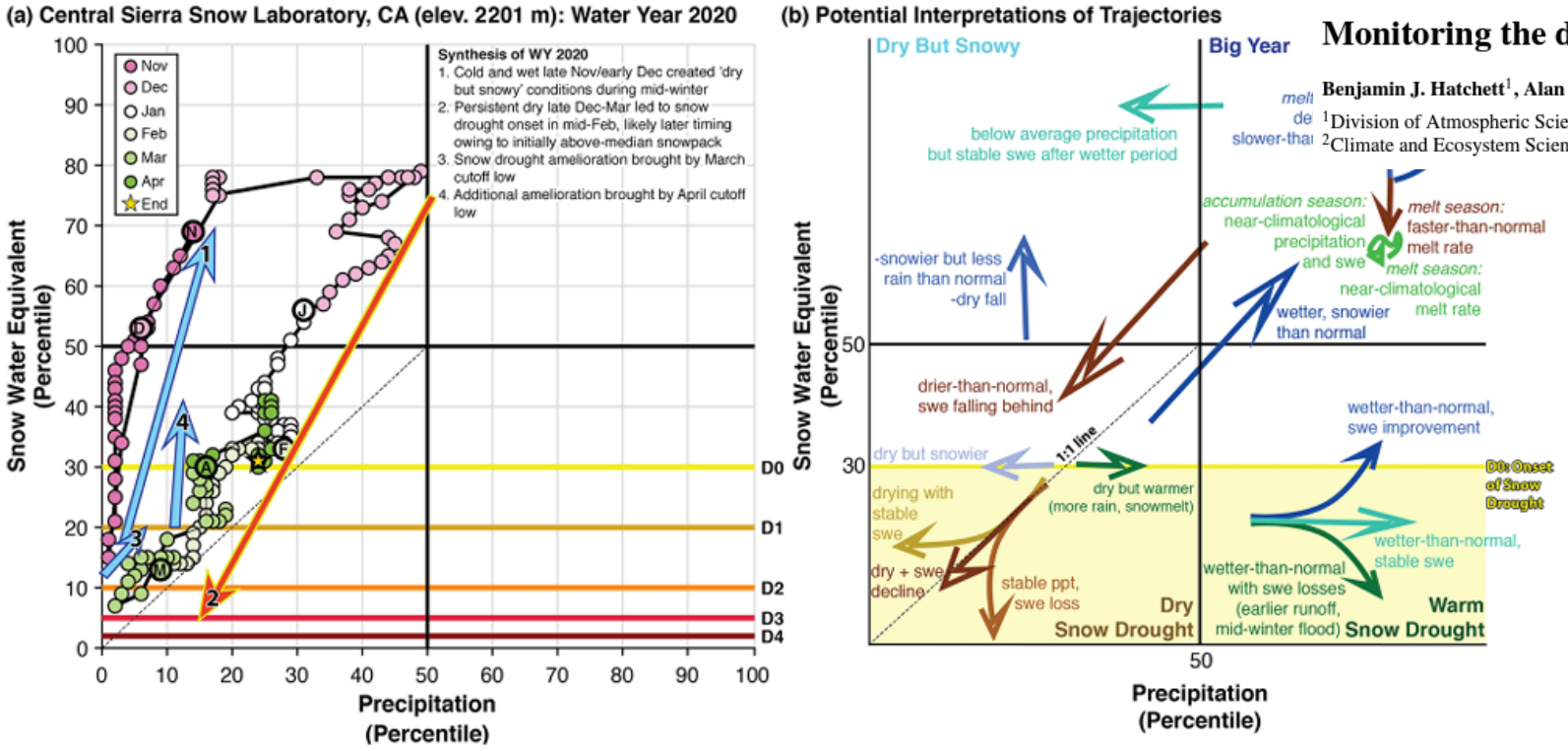
Hatchett, B. and D. J. McEvoy (2018), *Earth Interactions*, **22 (2)** https://doi.org/10.1175/EI-D-17-0027.1.

Snow Drought Phase Diagrams

- Track the **daily** progression of SWE and precipitation relationships **together**

Nat. Hazards Earth Syst. Sci., 22, 869–890, 2022
https://doi.org/10.5194/nhess-22-869-2022

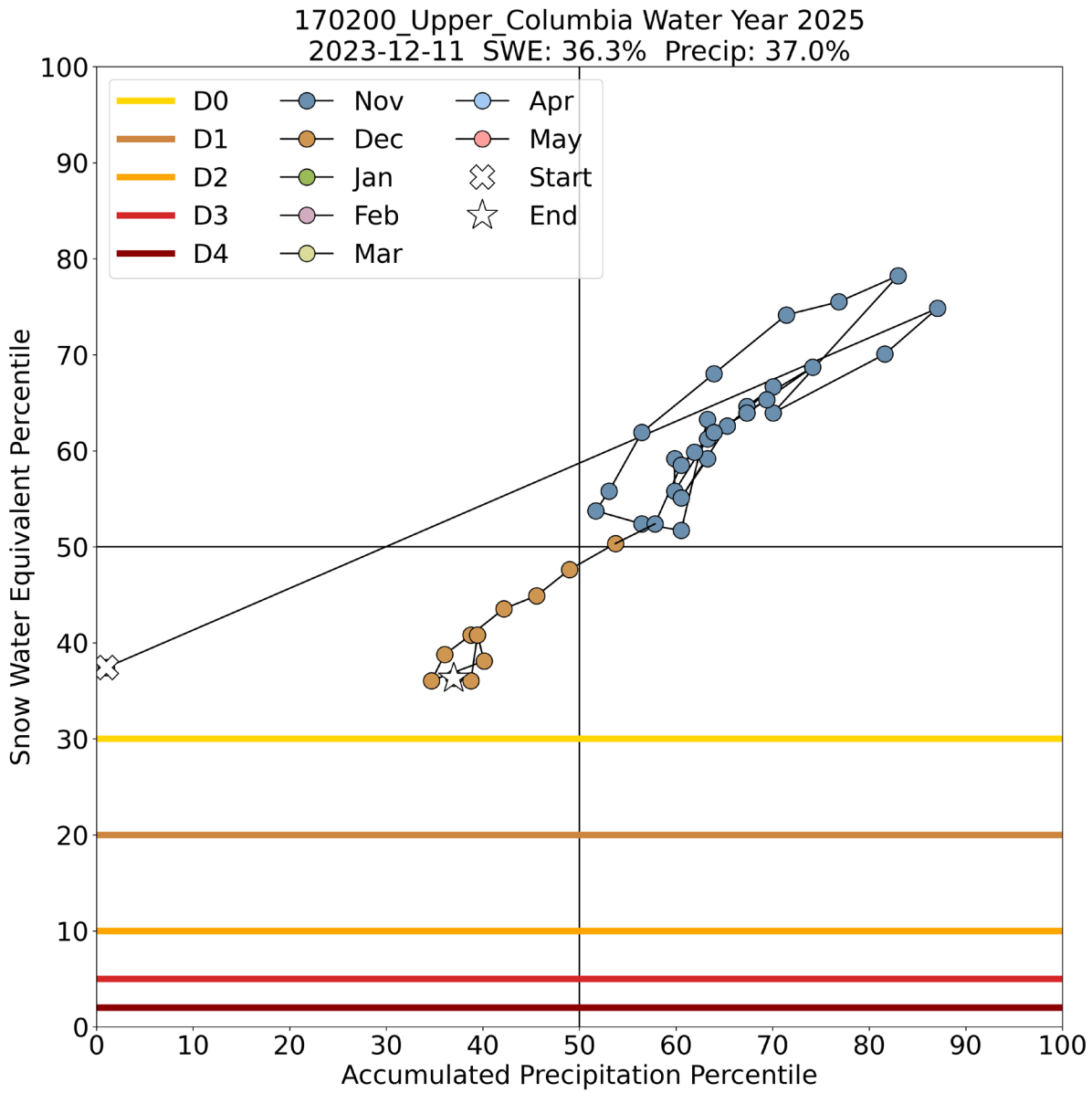
Natural Hazards and Earth System Sciences
Open Access
EGU

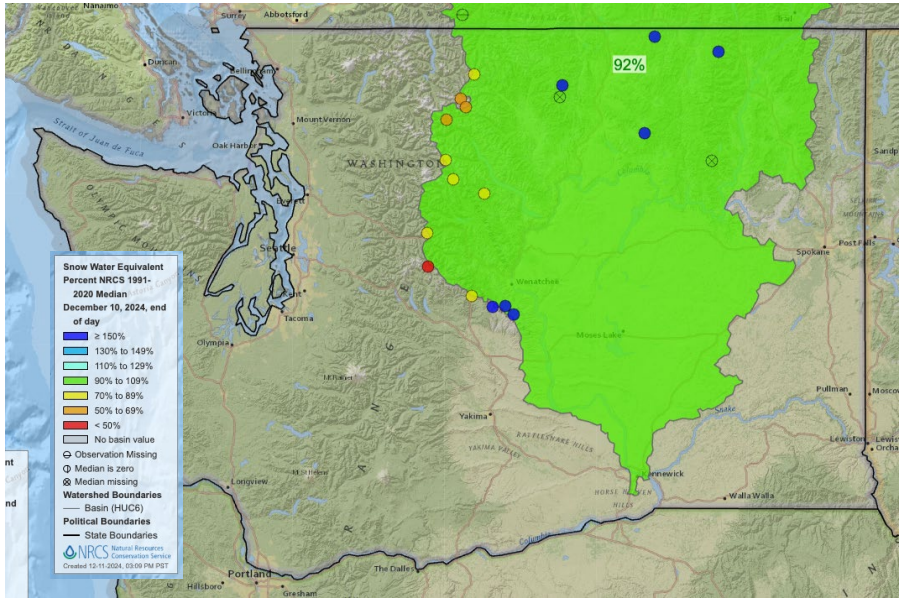


Monitoring the daily evolution and extent of snow drought

Benjamin J. Hatchett[1], Alan M. Rhoades[2], and Daniel J. McEvoy[1]
[1]Division of Atmospheric Sciences, Desert Research Institute, Reno, Nevada 89512, USA
[2]Climate and Ecosystem Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720, USA

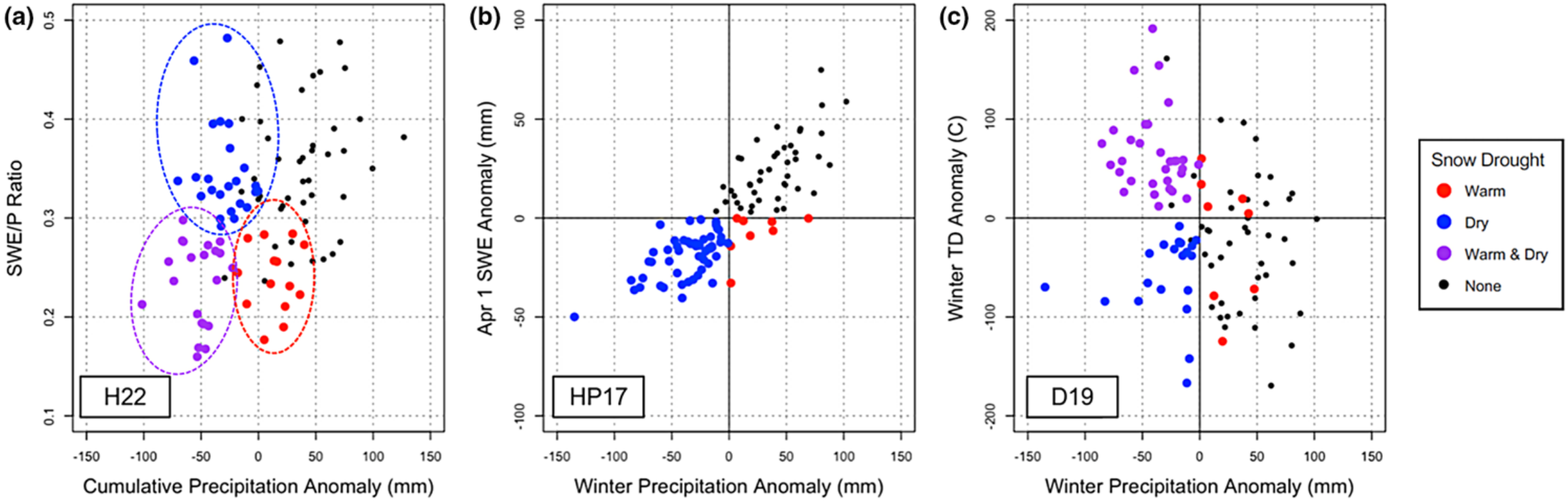
- Point and basin-scale application
- Use percentiles and "DX" drought categories





- Real-time HUC 6 basin phase diagrams: http://52.9.95.82/snowdrought/
- Experimental and still in development!

Defining snow drought still an active area of research



Harpold et al., 2017

Dierauer et al., 2019

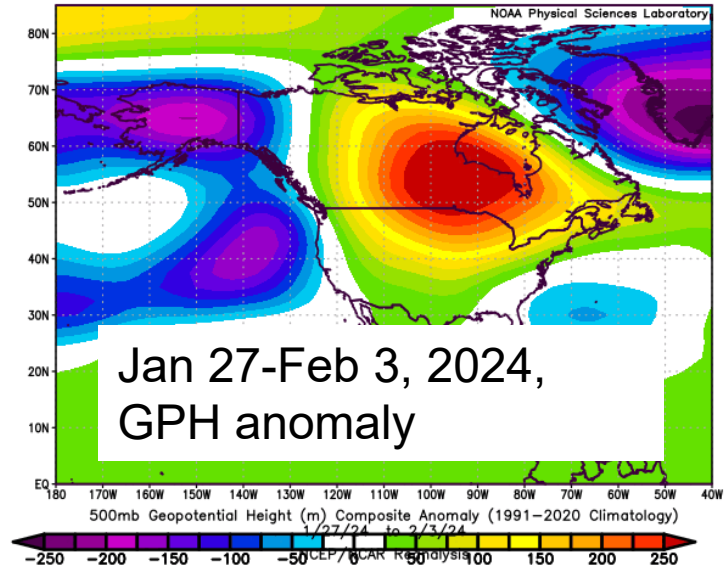
Figure 3: Heldmyer et al. (2023), *JAWRA*.

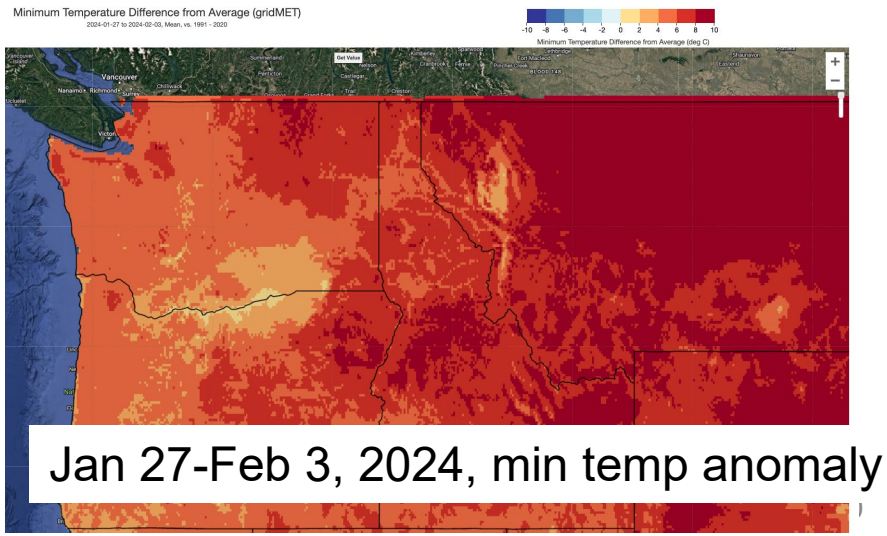
Understanding heatwave-snow drought relationships across the western United States

- 3-year (2023-2026) project NOAA MAPP-NIDIS—Science for 21st Century Western U.S. Hydroclimate

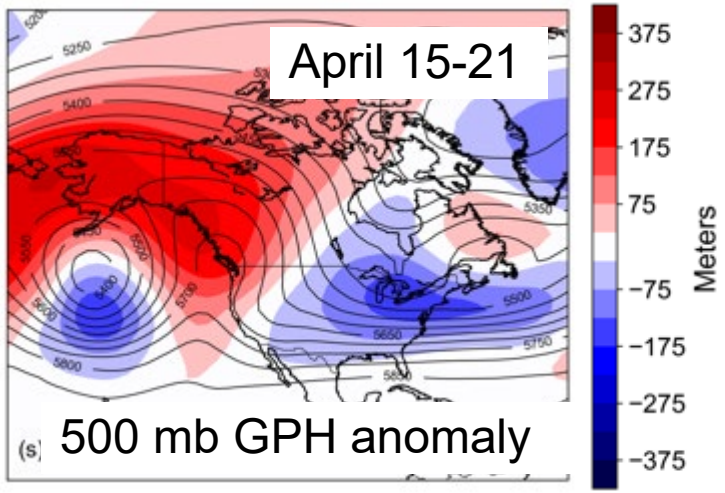
- Laurie Huning, CA State University, Long Beach (PI); Alan Rhoades, Lawrence Berkely National Lab (co-PI)

- How do we classify spring heat waves?
- How frequently do spring heat waves trigger rapid snow melt and potentially snow drought?
- How do spring heat waves impact runoff efficiency and snowmelt timing?

