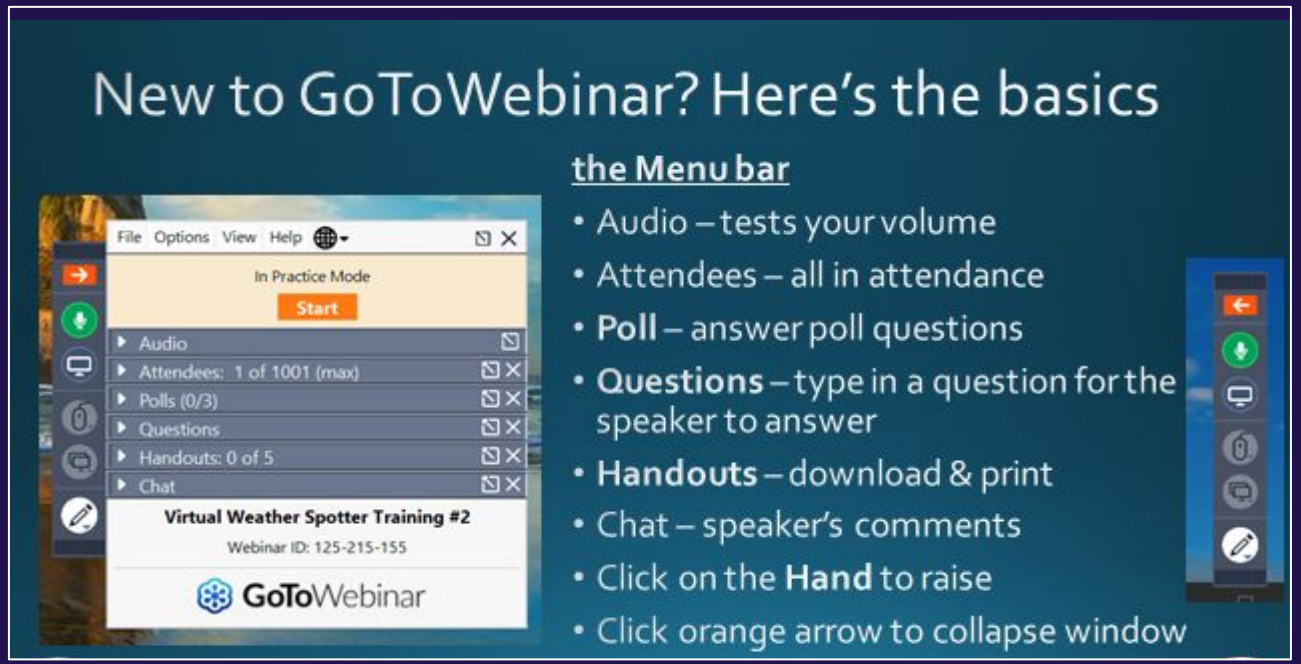
Snow Measurements

Fall 2024
National Weather Service
Spokane, WA

This is a Live Virtual Class

- Voice in Computer - no phone needed - headphones helpful
- All are in listen mode until the end
- There is a phone in option as well!



Objectives

- Understand the importance of the Precipitation Observations
- Learn how to take accurate rain and snow reports
- Learn how to prepare and be safe during hazardous weather
- Receive the Winter Outlook 2024-25

Now let's look back at last year.....

Heavy Snow: January 17, 2024

Heavy Snow
Numerous Accidents
Road Closures & Slowdowns

Use
Rulers!

Sending pictures is even better

December 16, 2022 - Rime Ice

Deposition of ice

NOT precipitation

Ice fog

December 25, 2022: Freezing Rain

Yes, Precipitation!
Rain that freezes

Measure the thickness AND melt down the ice to measure how much water.

Need FLAT ice thickness - windshield
(not radial - tree branch)

To our current Observers....

THANK YOU!

Community Collaborative Rain Hail and Snow Network

- NWS Partner
- Fort Collins, Colorado
- Manages sites all over North America
- Began in WA/ID 2008 - 15 years ago

What is CoCoRaHS?

CoCoRaHS is a national grassroots, non-profit, community-based, high-density precipitation network . . .

. . . made up of volunteers of all ages and backgrounds

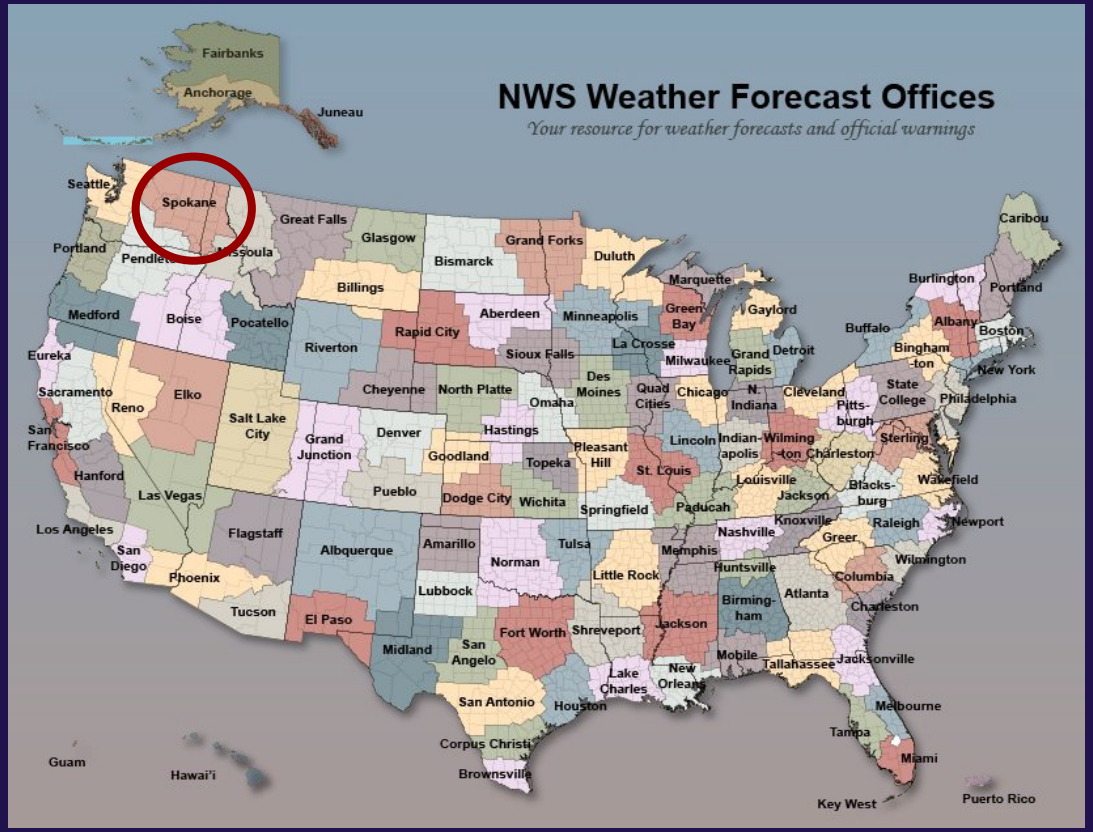
. . . who take daily measurements of precipitation right in their own backyards

National Weather Service (NWS)

- Part of the Federal Government – Dept of Commerce
- Responsible for all weather/water Watches & Warnings
- 126 offices across the country
- Works with local agencies
- Observe & Forecast
- "Behind the Scenes"
- Decision Support
- Preparedness & Education

Issue Weather and Water watches/warnings for the protection of life and property.

NWS Spokane Forecast and Warning Area

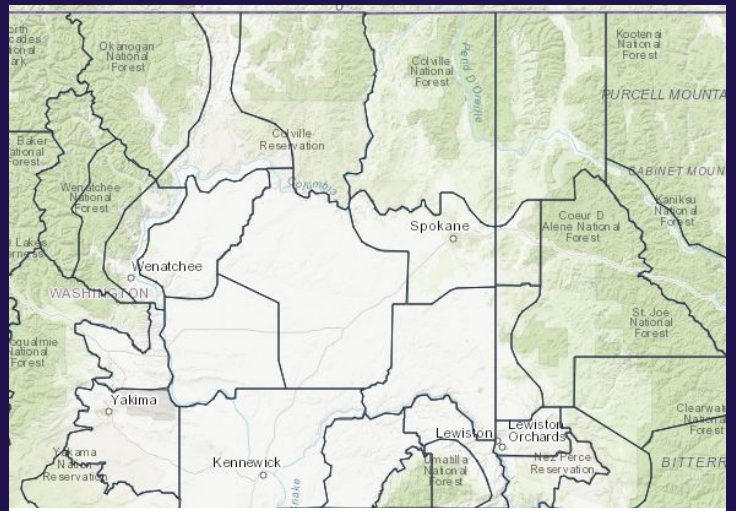


Includes 2 states

- 13 counties in eastern WA
- 8 counties in north Idaho

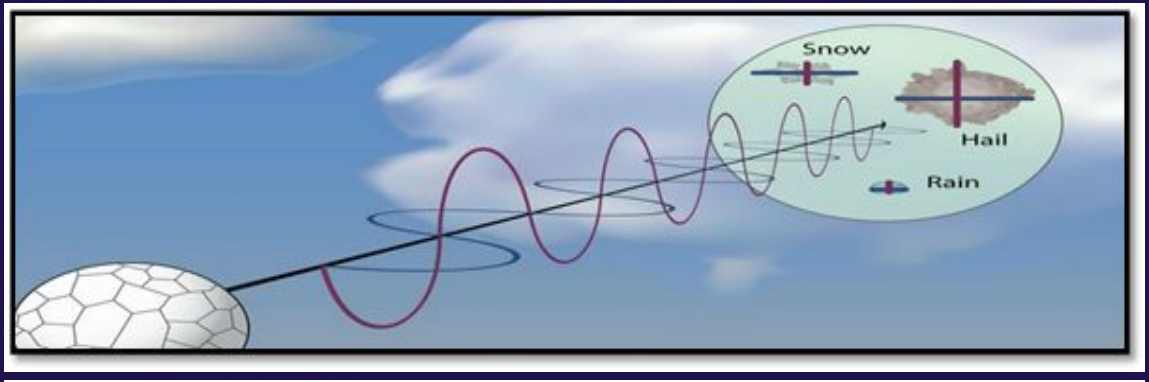
Elevations range

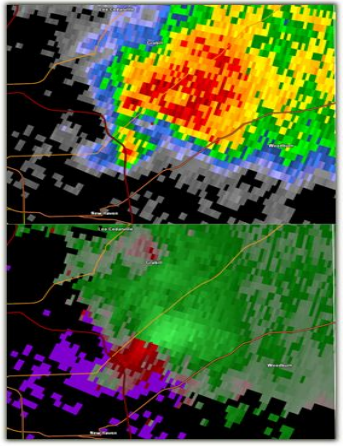
- 9500+ ft in the north Cascades
- 170 ft along the mid Columbia River



Public Forecast Zones

NWS Tools: Doppler Weather Radar



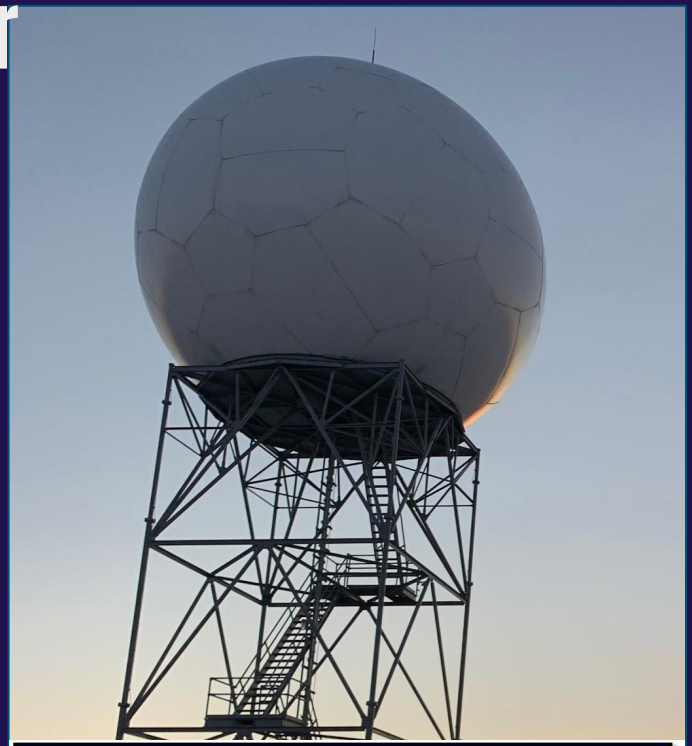


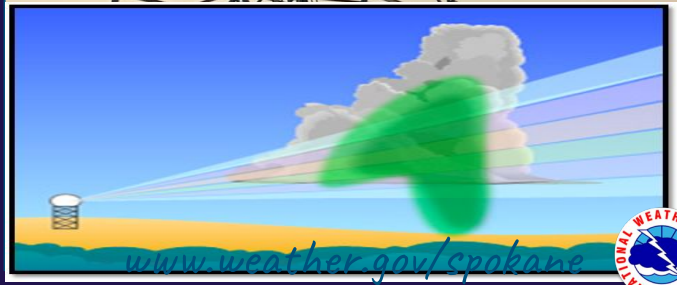
Reflectivity (dBZ)

Small Particles	Big Particles
Light Rain, Dust, Bugs	Hail, Big Rain Drops

Velocity (kts)

- Speed Moving Away from Radar
- Speed Moving Toward Radar





NATIONAL WEATHER SERVICE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION
Spokane, WA

NWS Tools: Weather Balloon - Radiosonde

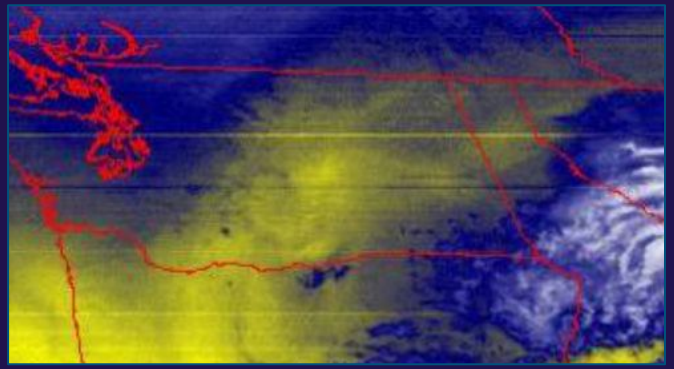
Twice a day - every day
92 Upper Air sites across the U.S.
Flight time ~ 1 hour 45 min

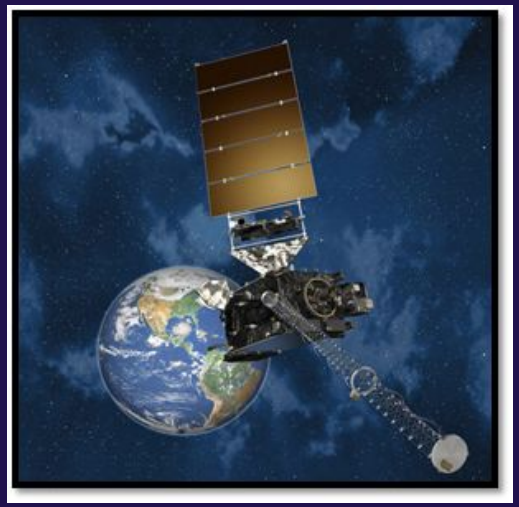
NWS Tools: Weather Satellites

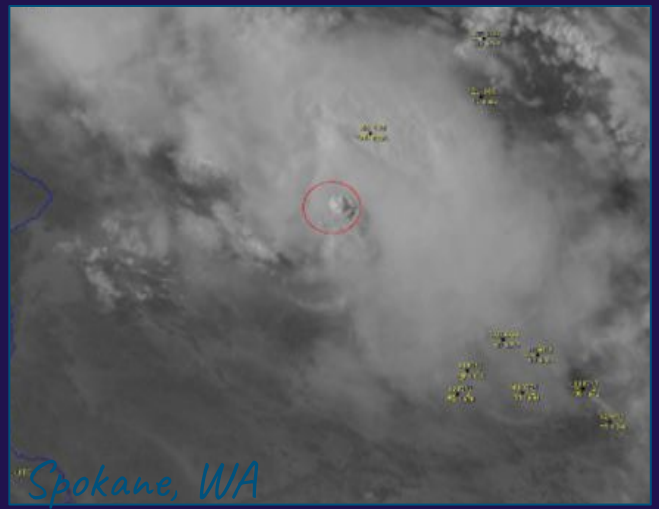
GOES 18 - 16 different channels
- IR, Water Vapor & Visible

