Advanced Weather Spotting for the Inland Northwest

SKYWARN

Spring 2023

National Weather Service - Spokane

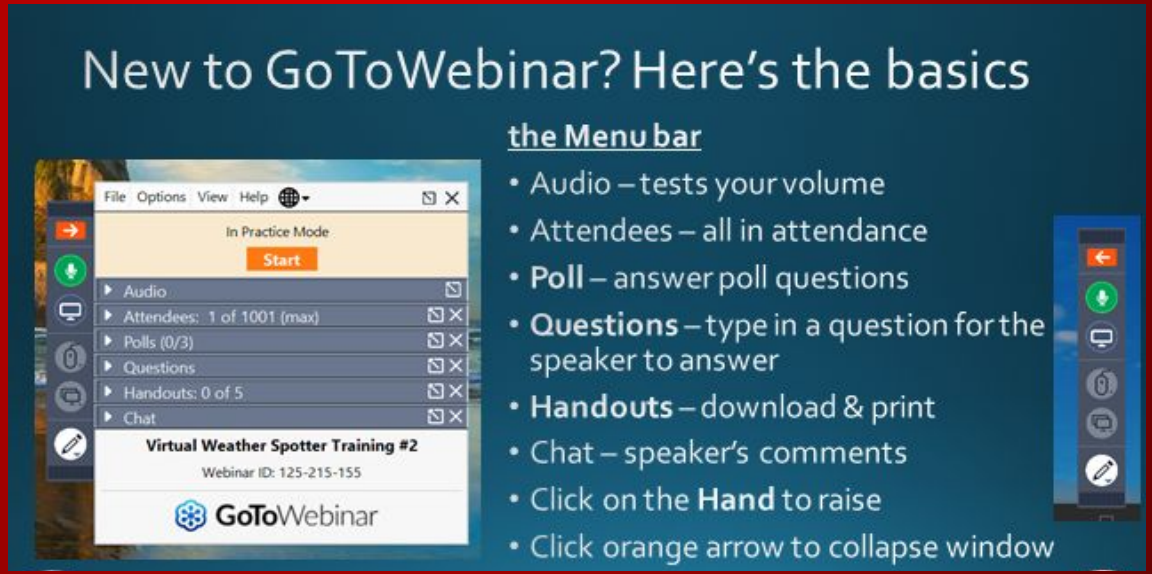
Tornadic Thunderstorm viewed from Dishman Hills on May 6, 2022 (courtesy of Joe Bruce)

National Weather Service - Spokane, WA

www.weather.gov/spokane

This is a Live Virtual Class

- Voice in Computer - no phone needed - headphones helpful
- All are in listen mode until the end



Objectives

- Understand the roles & importance of the Weather Spotter
- Describe your community's severe weather threats
- Provide accurate and timely reports of severe weather
- Properly define a severe thunderstorm and basic thunderstorm structure
- Identify cloud types and features of thunderstorms.
- Learn how to prepare and be safe during severe weather

Concentration on Thunderstorms and Severe Weather Risk Awareness

Now let's look back to last year…

Wind & Tornado Damage - May 6, 2022

Spokane, WA

National Weather Service - Spokane, WA

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Flooding - June 13-14, 2022

Palouse River, St. Joe River and the Pend Oreille River

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Flash Flooding - July 4, 2022

Conconully, WA

National Weather Service - Spokane, WA

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Large Hail - August 11, 2022

Rockford, Otis Orchards to Newman Lake

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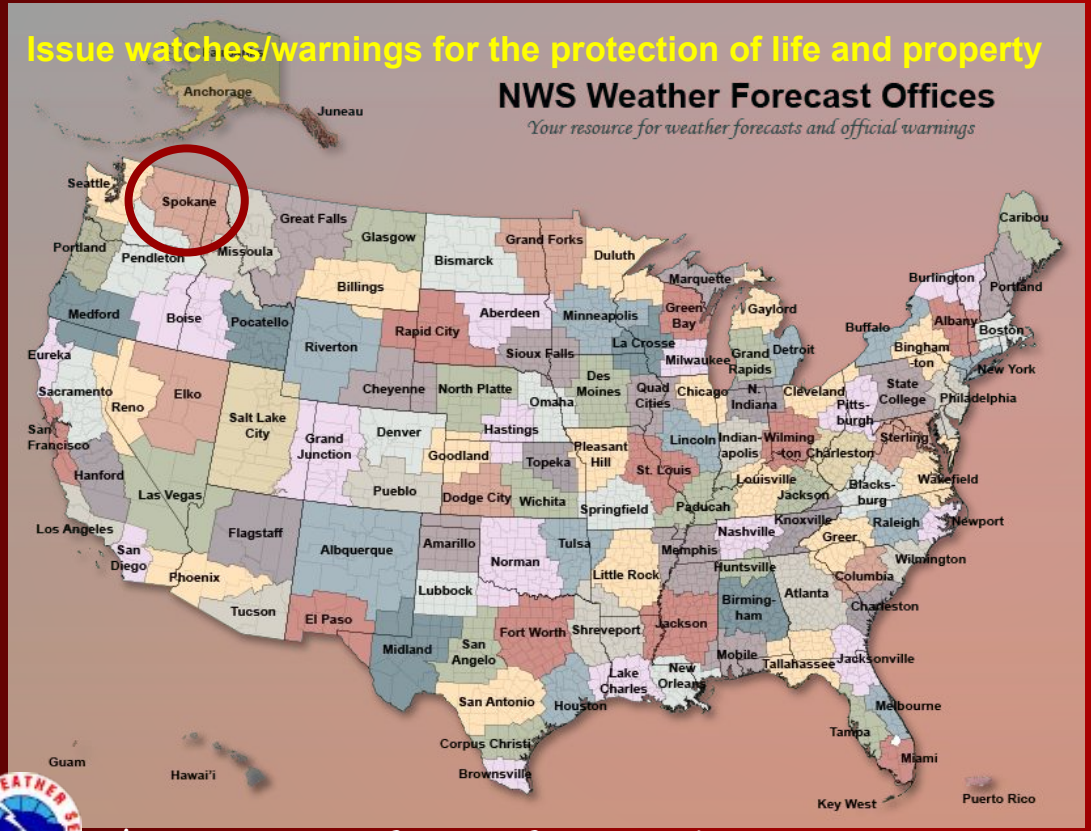
National Weather Service (NWS)

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

NWS Spokane Forecast & Warning Area



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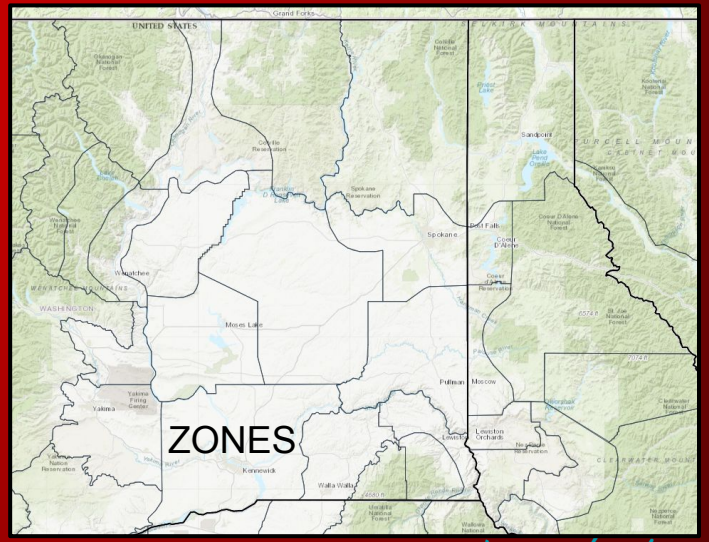
Includes 2 states

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

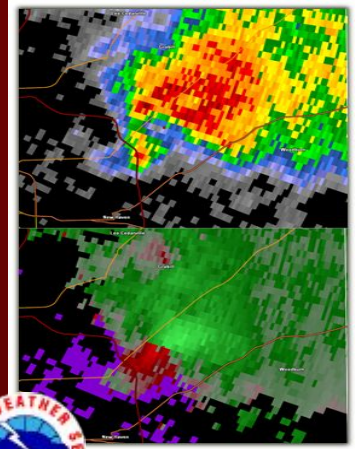
Elevations range

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



www.weather.gov/spokane

Doppler Weather Radar



Reflectivity (dBZ)

Small Particles
Light Rain, Dust, Bugs

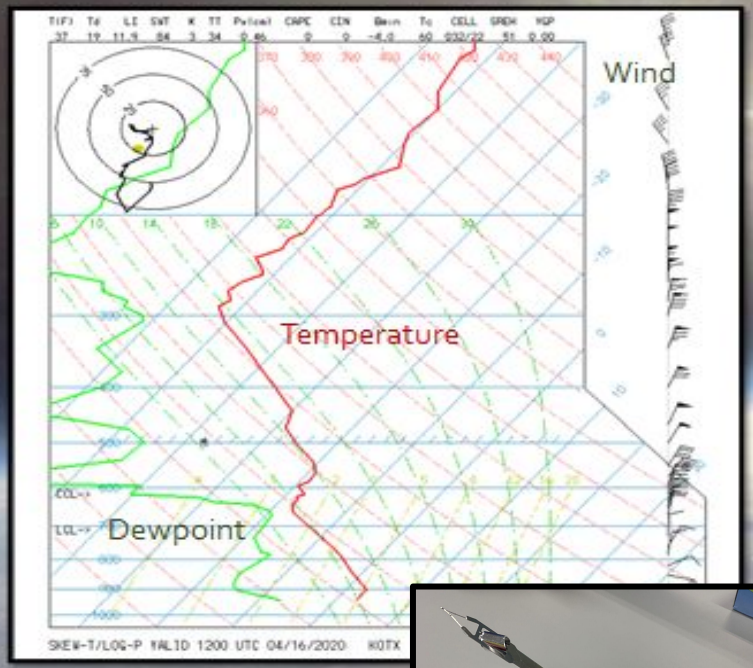
Big Particles
Hail, Big Rain Drops

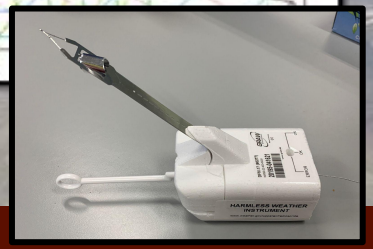
Velocity (kts)

Speed Moving Away from Radar

Speed Moving Toward Radar

Radiosondes





- Twice a day; every day
- 92 Upper Air sites across the U.S.
- About 100,000 ft (~19 miles) high
- One hour and 45 minutes flight
- After the balloon pops, a parachute opens and it falls back to the earth
- Less than 20% are recovered and mailed back
- Radiosonde chart gives a profile of temperature, dewpoint, winds through a column of the atmosphere.