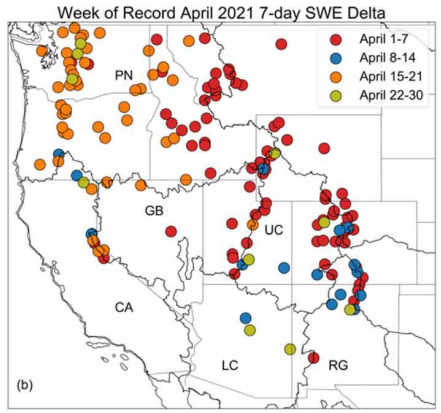


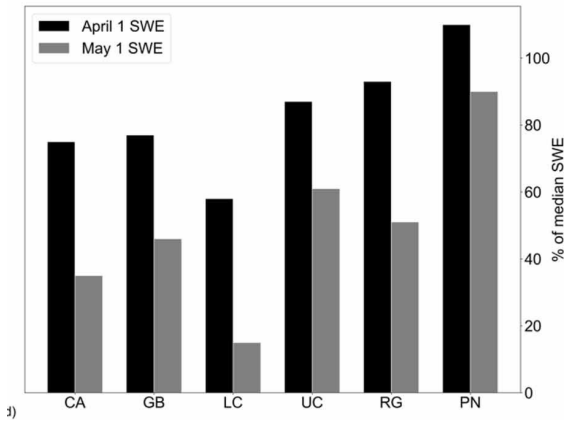


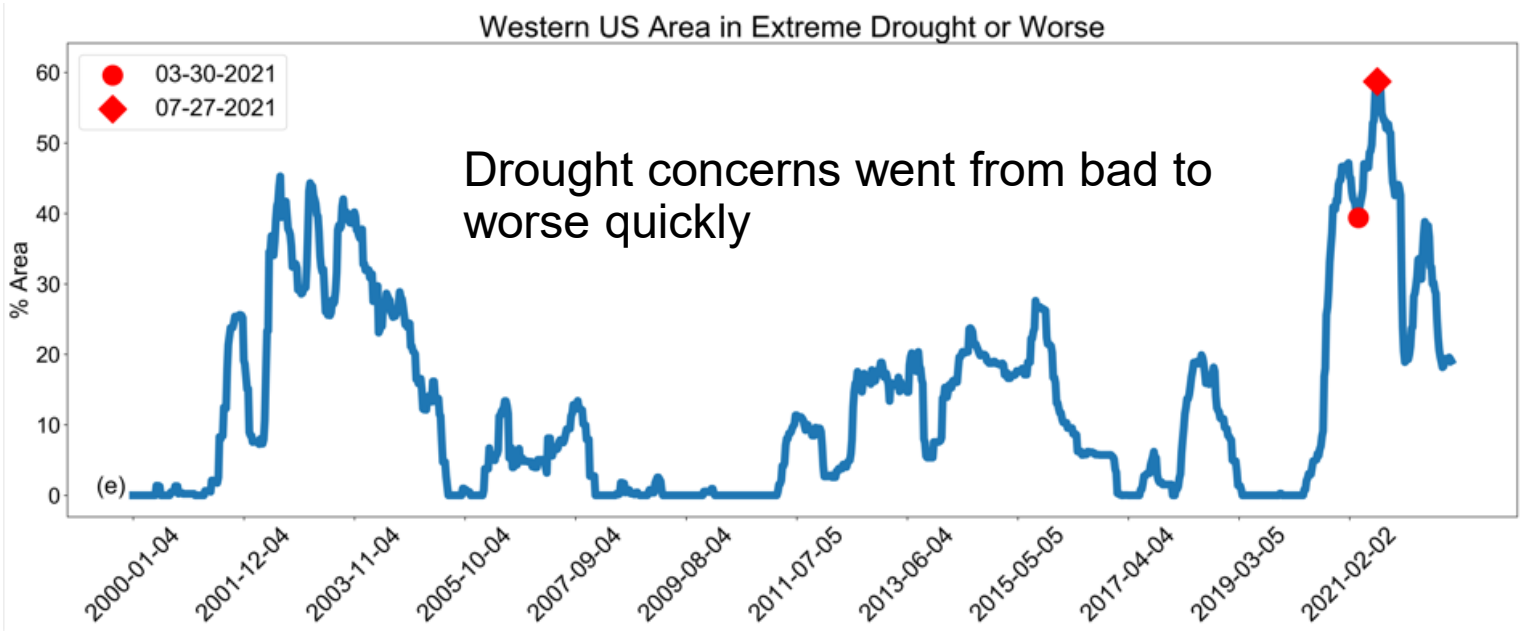
April 2021 Rapid Snowmelt Event



- Widespread rapid and record-breaking snowmelt rates (~25% of all sites) in **April 2021**
- **Spring heat waves a key driver**







McEvoy and Hatchett, 2023, *Environmental Research Letters*

Developing a Cooperative Snow Temperature Survey

Anne Heggli, PhD

Mountain Hydrometeorology

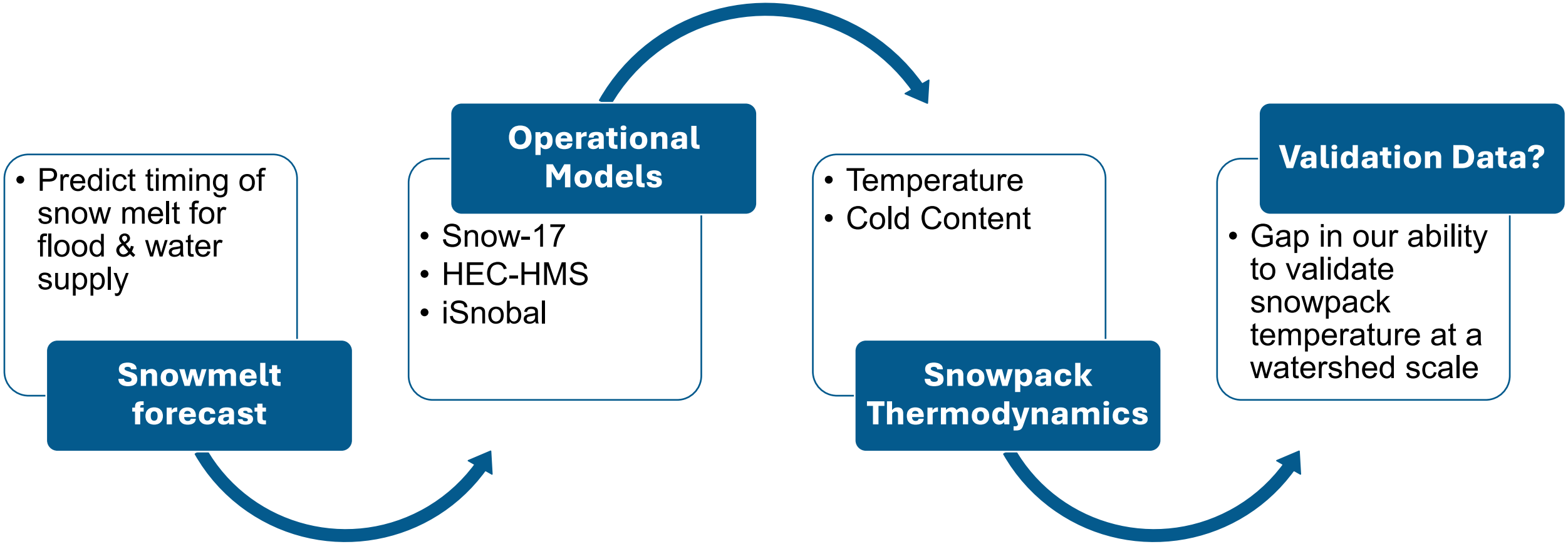
(Next several slides courtesy Anne Heggli)

Dan McEvoy, Rosemary Carroll, Christine Albano, Lucas Zukiewicz

DRI

BUREAU OF RECLAMATION

Why measure snowpack temperature?



Improvement on current practice

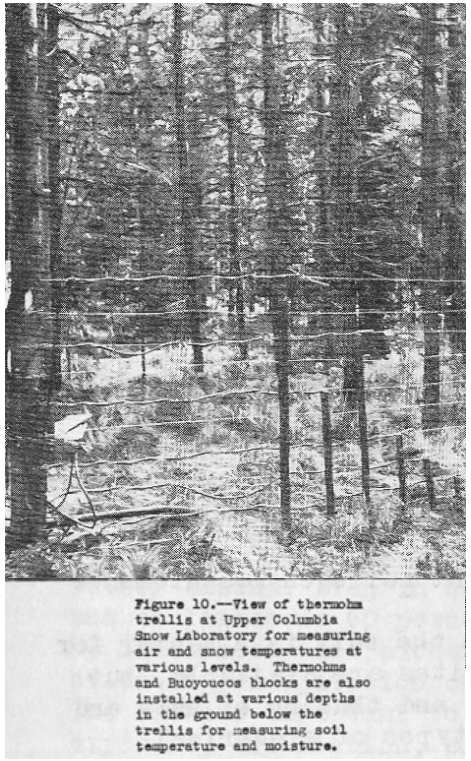


Figure 10.—View of thermohm trellis at Upper Columbia Snow Laboratory for measuring air and snow temperatures at various levels. Thermohms and Buoyoucos blocks are also installed at various depths in the ground below the trellis for measuring soil temperature and moisture.

WSC 1948

McGurk 1983

Dettinger mid-2000's

Luce 2020

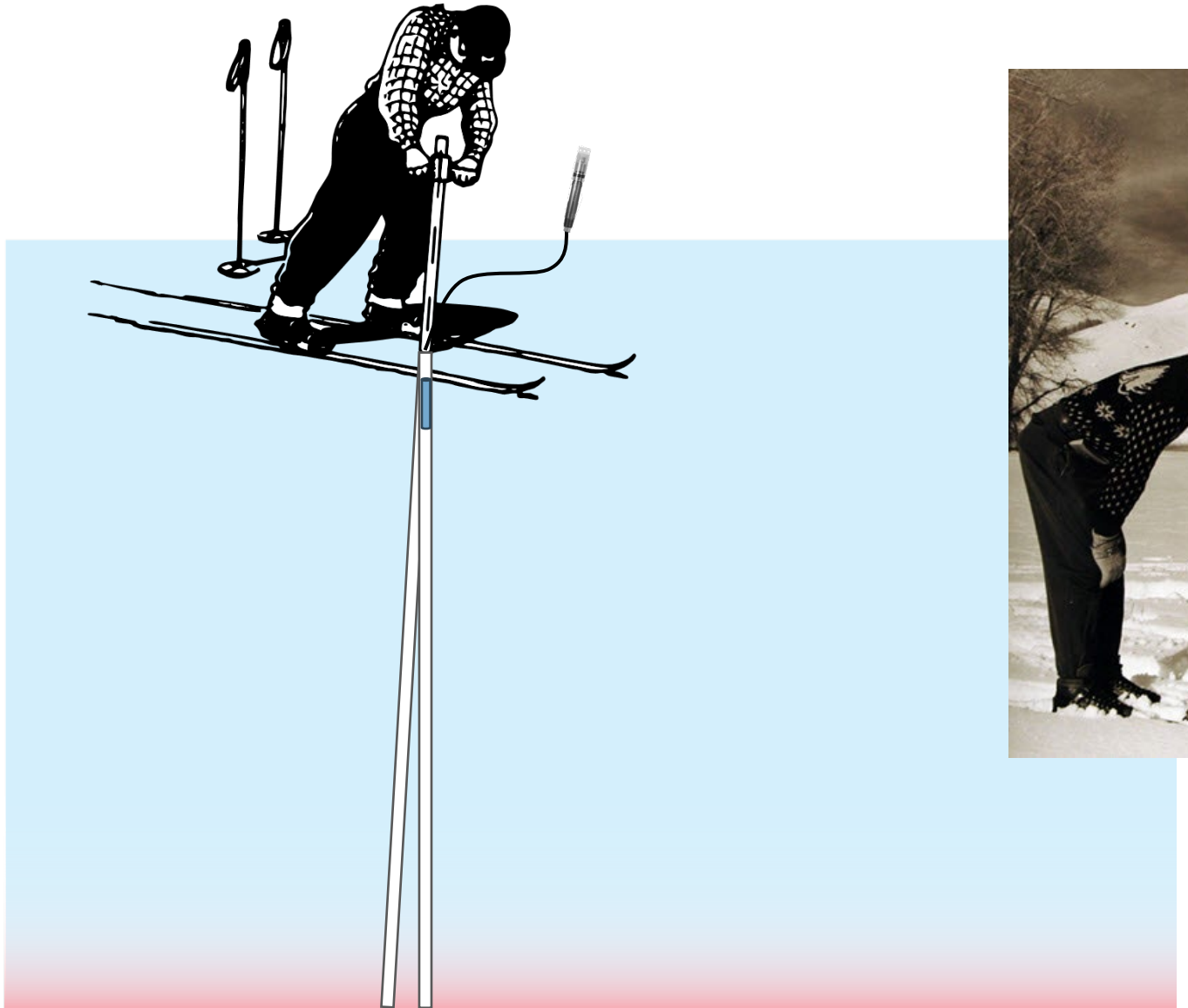
A non-contact approach

This project proposes the use of a non-contact infrared **Snow Temperature Profiler (STP)** to be deployed with manual snow surveys to obtain snow temperature and cold content observations.

The STP is not a new technology, but a **new application for an existing technology**.

Desert Research Institute

STP Deployment



Year 1 Research Grade Field Observations

California – Central Sierra Snow Lab

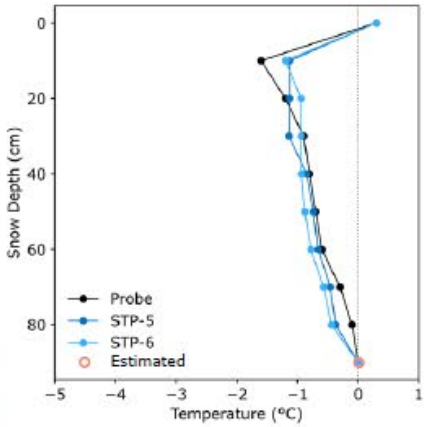
Colorado – Upper Gunnison

Montana – NRCS Field Stations

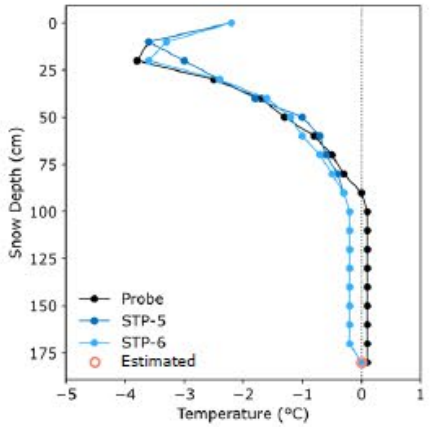
DRI
Desert Research Institute

Year 1 California – CSSL Results

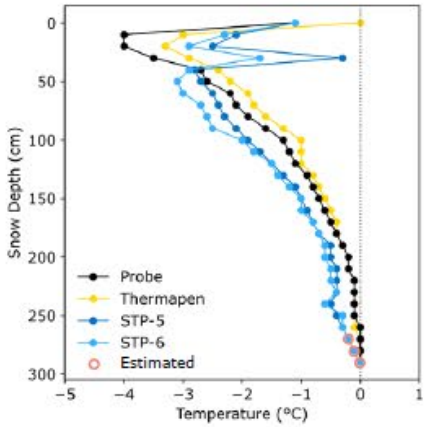
18 January 2024



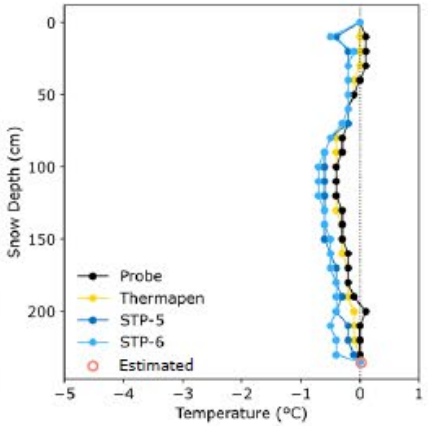
8 February 2024



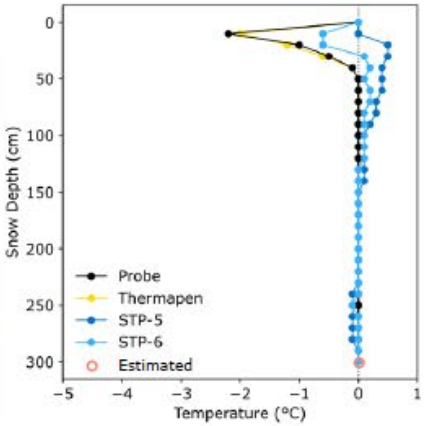
8 March 2024



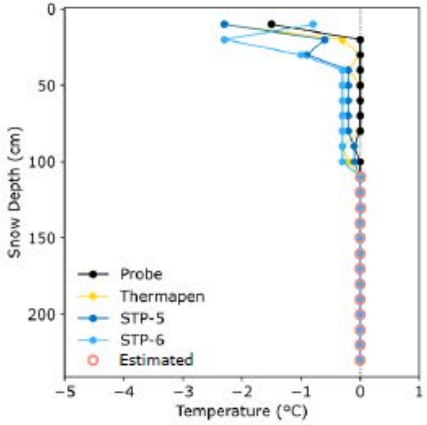
22 March 2024



1 April 2022



8 April 2022



Next Steps

WY2025

1. Upgrade to STP V3

2. Repeat snow pit comparisons in CA, CO and MT

3. Put the sensor in the hands of the snow surveyors

53 locations in California, Nevada, Colorado, and Montana.

ASO field team and BSU have recently joined (Idaho!)

4. Compare the snow temperature observations to model outputs with SNOW-17, iSnobal, HEC-HMS

5. Examine the feasibility of operational integration.

Cooperative Surveys

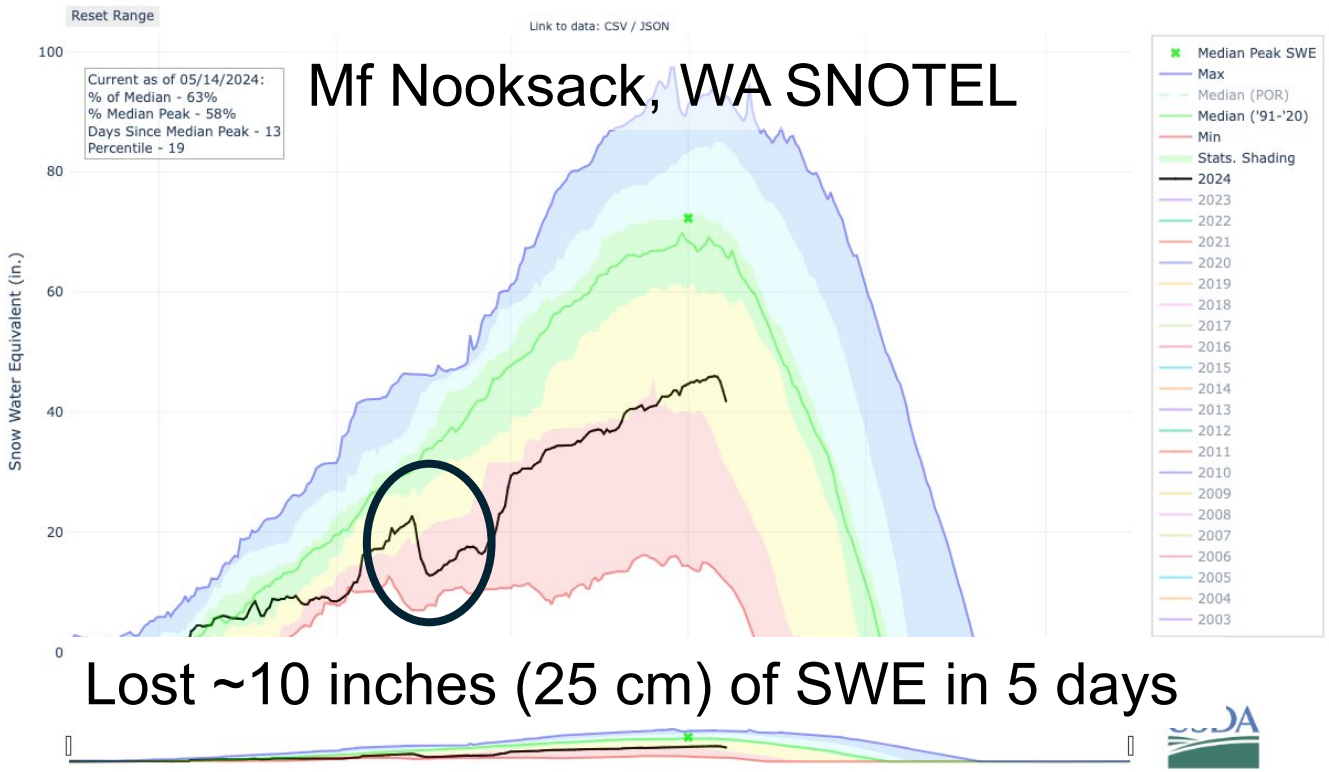
- California DWR
- Upper Gunnison River WCD
- Yuba Water Agency
- Nevada Irrigation District
- Placer County Water Agency
- El Dorado Irrigation District
- Pacific Gas & Electric
- South Feather Water & Power
- Central Sierra Snow Laboratory
- NRCS Nevada, Colorado, Montana