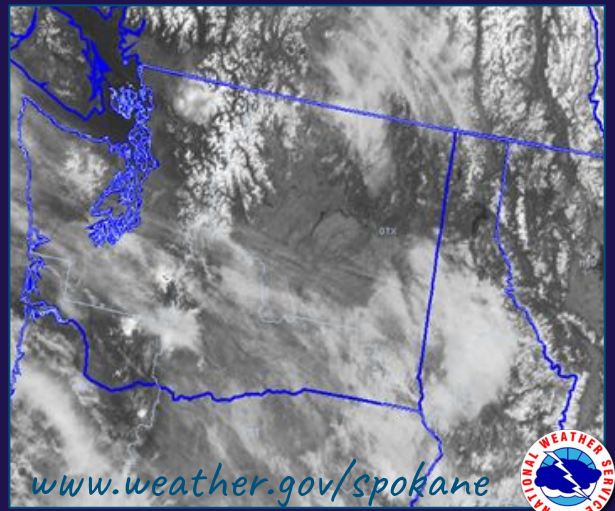
New images every 5 minutes

Aids in early detection
- Thunderstorms & Wildfires



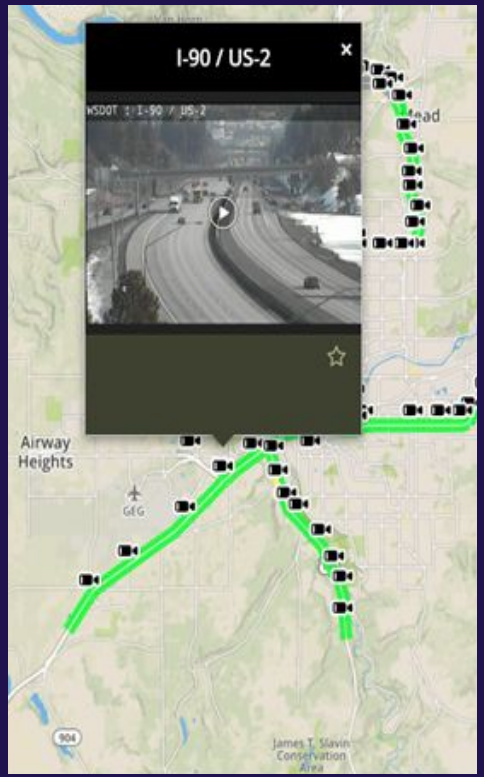


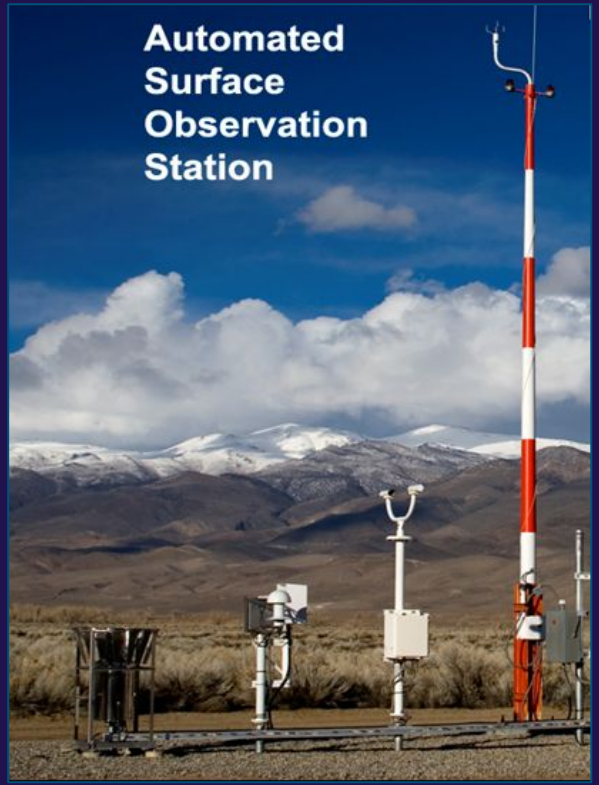


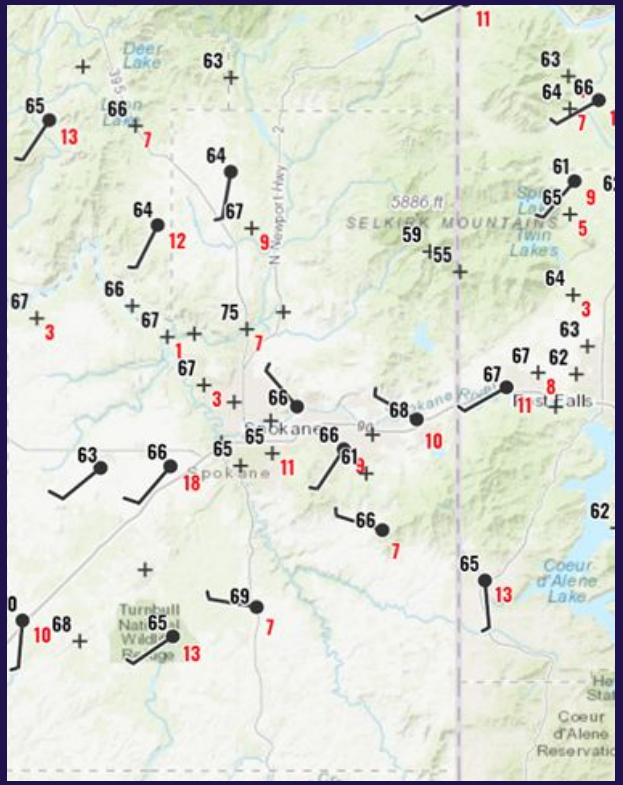


NATIONAL WEATHER SERVICE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION

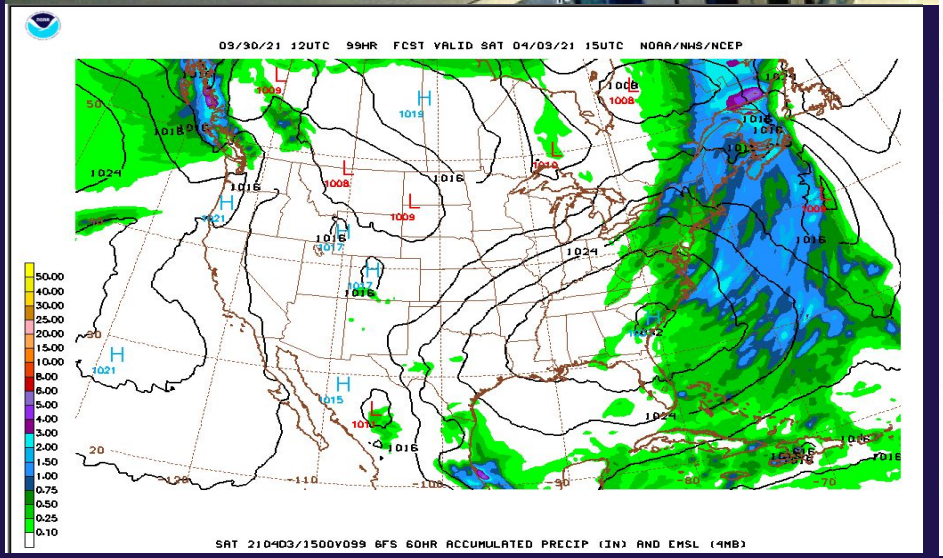
NWS Tools: Surface Observations & Web Cams

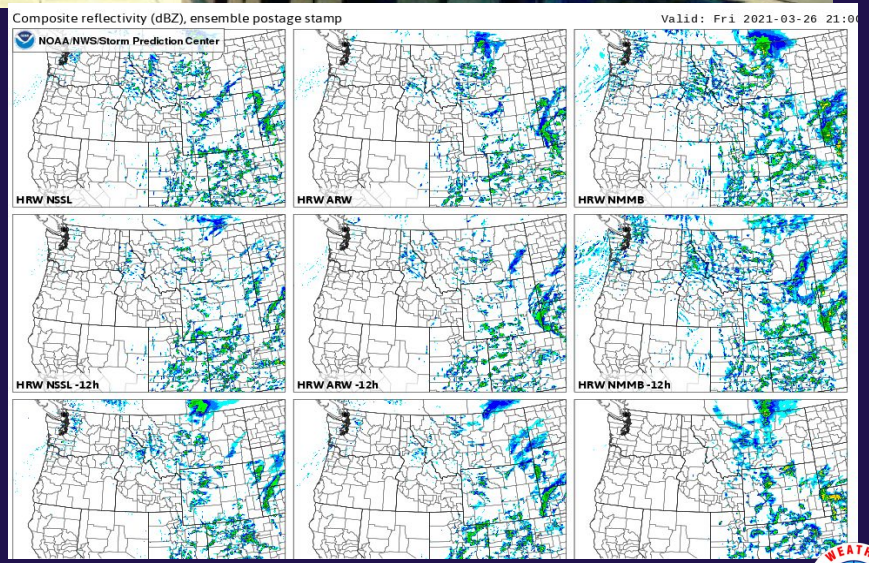




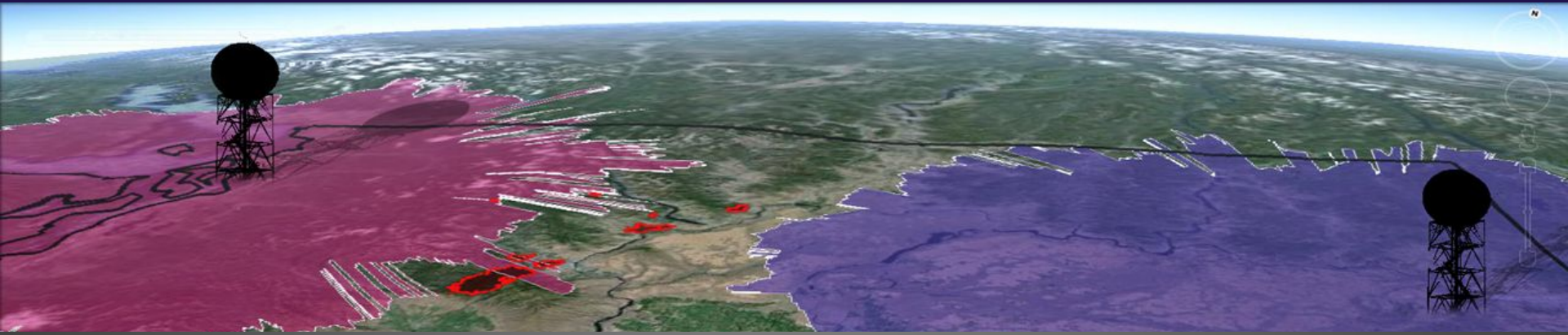


NWS Tools: High Resolution Weather Models



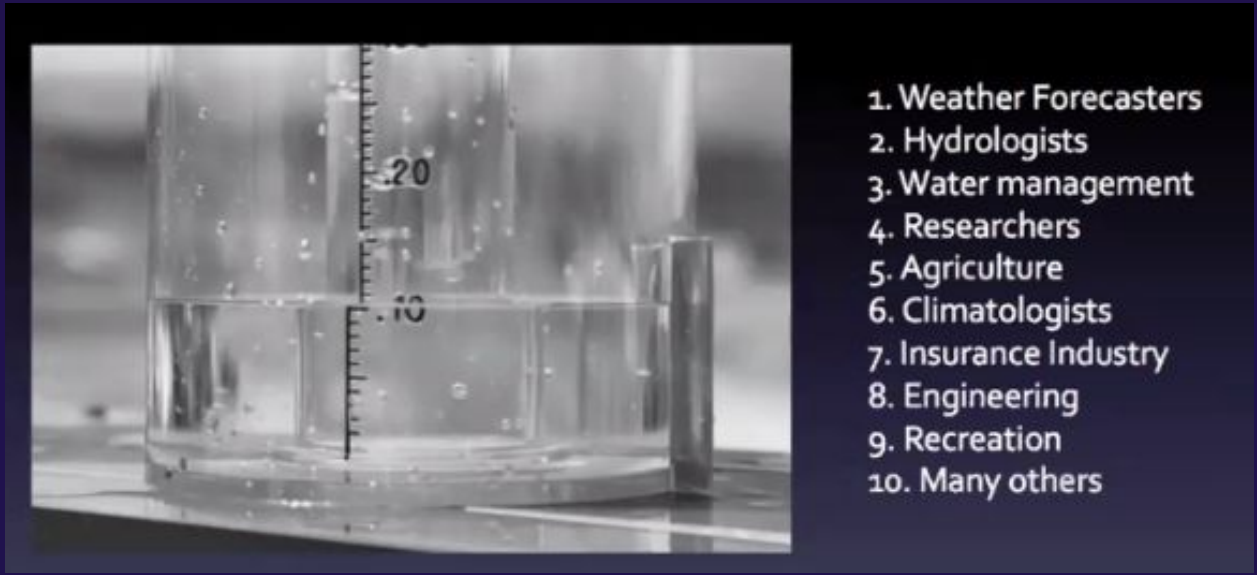


We need observers! Why?



- Limitations to radar, satellite, and surface observations
- Receive Ground Truth on events - SNOWFALL, SNOW DEPTH
- Fill in the “holes” not seen by observations
- Understand the many micro-climates in the region
- Maximize Warning effectiveness and Lead Times
- Add Credibility to NWS Warnings - Leads to Public Action!

Who else uses CoCoRaHS observations?

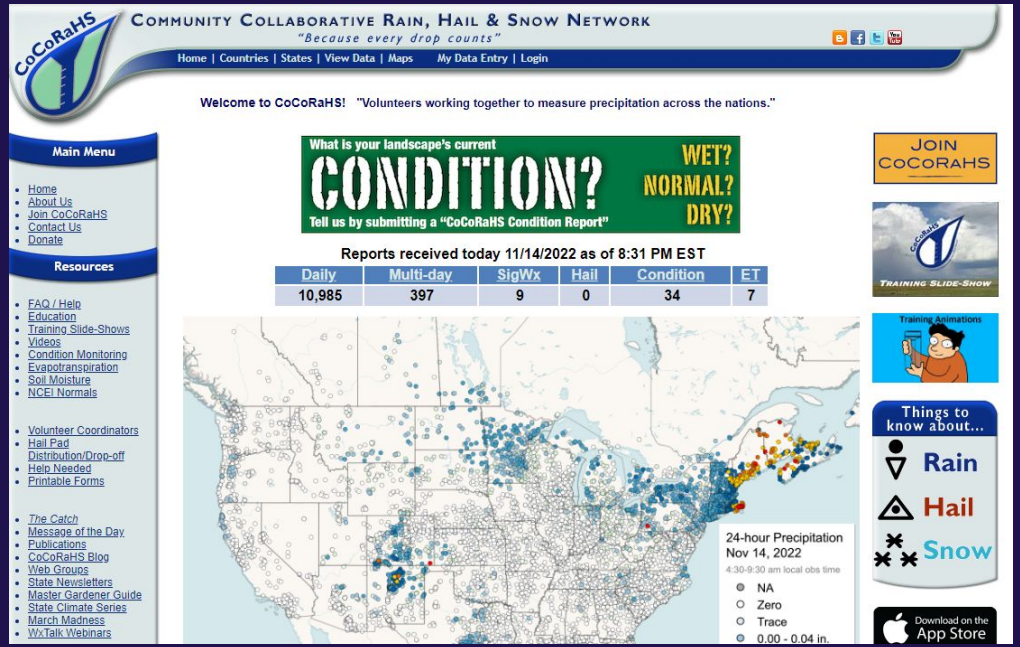


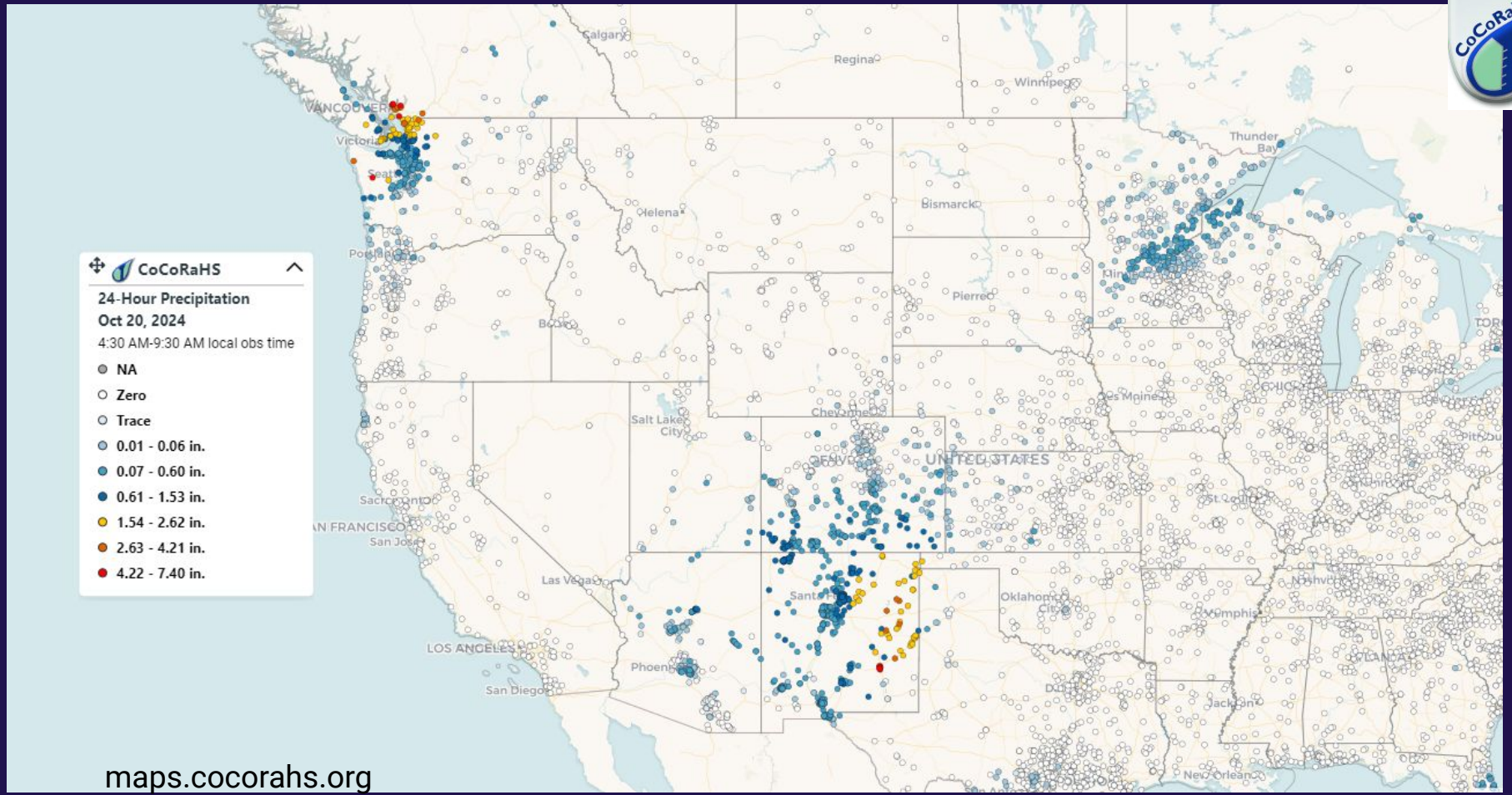
CoCoRaHS is critical to hazardous weather operations. We use the daily precipitation reports to produce maps, that are share with media, social media, and emergency managements partners!