Where to find this chart online?
http://weather.rap.ucar.edu/upper/otx.gif

NWS Spokane web page:
Forecasts tab – Forecast models

Weather Satellites

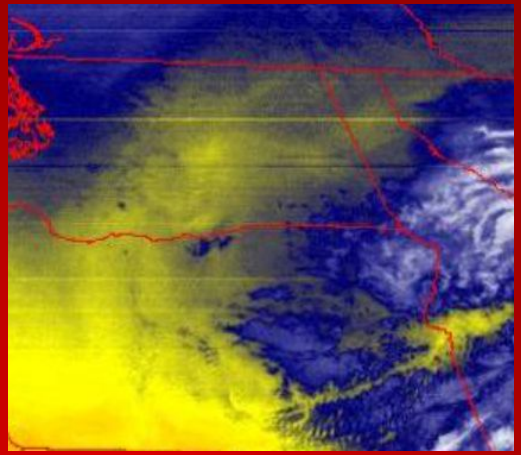
GOES 18 - 16 different channels

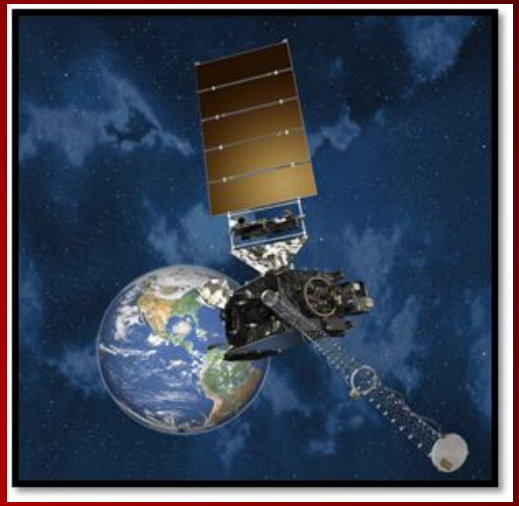
IR, Water Vapor & Visible

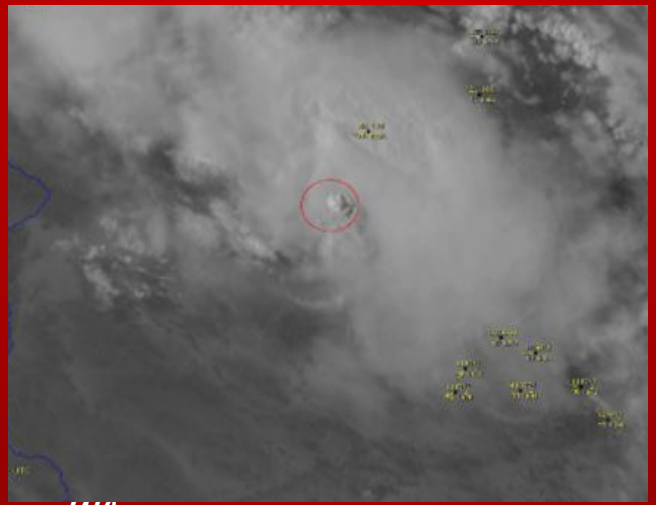
New images every 5 minutes

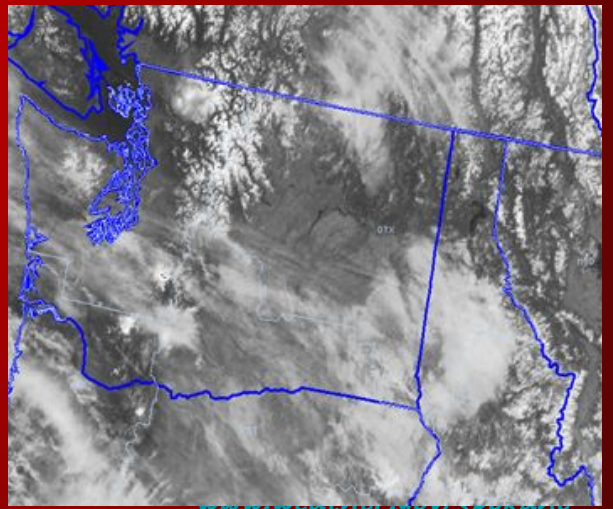
Aids in early detection

Thunderstorms & Wildfires









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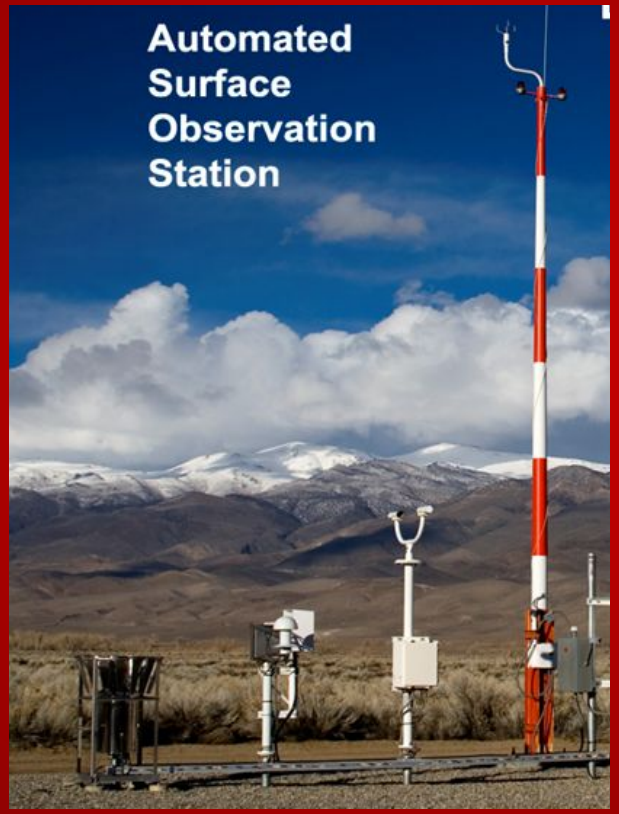
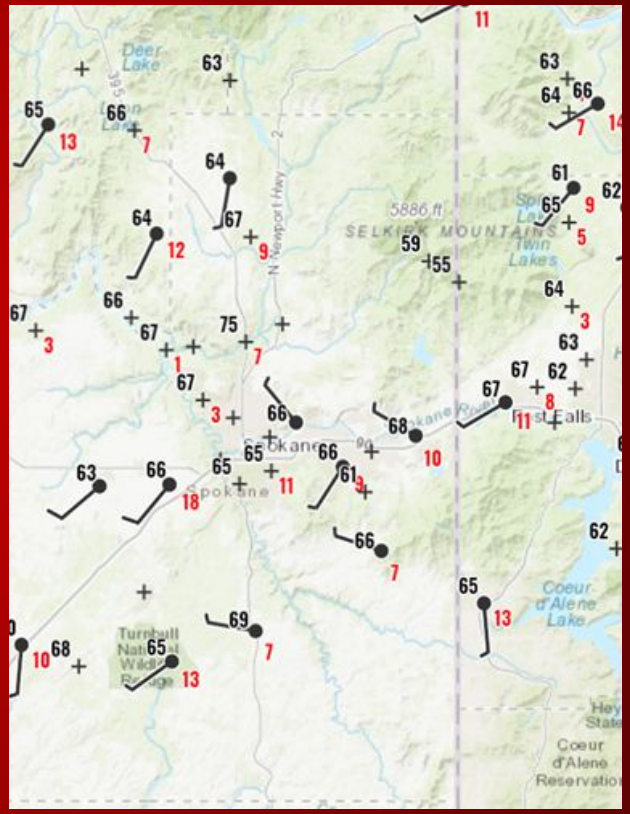
Surface Observations & Web Cams





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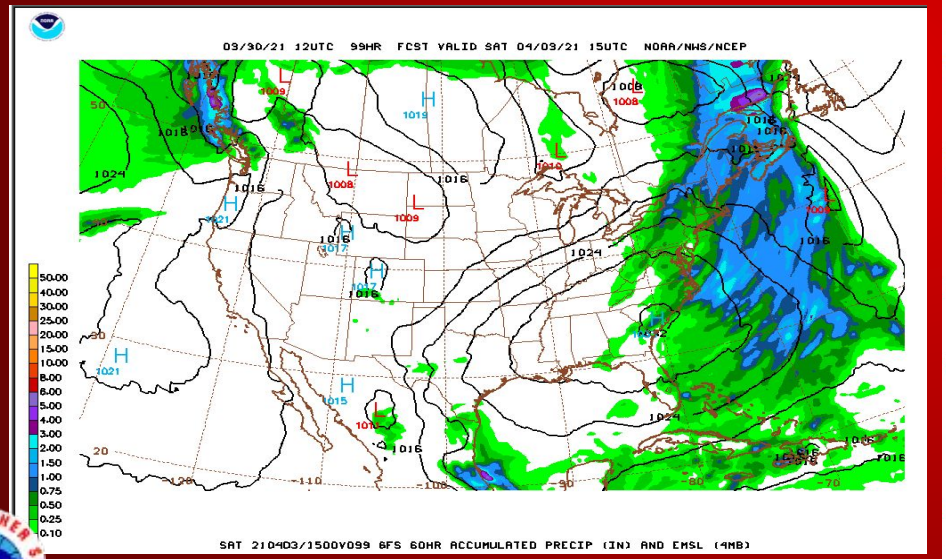
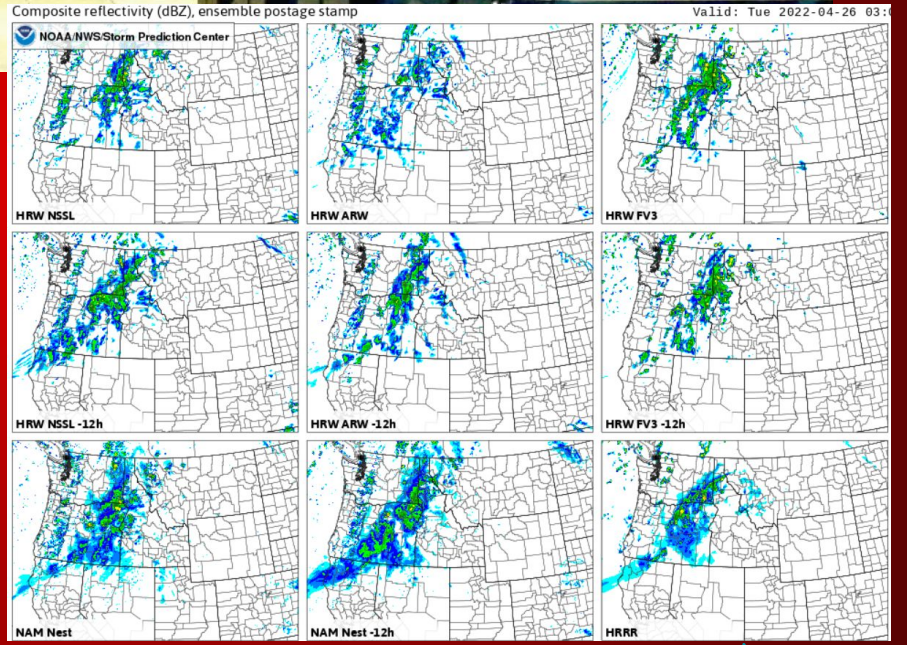
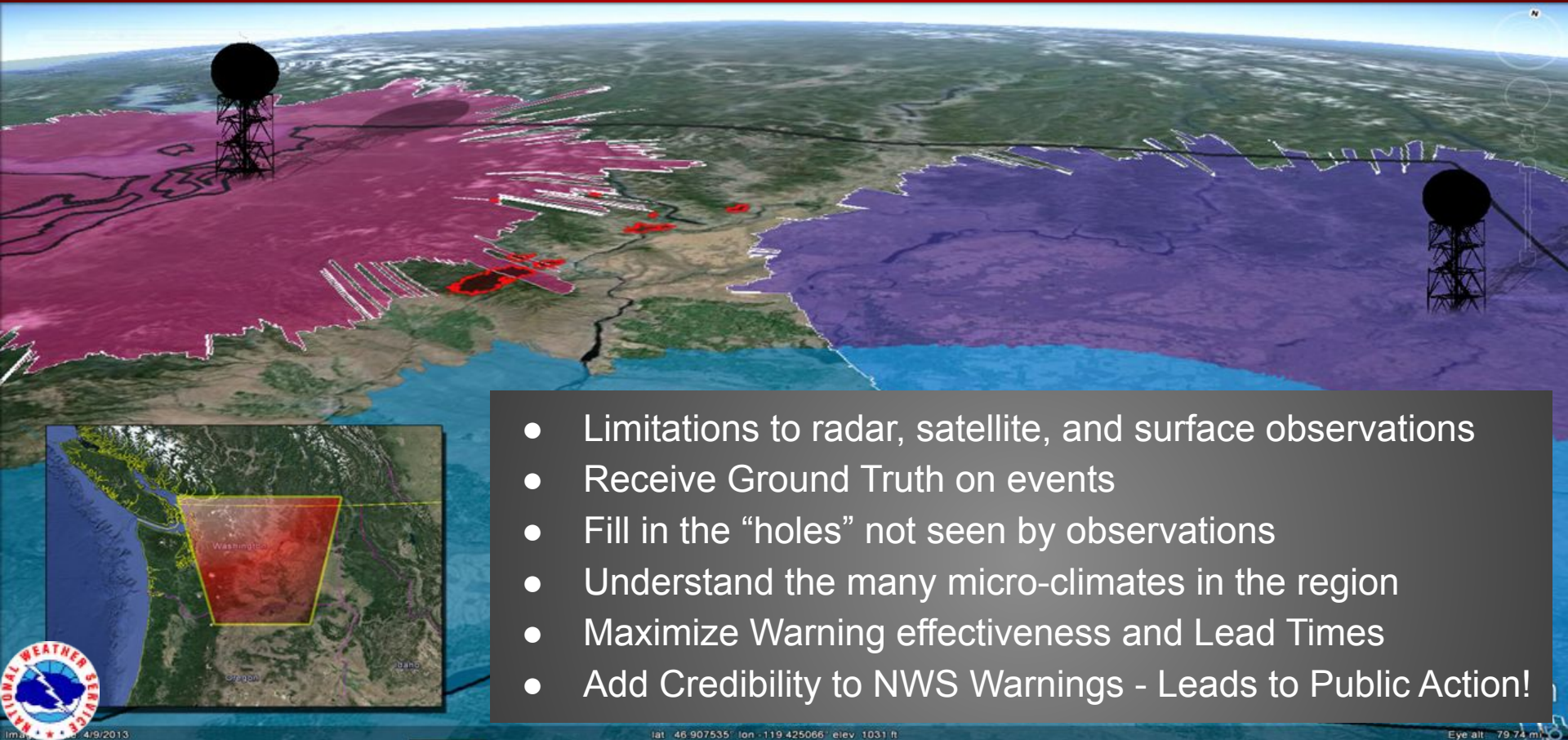
Supercomputers & High Resolution Models





We need weather spotters! Why?



- Limitations to radar, satellite, and surface observations
- Receive Ground Truth on events
- 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!