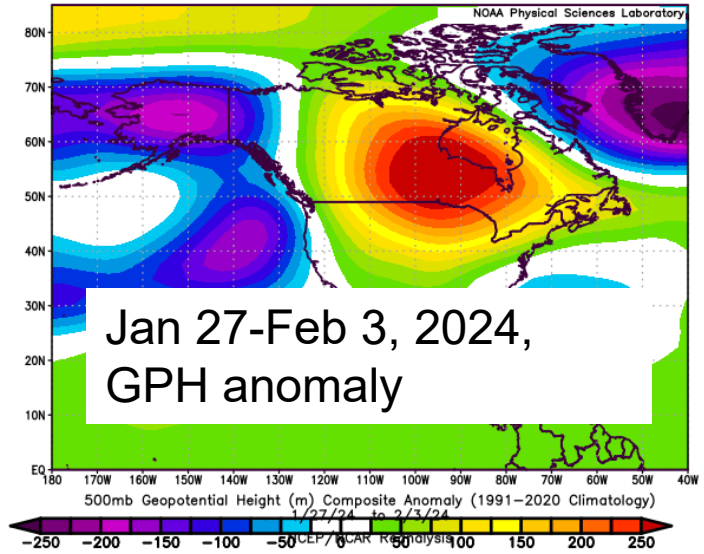
Cooperative Modeling

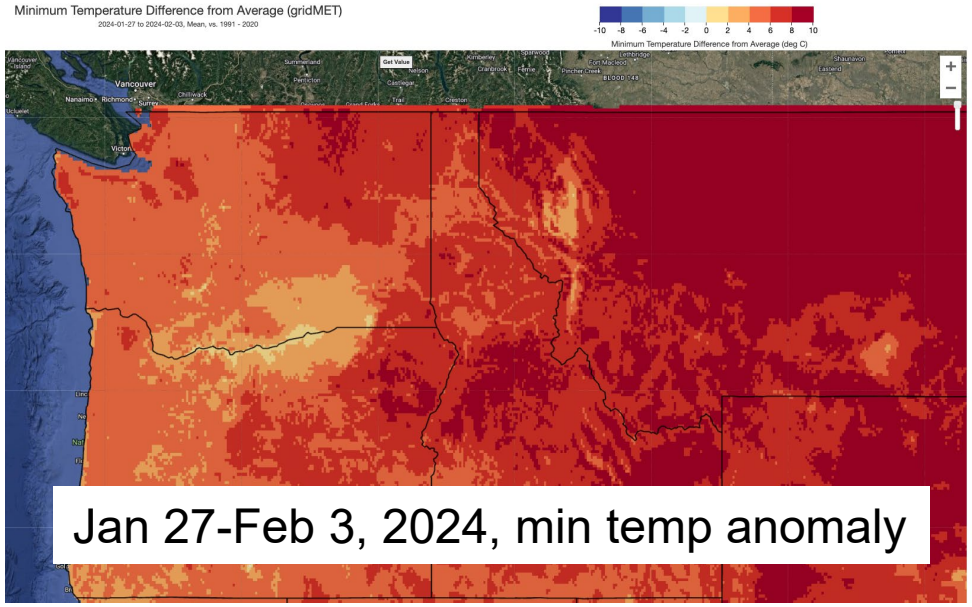
- iSnobal (M3Works)
- SNOW-17 (CNRFC & CBRFC)
- HEC-HMS (USACE)

DRI Desert Research Institute


Thank you!
mcevoyd@dri.edu
Snake Range, Nevada near Great Basin National Park
June 26, 2024







- 2024 rain-on-snow event
- What role did winter heat wave play in melting snow?

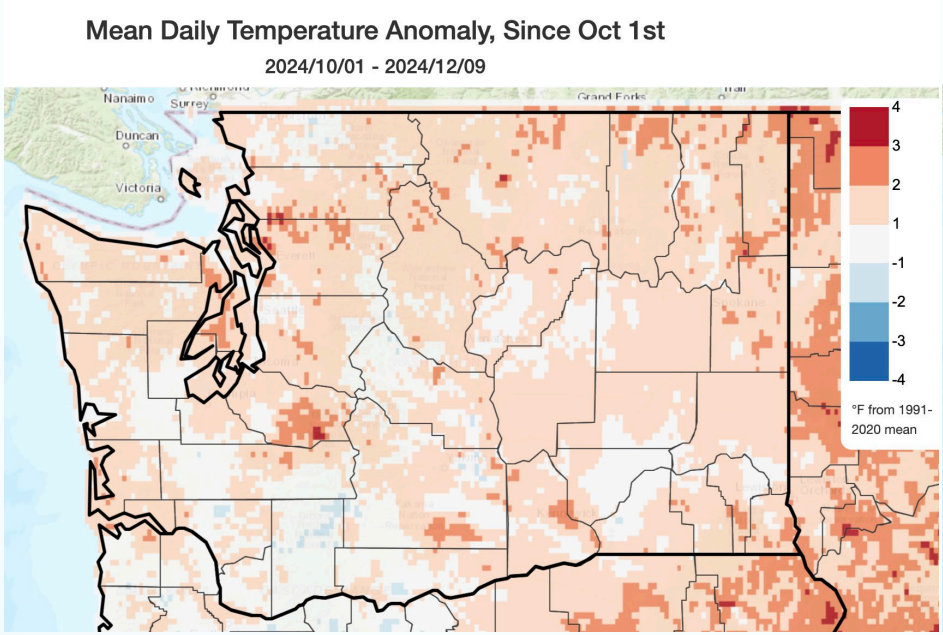
Office of the Washington State Climatologist

Current Conditions and Seasonal Outlook

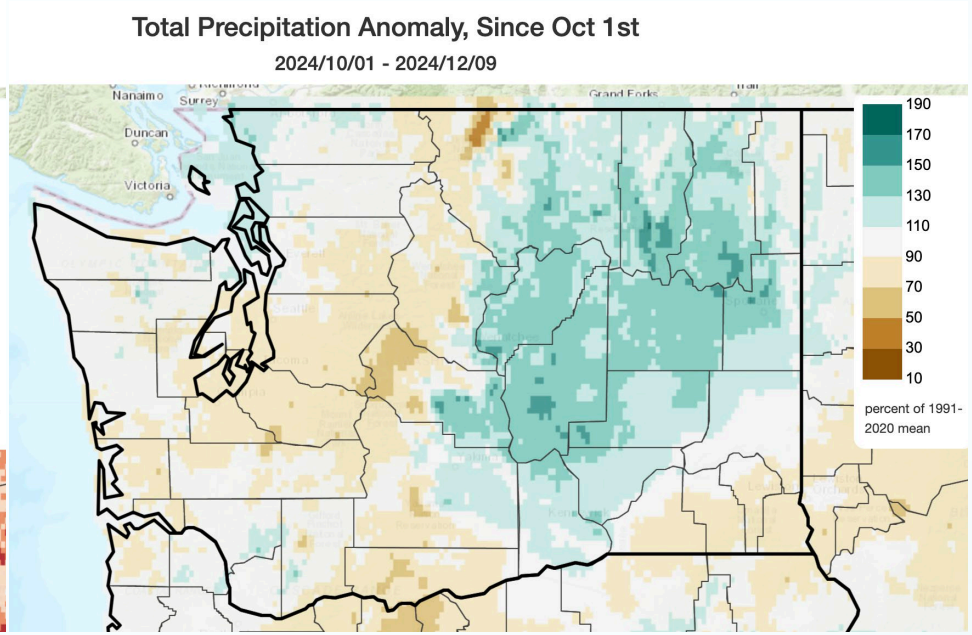
Karin Bumbaco
Office of the Washington State Climatologist
Climate Impacts Group
University of Washington
December 12, 2024

Water Year 2025

Temperature



Precipitation



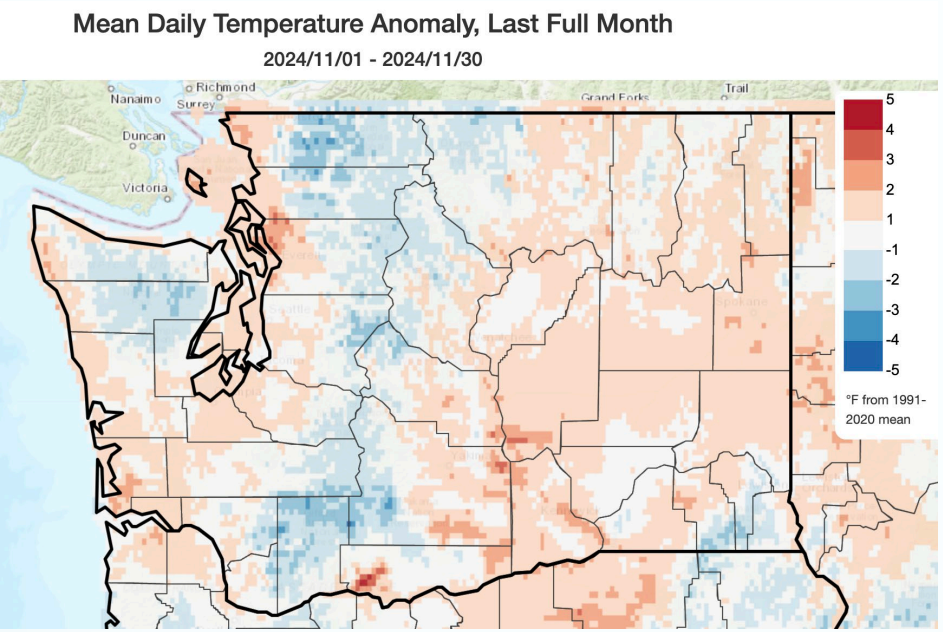
Climate Toolbox

- Averaged statewide, Oct-Nov temperatures were slightly above normal (+0.9°F)*
- Averaged statewide, Oct-Nov precipitation was near-normal (101% of normal)

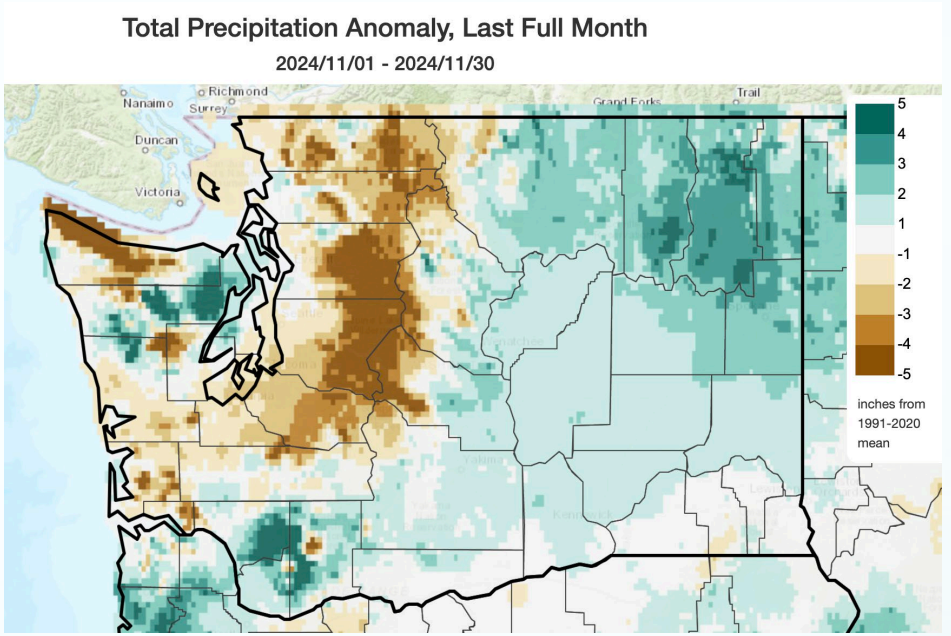
*Records since 1895; Normal is 1991-2020

November 2024

Temperature



Precipitation



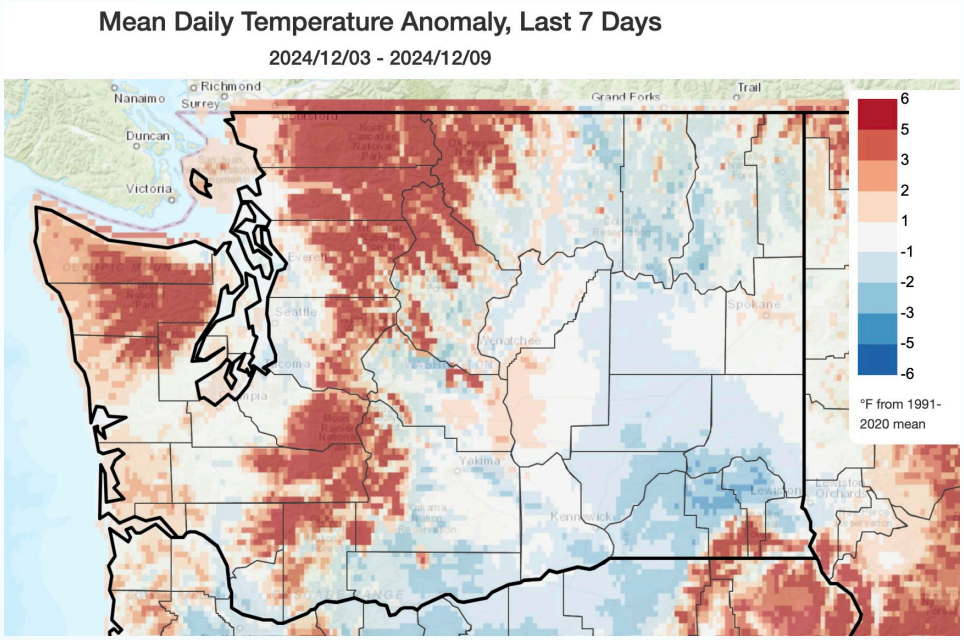
Climate Toolbox

- Averaged statewide, Nov temperatures were near-normal (+0.7°F)*
- Averaged statewide, Nov precipitation was above normal (113% of normal)

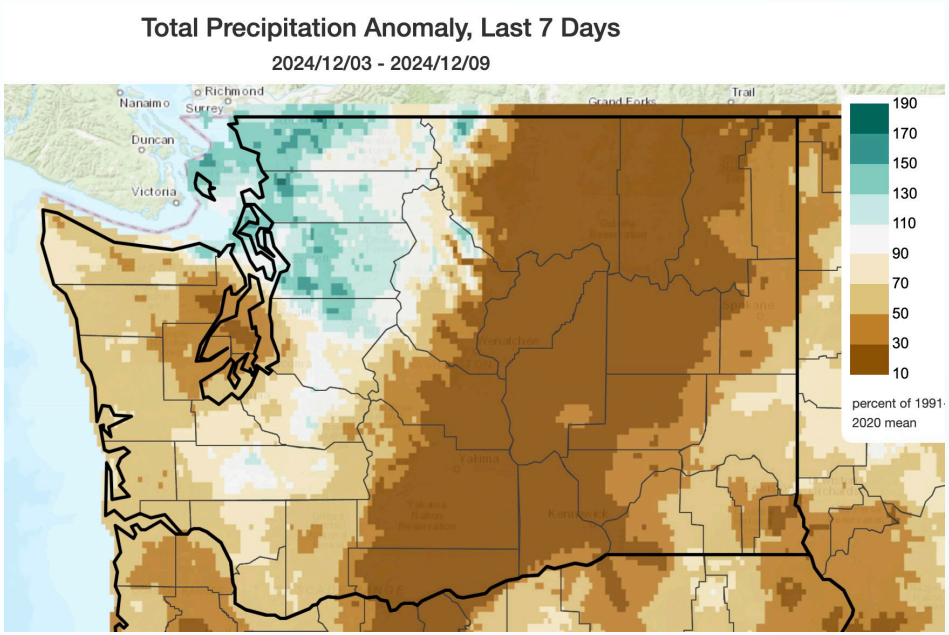
*Records since 1895; Normal is 1991-2020

December 2024 so far...

Temperature

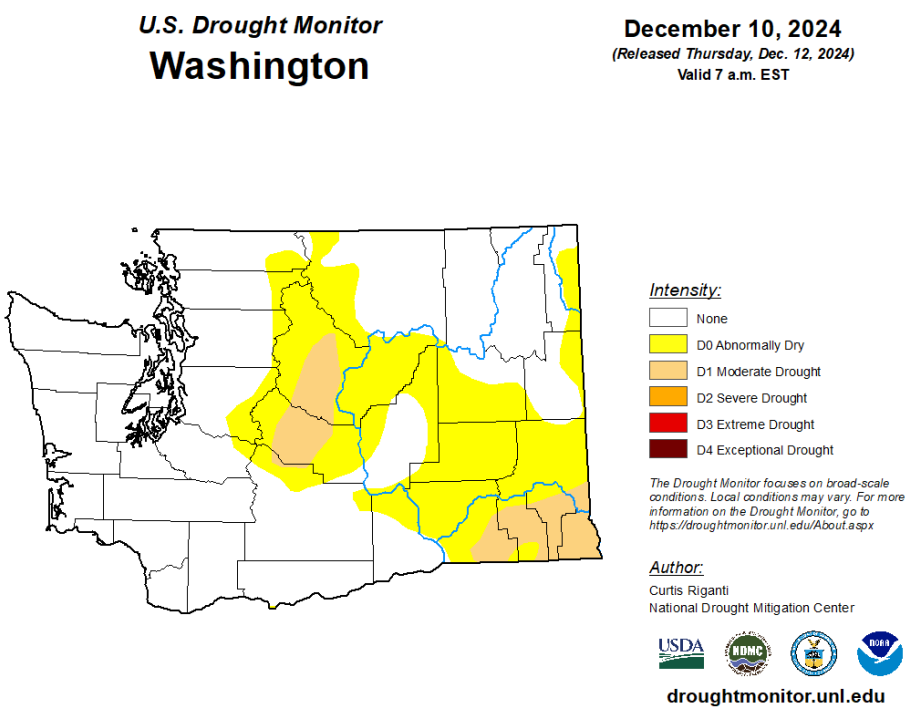


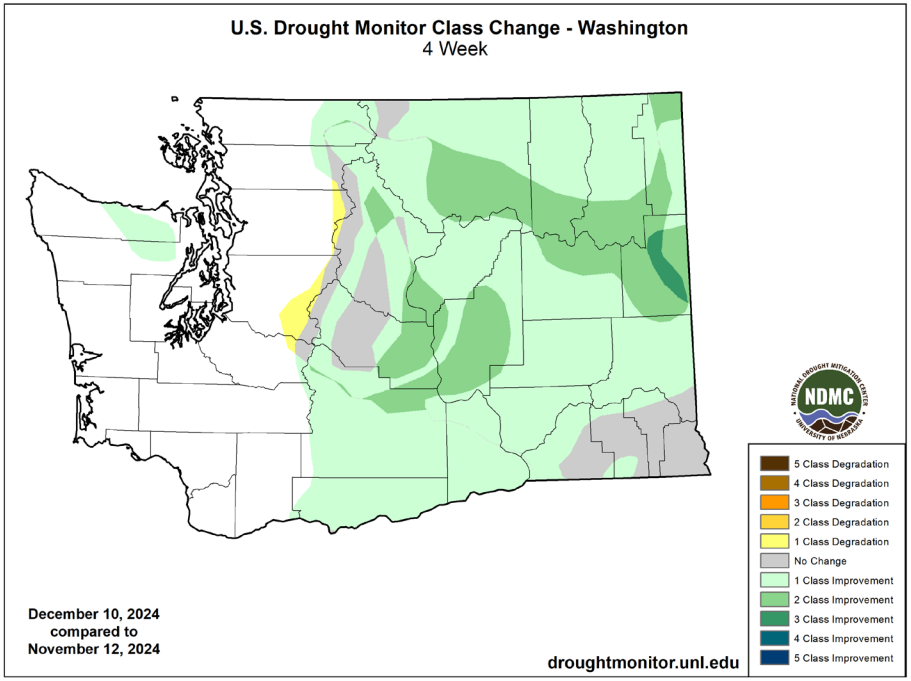
Precipitation



[Climate Toolbox]