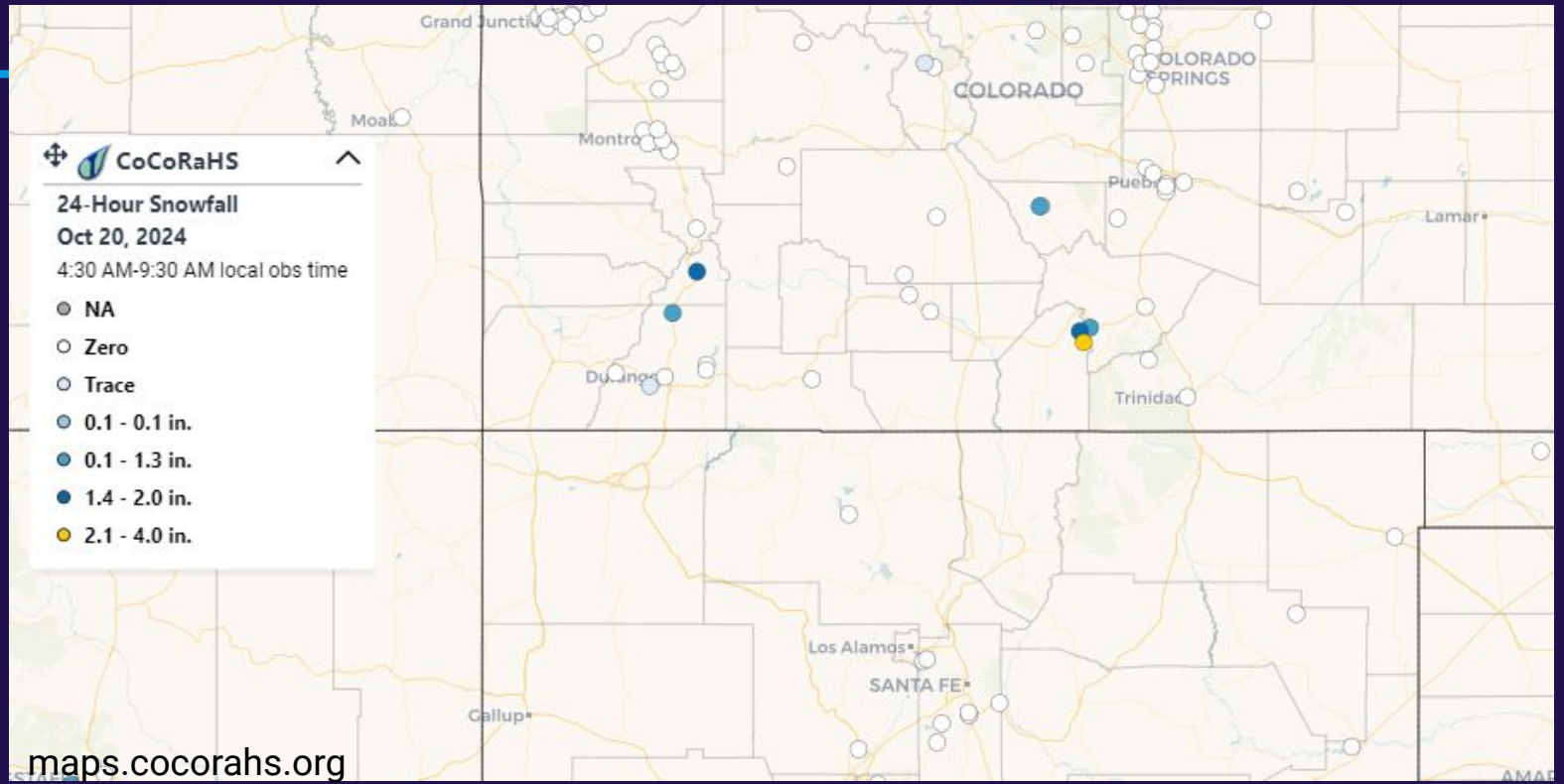
CoCoRaHS - easy to report

Help Observe Precipitation in your Community www.cocorahs.org DEMO

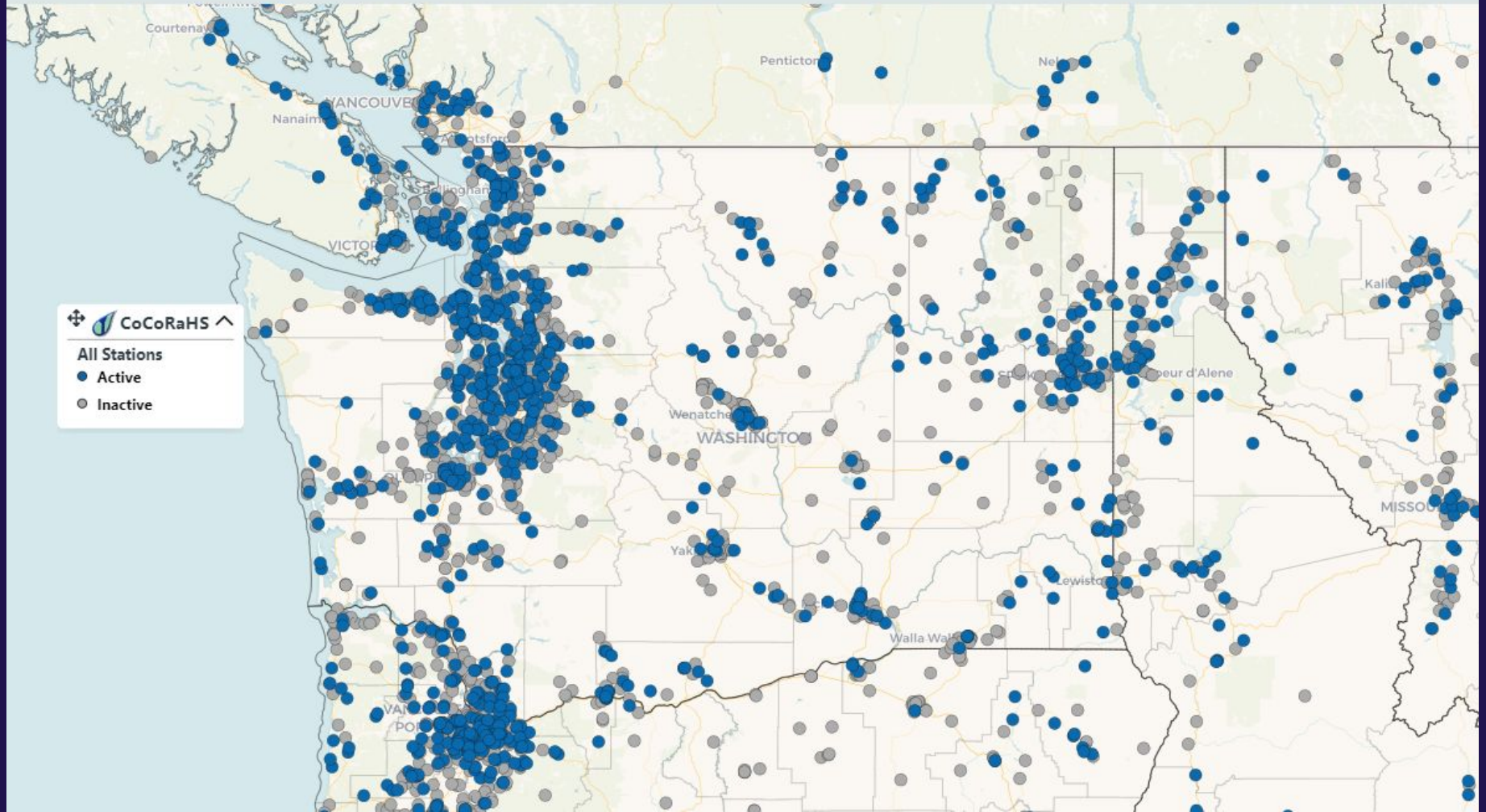
Volunteers take readings once a day - transmit online or on a mobile device

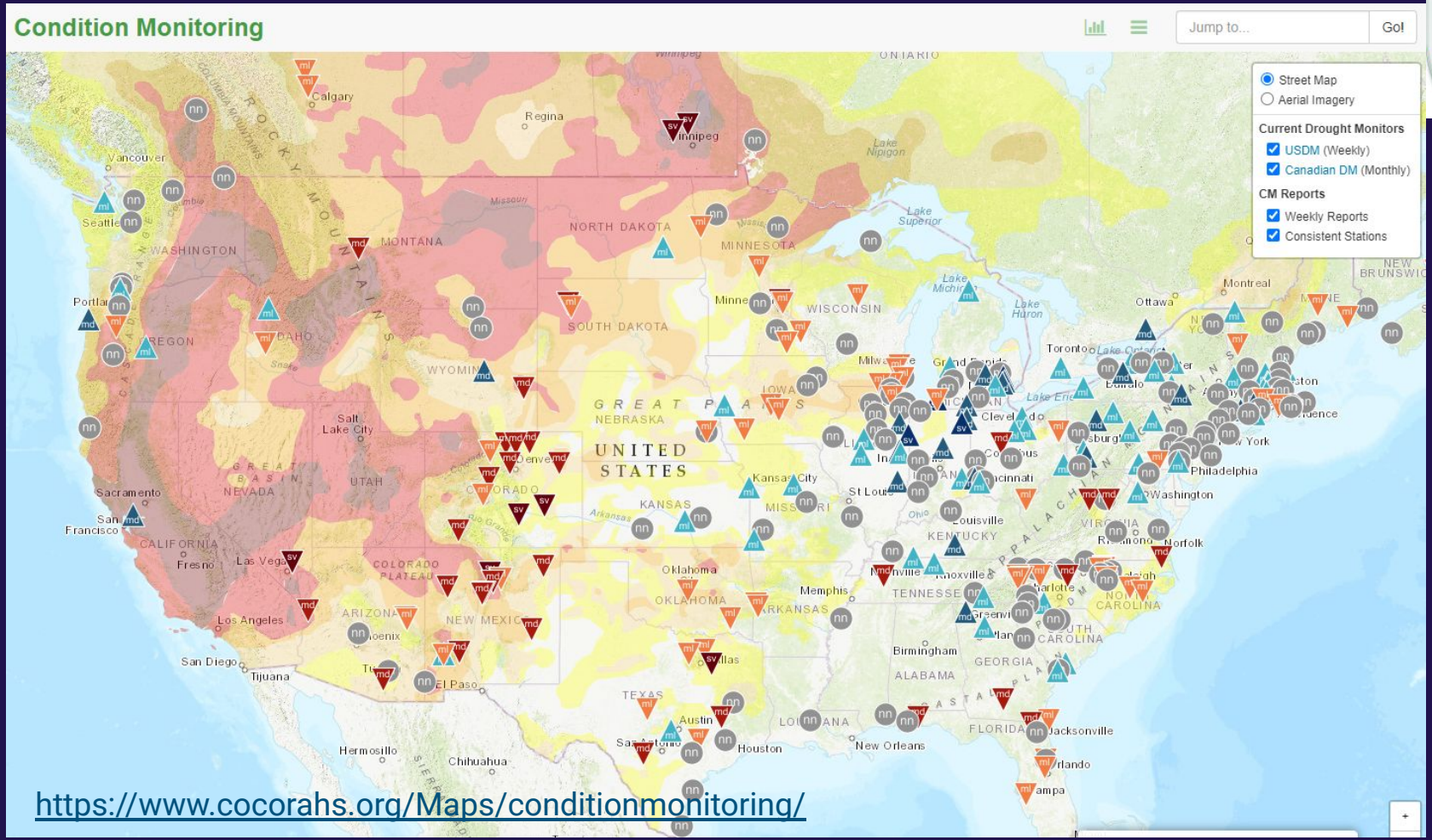



CoCoRaHS
24-Hour Precipitation
Oct 20, 2024
4:30 AM-9:30 AM local obs time
NA
Zero
Trace
0.01 - 0.06 in.
0.07 - 0.60 in.
0.61 - 1.53 in.
1.54 - 2.62 in.
2.63 - 4.21 in.
4.22 - 7.40 in.
Calgary
Regina
Winnipeg
Thunder Bay
Bismarck
Helena
Pierre
Salt Lake City
Las Vegas
Phoenix
San Diego
Oklahoma City
Memphis
Nashville
New Orleans
Jackson
Des Moines
UNITED STATES
maps.cocorahs.org


CoCoRaHS
24-Hour Snowfall
Oct 20, 2024
4:30 AM-9:30 AM local obs time
NA
Zero
Trace
0.1 - 0.1 in.
0.1 - 1.3 in.
1.4 - 2.0 in.
2.1 - 4.0 in.
Grand Junction
Moab
Montrose
COLORADO
COLORADO SPRINGS
Pueblo
Lamar
Durango
Trinidad
Los Alamos
SANTA FE
Gallup
maps.cocorahs.org

CoCoRaHS Mapping System




Condition Monitoring
Jump to...
Go!
Street Map
Aerial Imagery
Current Drought Monitors
USDM (Weekly)
Canadian DM (Monthly)
CM Reports
Weekly Reports
Consistent Stations
UNITED STATES
https://www.cocorahs.org/Maps/conditionmonitoring/

Conditioning Monitoring Reporting

What to Look For

The following tables provide examples of the types of conditions you might observe during different wet or dry periods. **These lists are designed as an aid.** The first table shows the condition monitoring scale bar categories and the types of conditions that correspond to those categories. The second table organizes different types of conditions and impacts by sectors and areas of interest. Be sure to note any other observations that you think may relate to dry or wet conditions.

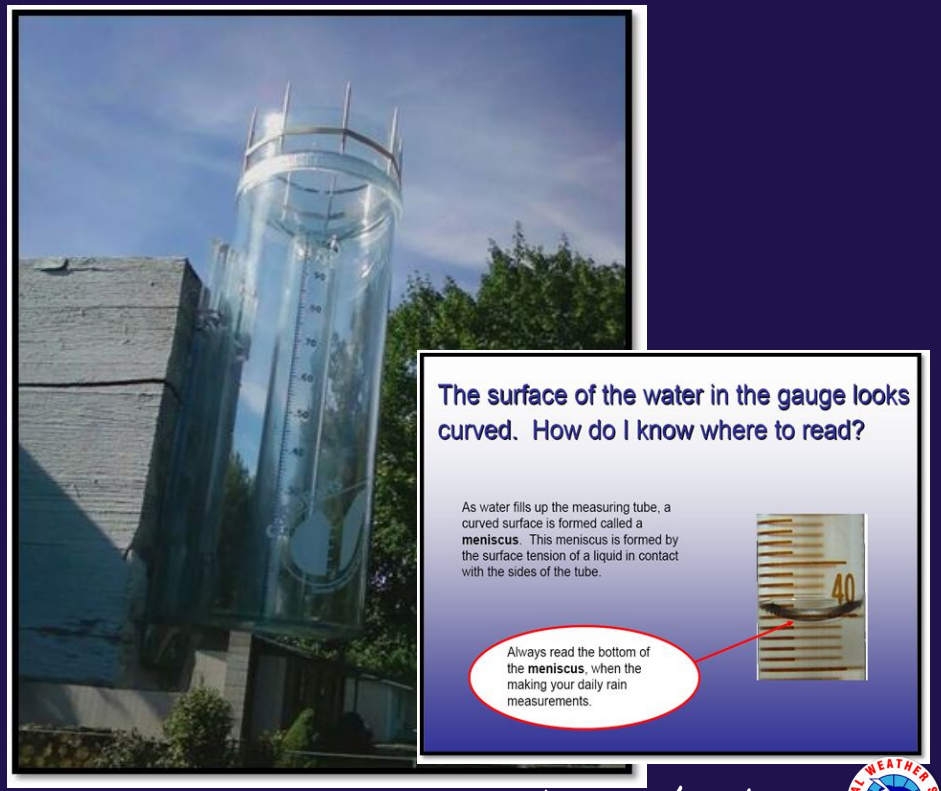
SEVERELY WET	MODERATELY WET	MILDLY WET	NEAR NORMAL	MILDLY DRY	MODERATELY DRY	SEVERELY DRY
• **Use this category sparingly** • Wet conditions have persisted for several weeks • Major flooding • Soil is saturated	• Wet conditions have persisted for a few weeks, or there has been a major rainfall event • Standing water and minor flooding • Soil is very damp	• Frequent precipitation for several days • Standing water is common • Soil moisture is above normal	• Observed conditions normal for this time of year • **This should be your default entry**	• Dry conditions have persisted for a few weeks • Soil is somewhat dry	• Dry conditions have persisted for several weeks • Lakes and rivers are low • Water use restrictions start • Soil is very dry	• **Use this category sparingly** • Dy conditions have persisted for months • Soil is completely dry • Water is scarce • State of Emergency

	WET	DRY
Agriculture	Crops and grazing pastures will likely be green and in healthy conditions. Even with moderately wet conditions, need for irrigation may drop off noticeably. Orchard fruits and berries will likely yield larger and more plentiful fruit.	Without enough water, crops may develop late, show stunted growth, or yield smaller harvests. Irrigation systems in the interior may be strained. Livestock may be smaller or require supplemental water and feed, especially where the growth of pastureland is stunted. Ranchers may reduce their herd sizes.

Interested in CoCoRaHS? How to Start!

Five easy steps

1. Sign-up at on the CoCoRaHS web site www.cocorahs.org
2. Obtain a 4” plastic rain gauge
3. View the online “training slide show”
4. Set up the gauge in a “good” location in your yard - away from trees
5. Start observing precipitation and report online daily



Snow

NWS Spokane appreciates the many snow reports each year!

Yes, It can be challenging!