#1 Poll Question

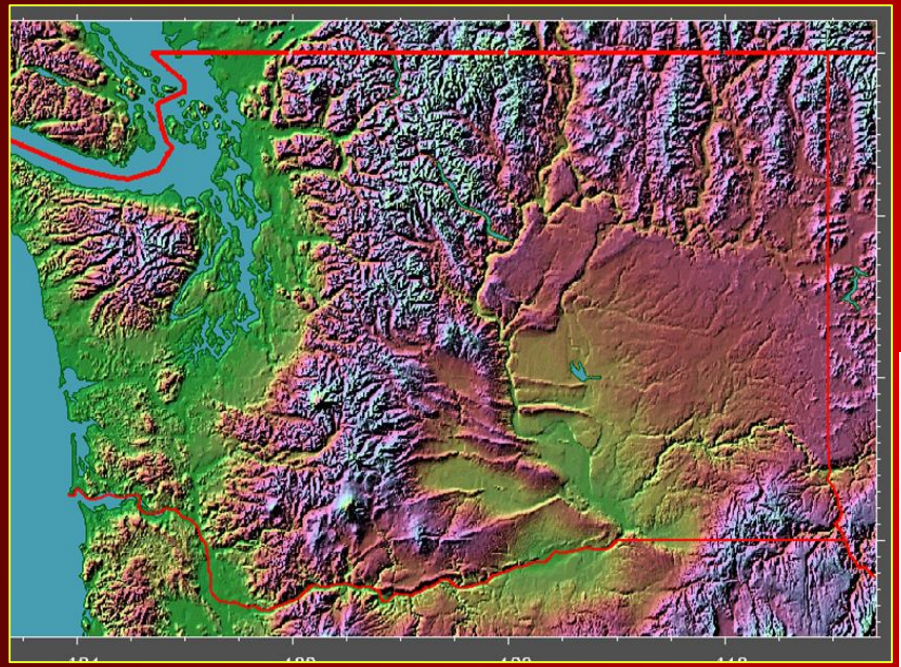
Why are weather spotters important?

Weather Hazards Change with the Seasons

- Flooding - river flooding and flash flooding
- Fire weather - wind and dryness - lightning and smoke
- Thunderstorms - hail, wind, rain and lightning
- Winter storms - snow, ice, rain and wind

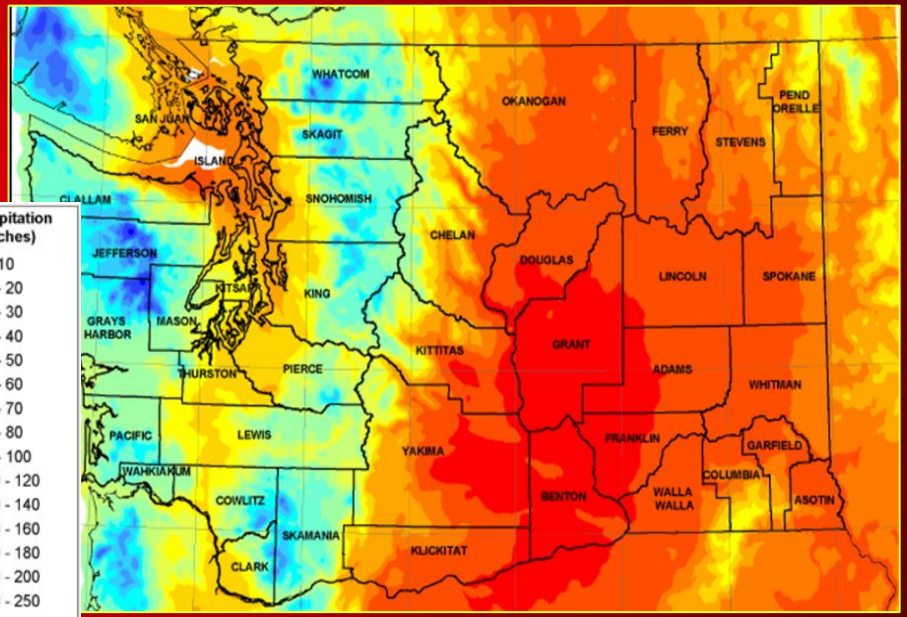



Terrain Makes ALL the Difference



Topography Map

Average Annual Precipitation Map



National Weather Service - Spokane, WA

www.weather.gov/spokane

What's in a Spotter Report?

Specifics...Tell us the Story!

Spotter ID & Location

- Who...What...and Where
- When the event began and/or ended
- Estimates of wind speeds and hail size
- Damage and injury reports

If unsure - report your concertainity

Feel free to include reports while traveling and any delayed or second hand reports

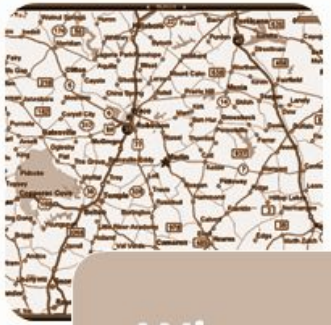
#2 Poll Question

What types of severe or hazardous weather do we NOT experience in the Inland NW?

How Spotters Report - Easiest Phone Call

Dial :
1-800-483-4532
Spotter ID

What:
Event you Witnessed

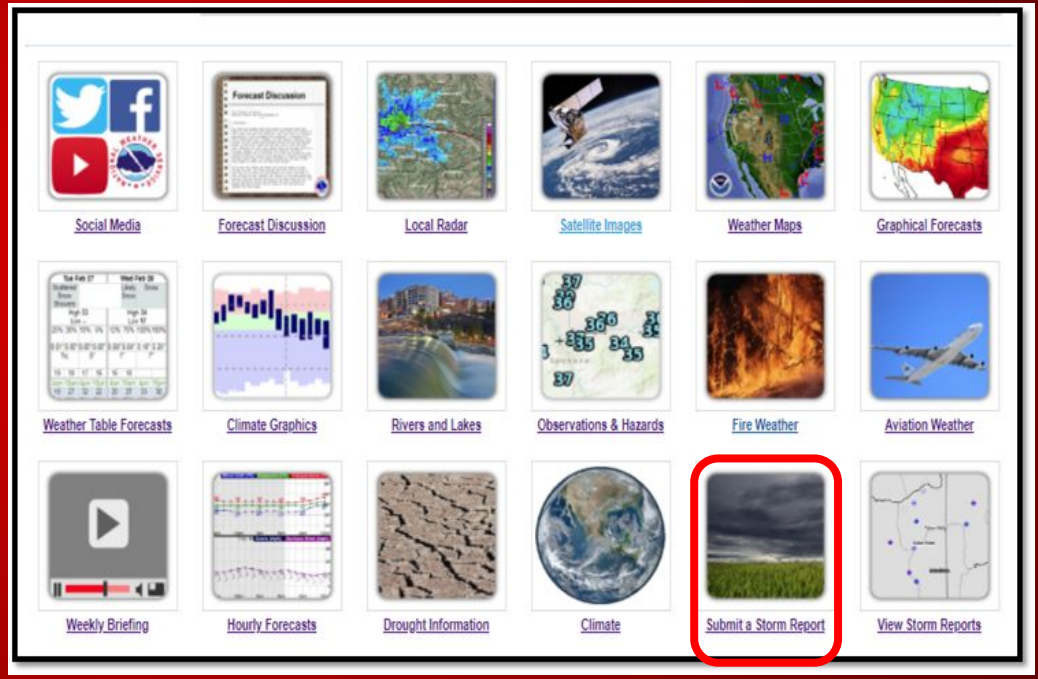


Where:
Location of event

When:
Time of the event

How Spotters Report – Just as easy Online Reports

www.weather.gov/Spokane



Share weather data - Social Media

Twitter

- @NWSSpokane
- #wawx & #idwx
- Share reports & pictures
- Monitored 24/7

Facebook

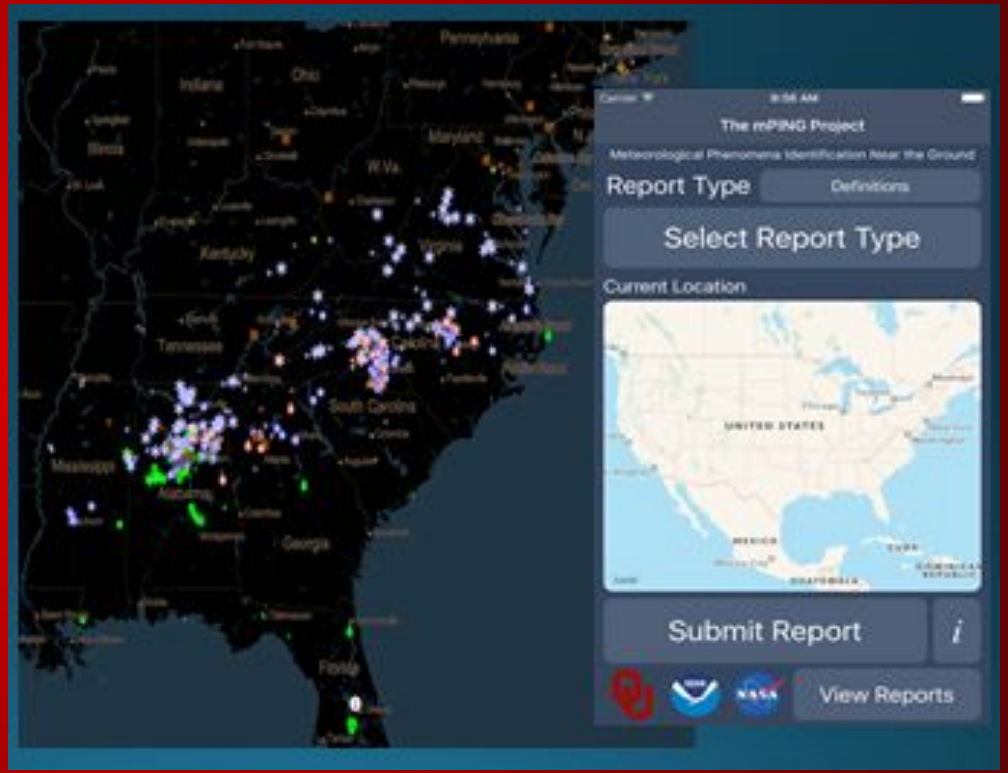
- NWS Spokane
- Send reports & pictures
- Monitored 24/7

National Weather Service - Spokane, WA

www.weather.gov/spokane

Share weather data - mPING

- Smartphone App
- Available on IOS and Android
- Reports sent to NWS
- Reports are anonymous
- Crowdsourcing
- Very easy to use
- https://mping.nssl.noaa.gov



Share weather data - Email Photos

nws.spokane@noaa.gov

National Weather Service - Spokane, WA

www.weather.gov/spokane

Emails are Important

Besides a phone number, it's important to share your email address!

You will likely be notified by email before there is a WIDESPREAD Severe Weather Risk or Thunderstorm Outbreak.

We send periodic emails to share quarterly newsletters and upcoming training opportunities.


YOUR NATIONAL WEATHER SERVICE SPOKANE QUARTERLY REPORT

Vol XXVIII Issue 1

The Weather Watcher

Of the Inland Northwest

www.weather.gov/Spokane

March 2023

NWS may Contact You!

As a registered weather spotter, you'll share your phone number with the NWS.

If we see severe or hazardous weather near your location...

We will likely try to call you to get get information on what you are experiencing (ground truth) based on what is seen on radar!

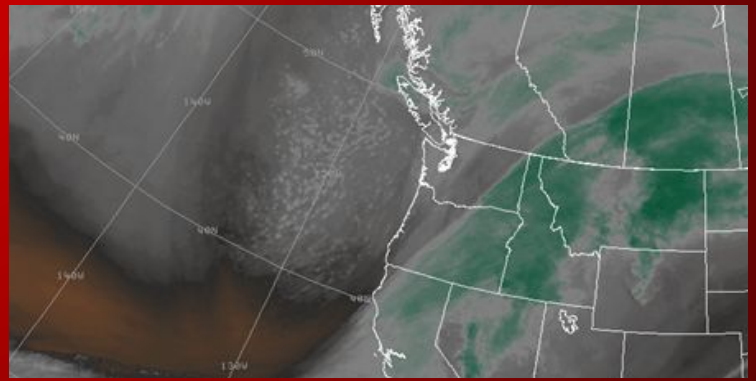
#3 Poll question

What would be your preferred way to send reports to the NWS?