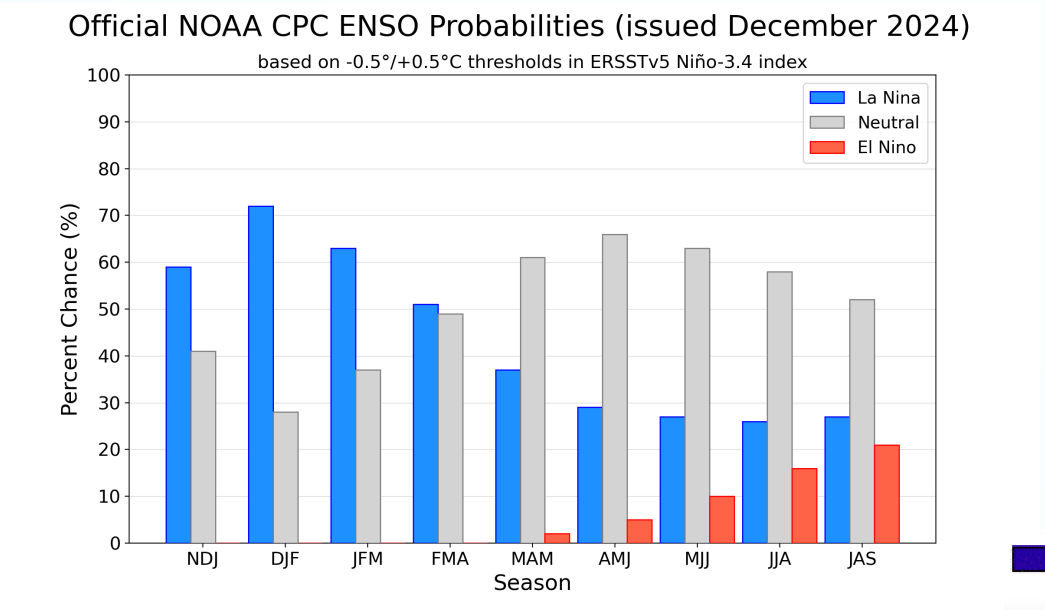
U.S. Drought Monitor

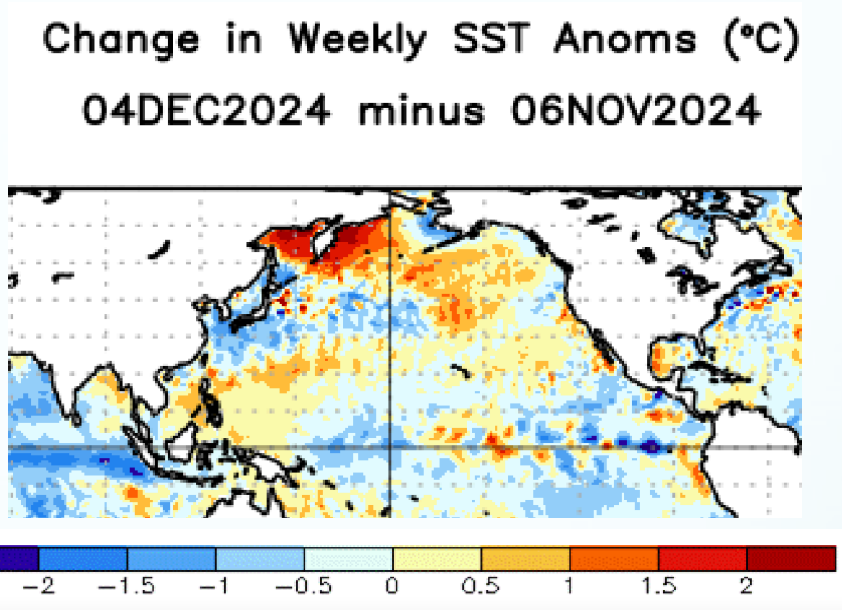




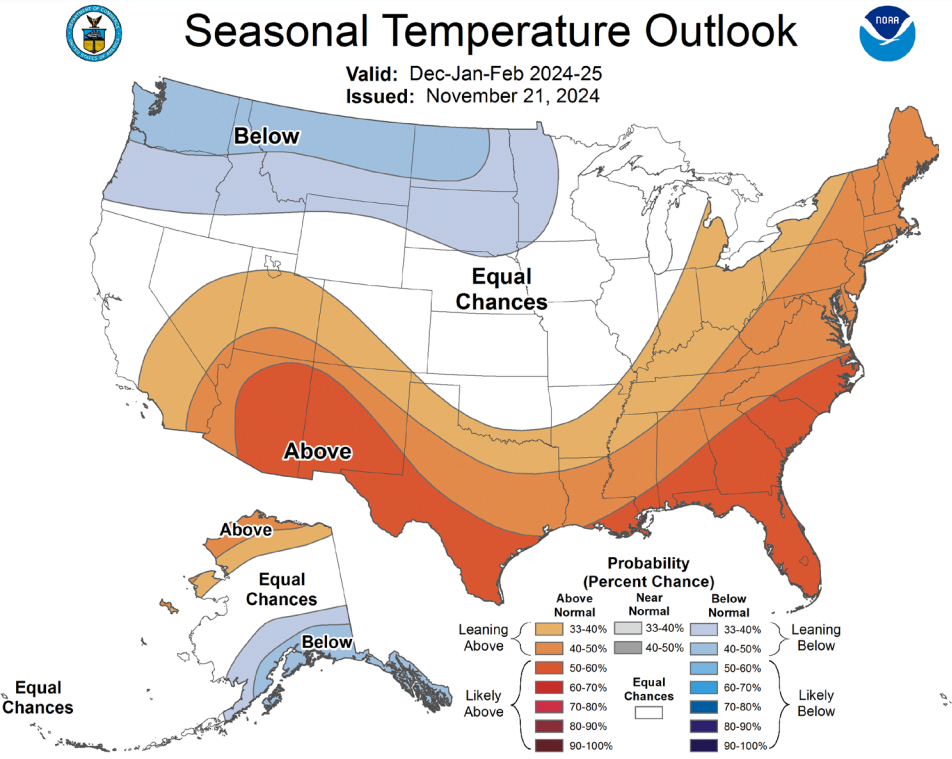
Current Status: Neutral Conditions

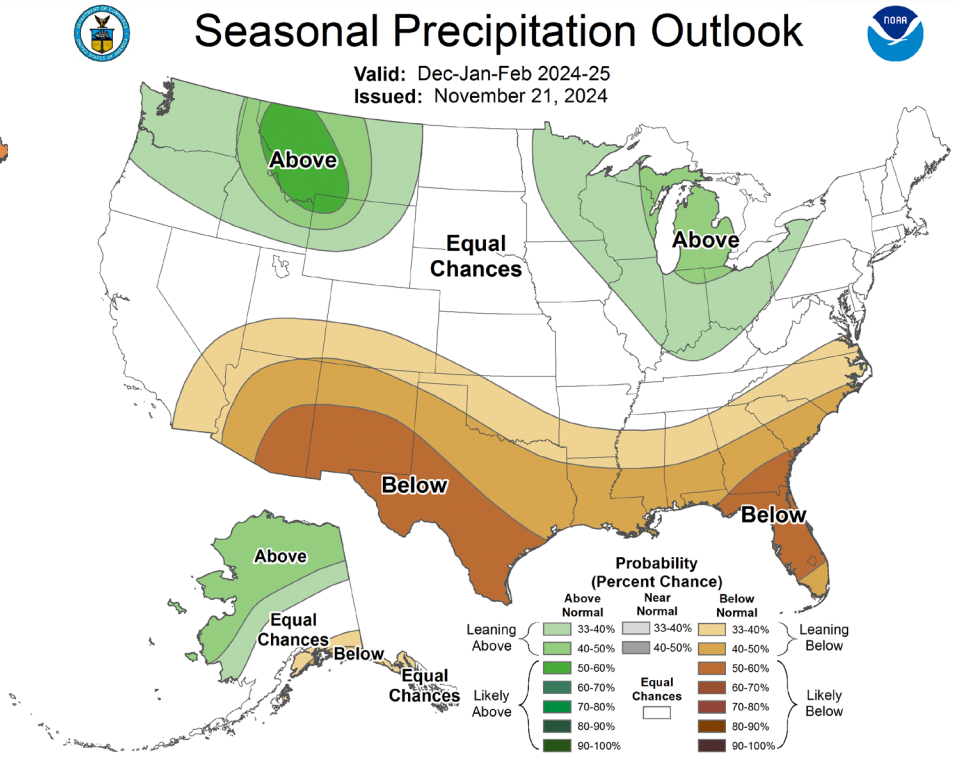
La Niña Watch





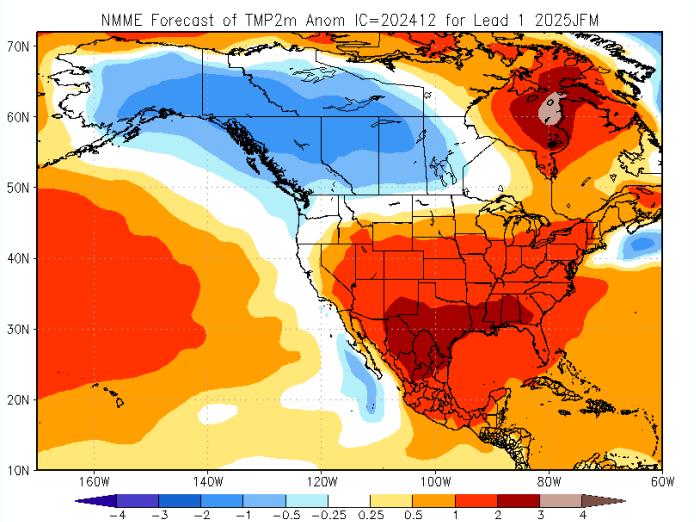
Climate Prediction Center Outlook: Dec-Feb



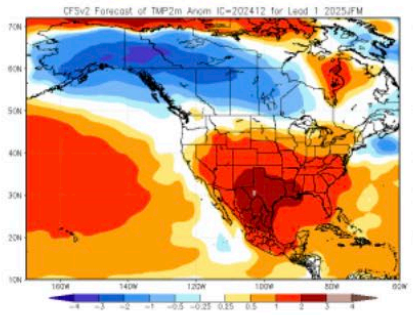


Jan-Mar: Similar odds of below normal temps; higher odds of above normal precip

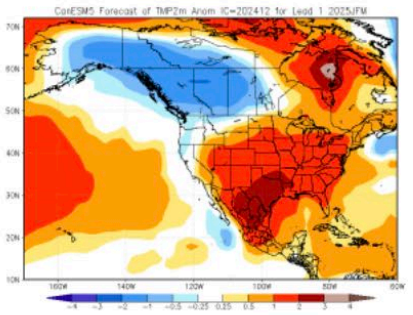
NMME: Jan-Mar Temperatures



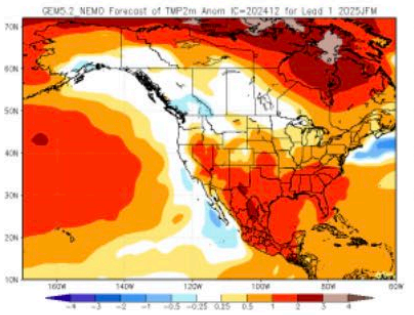
NCEP_CFSv2



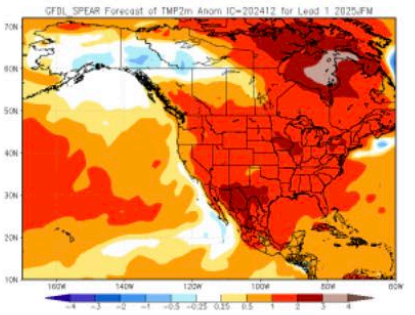
CanESM5



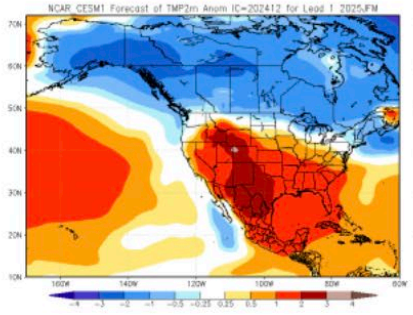
GEM5.2_NEMO



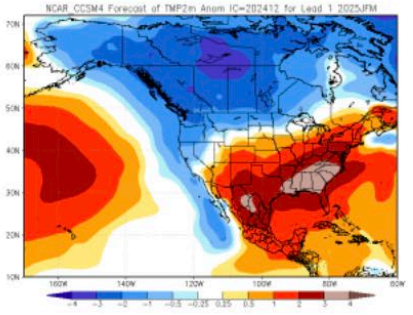
GFDL_SPEAR



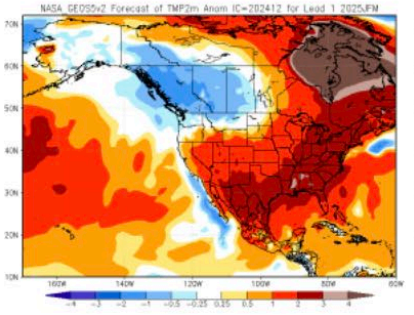
NCAR_CESM1



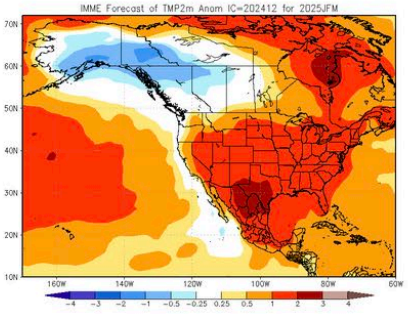
NCAR_CCSM4



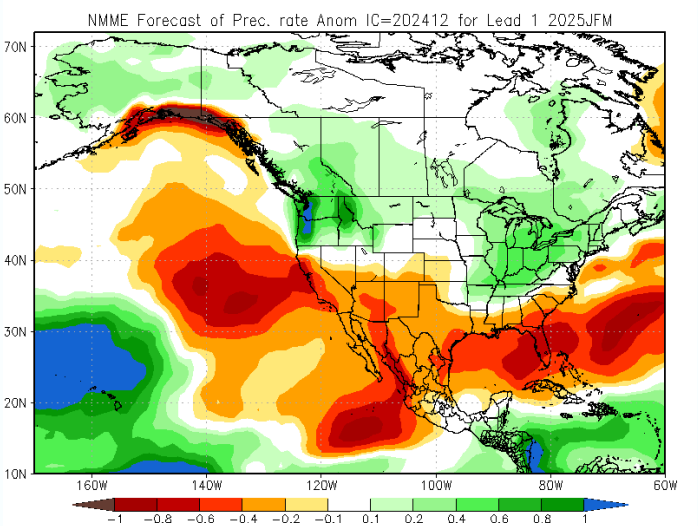
NASA_GEOS5v2



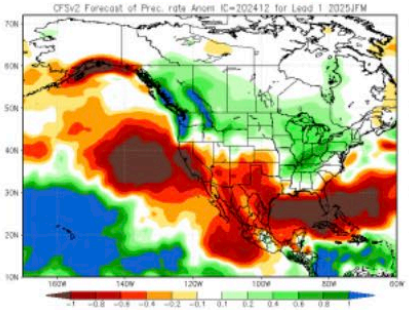
IMME



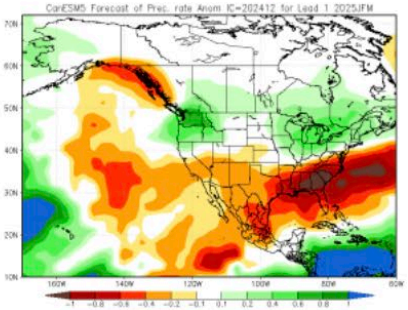
NMME: Jan-Mar Precipitation



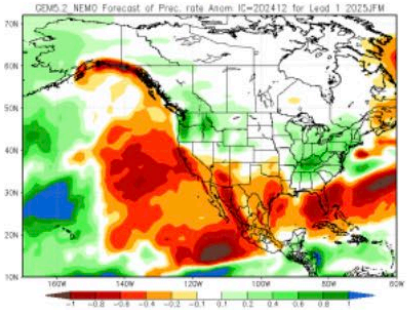
NCEP_CFSv2



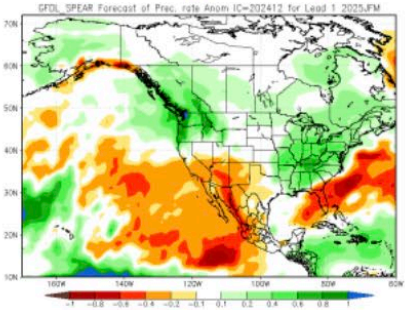
CanESM5



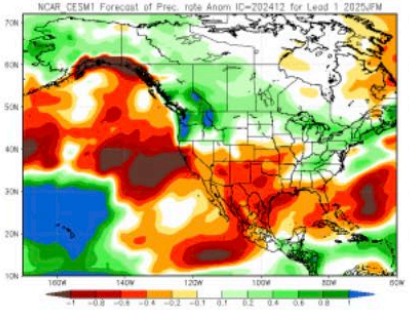
GEM5.2_NEMO



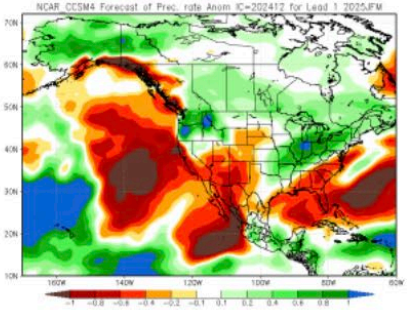
GFDL_SPEAR



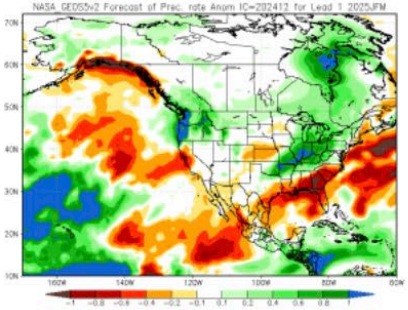
NCAR_CESM1



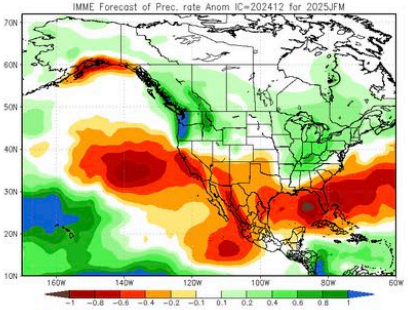
NCAR_CCSM4



NASA_GEOS5v2



IMME



Summary

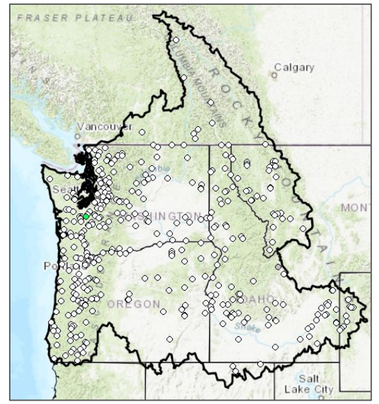
- Water year 2025 temperatures have been near-normal to slightly above normal so far
- Precipitation has been wetter than normal in eastern WA and near-normal to below normal in western WA so far
- Weak La Niña is still more likely to develop than not but other factors may be influencing the seasonal forecasts more
- There is more confidence in the forecast for above normal winter precipitation and more uncertainty about the below normal winter temperatures