Before the snow flies, make sure you remove the inner tube and funnel.

MEASURING SNOW

- Snowfall measurement is typically more difficult than rainfall
- Snowfall measurement takes a little more time

Accurate and timely snowfall measurements can be extremely important to your local National Weather Service office, public works departments, media outlets, climatologists, and other scientists.

Setting up for Measuring Snow

Video Courtesy of CoCoRaHS

Snow Tools

Snow Board

Snow Swatter

Ruler or yardstick

Snow Measurements - 4 part observation

1. The depth of new snow (new snowfall)
2. Liquid water equivalent of new snow (either in the gauge or on the snowboard)
3. The total depth of new snow and old snow and ice at observation time
4. Snow Water Equivalent (SWE) of total snow on the ground (optional)

Snow Measurements - 4 part observation

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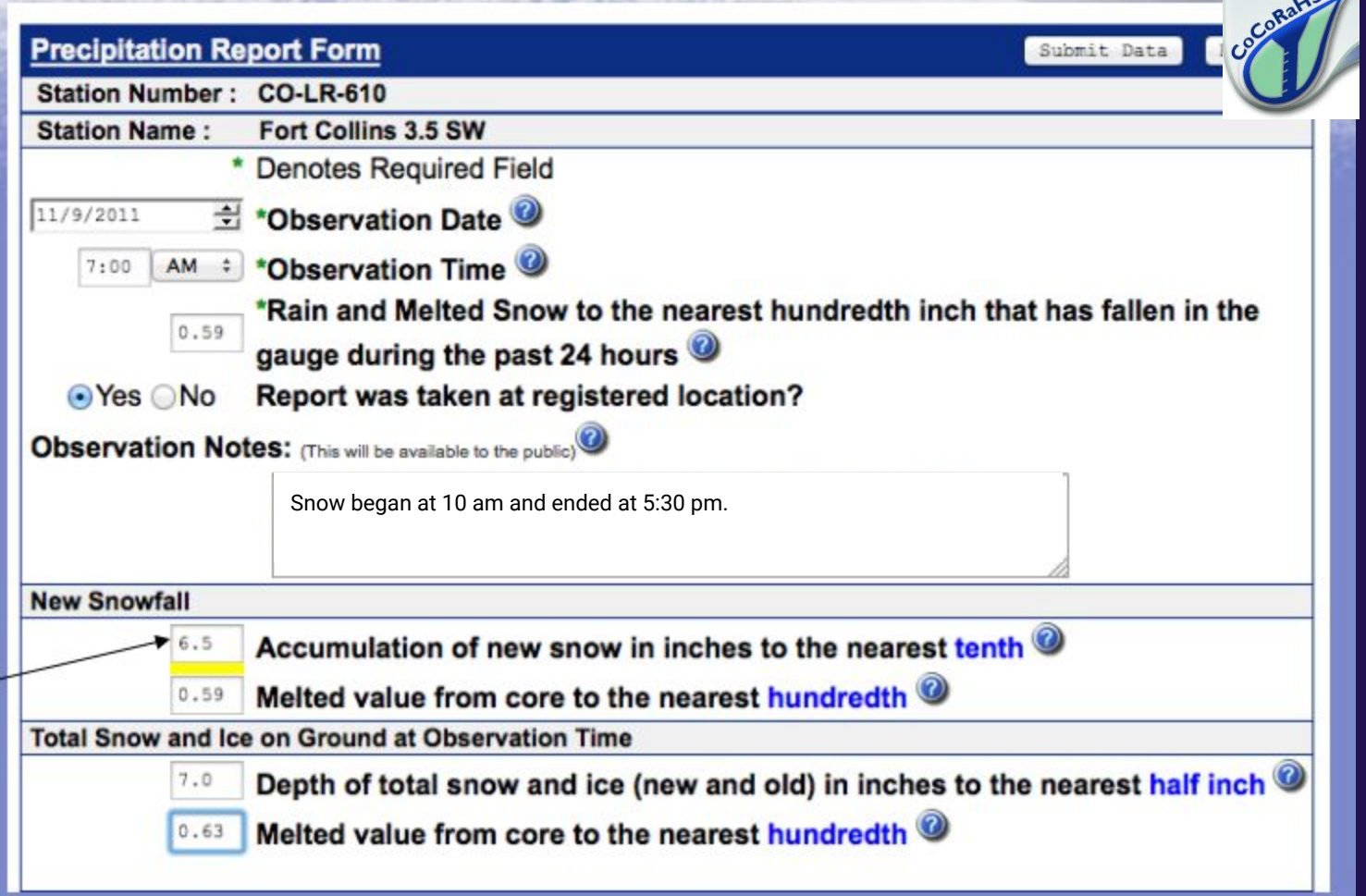
4. Snow Water Equivalent (SWE) of total snow on the ground (optional)

How to Measure New Snow Depth

Video Courtesy of CoCoRaHS

Snow Measurements - Depth of new Snowfall

- Snowfall is the accumulation of new snow (and ice) in the past 24 hours prior to melting or settling.
- Use a ruler and measure on the snow board or a level spot in your yard. Do not use a ruler in your gauge to measure snowfall.
- You can measure snowfall soon as it has stops snowing, it does not need to be at the observation time.
- Report snowfall to the nearest tenth of an inch.



Report your measurement of new snowfall to the nearest tenth of an inch

Snow Measurements - 4 part observation

1. The depth of new snow (new snowfall)
2. Liquid water equivalent of new snow (either in the gauge or on the snowboard)
3. The total depth of new snow and old snow and ice at observation time
4. Snow Water Equivalent (SWE) of total snow on the ground (optional)

Daily Precipitation When It Snows

Video Courtesy of CoCoRaHS

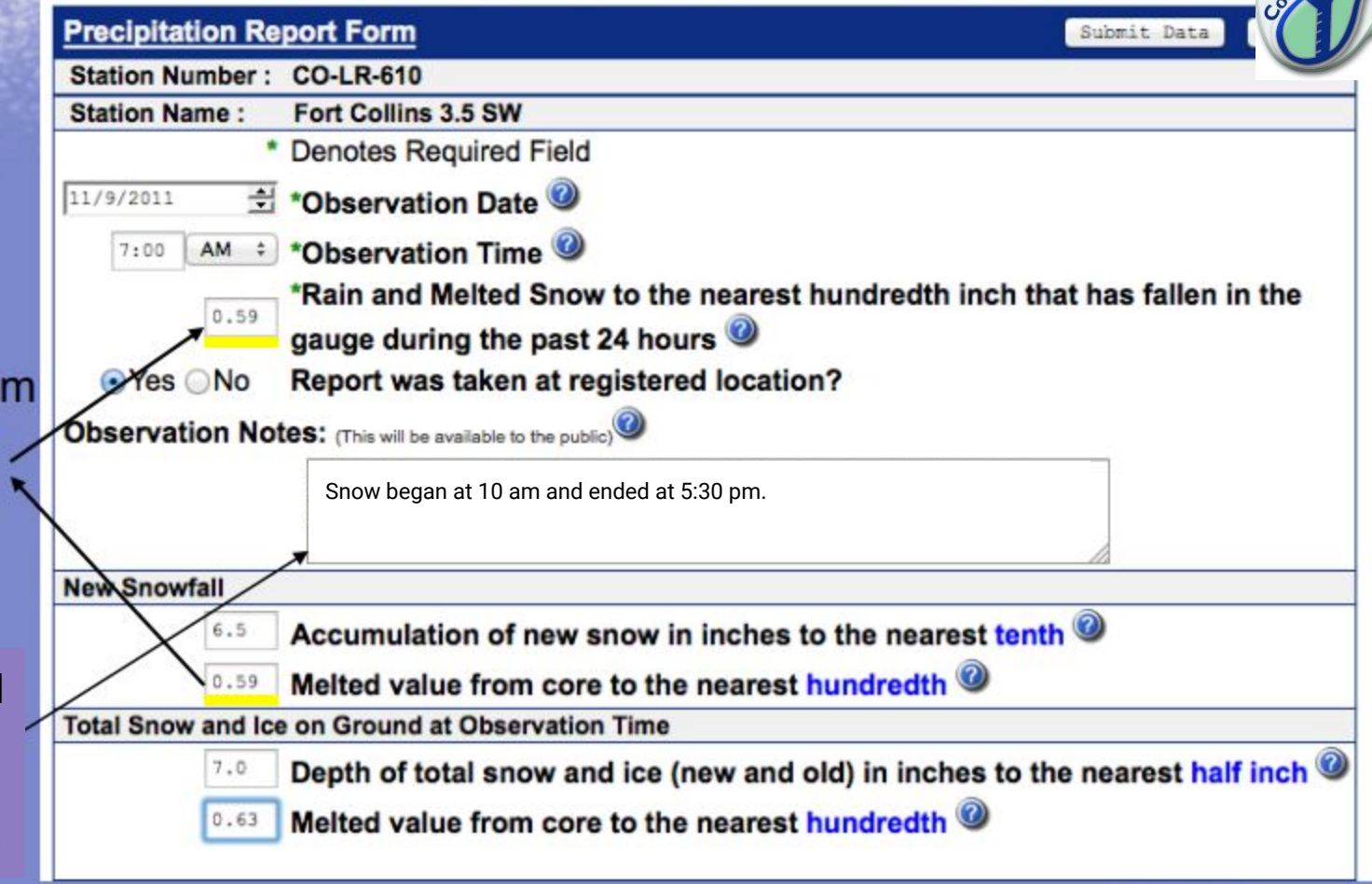
Snow Measurements - Liquid Water Equivalent

1. Swat excess snow from gauge
2. Bring outer gauge inside.
3. Fill inner gauge with warmer water
4. Pour a measured amount of warm water into the tube to melt the snow.

5. Once melted, pour contents of the snowmelt and warm water into the inner measuring tube.
6. Read the measurement, remember to subtract what you added!

Water melted from core is reported as the daily precipitation

Remember to add notes in the Comments section if needed.



Precipitation Report Form Submit Data

Station Number : CO-LR-610

Station Name : Fort Collins 3.5 SW

* Denotes Required Field

11/9/2011 *Observation Date

7:00 AM *Observation Time

0.59 *Rain and Melted Snow to the nearest hundredth inch that has fallen in the gauge during the past 24 hours

Yes No Report was taken at registered location?

Observation Notes: (This will be available to the public)

Snow began at 10 am and ended at 5:30 pm.

New Snowfall

6.5 Accumulation of new snow in inches to the nearest tenth

0.59 Melted value from core to the nearest hundredth

Total Snow and Ice on Ground at Observation Time

7.0 Depth of total snow and ice (new and old) in inches to the nearest half inch

0.63 Melted value from core to the nearest hundredth

Snow Measurements - 4 part observation

1. The depth of new snow (new snowfall)
2. Liquid water equivalent of new snow (either in the gauge or on the snowboard)
3. The total depth of new snow and old snow and ice at observation time
4. Snow Water Equivalent (SWE) of total snow on the ground (optional)

Measuring Total Depth and SWE

Video Courtesy of CoCoRaHS

Snow Measurements - Total Depth

- The Total Snow = **Old Snow + New Snow**
- The average depth of snow (including old snow and ice and new snow) that remains on the ground at observation time.
- Total depth of snow can be done in a flat portion of your yard, away from drifts or snow piles.
- Take several measurements and average them
- Report Total Snow Depth to nearest half inch

Precipitation Report Form

Submit Data | Re

Station Number : CO-LR-610

Station Name : Fort Collins 3.5 SW

* Denotes Required Field

11/9/2011 — *Observation Date

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Total Snow and Ice on Ground at Observation Time

7.0 — Depth of total snow and ice (new and old) in inches to the nearest half inch

0.63 — Melted value from core to the nearest hundredth

Report the total depth to the nearest half inch

Snow Measurements - 4 part observation

1. The depth of new snow (new snowfall)
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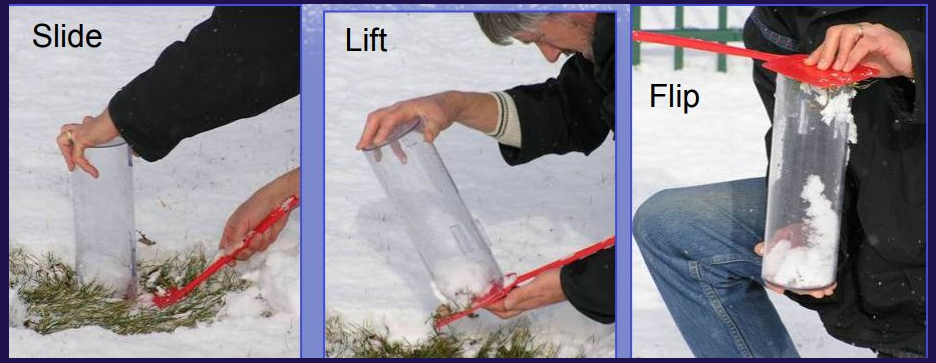
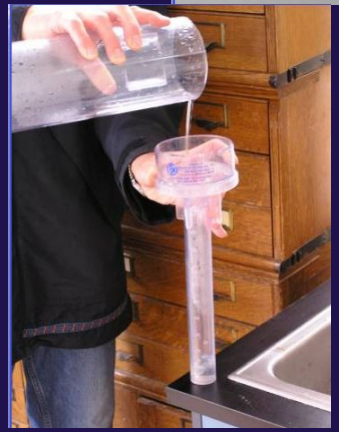
3. The total depth of new snow and old snow and ice at observation time
4. Snow Water Equivalent (SWE) of total snow on the ground (optional)

Snow Measurements - Snow Water Equivalent



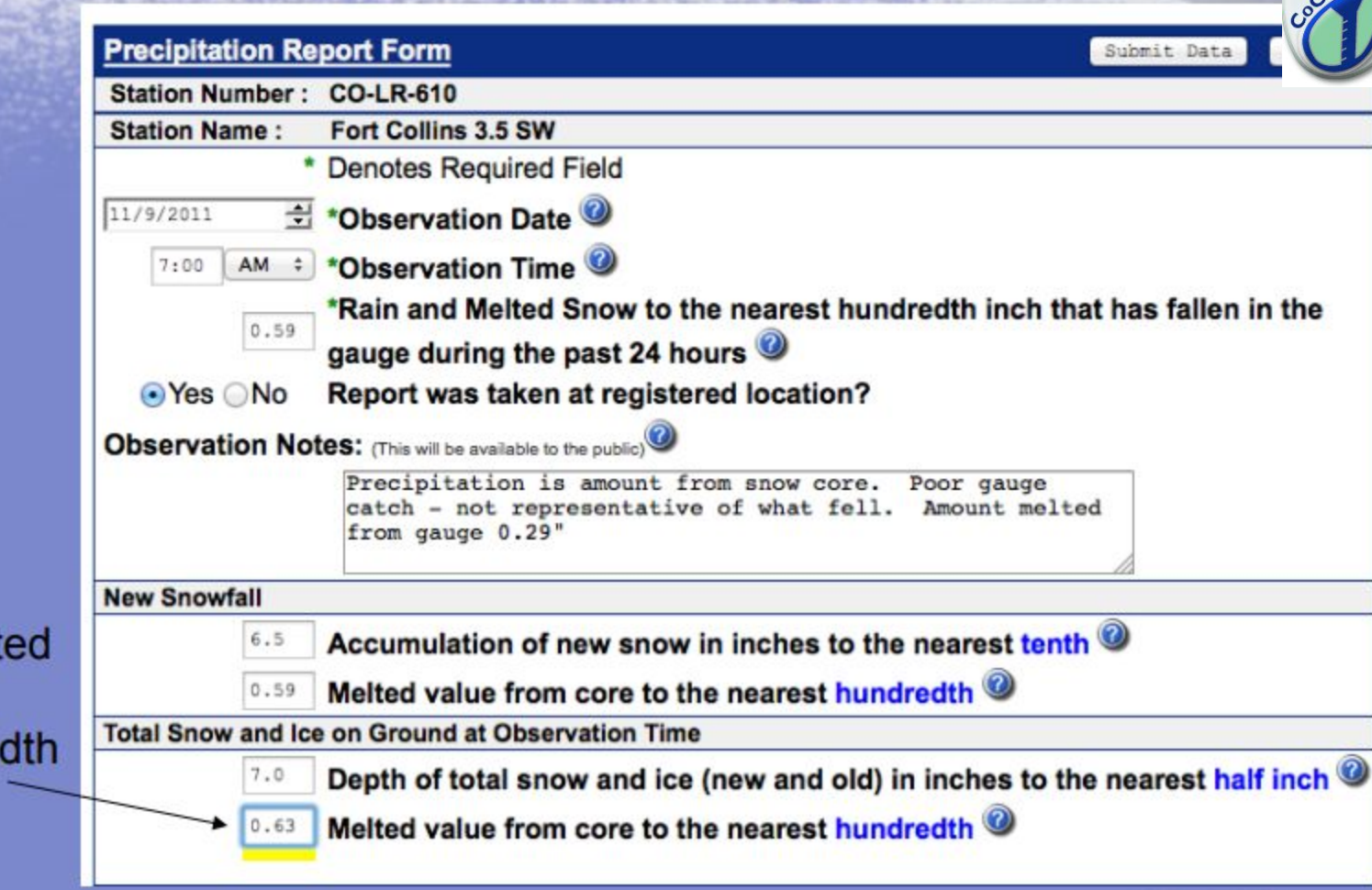
Light snow events

Once you have a core sample, melt it down with warm water and measure the liquid. Remember to subtract what you added!



Deeper snow events

SWE is important to know how much water is in the snow pack. It is usually done weekly (SWE Mondays) or when the snowpack is deep in an area.



Report the melted value to the nearest hundredth

CoCoRaHS Post It Notes

Even if there is **No New precipitation**, please send a report. Even zeros are important!

Windy conditions may lead to increased blowing and drifting. May need to take a core sample in a location more representative in your yard and not your gauge.