Thunderstorm Hazards

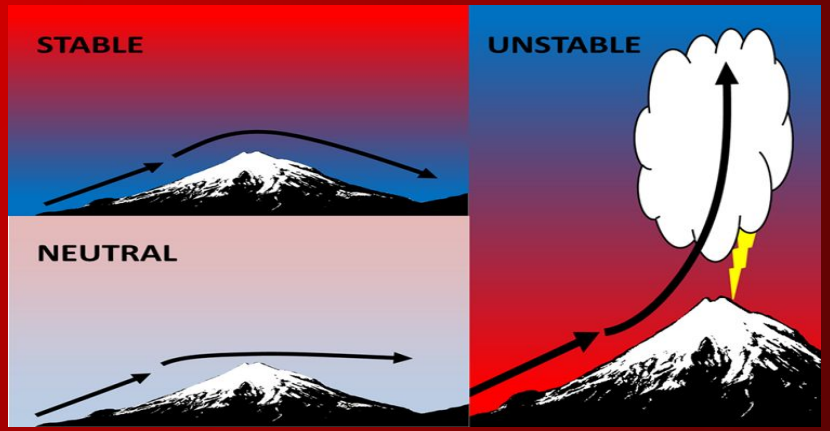
Ingredient #1: Moisture

- Forms the clouds and precipitation associated with thunderstorms
- Primary Sources: Pacific Ocean
- Occasionally: Gulf of California/Mexico during Monsoon Season
- Monitor with satellite, upper level soundings and surface observations
- Terms: Precipitable Water, Dewpoint, Relative Humidity



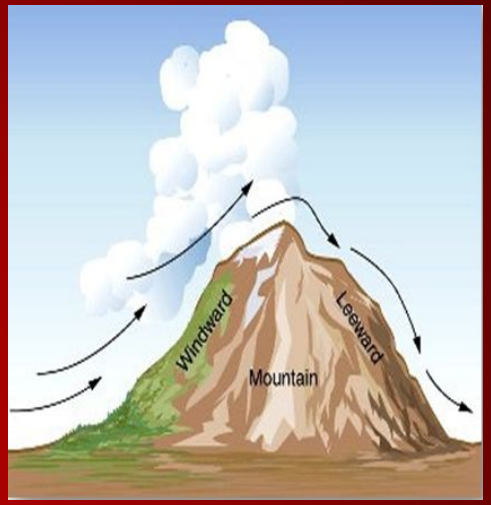
Ingredient #2: Instability

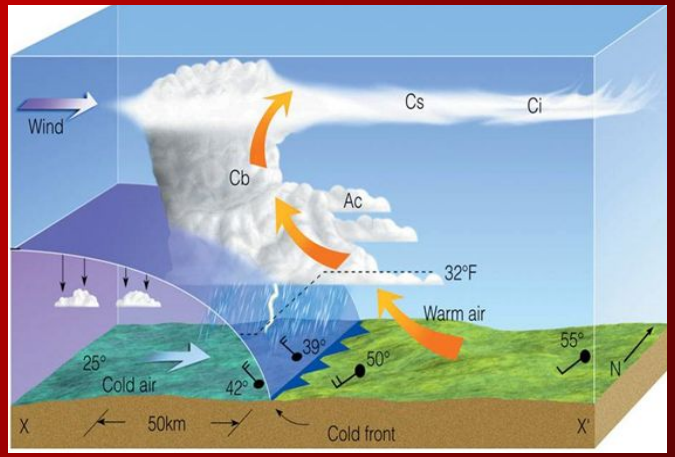
- How the atmosphere naturally mixes
- Unstable: warm moist air near the ground with cold air above
- Stable: cold air at the surface and warm air above
- Monitor with upper level soundings and surface observations
- Terms: CAPE, Lifted Index, Lapse Rates



Ingredient #3: Lifting Mechanism

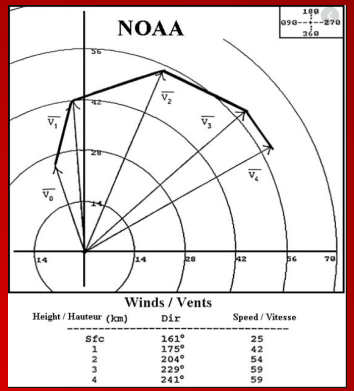
- Something to force the air upward in the atmosphere
- Mountains/Terrain: air forced up a slope
- Cold Front: air is forced up by a frontal boundary
- Monitor with satellite, radar, upper level soundings and surface observations
- Terms: vertical velocity, vorticity, fronts

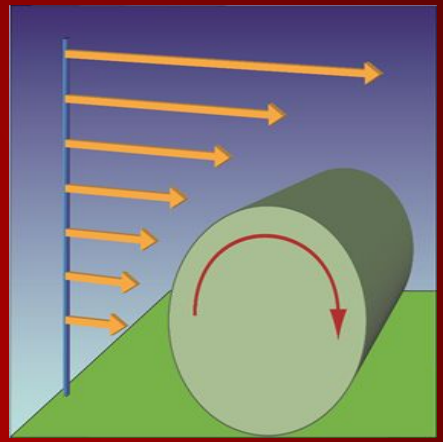


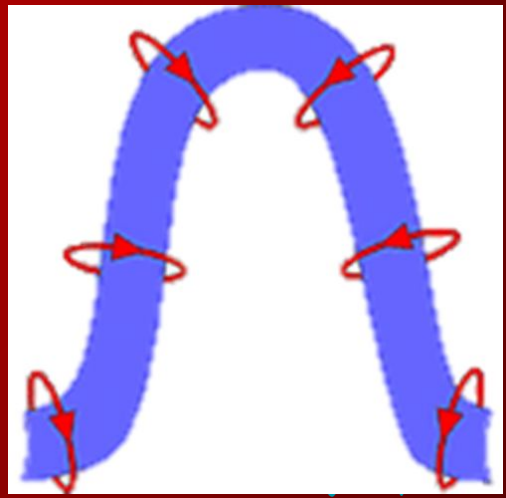


Ingredient #4: Wind Shear

- Creating the rotation
- Changes in wind speed & direction with height
- Monitor with radar, upper level soundings and surface observations
- Terms: Helicity, Shear, Hodograph



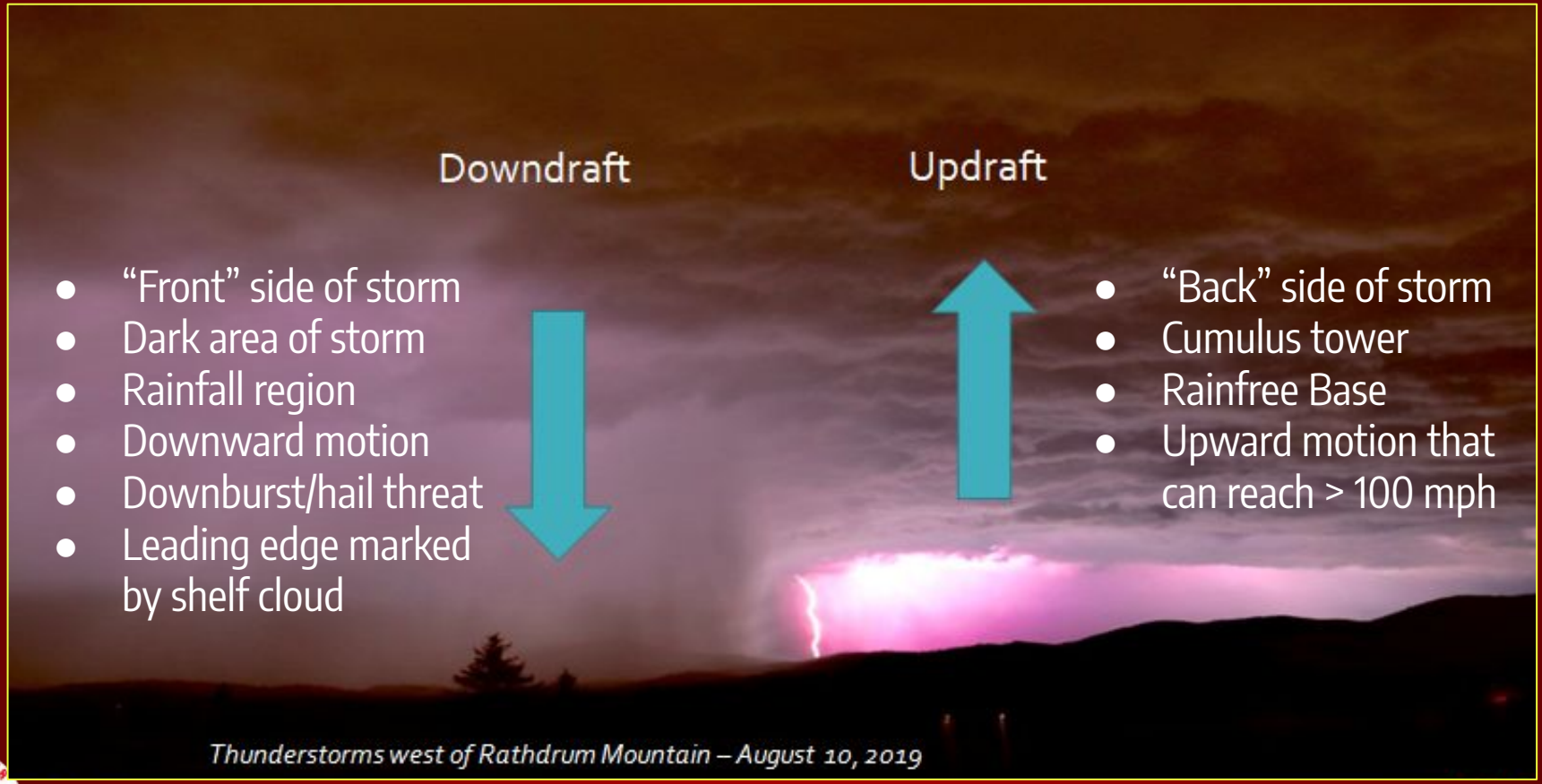




S-L-I-M – Basic Thunderstorm Elements

Shear	Lift	Instability	Moisture
Changing wind speed and direction with height	Mechanism to force air upwards	"Energy" for thunderstorms	Obviously!
Helps storms become better organized, increasing severity and longevity	Creates a focus for where storms can develop	Ability for air to rise or sink as storms develop	Needed to produce clouds and storms
Common ahead of or along a front	Cold Front, Warm Front, Leftover storm boundary, Lake Breeze	Warm surface, cool upper levels (cools at a very fast rate as you go up)	Use Dew Point

Thunderstorm Basics



What is a Severe Thunderstorm?

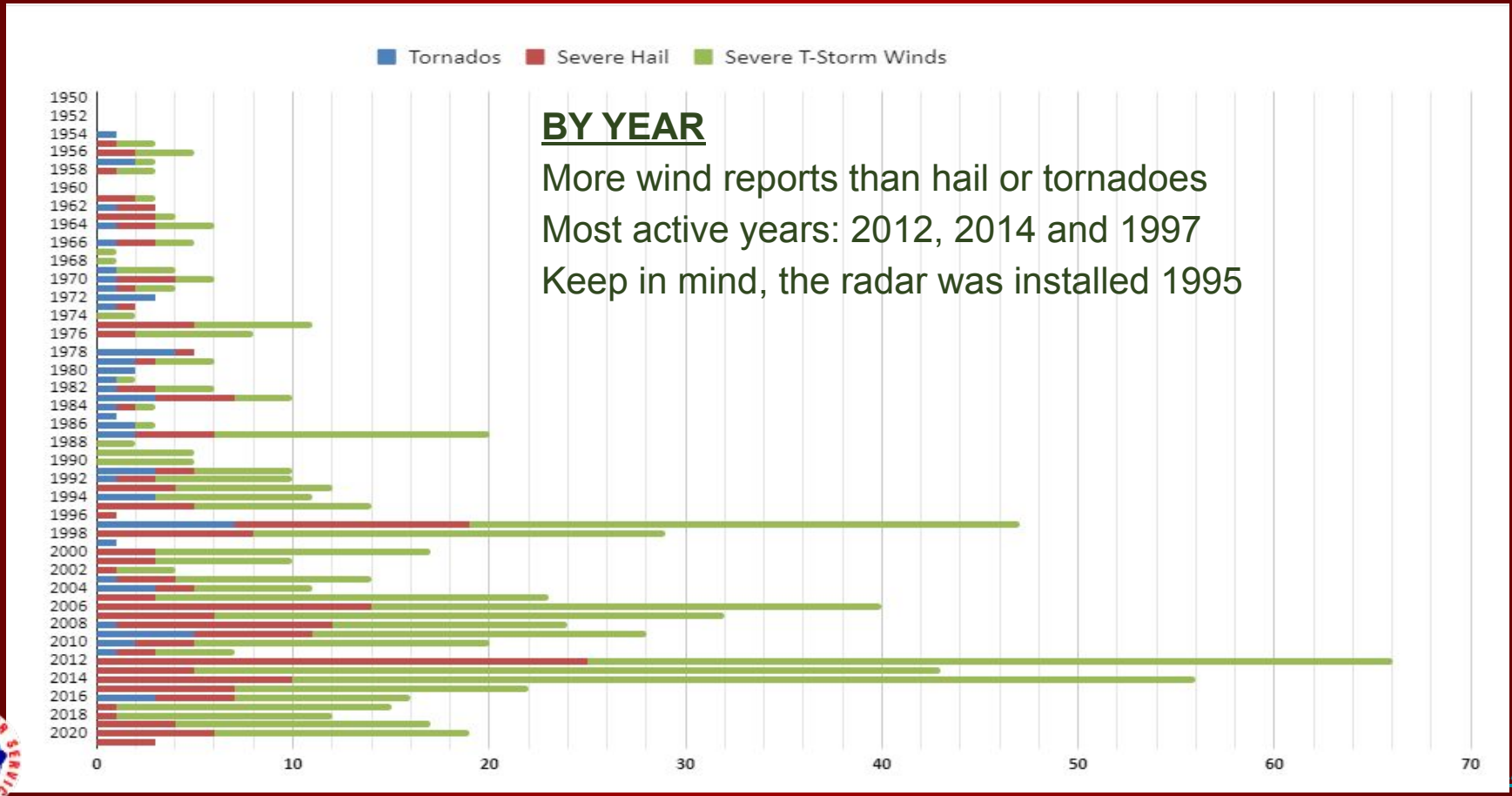
Winds ≥ 58 mph or Wind Damage

Hail > 1” in diameter

Tornado

- Less than 10% of all thunderstorms are Severe
- Though Lightning is ALWAYS extremely dangerous,
  the amount of lightning does not make a storm SEVERE.