NWS

November 2024 Washington Water Supply

Amy Burke, Sr Hydrologist - Northwest River Forecast Center
NWRFC.watersupply@noaa.gov

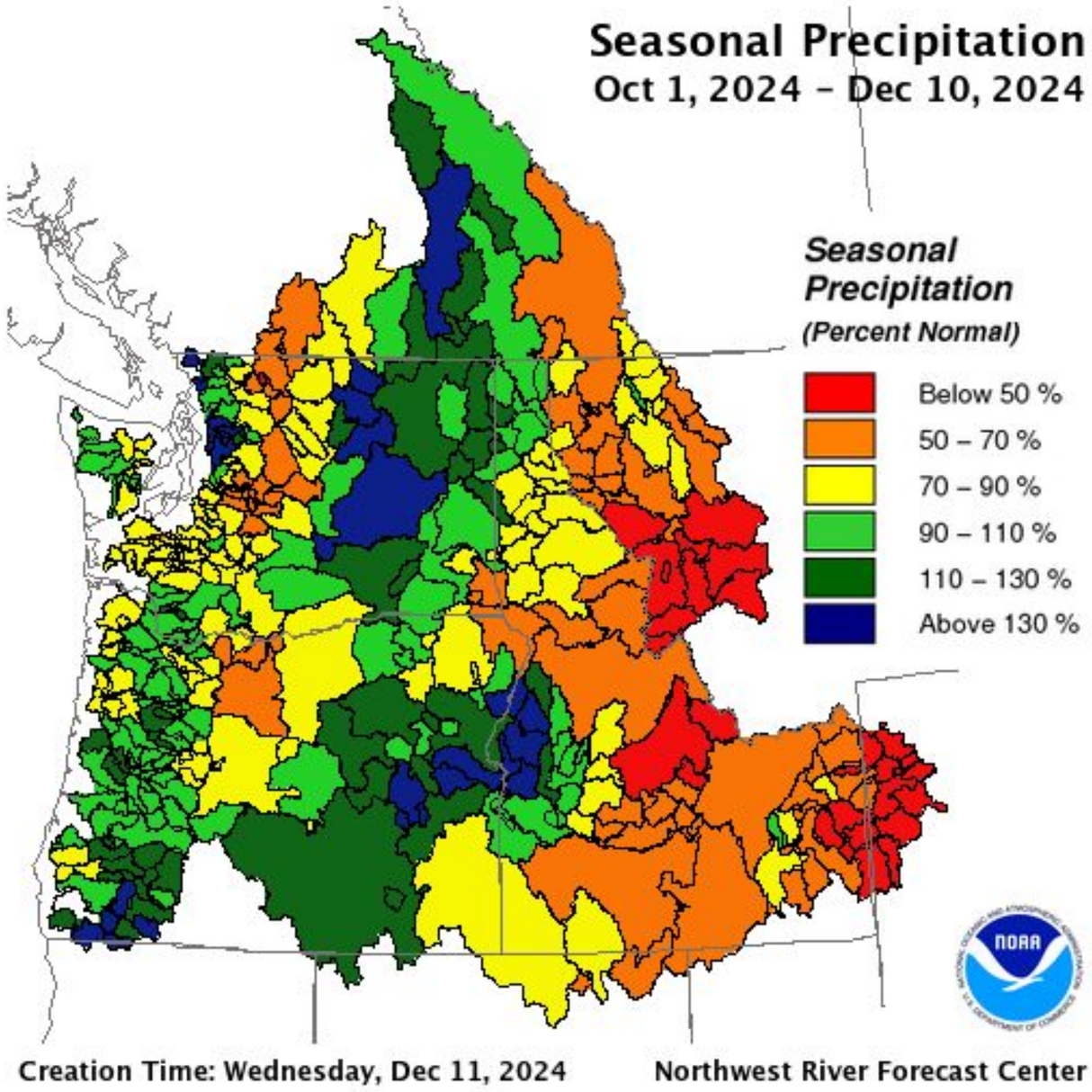
Brent Bower, Sr Service Hydrologist Seattle
Andy Bryant, Sr Service Hydrologist Portland
Robin Fox, Service Hydrologist Spokane
George Perry, Service Hydrologist Pendleton

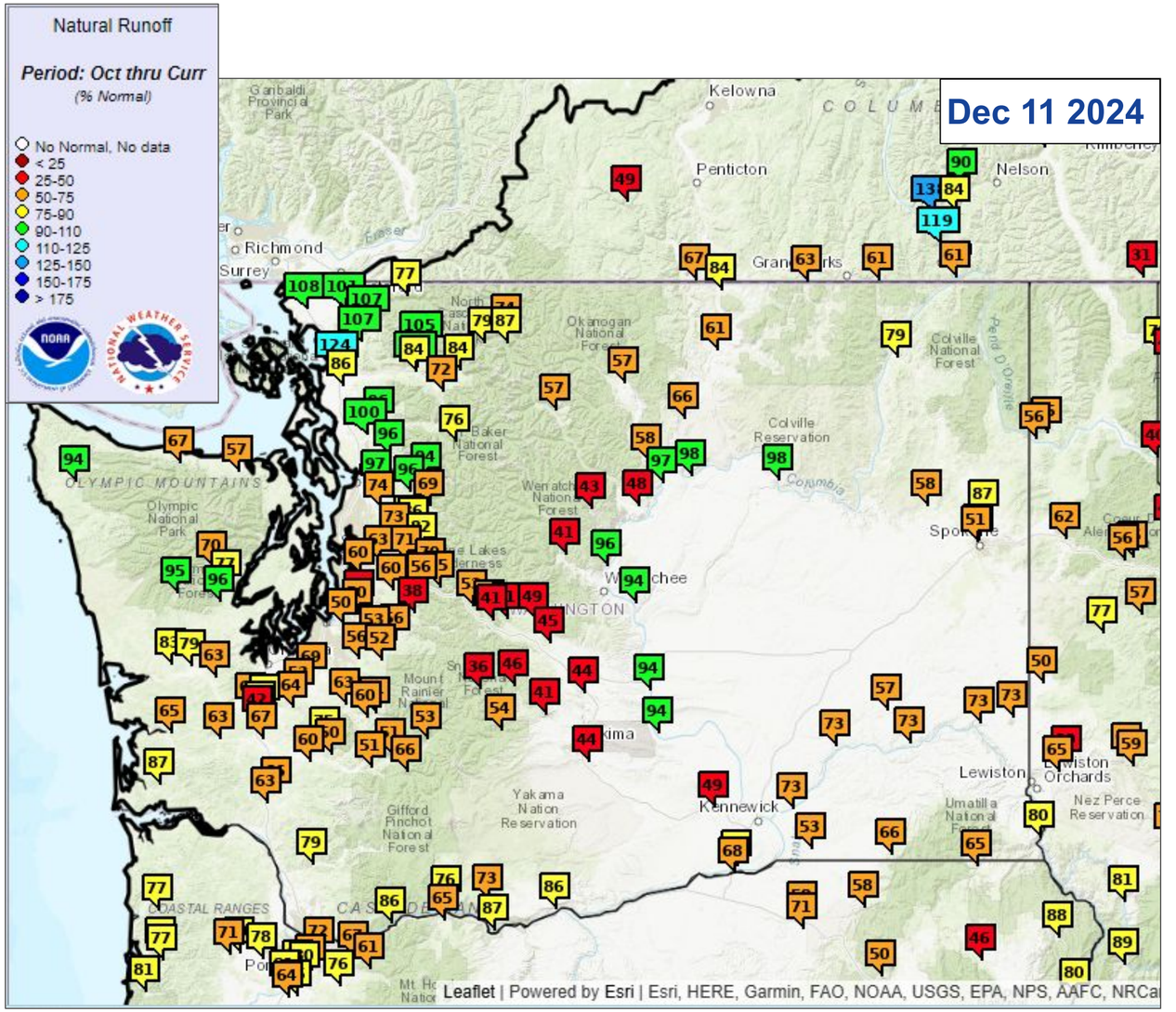


Washington State - Areas of Responsibility

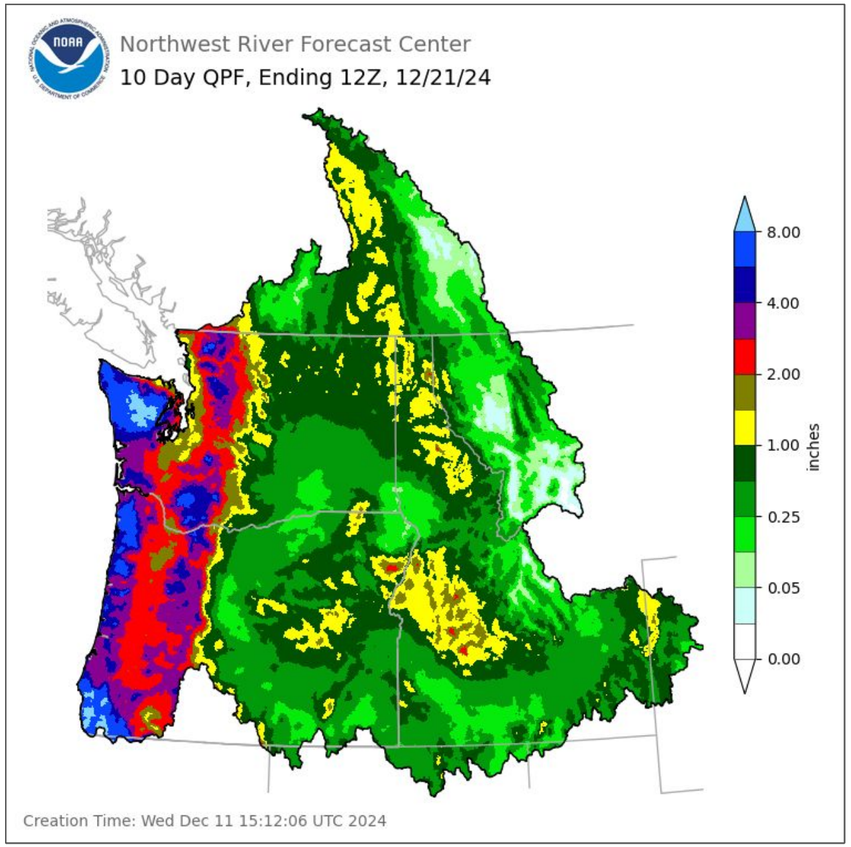
- Northwest Washington - NWS Seattle - nws.seattle@noaa.gov
- Southwest Washington - NWS Portland - nws.portland@noaa.gov
- Northeast Washington - NWS Spokane - nws.spokane@noaa.gov
- Southeast Washington - NWS Pendleton - pdt.operations@noaa.gov