If snow melts as it lands, report a **Trace (T)** of snow for the day and add it to comments

If **Heavy Snow** is falling, you can send in a Storm Report (available through the web page only)

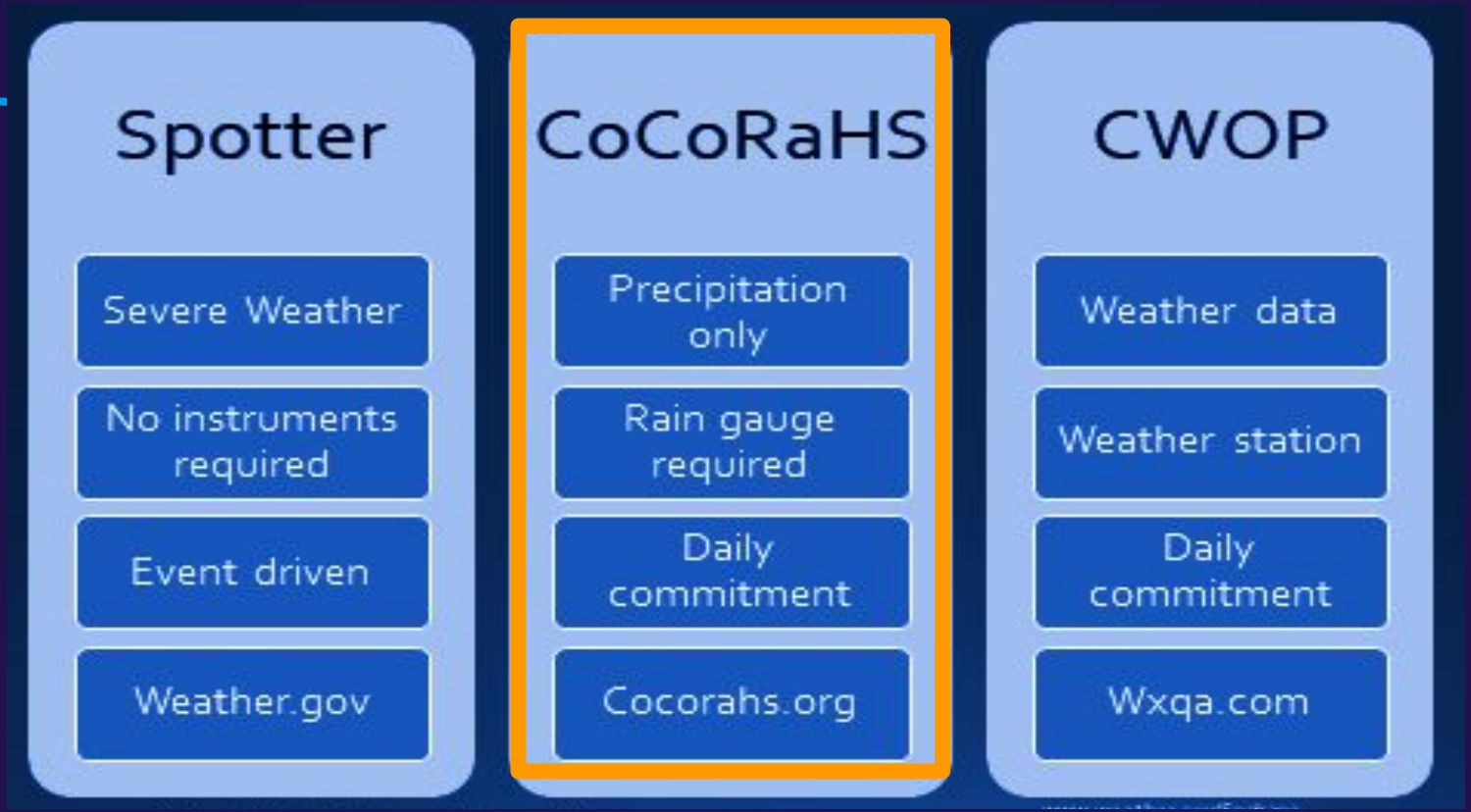
CoCoRaHS Post It Notes

What if you are **gone for a few days**? Send in a multi-day report

Freezing Rain - This is a liquid that freezes. Do not report it as snow. Meltdown what is frozen in the gage and report it as rain. Leave a note in comments section. New snowfall =0. Total Snow Depth= ice thickness.

What if you **run out of time** to finish your snow report? Put NA in the Rain and Melted snow box and leave a note in the comments box and then send in your report. You can return to the report to edit it later in the day.

Different programs - All useful to the NWS



Weather Spotter

Weather enthusiast who volunteers time to report severe or hazardous weather

- As needed basis
- No weather equipment is necessary
- Simply call, email or send a report online
- Checklist provided on weather to report

Register:
nws.spokane@noaa.gov

Citizen Weather Observers Program CWOP

www.wxqa.com

- Have a weather station and want to share data online
- Has a PC and Internet access
- Register Online & Receive a weather station ID
- Transmits data every 15 mins

Citizen Weather Observers Program

CWOP

Citizen Weather Observer Program

Site Contents:
News
Main Page
Data Quality
Member Lists
Map/Data Displays
Ham Wx Station Info
CW Packet Checking
Weather Station Resources
Computer Security and Archive

Related Links:
CWOP info
APRS-IS info
findu.com info
FAQs, Forums
Solar Radiation
MADIS Program
APRSWXNET info
APRS Servers to Use
NOAA mesonet display

Join CWOP or CWOP-snow
Search CWOP or shortform

What's going on here?

The Citizen Weather Observer Program (CWOP) is a public-private partnership with three goals: 1) to collect weather data contributed by citizens; 2) to make these data available for weather services and homeland security; and 3) to provide feedback to the data contributors so they have the tools to check and improve their data quality. In fact, the web address, wxqa.com, stands for weather quality assurance.

The number of North American CWOP stations sending data over the past several days is normally more than 7000 stations sending 50,000 to 75,000 observations every hour. The number of world-wide citizen weather stations sending data to CWOP is shown increasing over the past decade.

CWOP members send their weather data by internet alone or internet-wireless combination to the findU server and then every five minutes, the data are sent from the findU server to the NOAA MADIS server. The data undergo quality checking and then are distributed to users. There are over 800 different organizations using CWOP mesonet data. Here is a partial list:

Additional Training

Cocorahs.org

Slideshows Notes Videos

The Catch

NOLAN DOESKEN'S MONTHLY COCORAHS E-MAIL MESSAGE

CoCoRaHS -- New Water Year 2025!

Fort Collins, Colorado -- October 18, 2024

Thanks to everyone for seeing us all through another year of tracking precipitation. The two hurricanes in the past three weeks, Helene and Milton, produced devastation across the southeast U.S. Many CoCoRaHS observers are in the areas impacted by the storms, helping document the precipitation and other weather conditions. Our hearts sink every time storms like this hit, because we know that many of our observers will be affected. We know that with Helene and Milton, a number of our observers suffered catastrophic damage to their property and had their lives turned upside down. Others were without power, water, and internet for a significant period of time, and some still are. Some of their experiences are noted in the comments of observations they submitted.

YOUR NATIONAL WEATHER SERVICE SPOKANE QUARTERLY REPORT

Vol XXIX Issue 3

The Weather Watcher

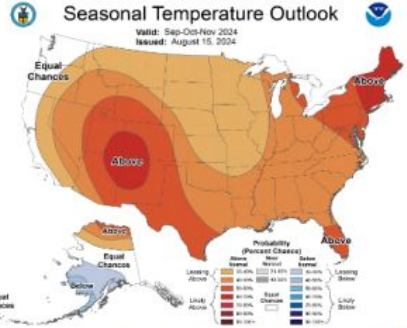
Of the Inland Northwest

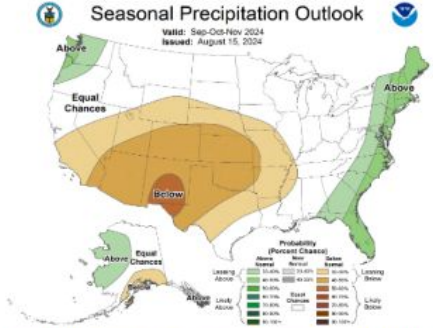
www.weather.gov/Spokane

September 2024

Fall Outlook 2024

The Climate Prediction Center CPC Seasonal Outlook for September-November 2024 is leaning toward equal chances to slightly above normal temperatures and equal chances to slightly above normal precipitation for the Inland NW.





As for fire season, the threat should be decreasing. The National Interagency Coordination Center suggests that the Wildland Fire Potential Outlook will be near normal for September- November 2024.

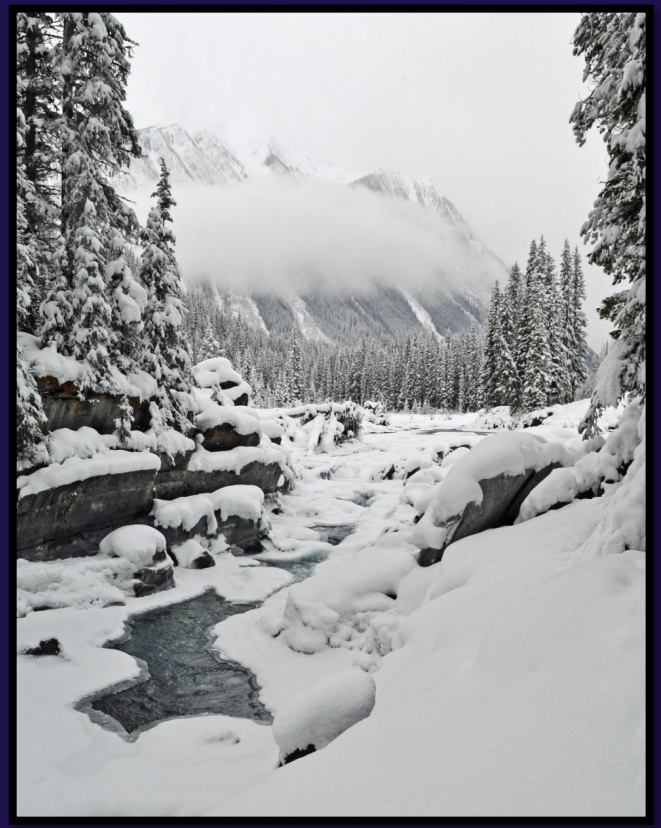
Emails & Phone Numbers

It's important to keep your contact information current. You may receive notifications on:

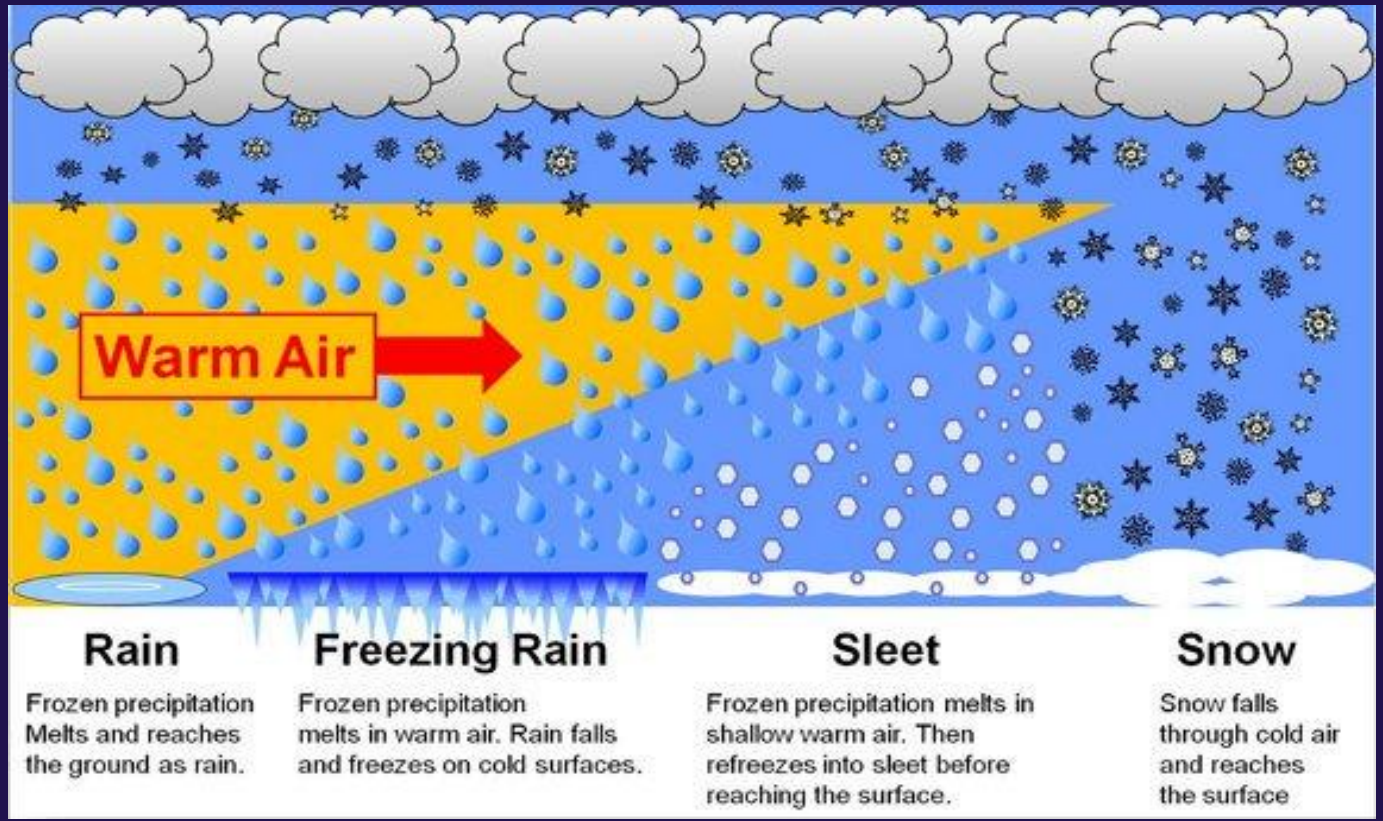
- Upcoming WIDESPREAD Severe Weather or Winter Storm events.
- Requests for SWE reports
- Training updates

Typical Winter Storm Scenario

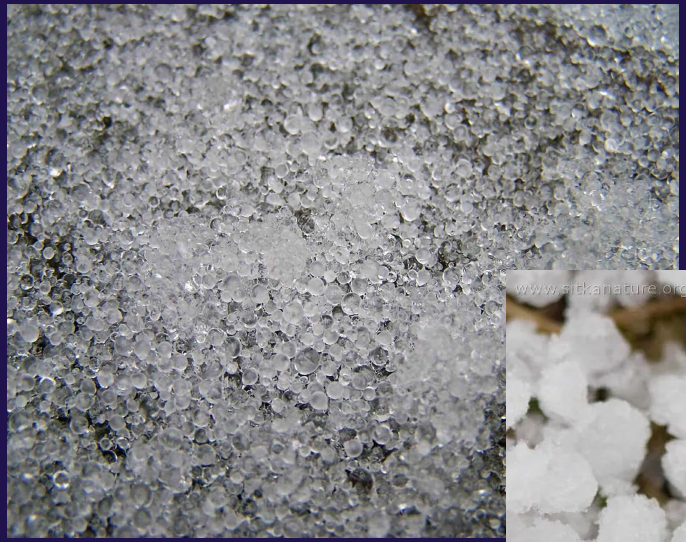
- Cold air in place over the Inland Northwest, especially in the valleys
- Warm Pacific Air rides over the cold air
- Precipitation begins as snow, occasionally changes to rain with possible freezing rain



Vertical Temperature Profile is Critical!



Winter Precipitation



Sleet

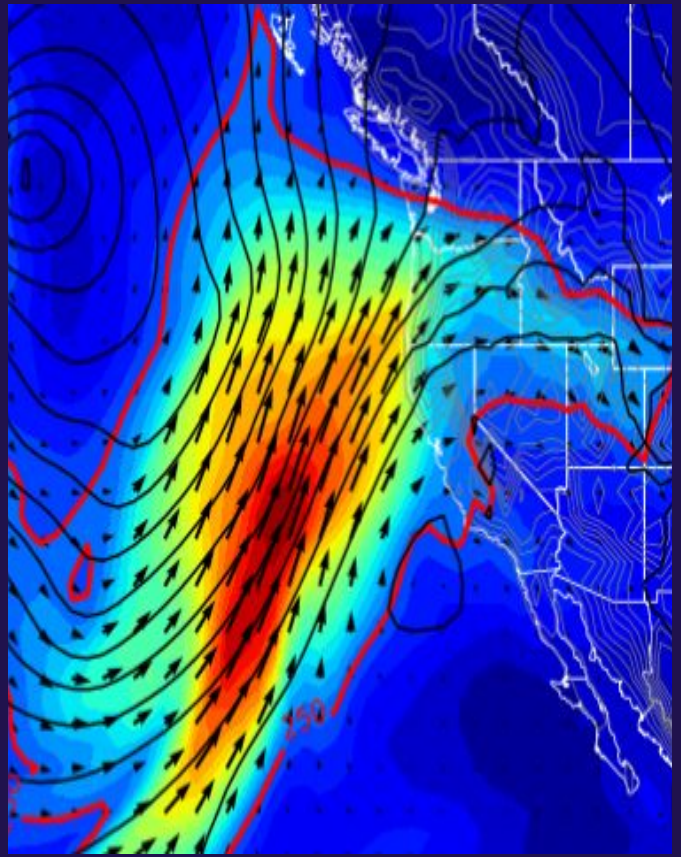
Graupel

Hail

Atmospheric Rivers

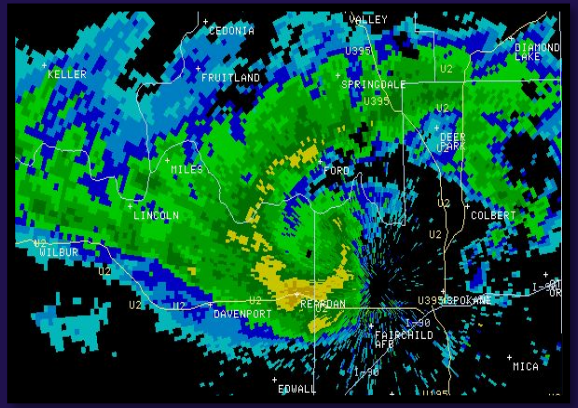
Plumes of atmospheric moisture

Mild & Wet Weather



Upper level troughs

- Cold air aloft - weak impulses
- May not be well forecast by models
- Potential for ~1 ft of snow in a short time
- Spotter play a BIG role with reports
- Can produce snow squalls



What is a

SNOW SQUALL?