Local Severe Weather Climatology



BY YEAR

More wind reports than hail or tornadoes

Most active years: 2012, 2014 and 1997

Keep in mind, the radar was installed 1995

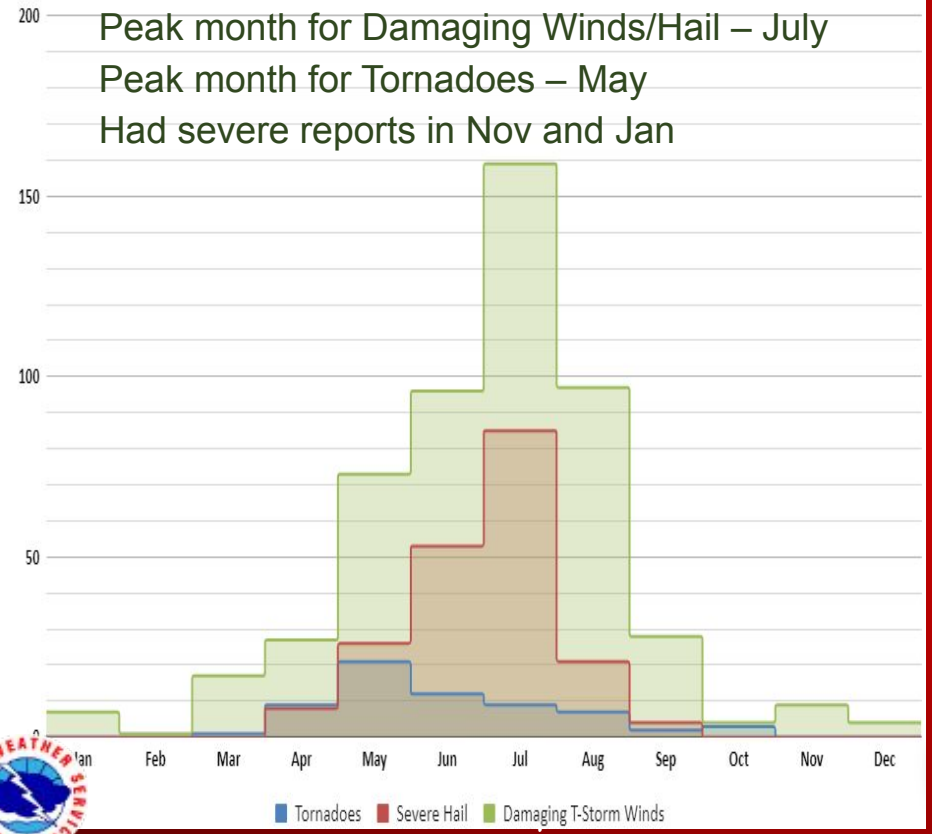
Local Severe Weather Climatology

BY MONTH

Peak month for Damaging Winds/Hail – July

Peak month for Tornadoes – May

Had severe reports in Nov and Jan

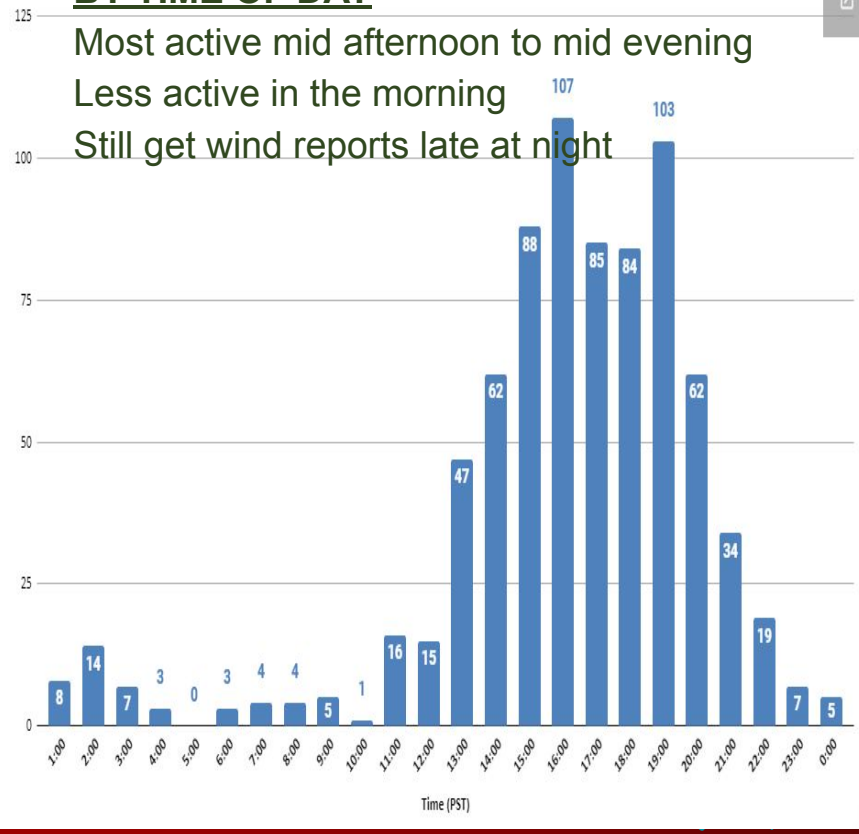


BY TIME OF DAY

Most active mid afternoon to mid evening

Less active in the morning

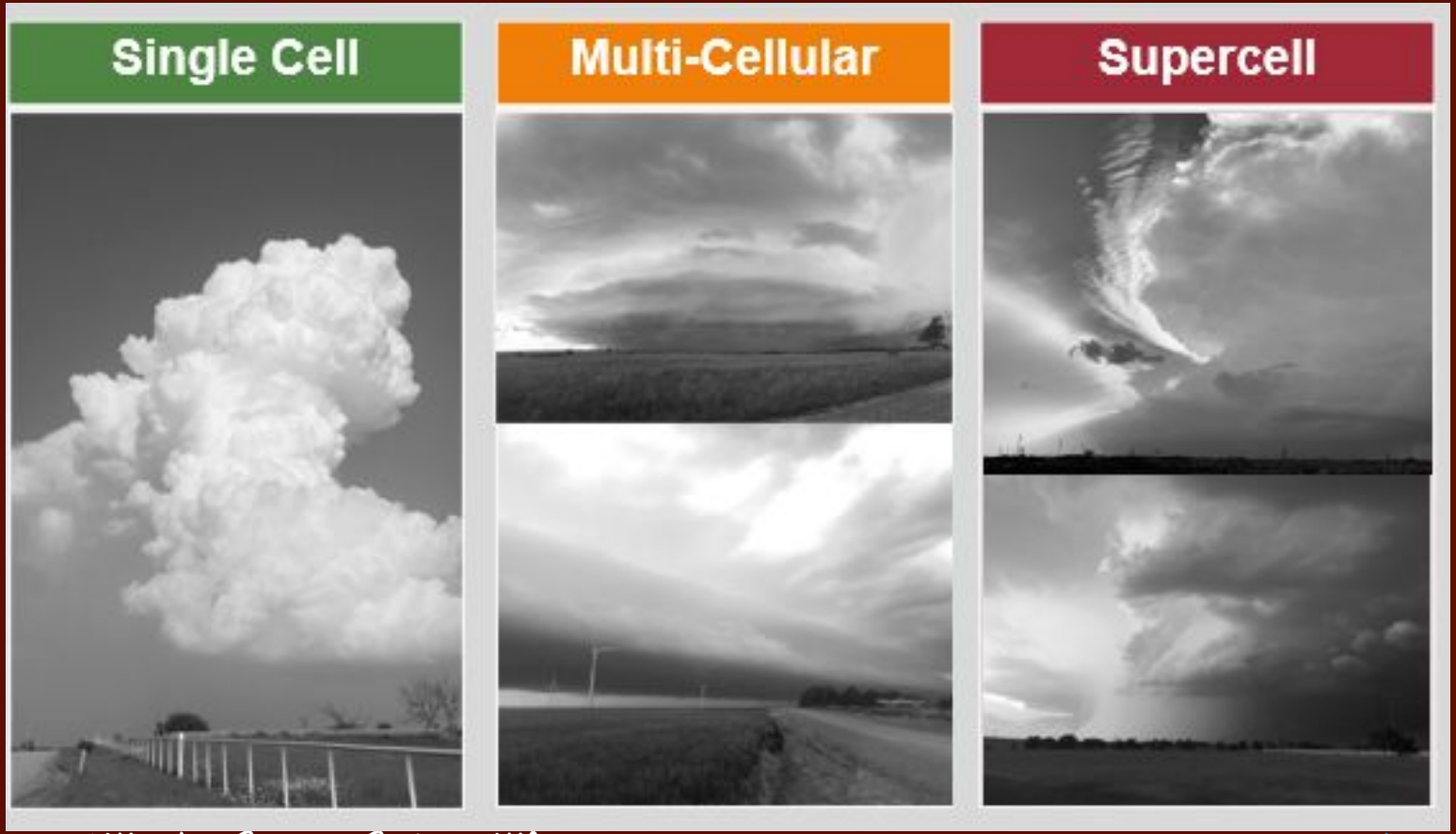
Still get wind reports late at night



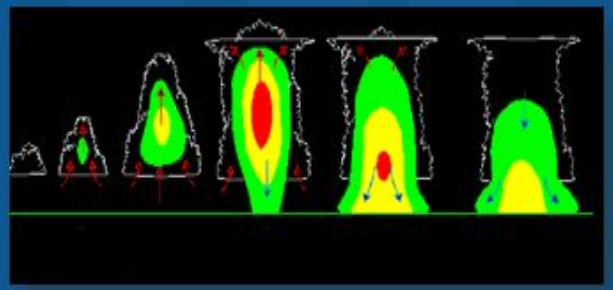
#4 Poll Question

What would be a good ingredient for thunderstorm development?

Types of Thunderstorms



Single Cell Thunderstorm



Mostly Non-Severe

Life Cycle of < 30 minutes

May Contain Small Hail

& Gusty Winds

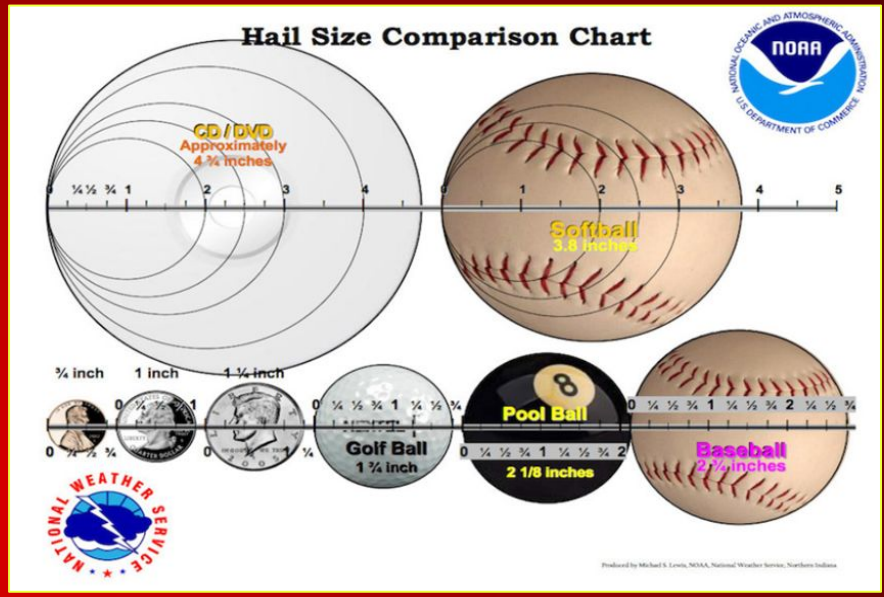
Heavy Rain

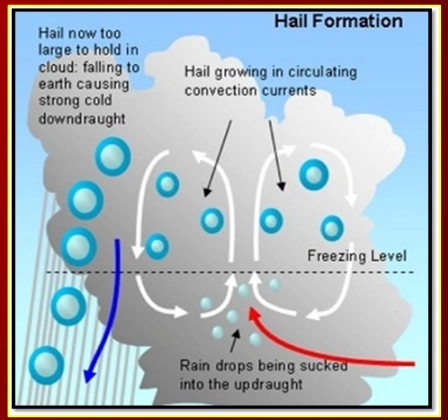
Report heavy downpours or long periods of steady rain
Give specific locations - streets and creeks

- 0.50”+ in 1 hour - convective
- 1.0” in 12 hours or 1.5”+ in 24 hours - stratiform

Hail

- Strong updraft keeps chunks of ice aloft
- Circulated within a storm and collects layers of water and freezes
- Can fall to the ground at > 100 mph
- Severe hail ≥ 1” diameter
- Always report the largest Hailstone you see in the pile.