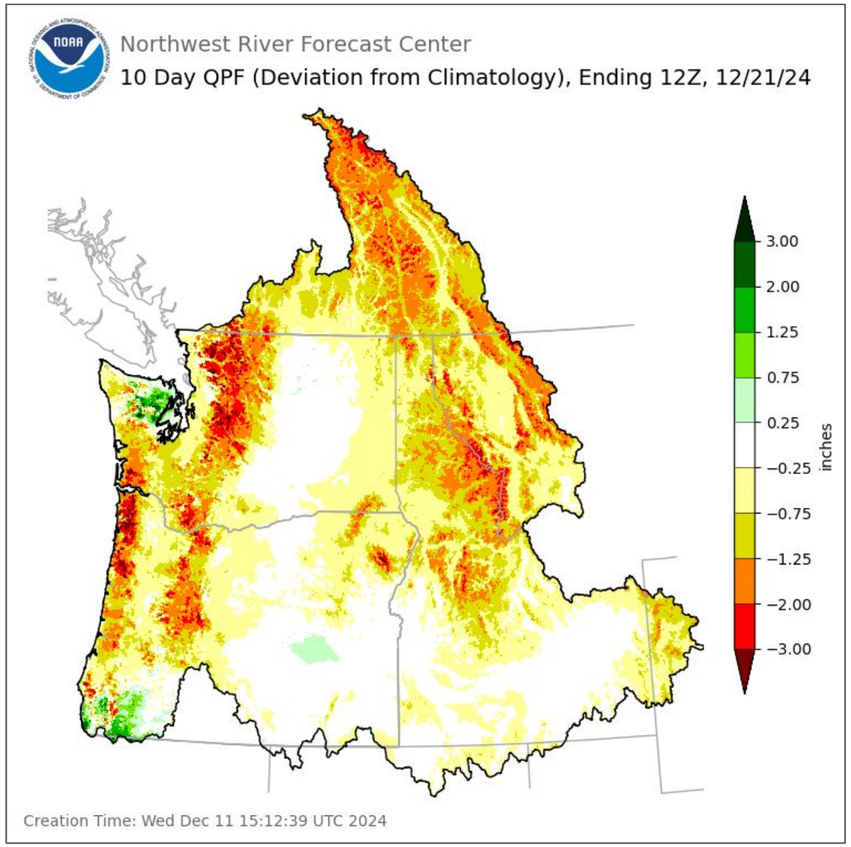
Precipitation and Runoff

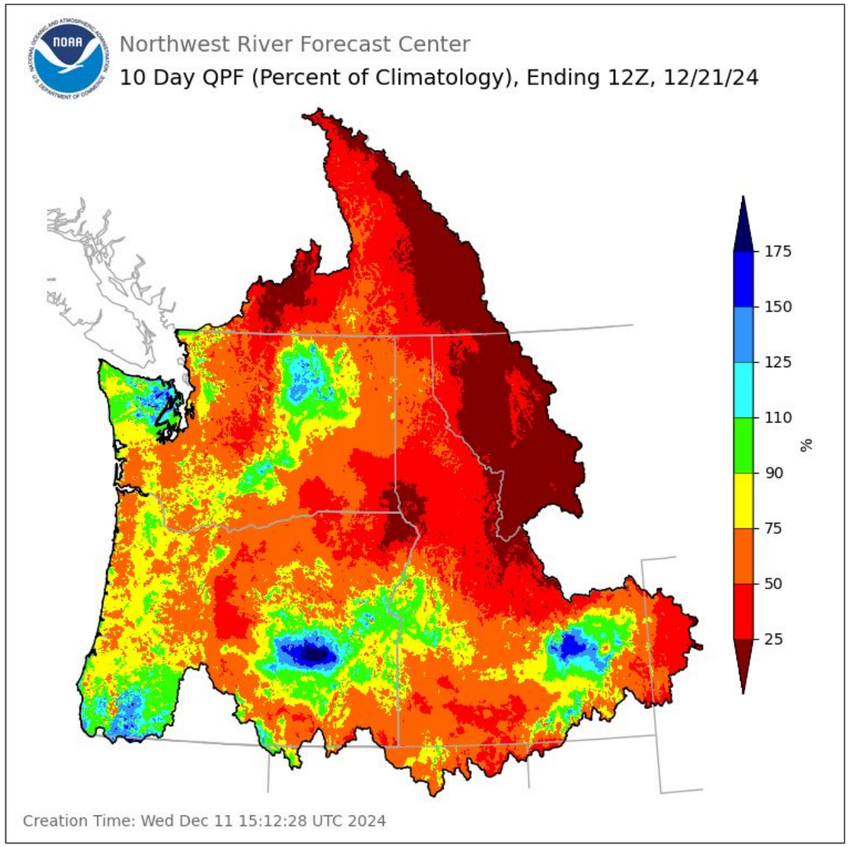




10 Day Precipitation Forecast used in ESP10 Forecasts

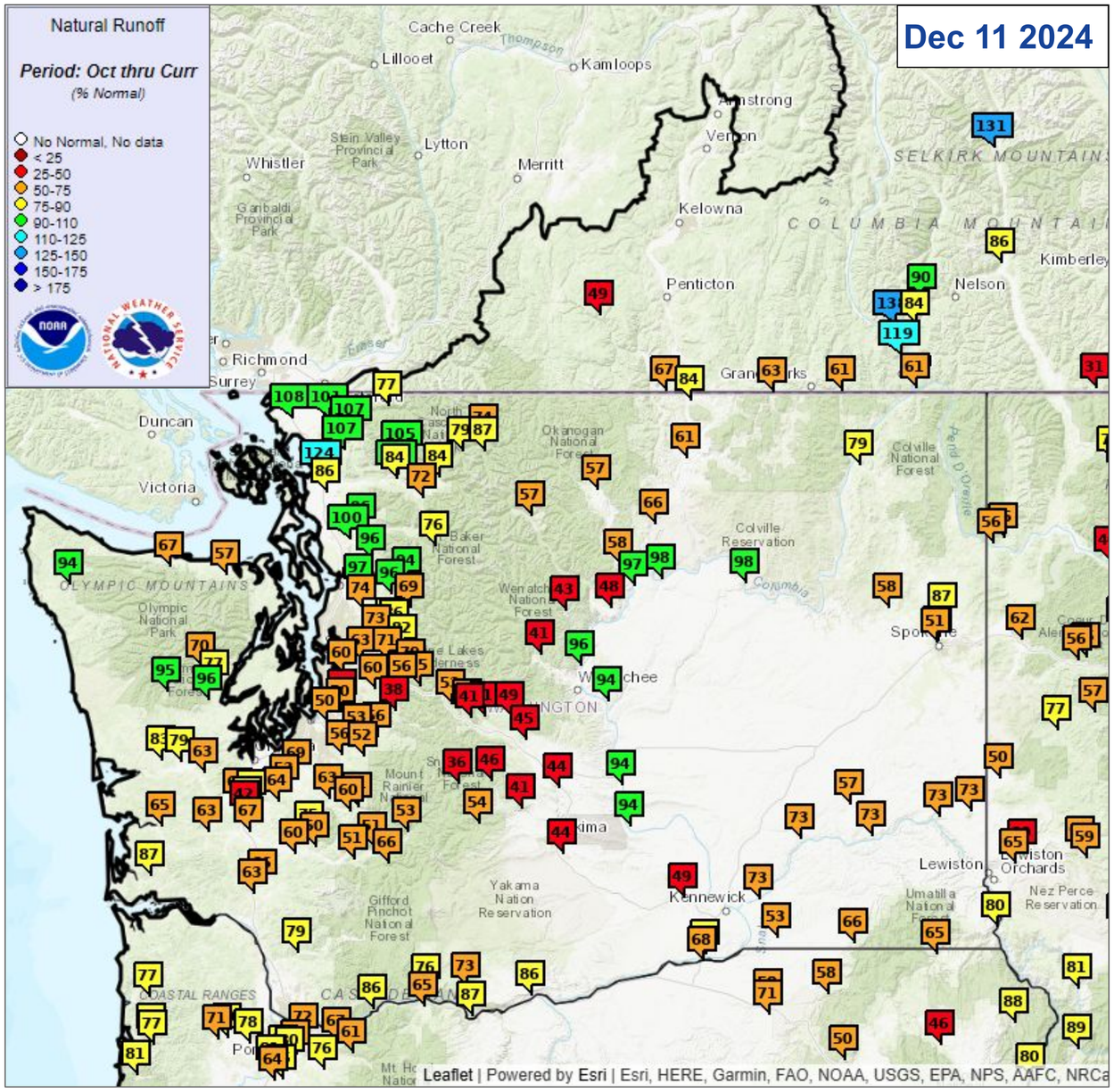


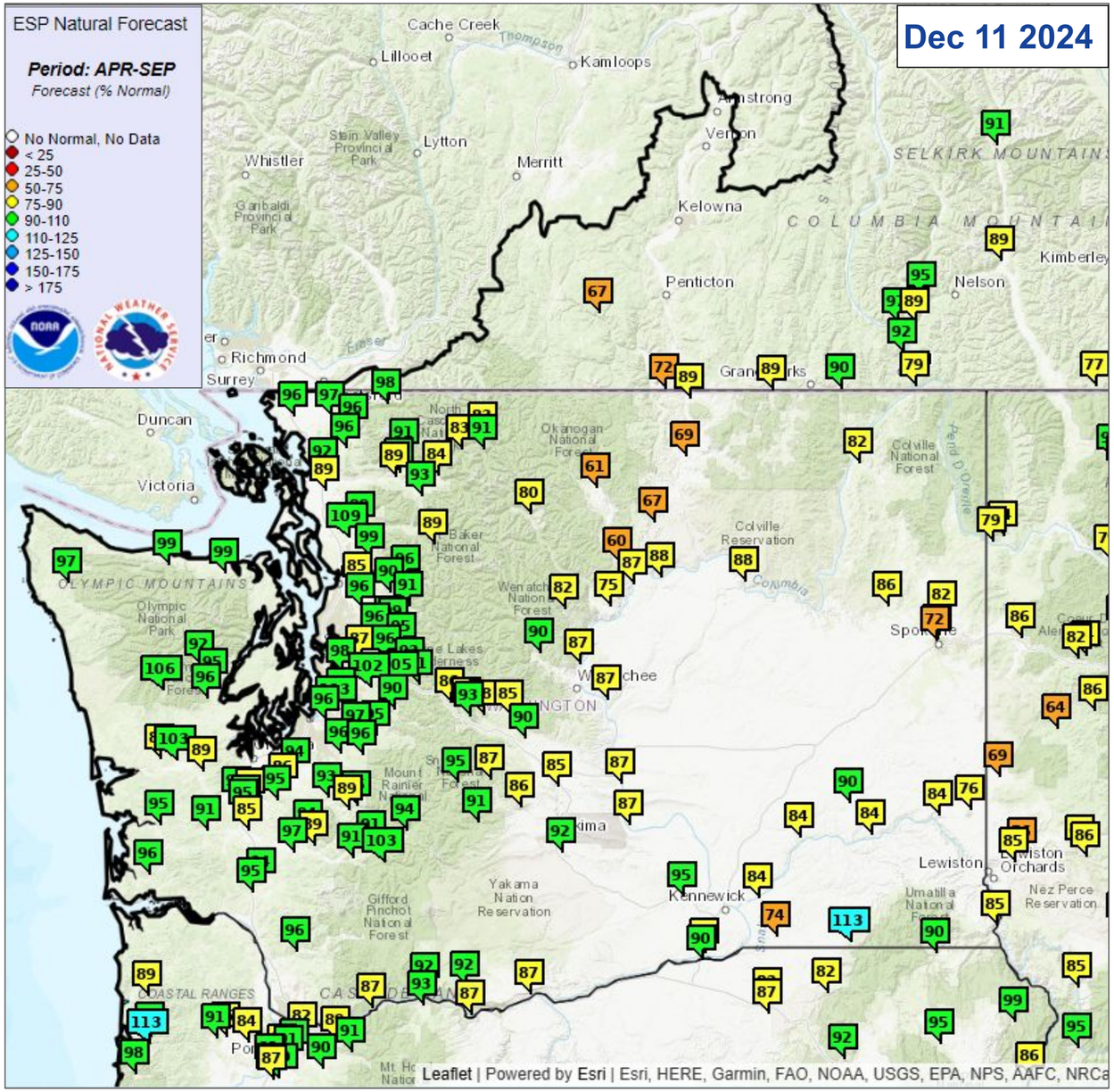




Quantitative Precipitation Forecast (QPF) Sources
Days 1 - 2 NWS Weather Forecast Offices (WFO) in the US, WPC in BC
Days 3 - 7 NWS Weather Prediction Center (WPC)
Days 8 - 10 NWS National Blend of Models (NBM)

WY Runoff and Apr - Sep Forecasts





Takeaways

- Runoff since October 1 has largely been normal to below normal despite several weather systems passing through since November.
- The active weather pattern is expected to continue.

USDA United States Department of Agriculture

Natural Resources Conservation Service

USDA Natural Resources Conservation Service

Snow Survey and Water Supply Forecasting Program

Washington

Water Supply Availability Committee

Dec. 12, 2024

Matt Warbritton
Supervisory Hydrologist
USDA NRCS SSWSF
Portland Data Collection Office
matt.warbritton@usda.gov
503-307-2829

USDA United States Department of Agriculture

Natural Resources Conservation Service

Snowpack Conditions

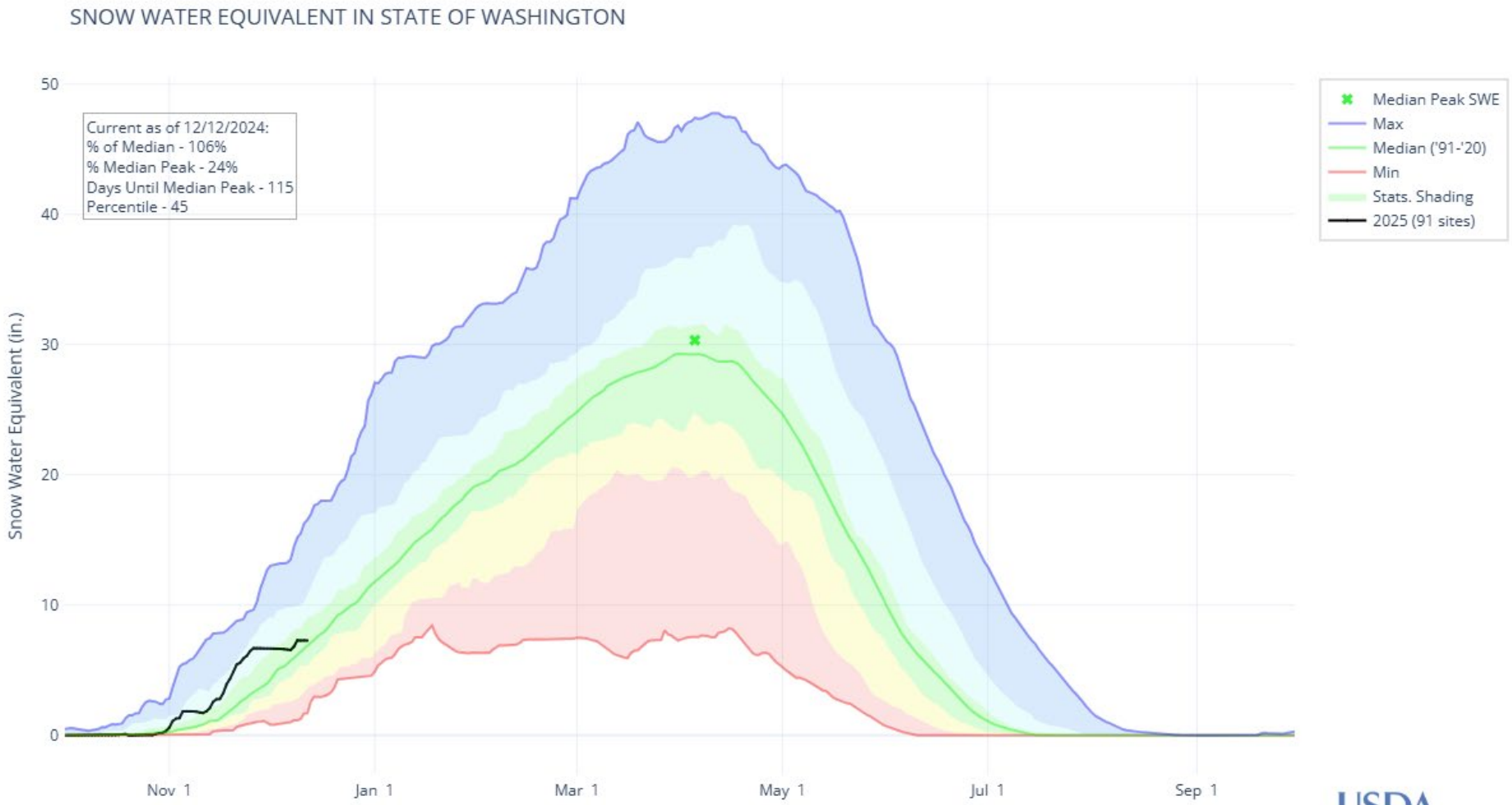
Statewide Snowpack

Profile for Snow Water Equivalent

United States Department of Agriculture
Natural Resources Conservation Service

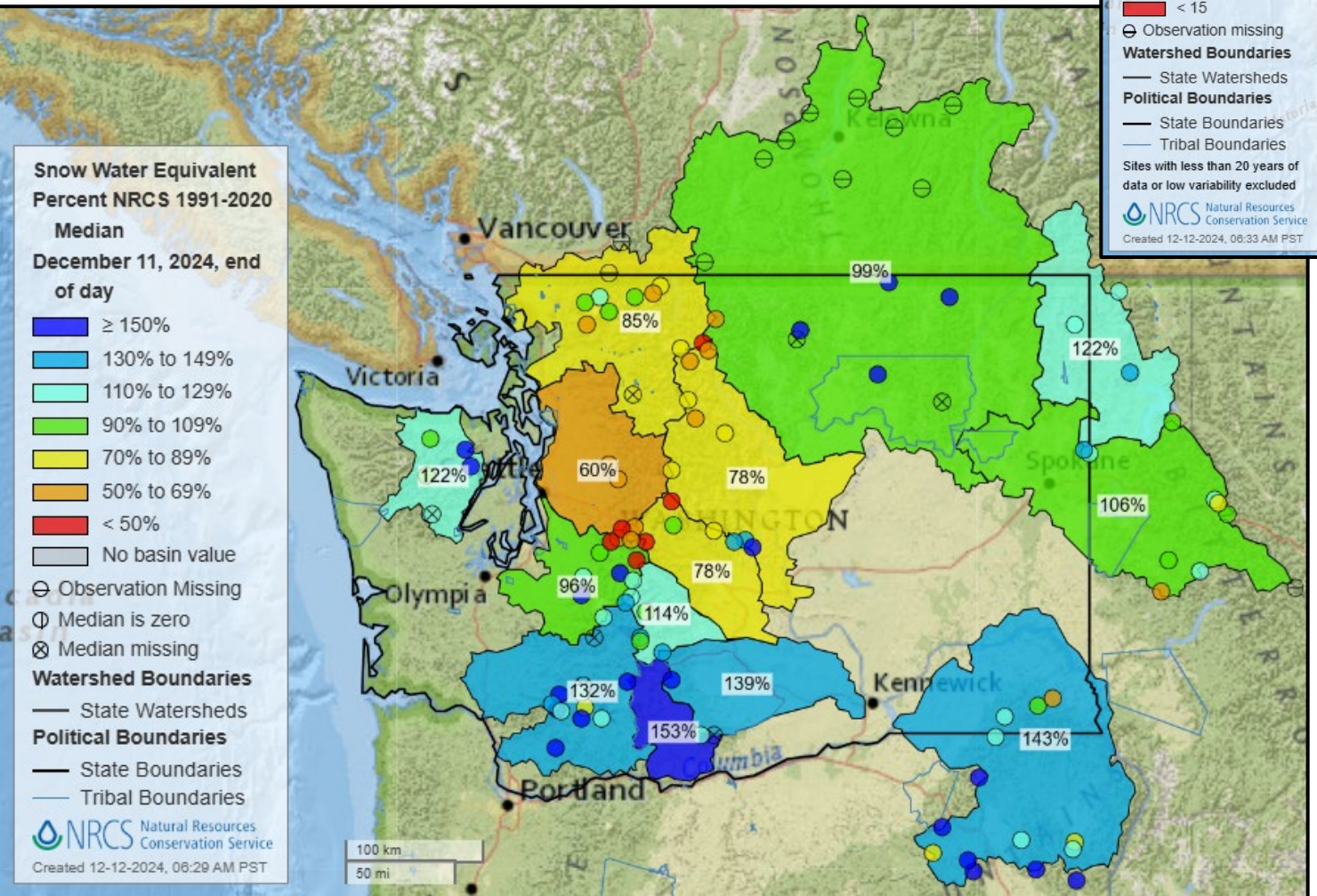
Statewide Snowpack:
106% of Normal
24% of median peak

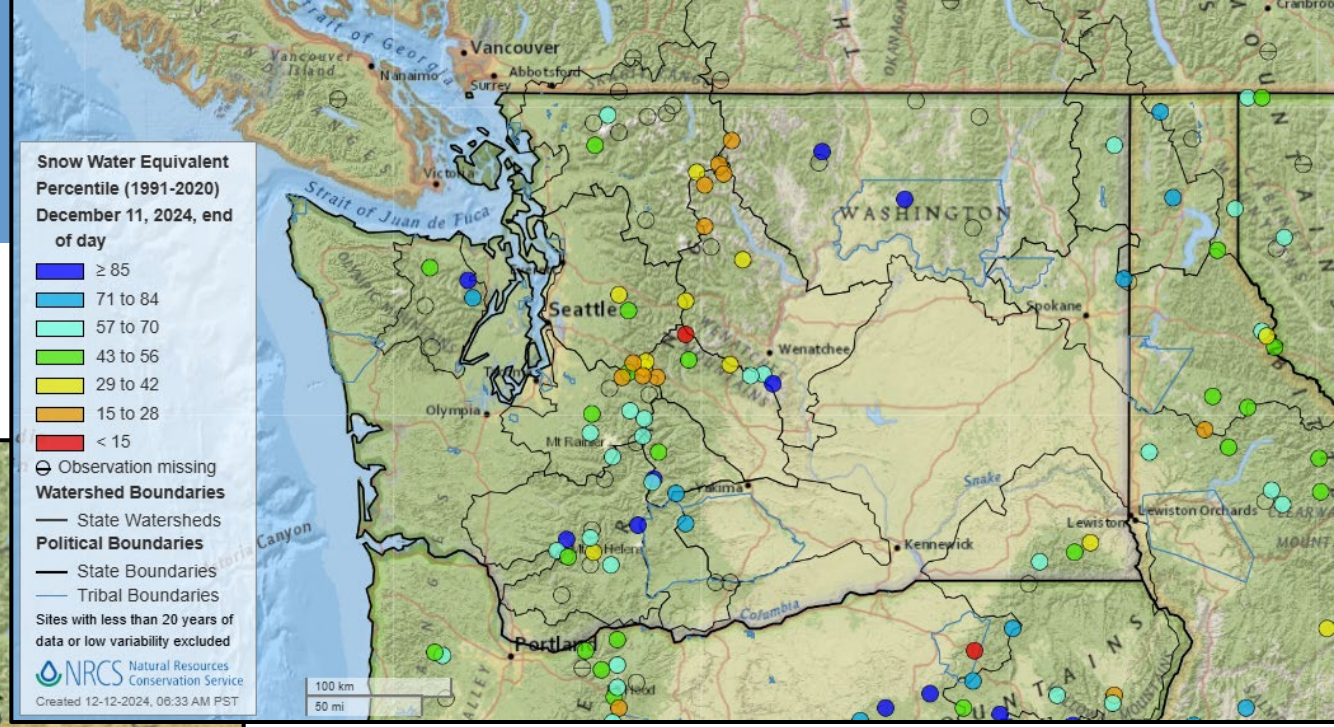
Snowpack Percentile: 45



Basin Snowpack

Sub-basin and site map

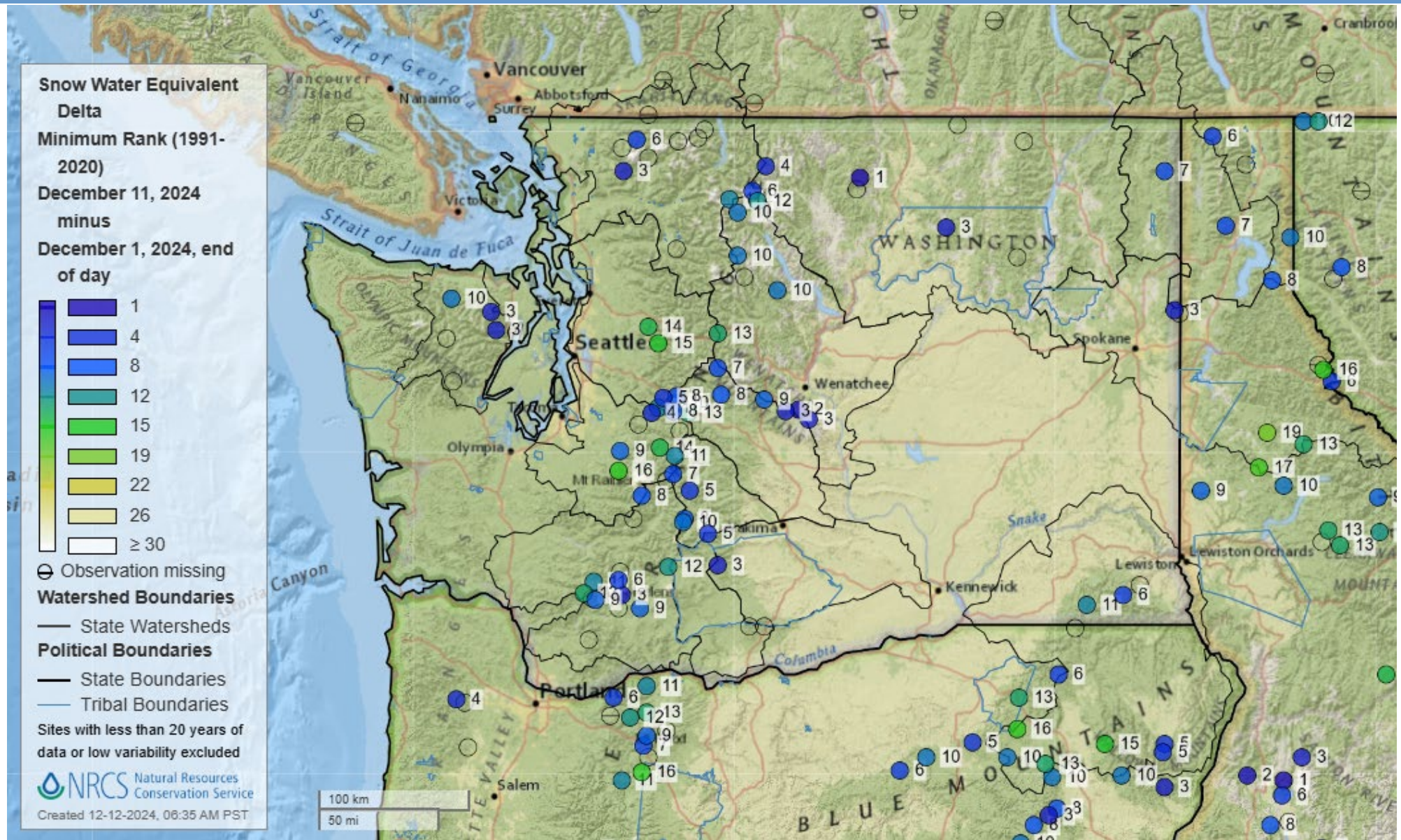




Minimum Ranking – Delta SWE for November

(1991-2020)