Intense burst of snow and winds
Short duration (1-3 hours)
Whiteout visibility
Rapidly deteriorating road conditions

NATIONAL WEATHER SERVICE
WWW.WEATHER.GOV/SAFETY

IOWA DOT

QUESTIONS AND ANSWERS ABOUT

SNOW SQUALLS

WWW.WEATHER.GOV/SAFETY

WHAT ARE THEY?

Quick intense bursts of snow
Accompanied by strong gusty winds
Short-lived, typically less than 3 hours
Normally occur during the day

WHAT ARE THE IMPACTS?

Rapidly reduced visibility
Treacherous travel conditions
Potential for chain-reaction accidents

WHAT'S A SNOW SQUALL WARNING?

Warning is usually 30-60 minutes in length
Issued for small areas where snow squalls are expected
Similar to a Tornado or Severe Thunderstorm Warning

HOW CAN YOU STAY SAFE?

Have a way to get forecasts and warnings
Consider an alternate route or delaying travel
Stay alert for rapidly changing road conditions
Reduce speed and use low beam headlights

WEATHER.GOV

Safety

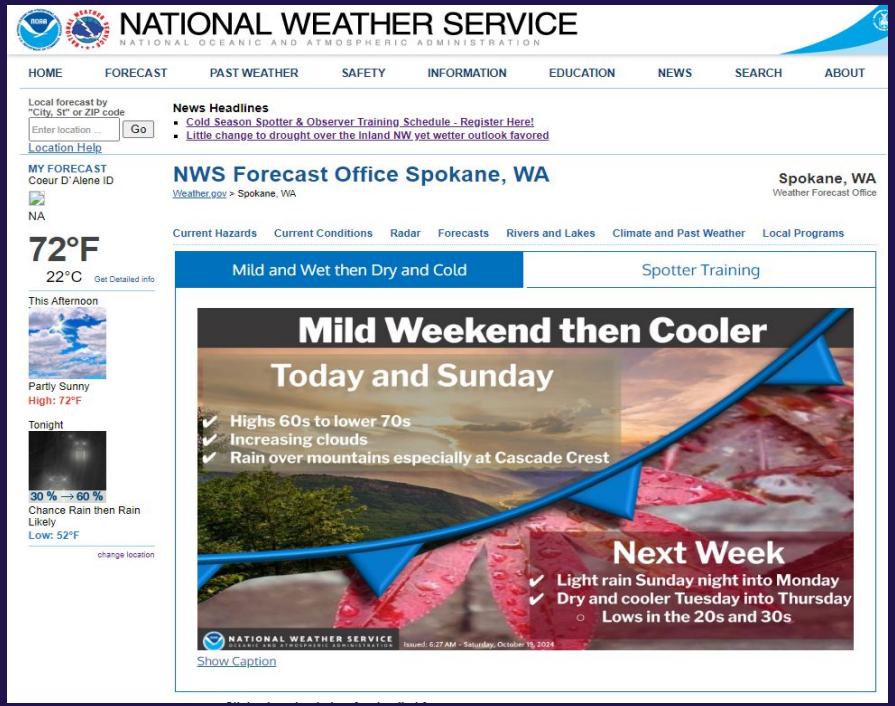
- Personal Safety is the Primary Objective of every observer
- Protect You and Your Family First
- Do NOT put yourself in harm's way
  - Don't walk or drive over obstructions as flooded roads or downed power lines
  - Don't put yourself under objects that have the potential to fall or be blown over
- **ACES - Awareness, Communication, Escape Route and Safe Zones**

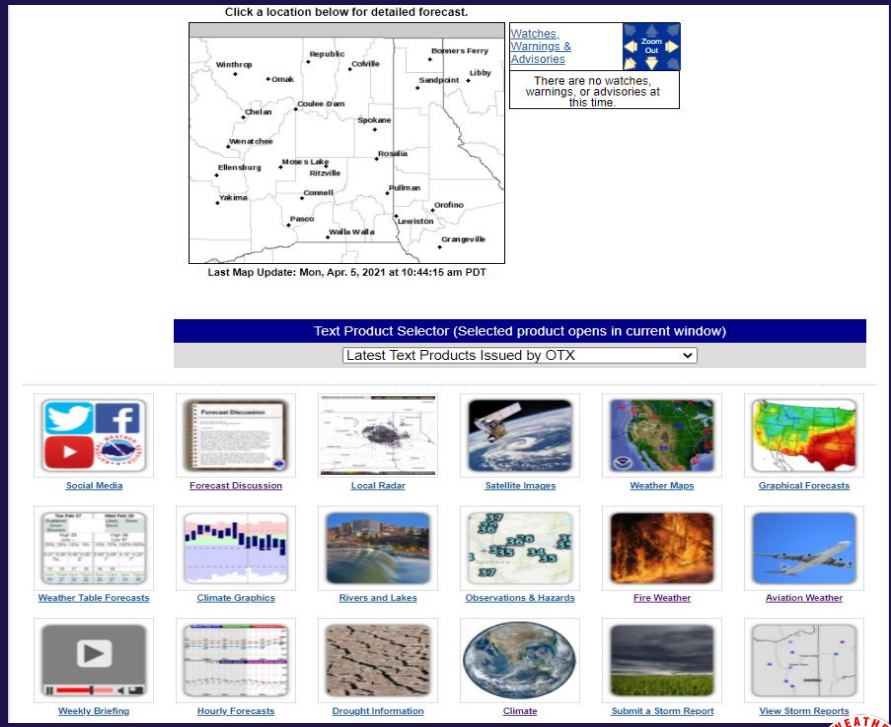

Spokane Valley Dec 2021


Spokane Dec 2021

Stay Informed

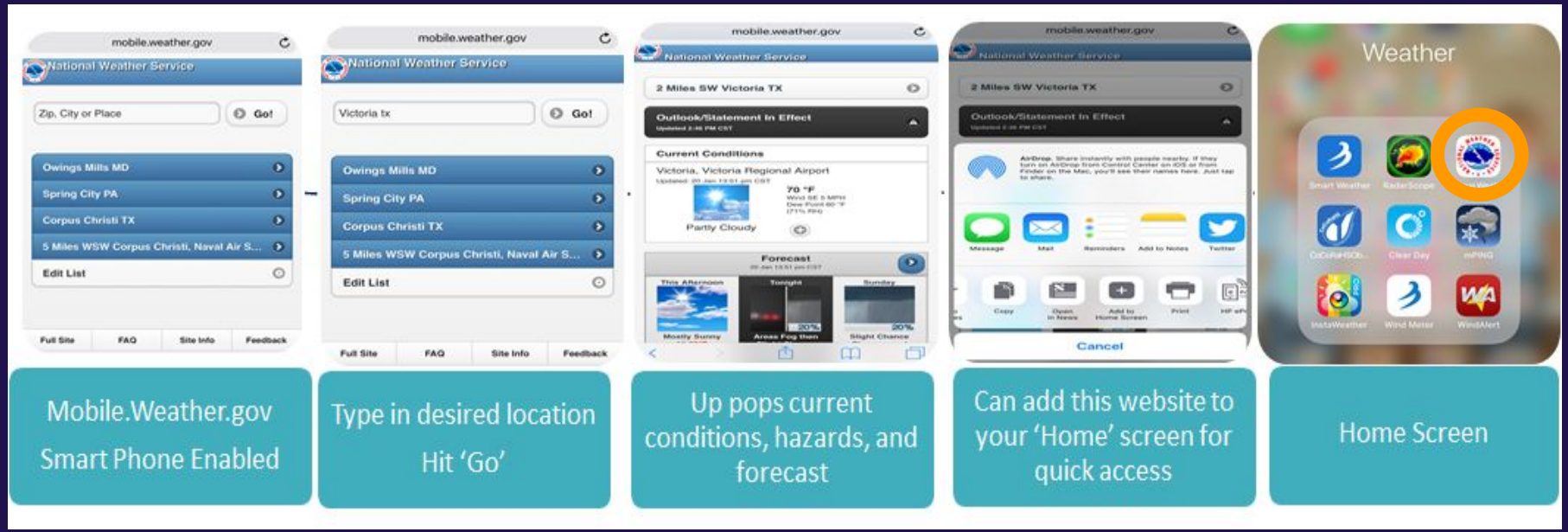
NWS Spokane Web Page www.weather.gov/Spokane





Stay Informed
On your Smartphone

mobile.weather.gov



Staying Informed
On Your Phone!

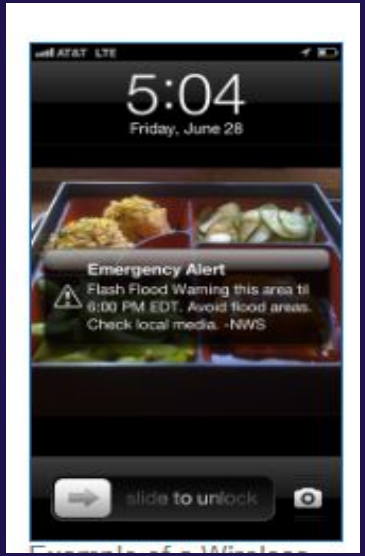
WIRELESS EMERGENCY ALERTS CAPABLE

Weather Warnings

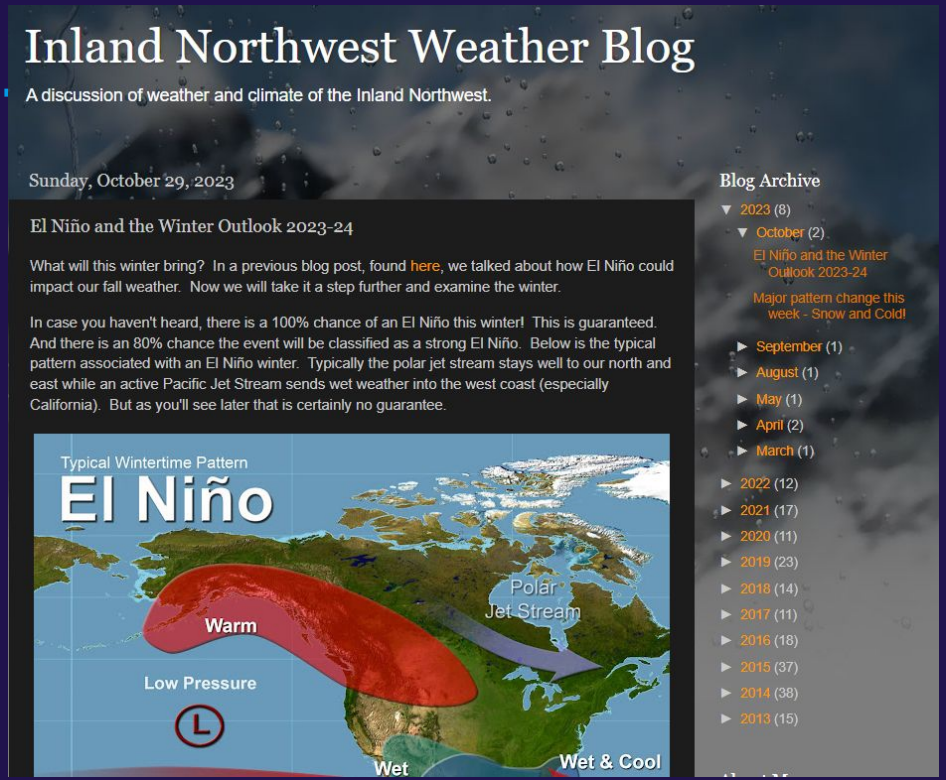
- Tornado Warnings
- Flash Flooding Warnings
- Extreme Wind Warnings
- Dust Storm Warnings
- Snow Squall Warnings

Alert Categories

Extreme Weather & Water Warnings
Local emergencies & Evacuations
AMBER Alerts
Presidential Alerts – National emergency



Stay Informed - Inland Nw Weather Blog



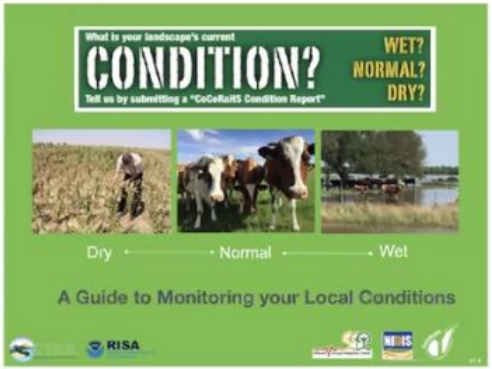
https://inlandnorthwestweather.blogspot.com/

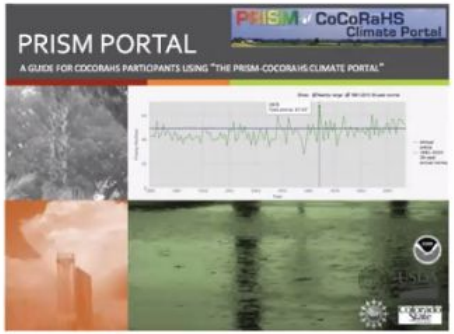
Great Way to understand more on weather events and outlooks!

Be Prepared - Disaster Kits and Disaster Plans

Introduce your observers to our wealth of learning products

Training Animations





Climate Records

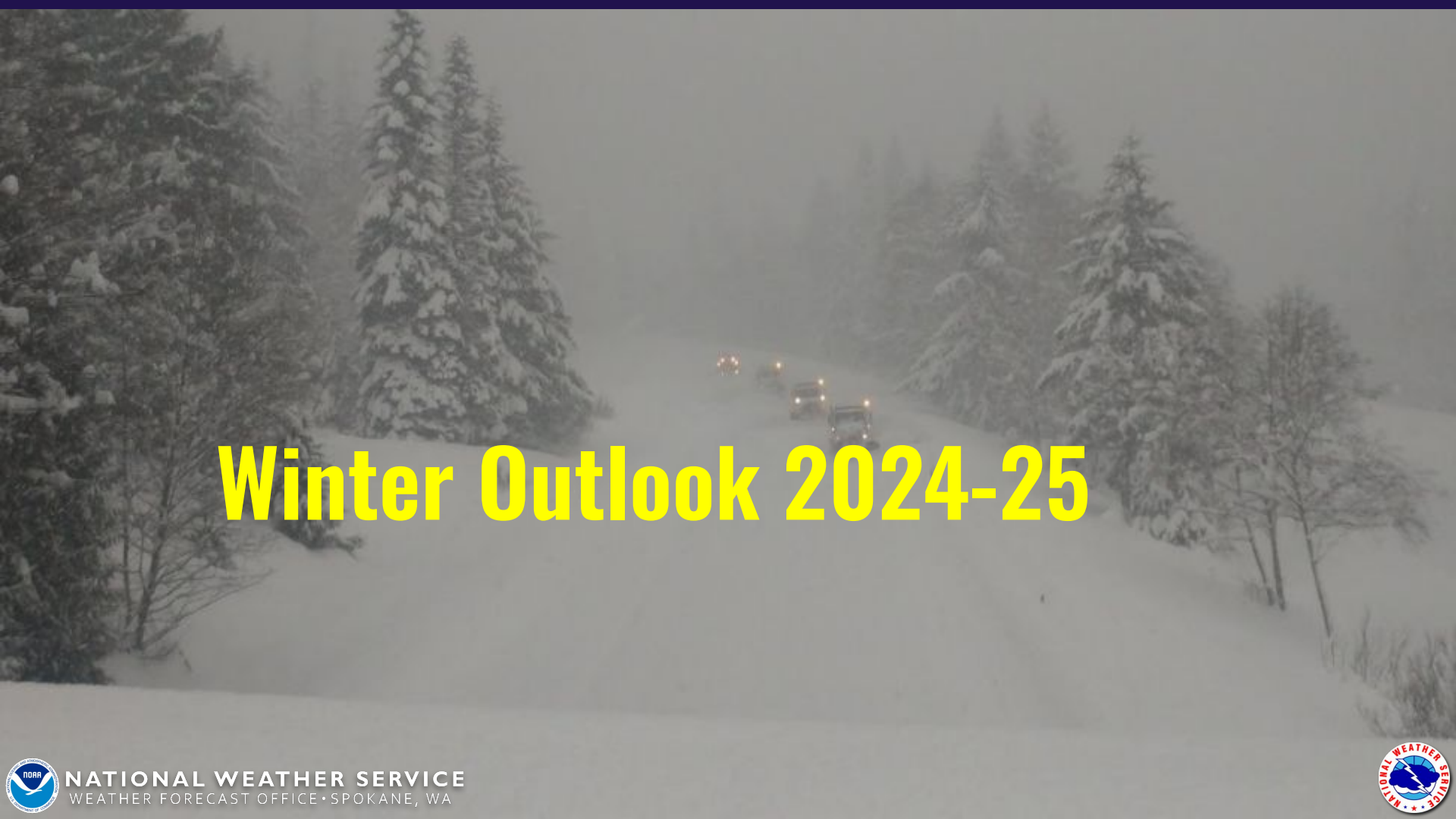
After 100 reports, your site becomes a climate site!