Damaging Winds

- Strong downburst winds or straight line winds
- Can be convective or sustained strong winds
- Report any winds estimated to be over 40 mph
- Winds that product any damage
  - Downed trees, power lines, structure damage
- Remember, severe/high winds ≥ 58 mph

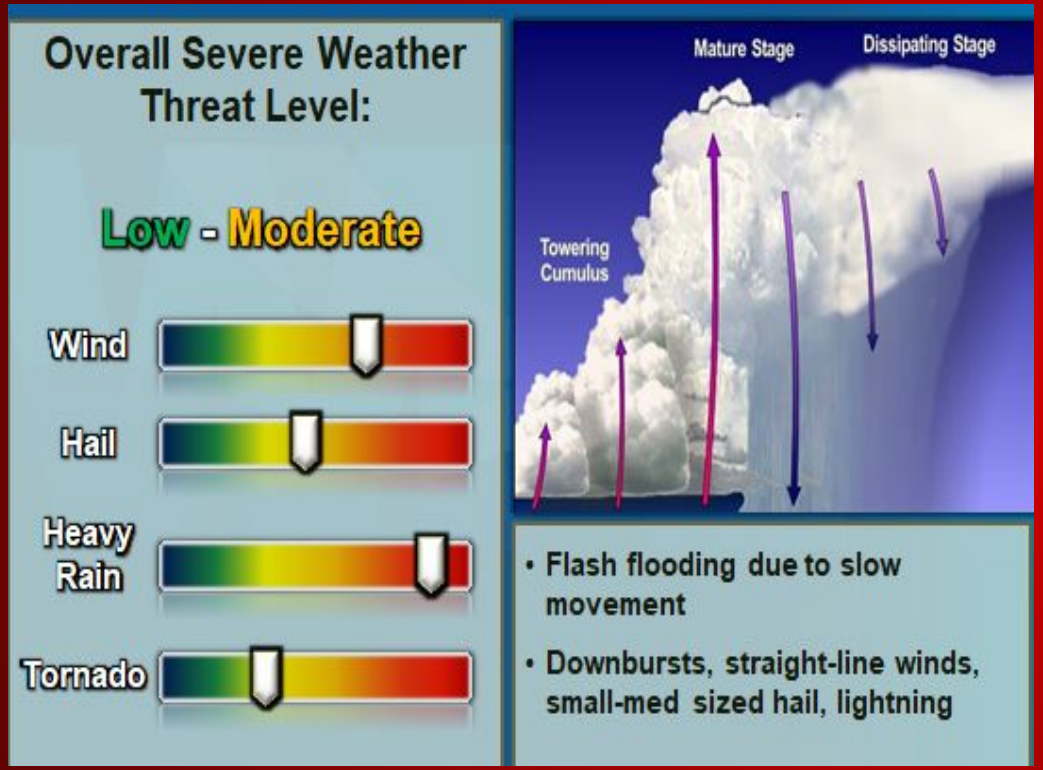
Beaufort Wind Chart – Estimating Winds Speeds

Beaufort Number	MPH Range	MPH Average	Terminology	Description
0	0	0	Calm	Calm. Smoke rises vertically.
1	1-3	2	Light air	Wind motion visible in smoke.
2	4-7	6	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	11	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-18	15	Moderate breeze	Dust and loose paper is raised. Small branches begin to move.
5	19-24	22	Fresh breeze	Smaller trees sway.
6	25-31	27	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult.
7	32-38	35	Near gale	Whole trees in motion. Some difficulty when walking into the wind.
8	39-46	42	Gale	Twigs broken from trees. Cars veer on road.
9	47-54	50	**Severe gale**	**Light structure damage.**
10	55-63	60	**Storm**	**Trees uprooted. Considerable structural damage.**
11	64-73	70	**Violent storm**	**Widespread structural damage.**

Dust Storms

- Prolonged dry spell + strong winds + plowed fields
- Sudden reduction in visibility
- Give locations of roads and intersections
- Also called Haboobs

Multicell Thunderstorms



Downburst & Straight Line Winds

Microburst: affecting an area *less than 2.5 miles* across.

Macroburst: winds extending in *excess of 2.5 miles* across.

Flooding & Flash Flooding

Rising water on rivers, streams & low lying areas

Give specific locations of streams & streets

Turn Around, Don't Drown

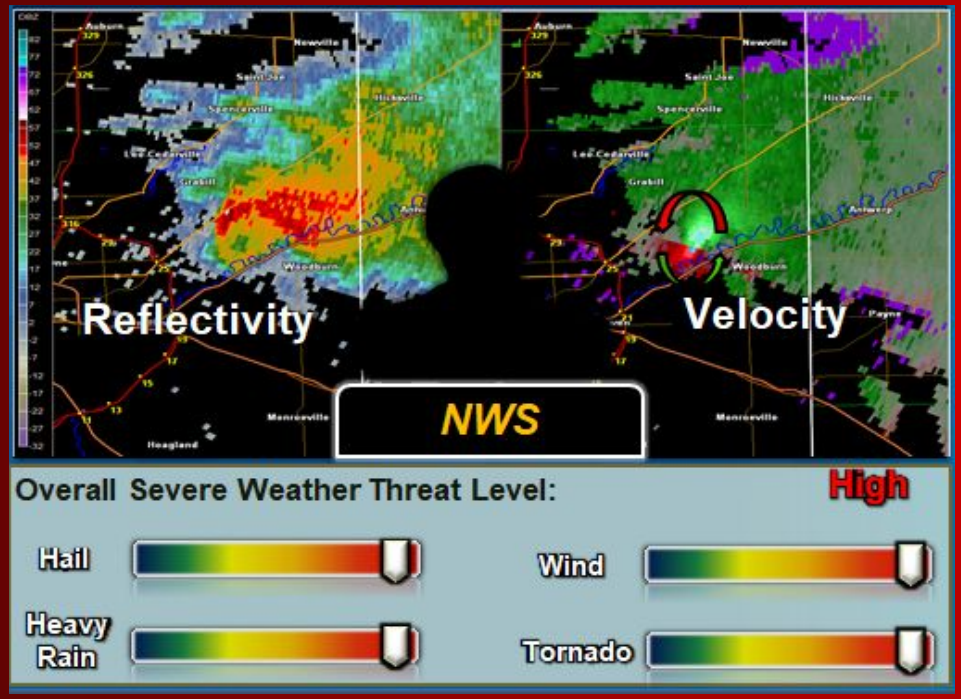
Mud & Debris Flows

Water-saturated rock, mud and debris moving down a slope

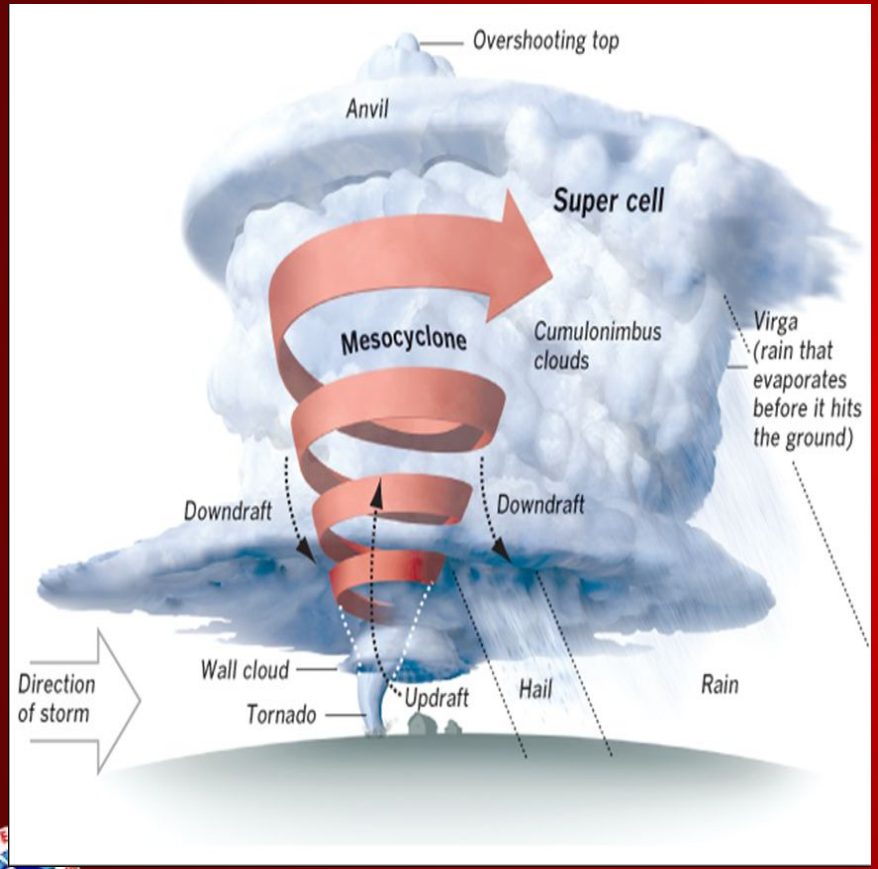
Give specific locations, roadways or intersections

Post-fire Floods

Supercell Thunderstorms



Supercell Thunderstorm Clues



Overshooting Tops

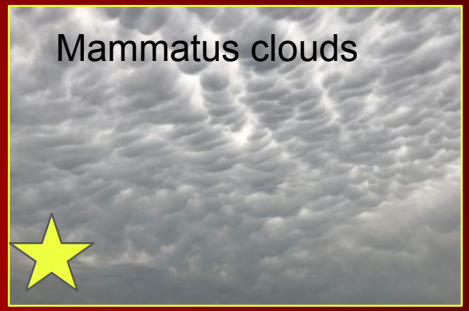
Cauliflower shaped towers

Mesocyclone or Wall Cloud

Cloud Types

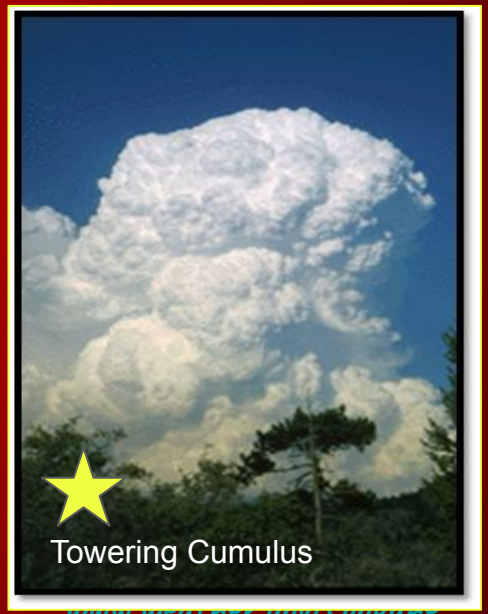

Scud clouds - ragged


Cumulus


Mammatus clouds


Stratus clouds - stable, hugs mountains


Wall Cloud - lowering cloud with rotation


Towering Cumulus

Tornado

A violently rotating column of air, attached to a thunderstorm and touching the ground.