United States Department of Agriculture
Natural Resources Conservation Service



USDA United States Department of Agriculture

Natural Resources Conservation Service

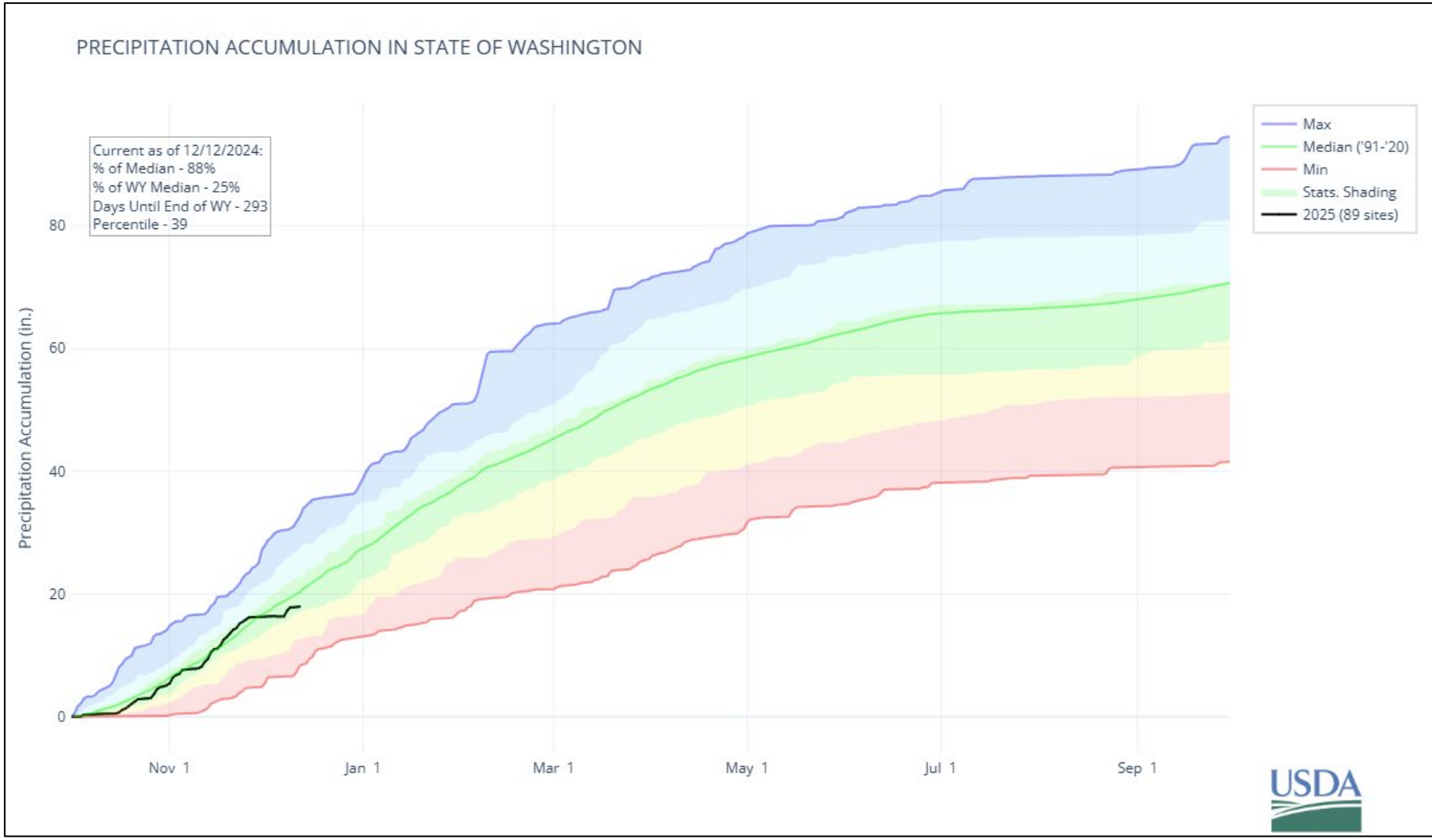
Precipitation Conditions

WYTD Precipitation – Basin Map

USDA United States Department of Agriculture
Natural Resources Conservation Service

Statewide WYTD Precipitation:
86% of normal

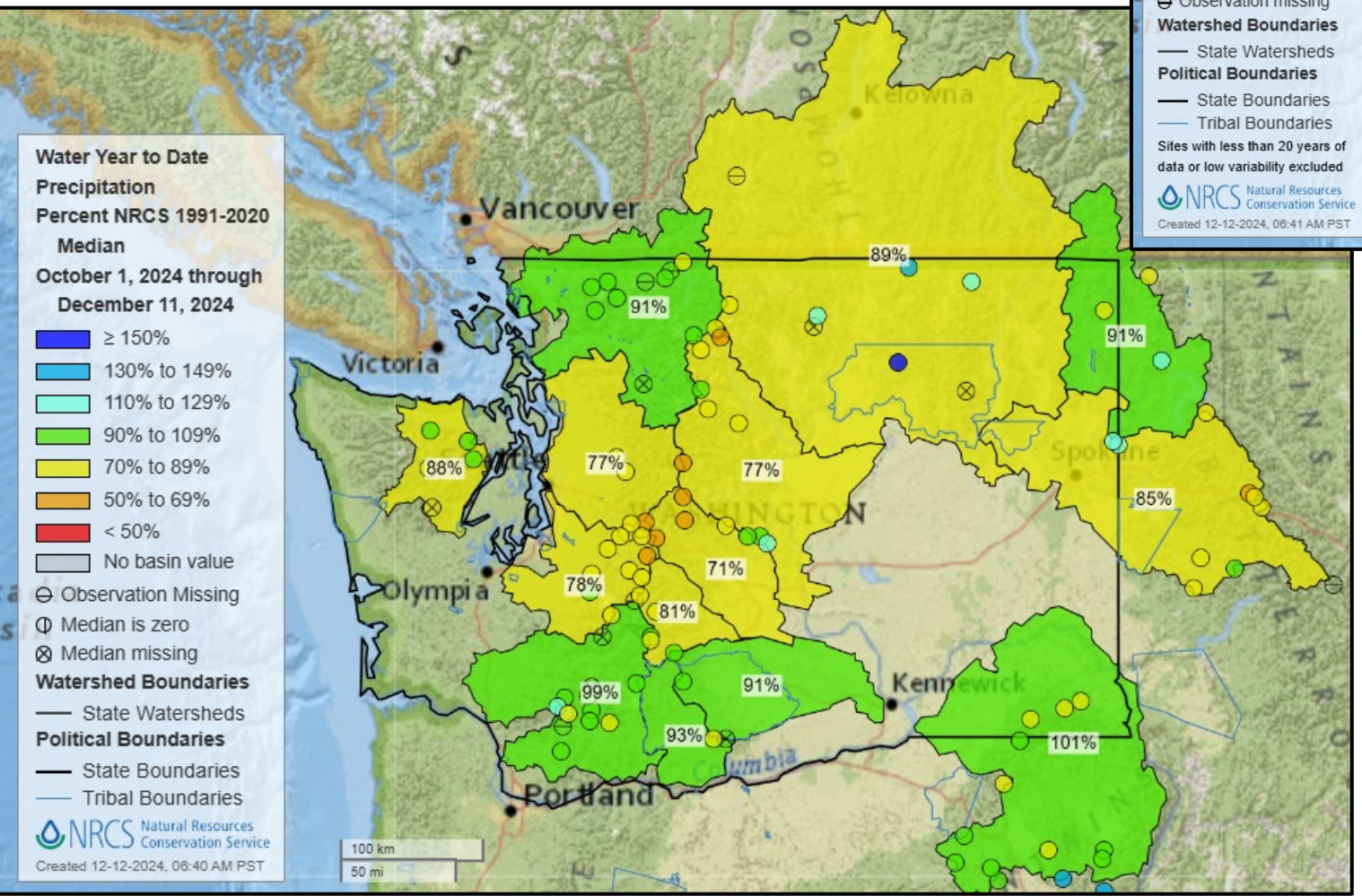
39 – percentile (normal period)



WYTD Precipitation – Site Map

Percent of Normal and Percentile

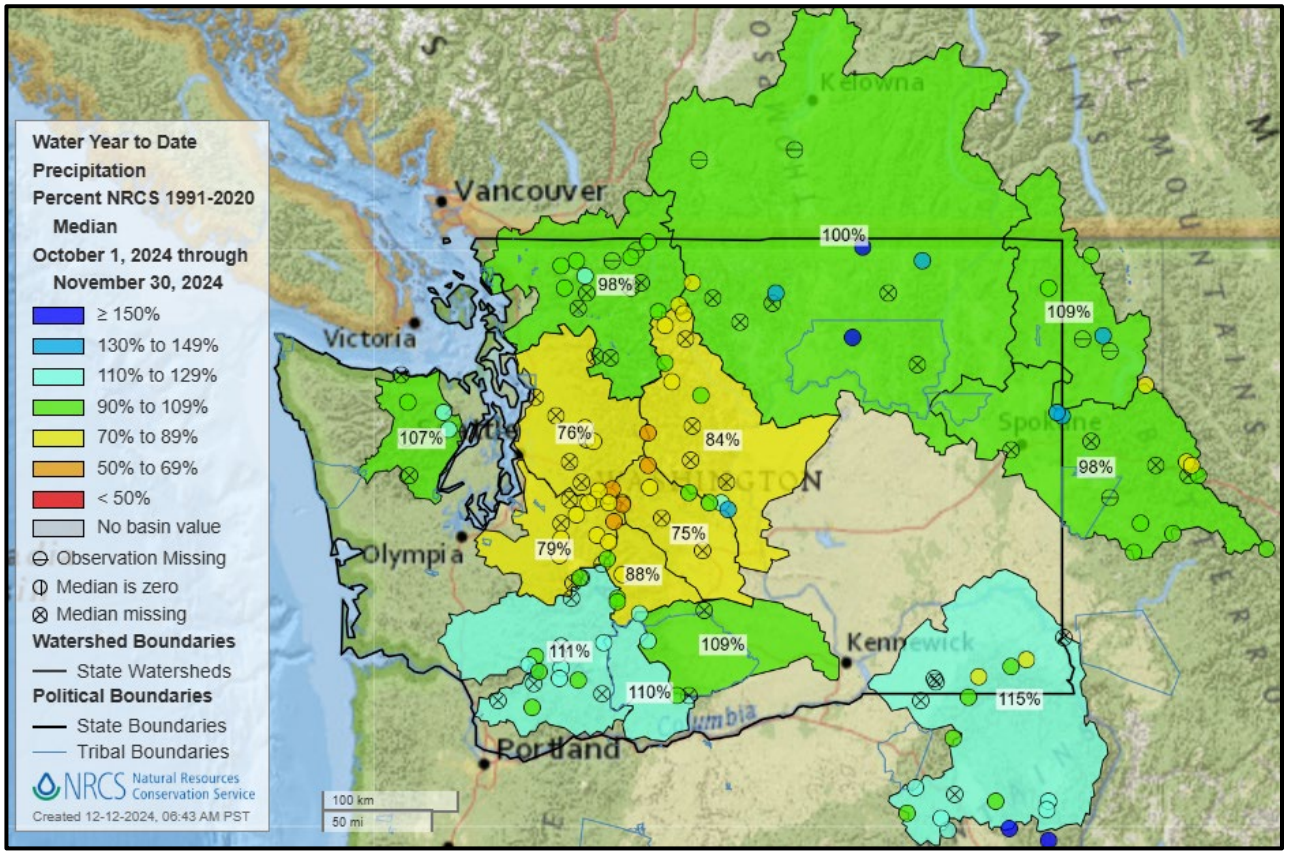
Percent of Normal (1991-2020)



Percentile (1991-2020)

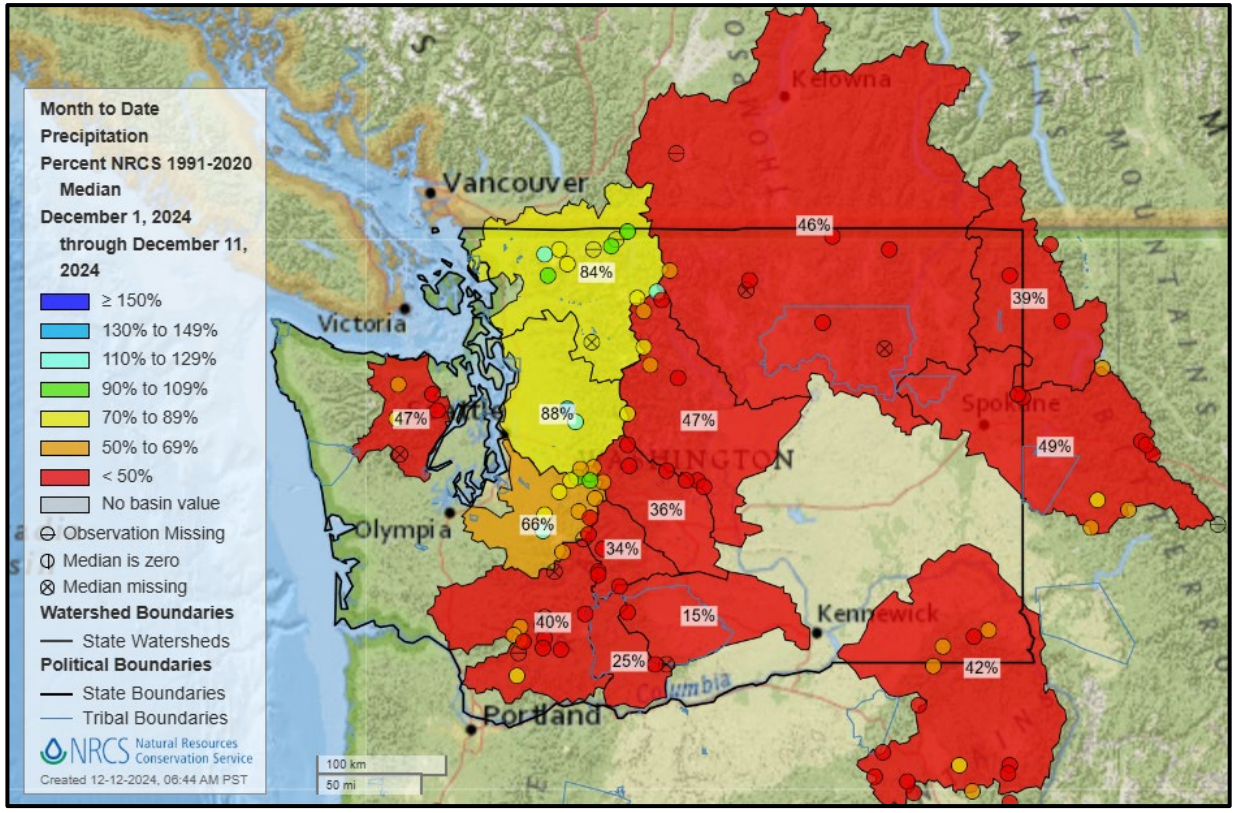
Month-to-Date Precipitation

United States Department of Agriculture
Natural Resources Conservation Service



November

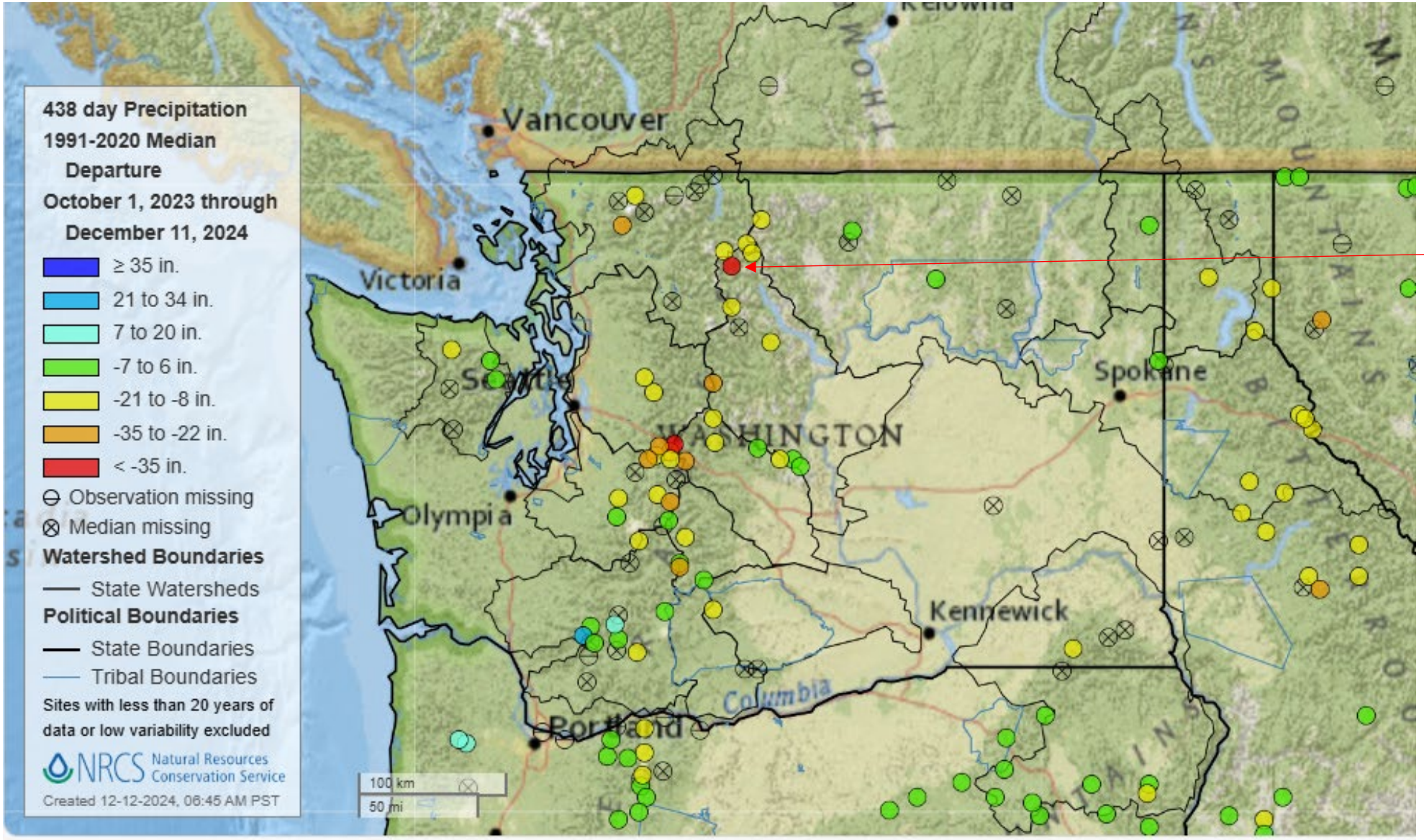
Month-to-date



Precipitation: Compounding Deficits

Oct. 1 2023 - present

USDA United States Department of Agriculture
Natural Resources Conservation Service