Water Year reports are available each year

First time, CoCoRaHS stations have been incorporated into the new Climate normals. - NCEI Normals (5448 CoCoRaHS stations)

2008 Water Year Report	2009 Water Year Report	2010 Water Year Report	2011 Water Year Report
2012 Water Year Report	2013 Water Year Report	2014 Water Year Report	2015 Water Year Report
2016 Water Year Report | Certificate	2017 Water Year Report | Certificate	2018 Water Year Report | Certificate	2019 Water Year Report | Certificate
2020 Water Year Report | Certificate	2021 Water Year Report | Coming Soon	Current Water Year Report	

National Centers for Environmental Information (NCEI)



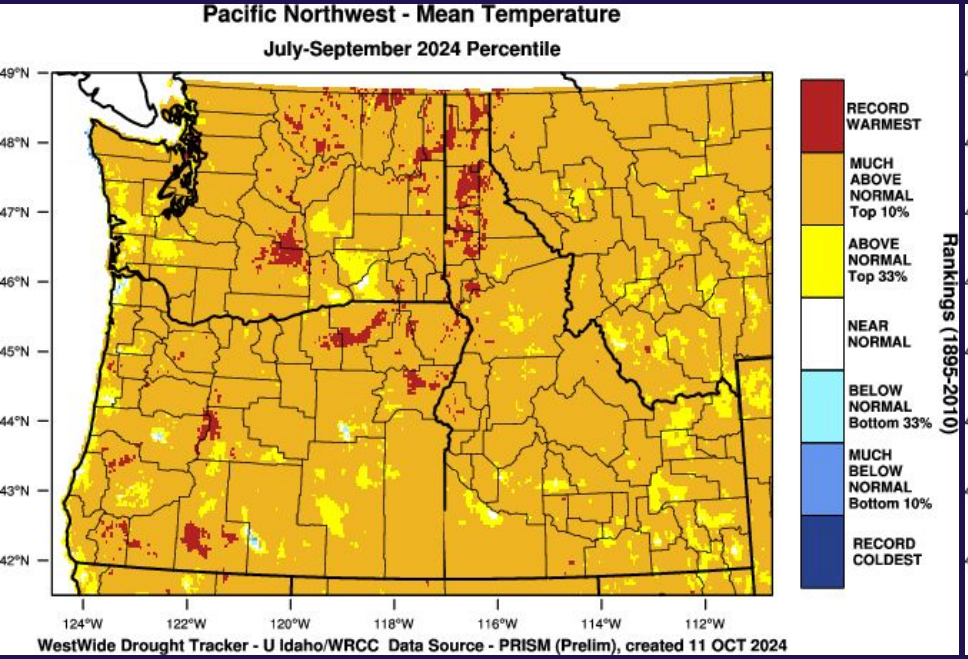
Winter Outlook 2024-25

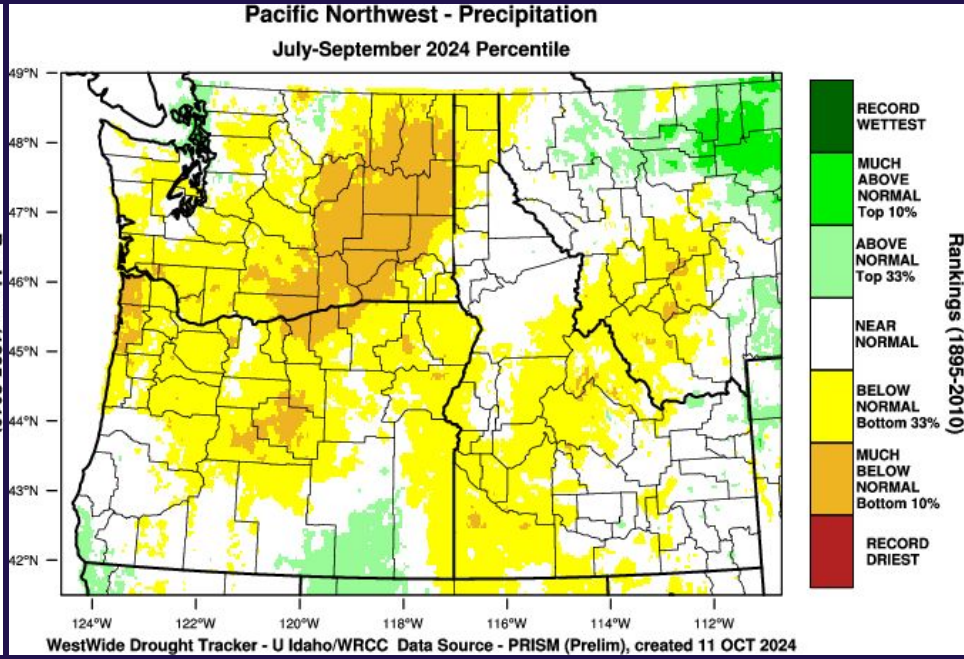
NATIONAL WEATHER SERVICE
WEATHER FORECAST OFFICE • SPOKANE, WA

Past 3 Months

wrcc.dri.edu/

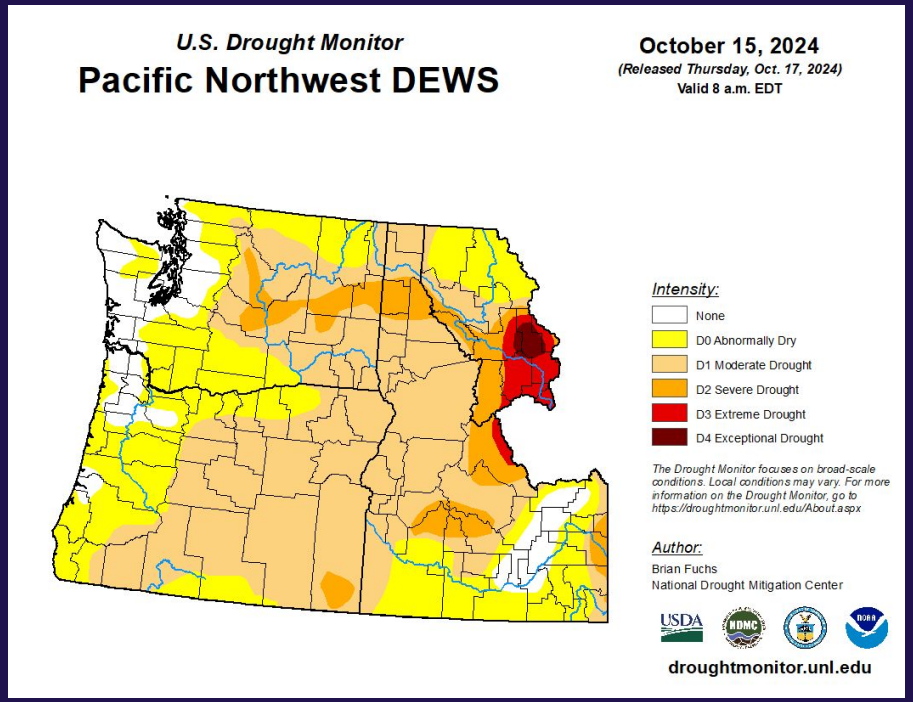
It has been warmer across the Inland NW with below normal precipitation

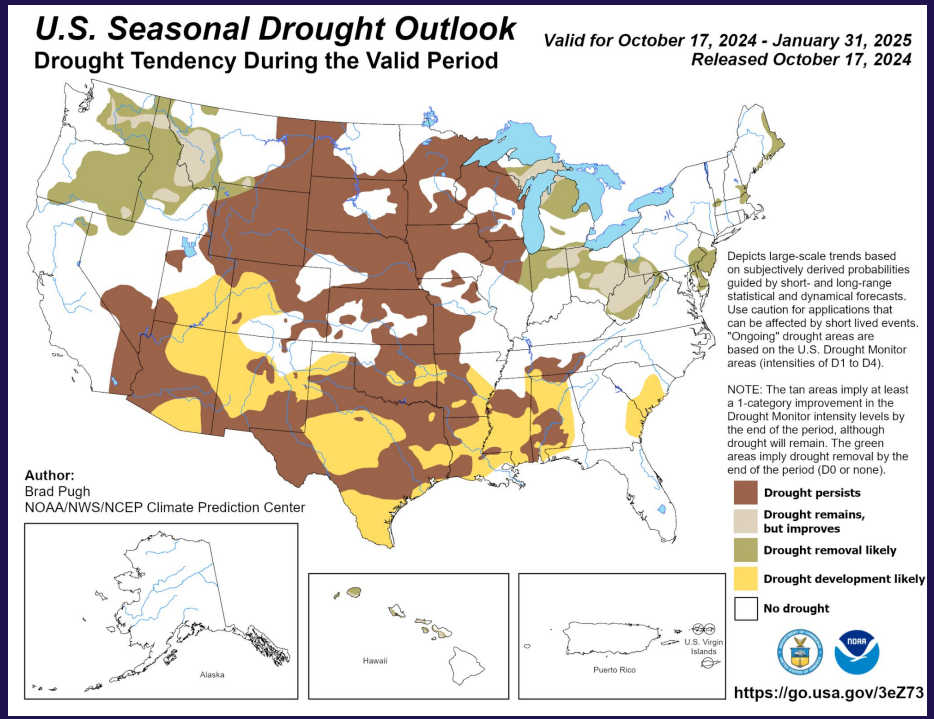




Drought Update
US Drought Monitor & Seasonal Outlook

www.cpc.noaa.gov





ENSO Status

ENSO Alert System Status: La Niña Watch

- 60 percent chance for La Niña to emerge Sept–Nov and will persist through January-March 2025.
- Favors at least a "weak" event. A weaker La Niña implies that it would be less likely to result in conventional winter impacts, though predictable signals could still influence the forecast guidance (e.g., CPC's seasonal outlooks)

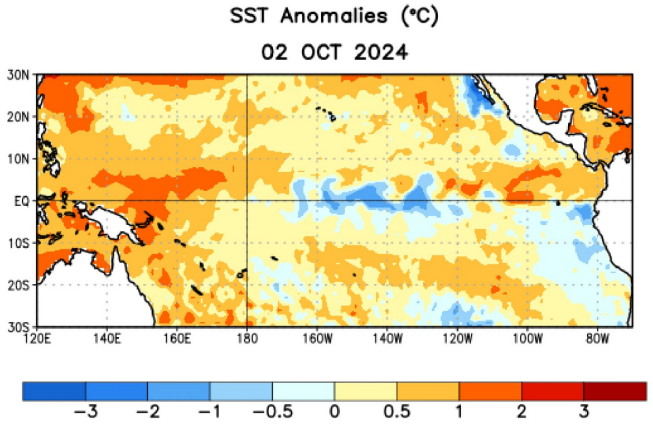


Figure 1. Average sea surface temperature (SST) anomalies (°C) for the week centered on 2 October 2024. Anomalies are computed with respect to the 1991-2020 base period weekly means. Data credit: UKMet OSTIA.

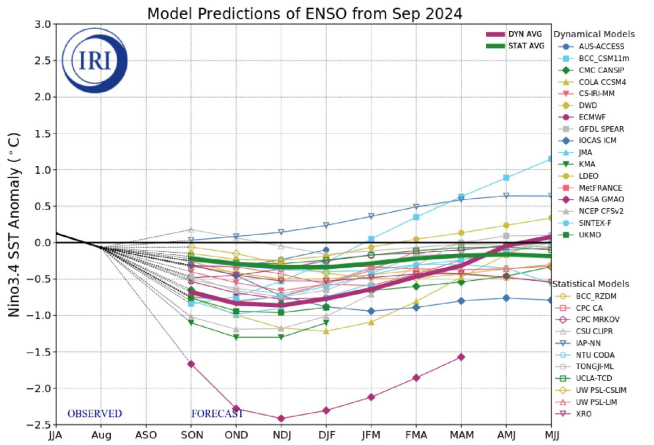
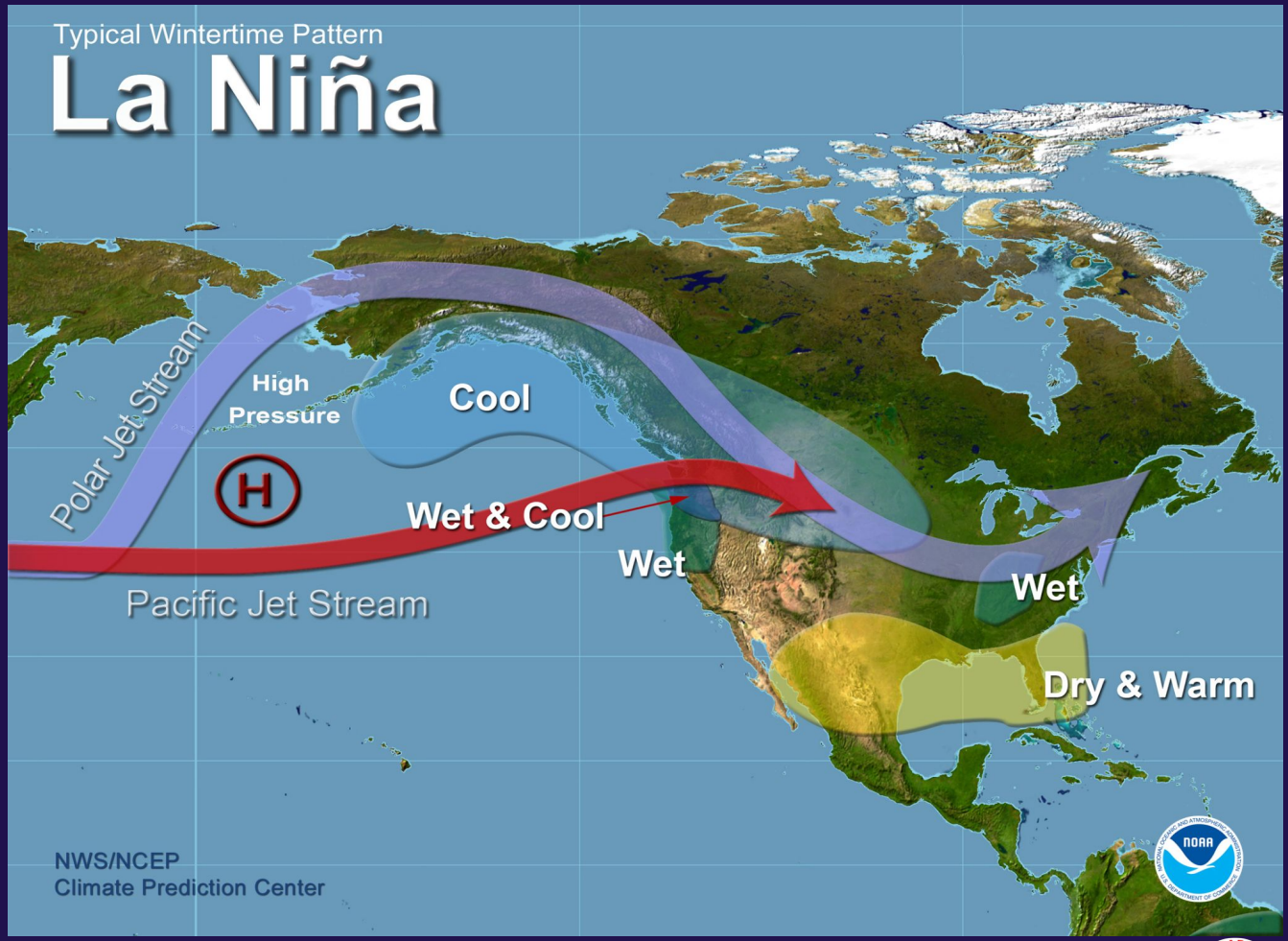


Figure 6. Forecasts of sea surface temperature (SST) anomalies for the Niño 3.4 region (5°N-5°S, 120°W-170°W). Figure updated 19 September 2024 by the International Research Institute (IRI) for Climate and Society.