Typical Inland NW Tornado

- Less than 5 minutes on the ground
- 100 yards in diameter
- ¼ mile track
- Max wind speeds of 85-115 mph
- Mostly EF0 to EF1

National Weather Service - Spokane, WA

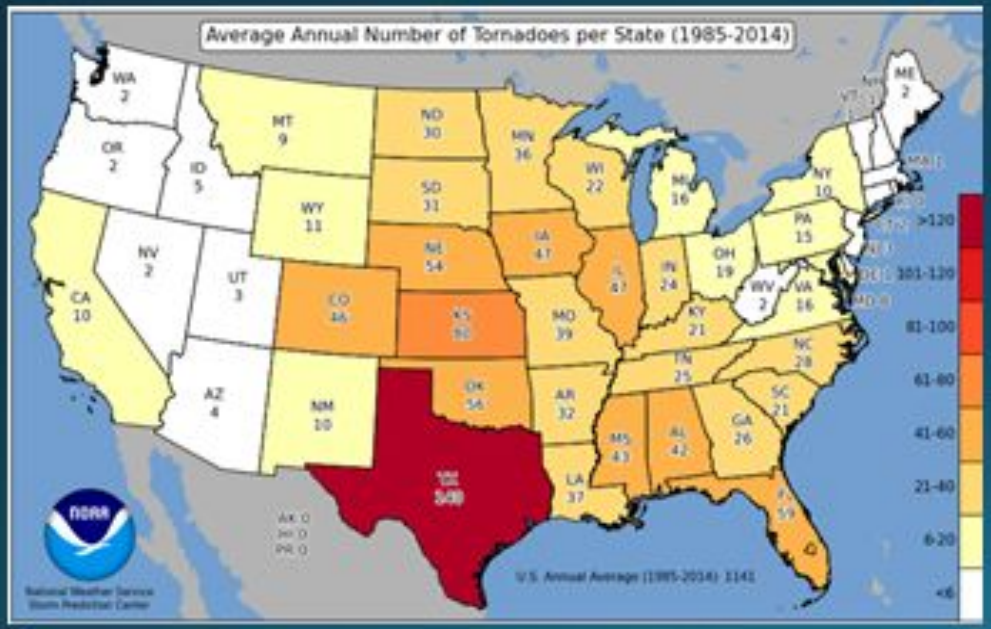
www.weather.gov/spokane


Posted by KREM 2 News
408,129 Views
Press Esc to exit full screen

/spokane

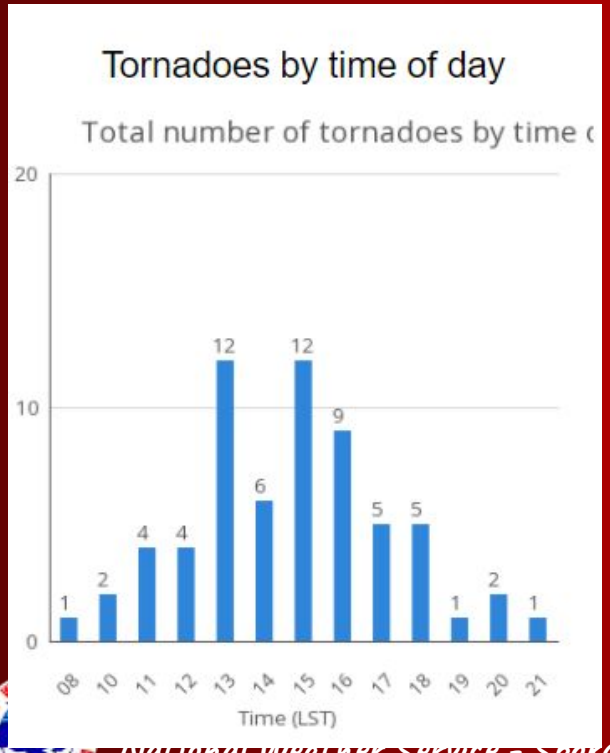
How are tornadoes measured?

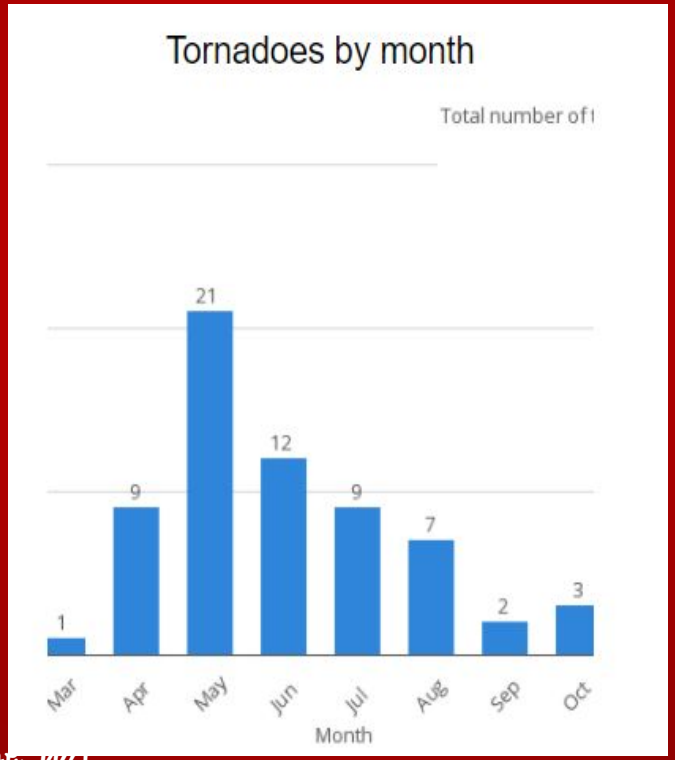
The Enhanced Fujita Scale

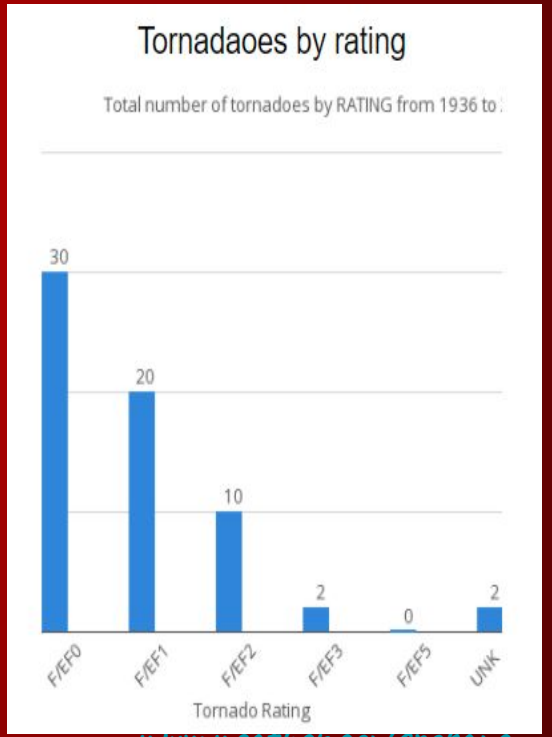


EF-Scale	Speed
EF0	65-85 mph
EF1	86-110 mph
EF2	111-135 mph
EF3	136-165 mph
EF4	166-200 mph
EF5	>200 mph

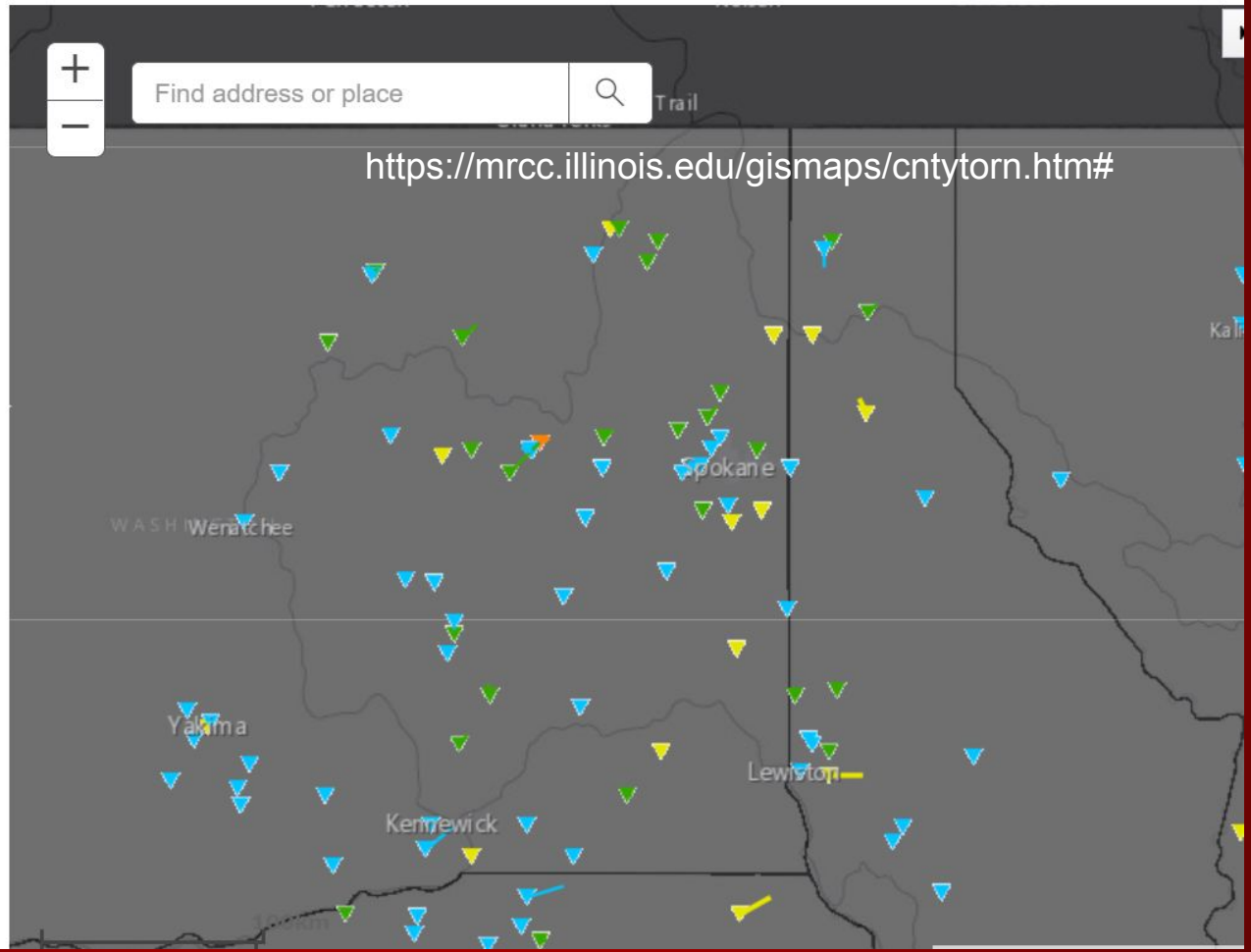
Inland NW Tornado Stats ~ 64 reports
(1936-2016)







Tornado Tracks, 1950-2017



Show Touchdown Points

Filter by Magnitude:

- F/EF 0
- F/EF 1
- F/EF 2
- F/EF 3
- F/EF 4
- F/EF 5

Filter by Year Range:

1950 through 2017

Filter by Month:

All Months

Filter by Casualties:

- Injuries > 0
- Fatalities > 0

What about Funnel Clouds & Dust Devils?

- Funnel clouds stay aloft attached to storm cloud
- Dust devils start at the ground and extend upward
- Tornadoes extend from storm cloud to the ground
- In doubt, check for cloud cover and debris on ground
- Take a picture and share!

National Weather Service - Spokane, WA

www.weather.gov/spokane

Cold Air Funnels - May 2020 Pullman

- No reports of damage or touchdowns
- Additional reports in Ritzville & Columbia Basin
- Weather pattern - upper level trough

#5 Poll Question

Identify this image.

#6 Poll Question

Identify this image.