Park Creek Ridge
SNOTEL: **-38.4 in**

USDA United States Department of Agriculture

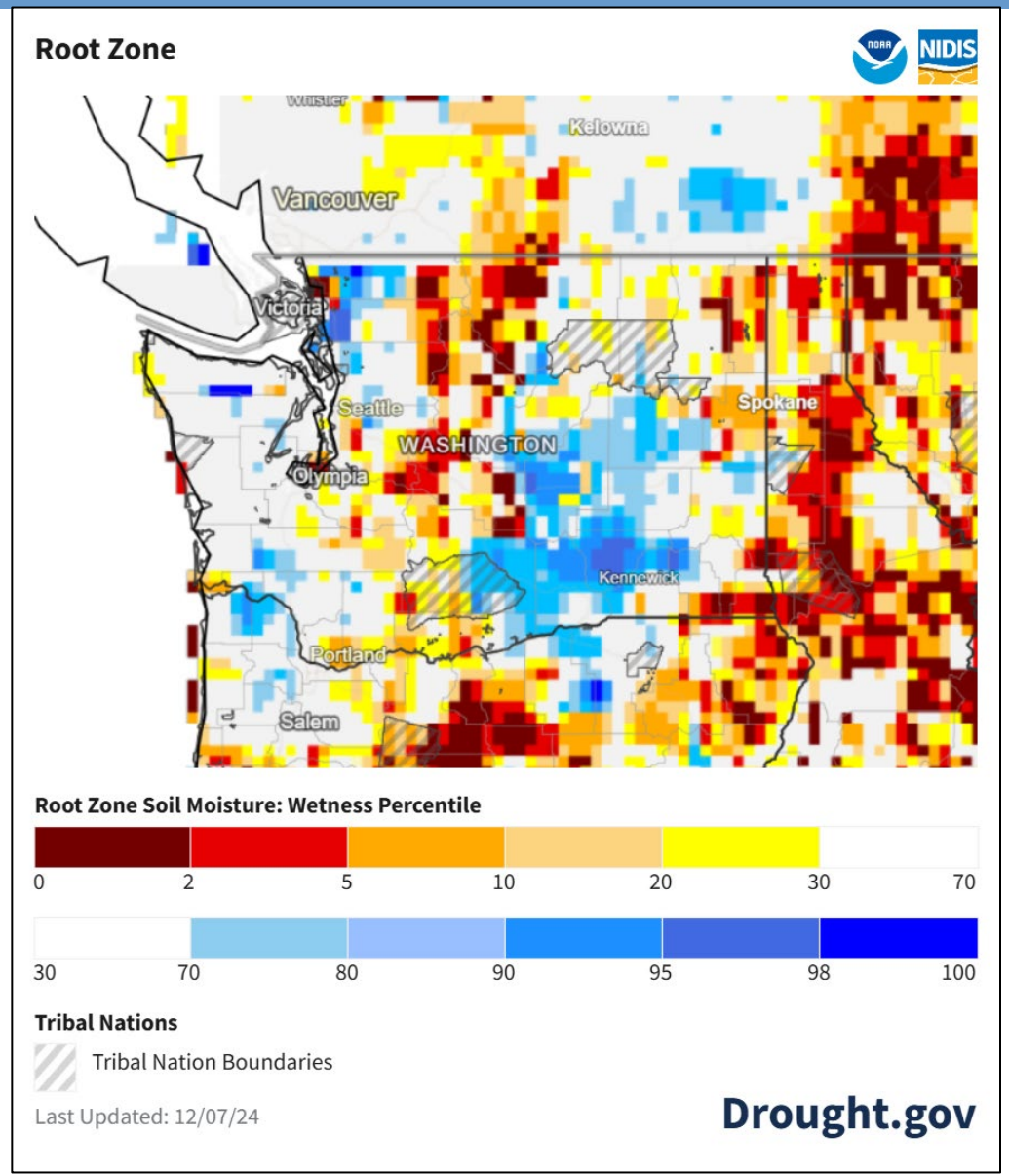
Natural Resources Conservation Service

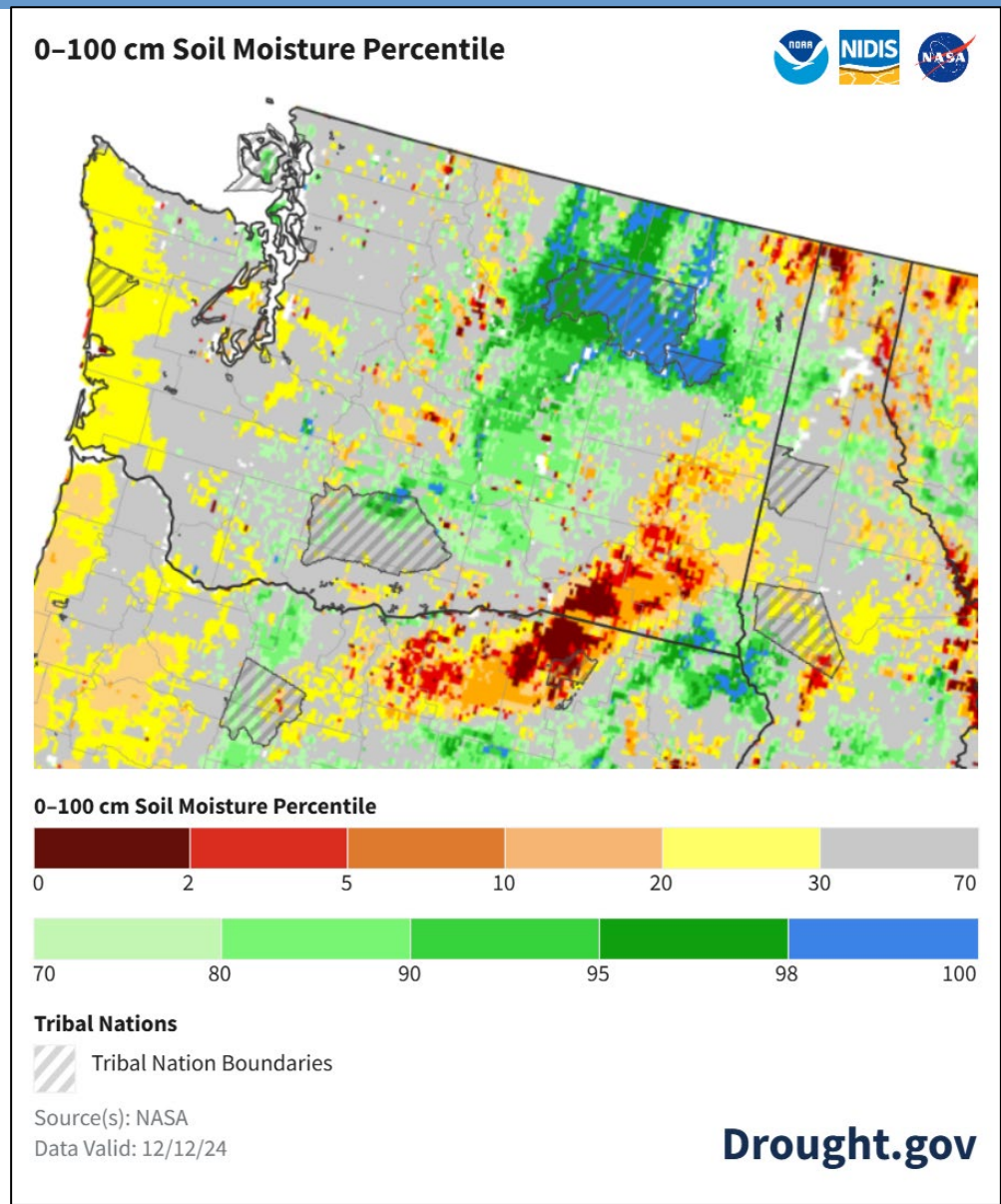
Soil Moisture

Soil Moisture

NASA GRACE and SPoRT-LiS

USDA United States Department of Agriculture
Natural Resources Conservation Service



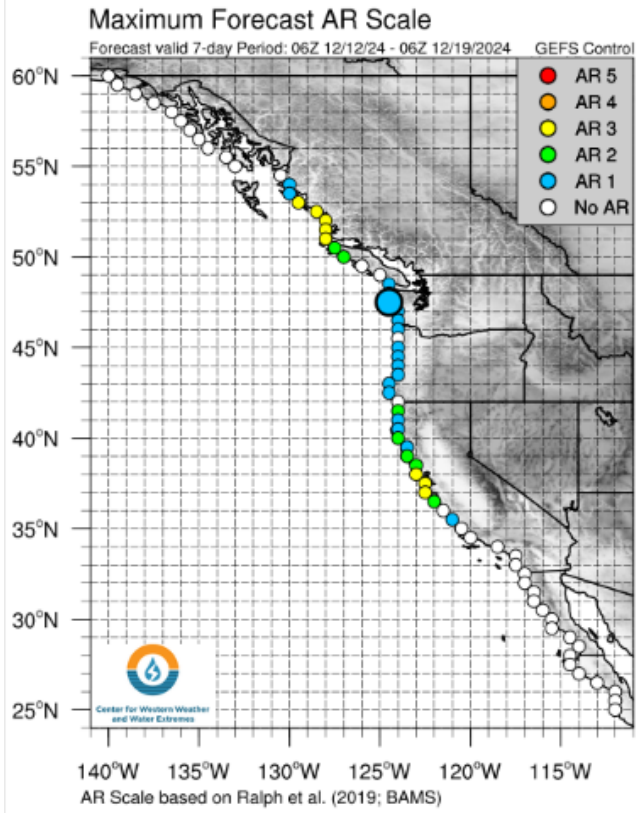


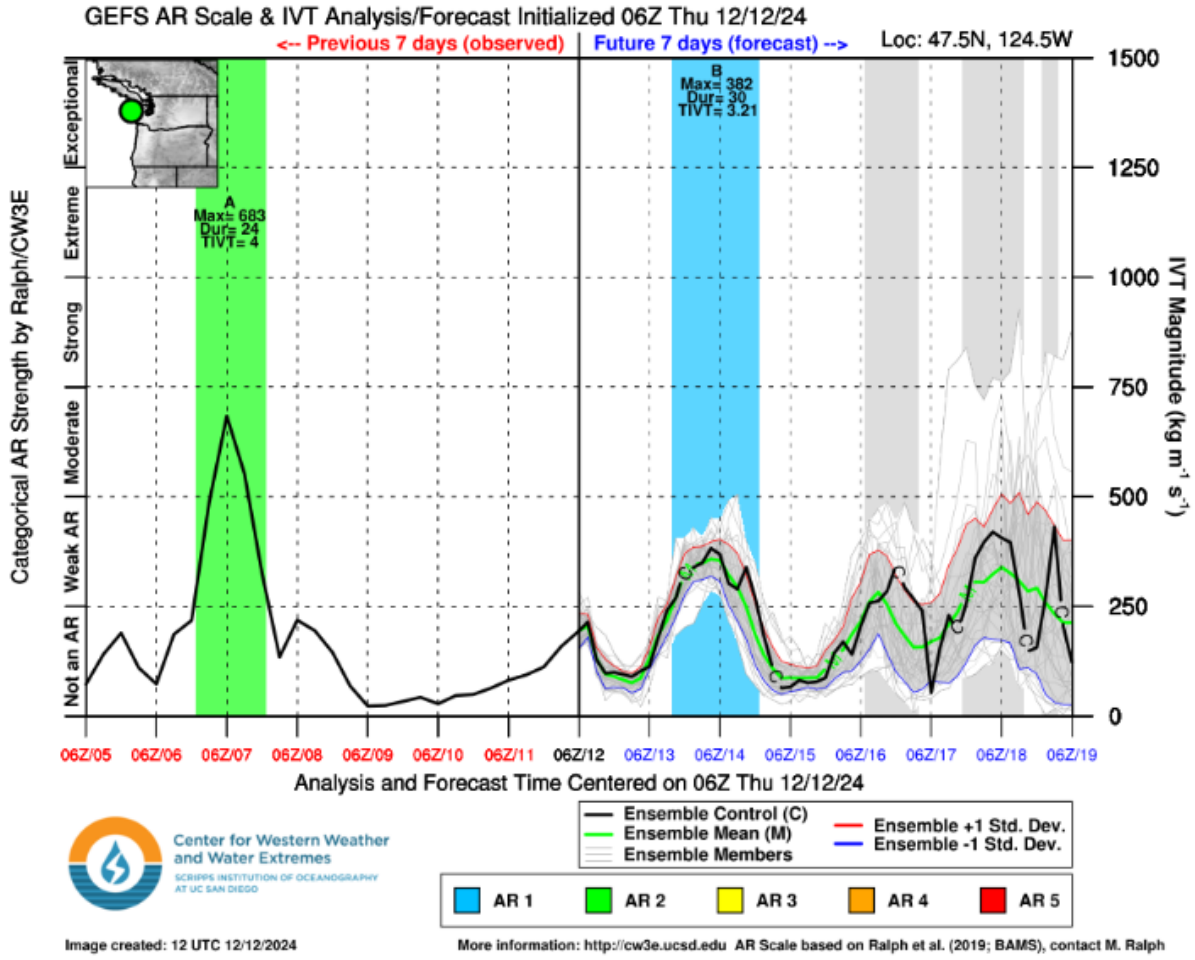
Looking ahead

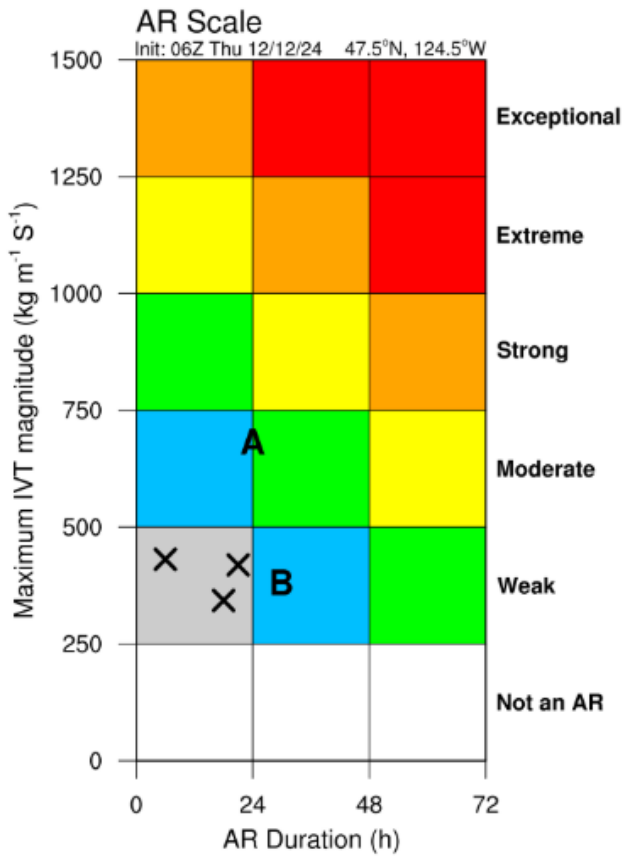
Atmospheric River Forecast

CW3E

United States Department of Agriculture
Natural Resources Conservation Service



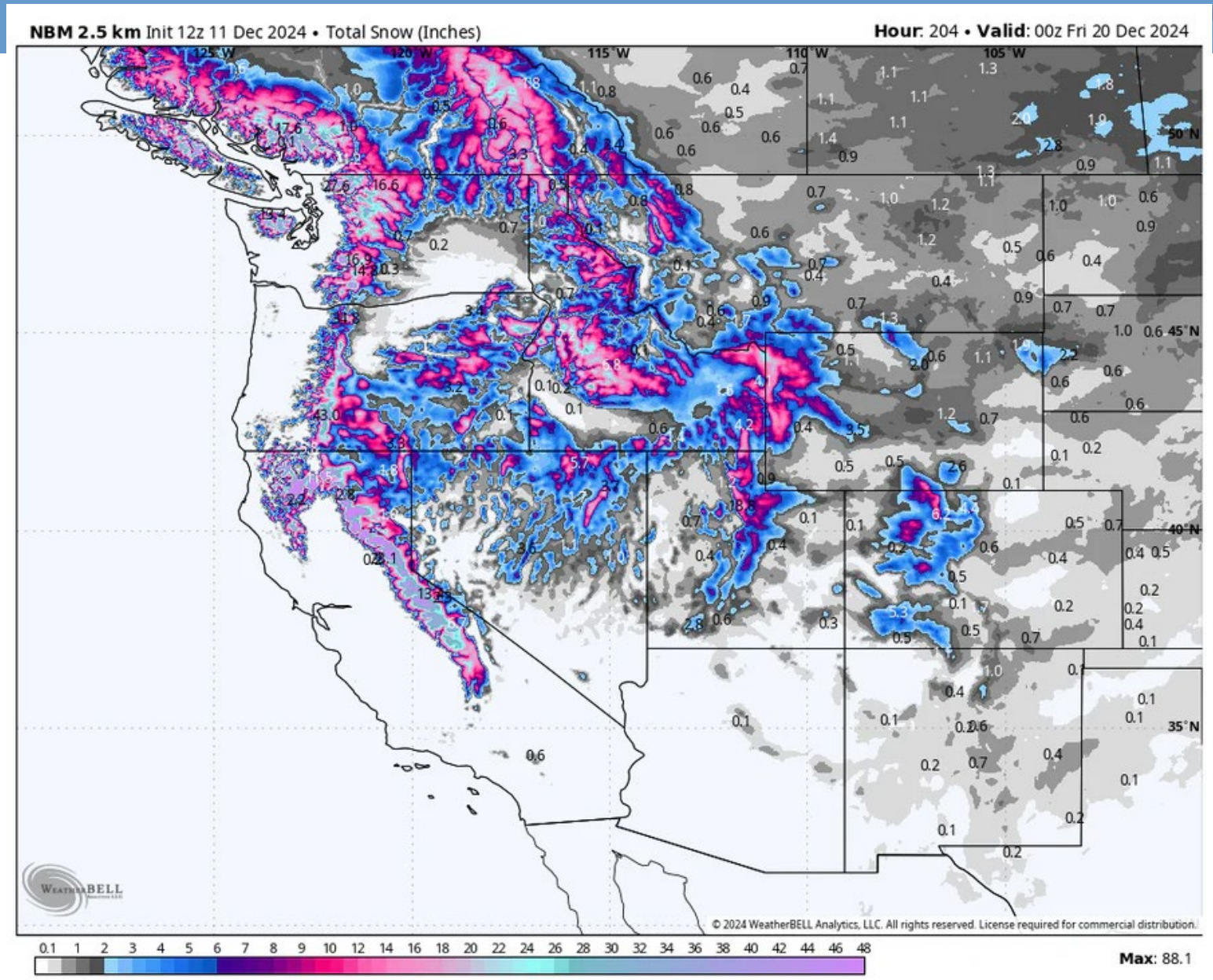




December 11-20 Snow Forecast

CW3E

United States Department of Agriculture
Natural Resources Conservation Service



USDA United States Department of Agriculture

Natural Resources Conservation Service

Thank you!

Matt Warbritton
Supervisory Hydrologist
USDA NRCS SSWSF
Portland Data Collection Office
matt.warbritton@usda.gov
503-307-2829

Washington Snow Survey and Water Supply Program Website