“Typical” La Niña Atmospheric Setup



ANALOG YEARS

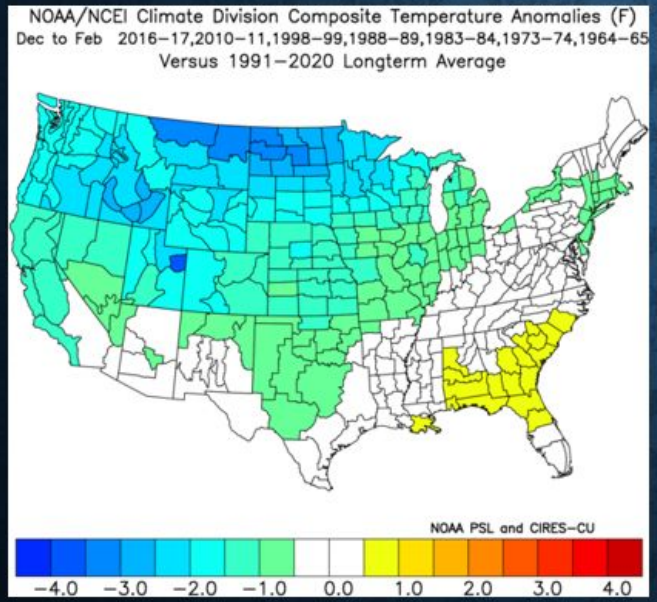
STRONG EL NINO ➡ LA NINA WINTERS

(1964/65, 1973/74, 1983/84, 1988/89, 1998/99, 2010/11, 2016/17)

Seven best fit winter seasons going back to year 1950

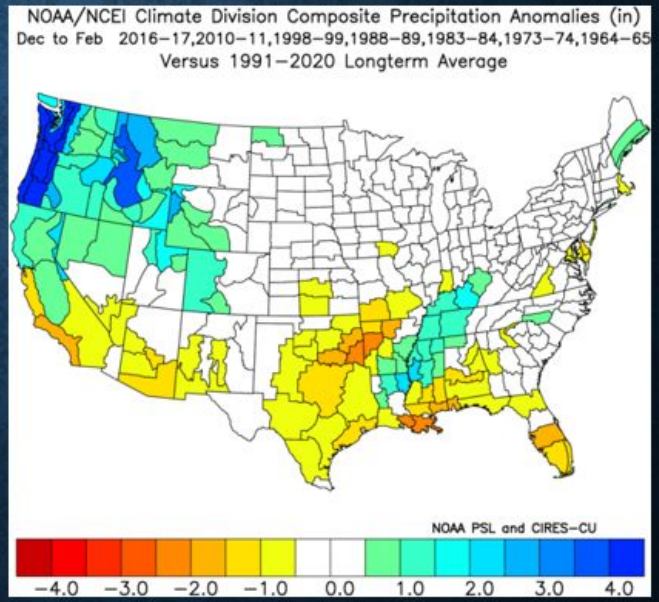
- 1964/65
- 1973/74
- 1983/84
- 1988/89
- 1998/99
- 2010/11
- 2016/17

Temperature



Colder Winters

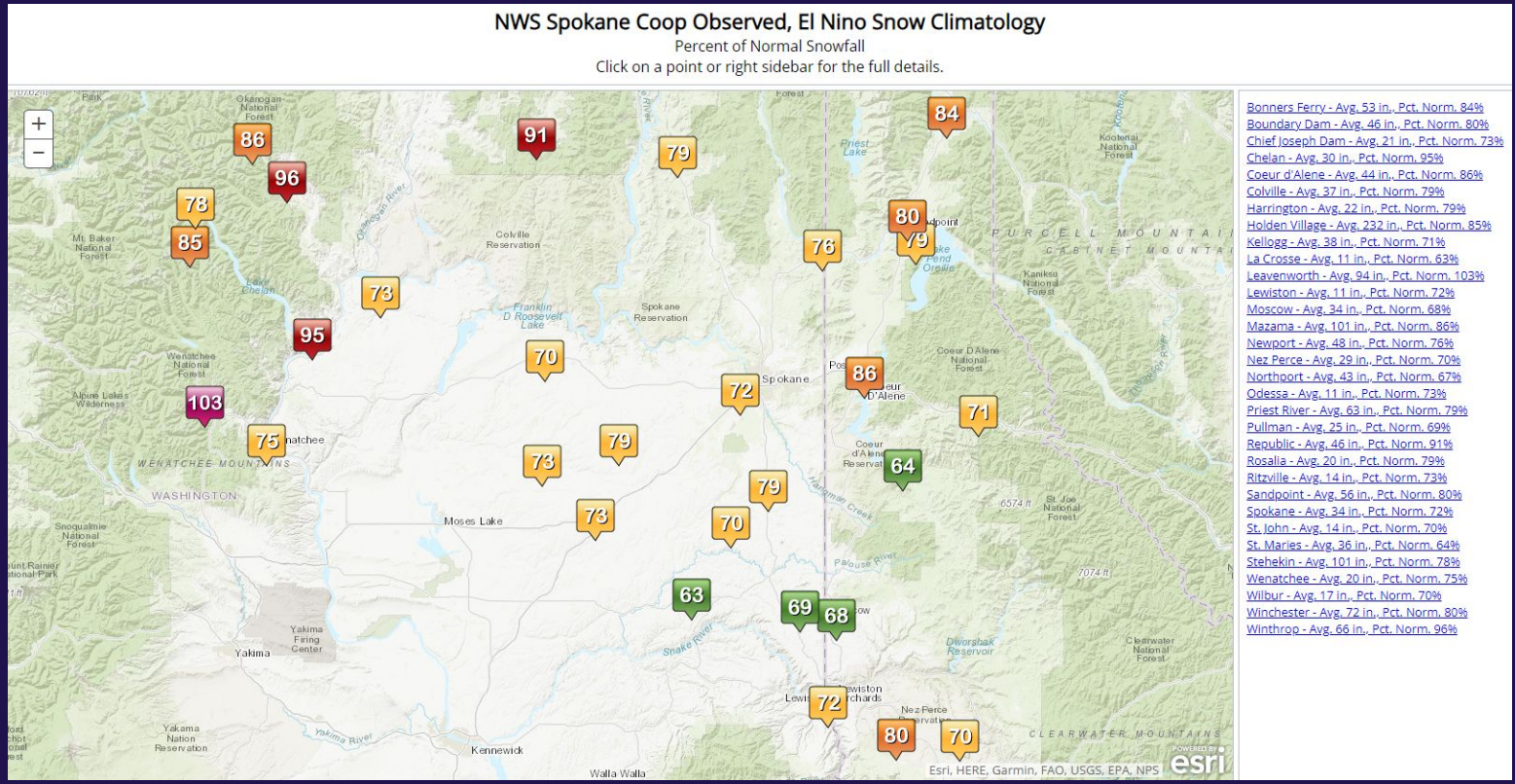
Precipitation



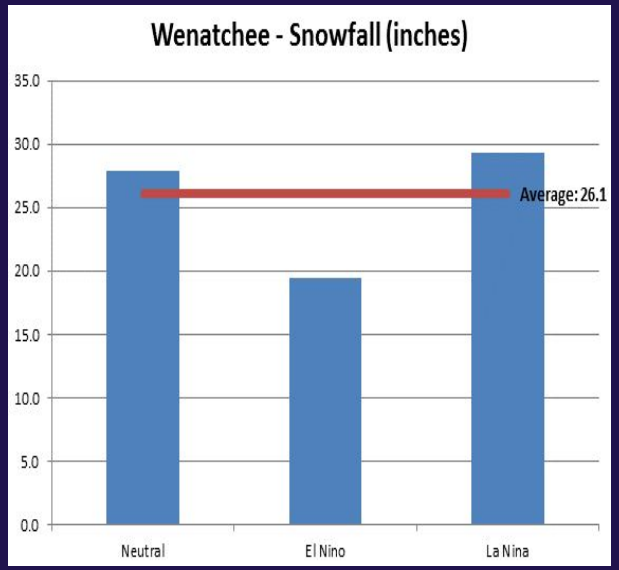
Wetter Winters

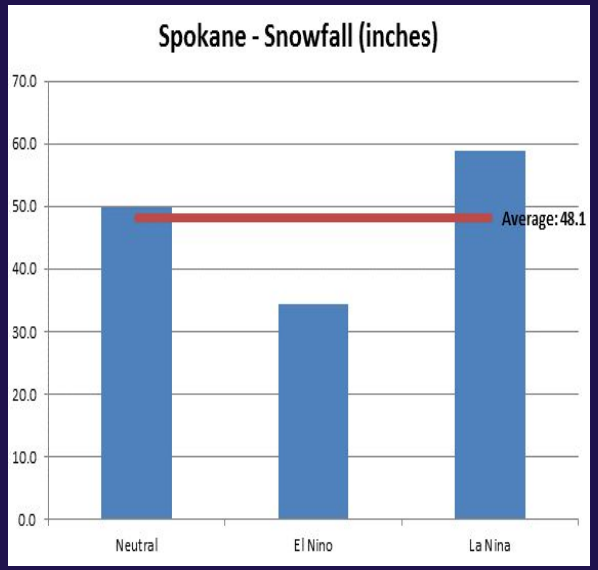
Interactive El Niño Snow Climatology

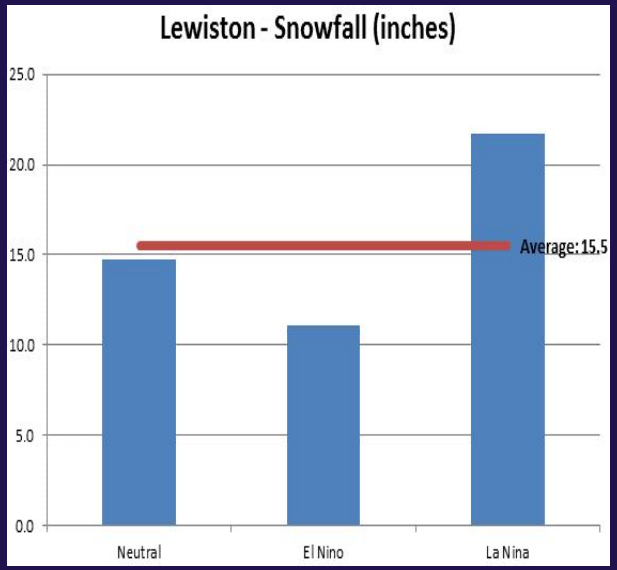
https://www.wrh.noaa.gov/otx/climate/coop/enso/ninaosnow/ninocoopsnowavgmap.php



Snow Sites - Clickable Points

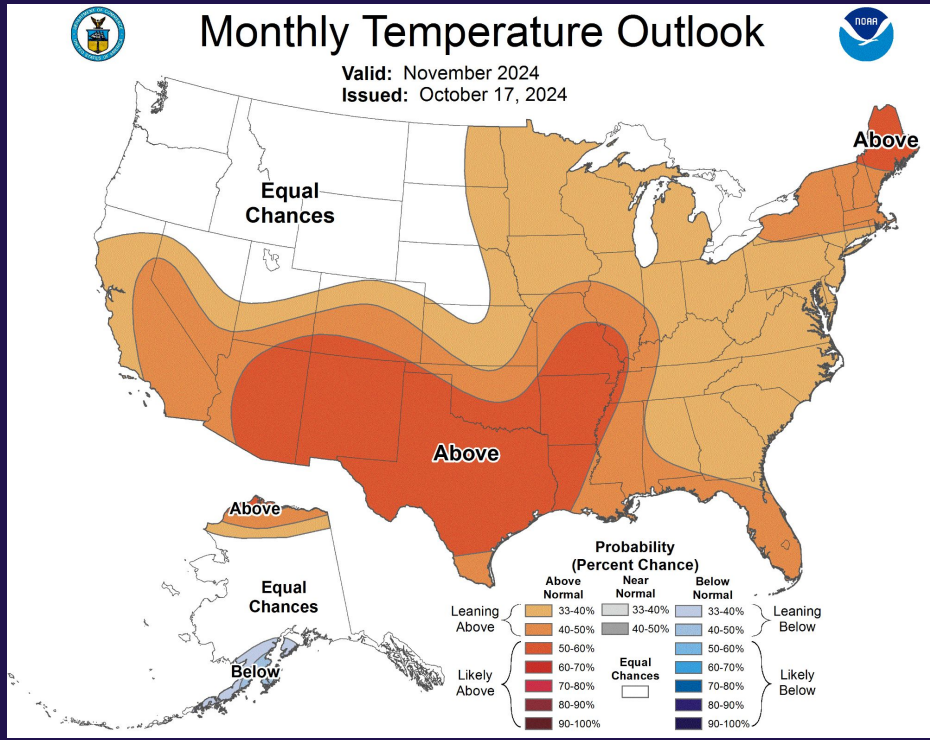


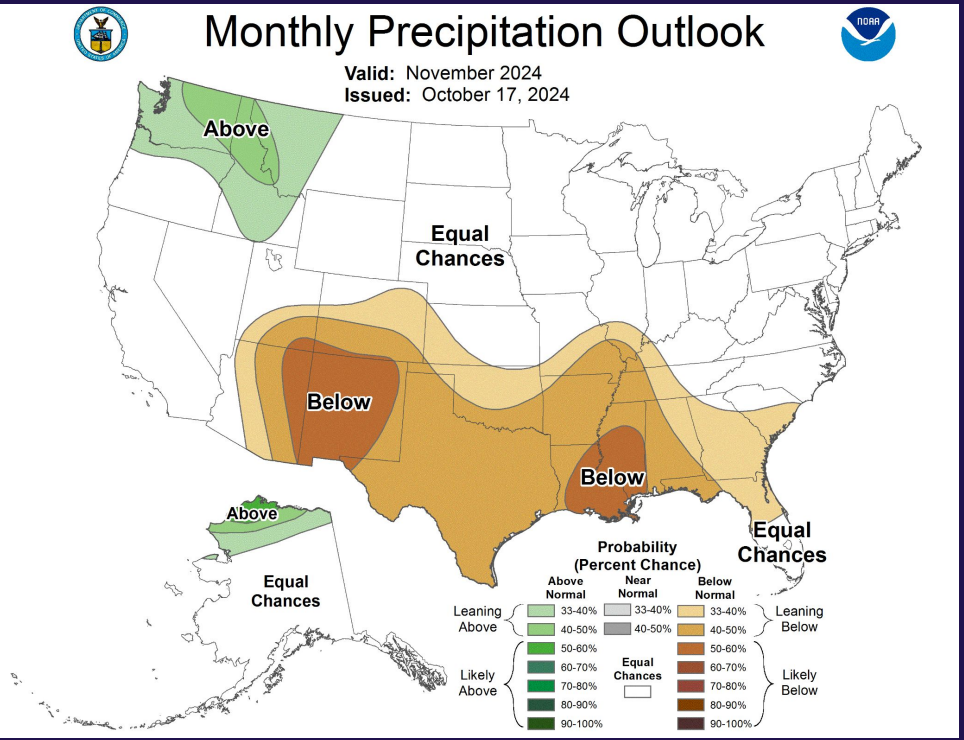




One Month Outlook
November

www.cpc.noaa.gov





Three Month Outlook

November - January

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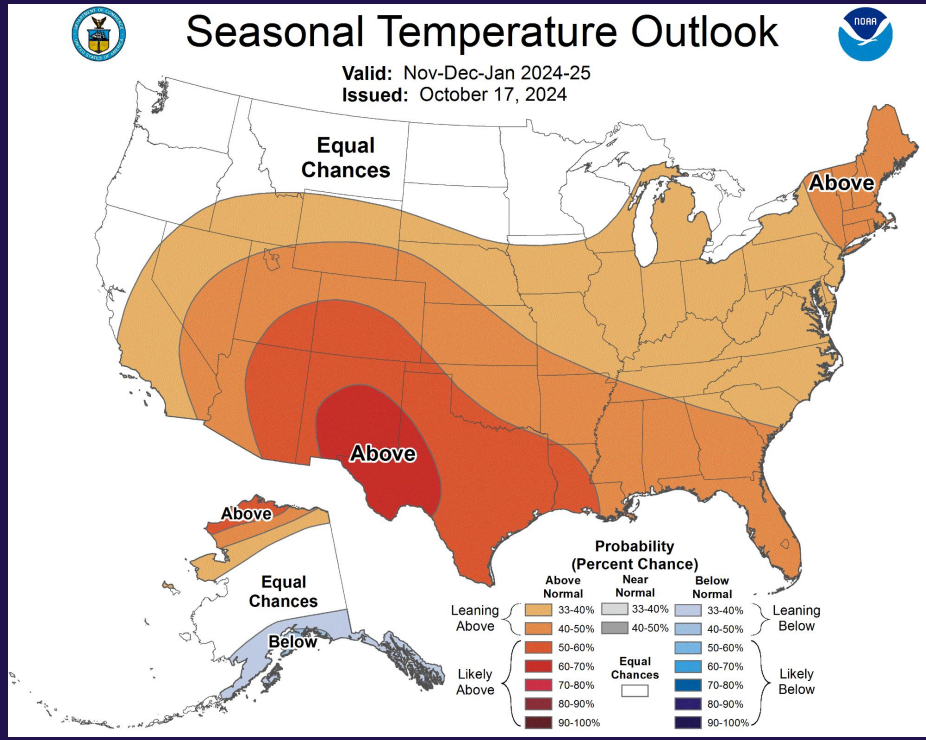

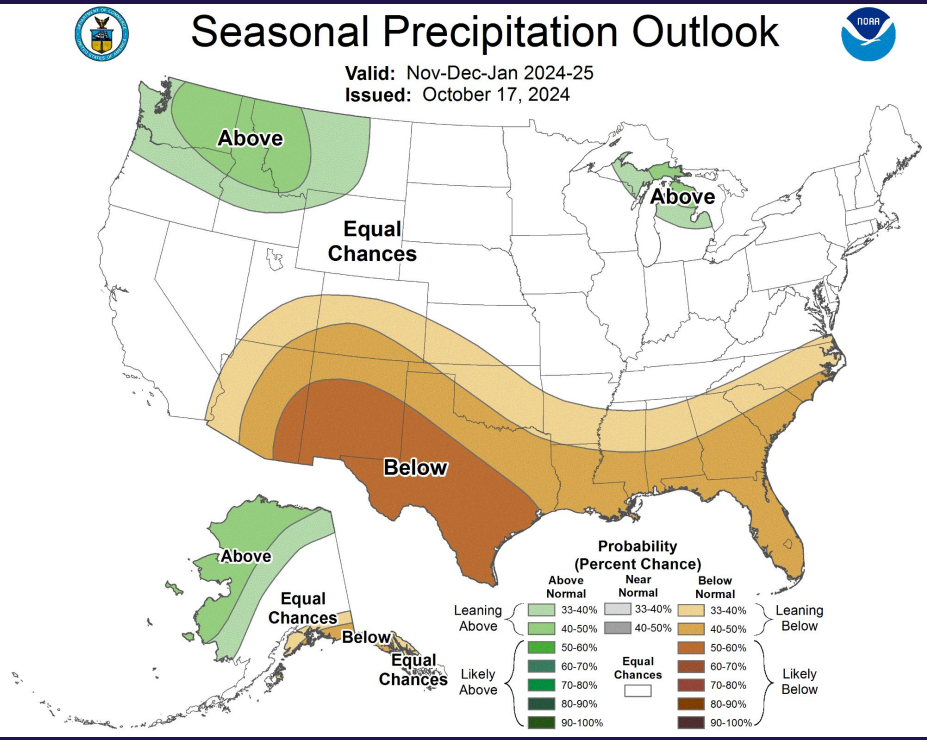

Key Points – Winter Outlook

- La Niña - She's on her way
- Fall should remain mild with seasonal precipitation
- Trending wetter and cooler than normal for the later half of the winter
- La Niña favors higher stream flows, drought improvements, increased snowpack, and a risk of floods

nws.spokane@noaa.gov

THANK YOU!

What's Next?

Visit cocorahs.org

- Register if you want to join
- Review training videos and slides
- Check out the latest precipitation maps

Any Questions?

Unmute yourself to talk

NATIONAL WEATHER SERVICE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION

Spokane, WA

www.weather.gov/spokane