Stay Informed

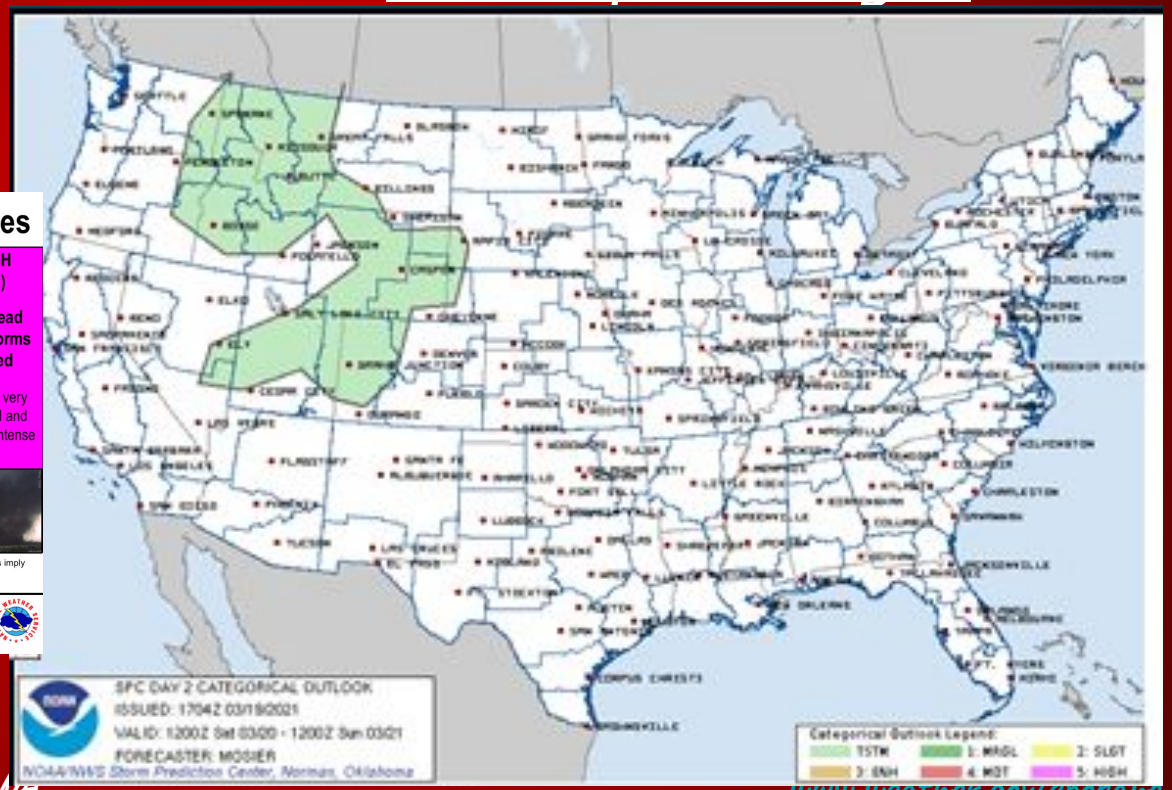
National Storm Prediction Center *www.spc.noaa.gov*

Understanding Severe Thunderstorm Risk Categories

THUNDERSTORMS (no label)	1 - MARGINAL (MRGL)	2 - SLIGHT (SLGT)	3 - ENHANCED (ENH)	4 - MODERATE (MDT)	5 - HIGH (HIGH)
No severe* thunderstorms expected	**Isolated severe thunderstorms possible**	**Scattered severe storms possible**	**Numerous severe storms possible**	**Widespread severe storms likely**	**Widespread severe storms expected**
Lightning/flooding threats exist with all thunderstorms	Limited in duration and/or coverage and/or intensity	Short-lived and/or not widespread, isolated intense storms possible	More persistent and/or widespread, a few intense	Long-lived, widespread and intense	Long-lived, very widespread and particularly intense

* NWS defines a severe thunderstorm as measured wind gusts to at least 58 mph, and/or hail to at least one inch in diameter, and/or a tornado. All thunderstorm categories imply lightning and the potential for flooding. Categories are also tied to the probability of a severe weather event within 25 miles of your location.

National Weather Service
www.spc.noaa.gov



National Weather Service - Spokane, WA

www.weather.gov/spokane

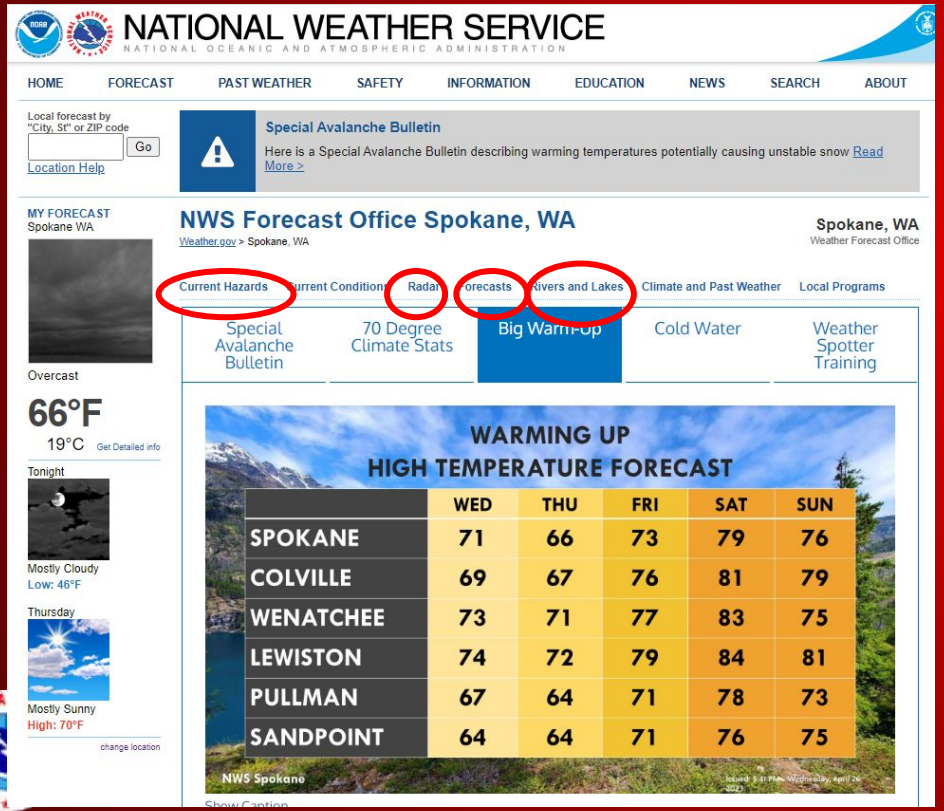
Stay Informed

Watch, Warning, Advisory

TYPE	DEFINITION	THREAT	ACTION
WARNING	Hazard is occurring, imminent, or very likely	Threat to life & property	Take protective action
WATCH	Conditions are favorable for hazard to occur	Threat to life & property	Have a plan of action
ADVISORY	Hazard is occurring, imminent, or very likely	Threat of significant inconvenience	Use caution

Stay Informed

NWS Spokane Web Page www.weather.gov/Spokane



Important NWS products to follow

- Current Hazards
- Radar data
- Forecast Computer Models
- River and Lake - forecasts

www.weather.gov/spokane

Stay Informed

NWS Spokane Web Page www.weather.gov/Spokane

Important NWS products to follow

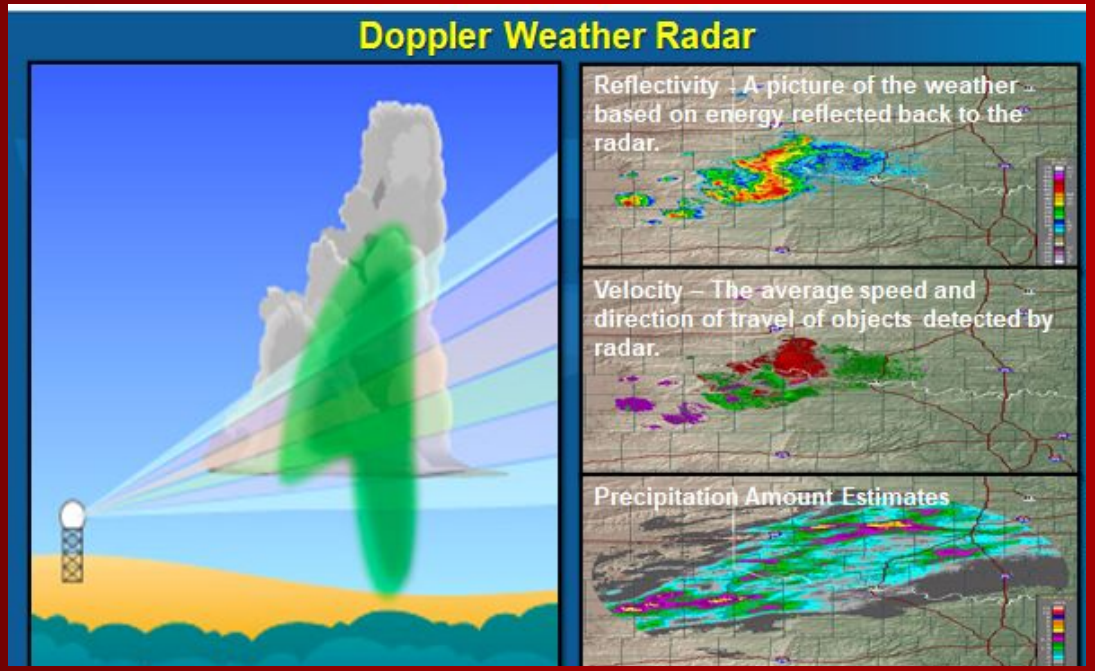
- Area Forecast Discussion (AFD)
- Radar images
- Satellite Images
- Current Observations
- Submit a Spotter Reports
- View Storm Reports

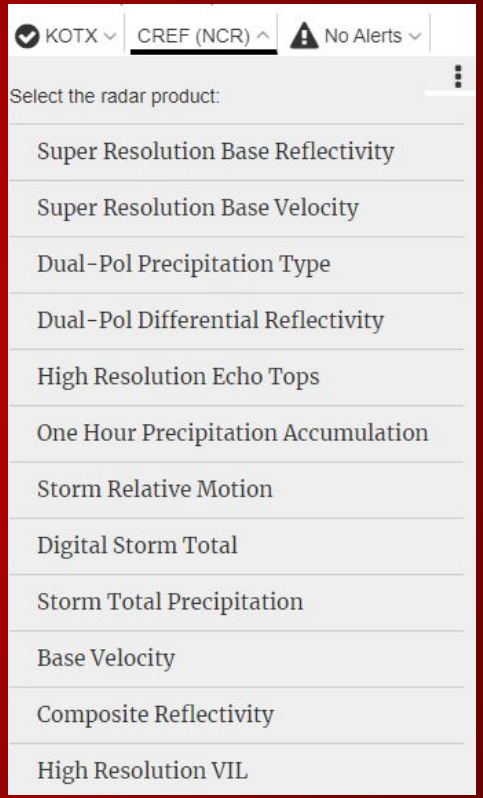
National Weather Service - Spokane, WA

Basic Radar Interpretation

Updated Radar Map

Local Radar - Select Site



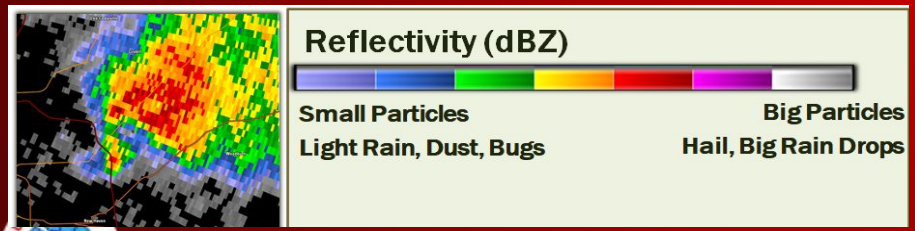


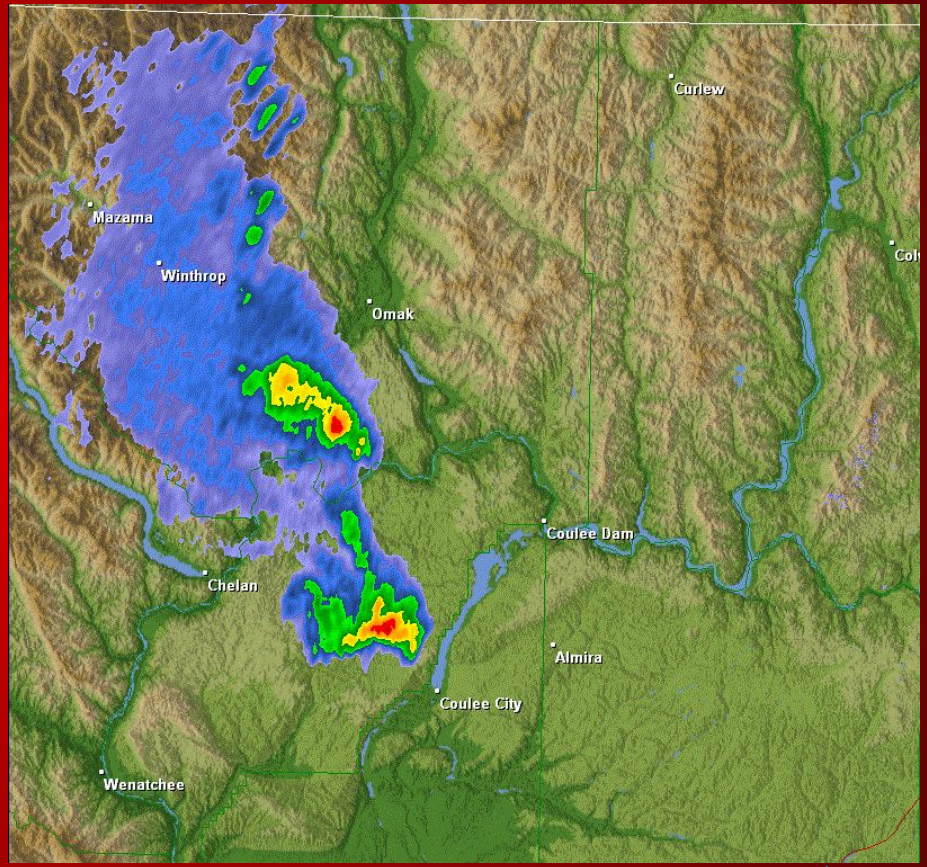
Radar Products - Reflectivity

Raw measure of how reflective targets within the beam are - typically (BUT NOT ALWAYS) indicates precipitation intensity

Measured in dbZ

“Base” or “Tilt X” = One Slice
“Composite” = Worst of all Slices



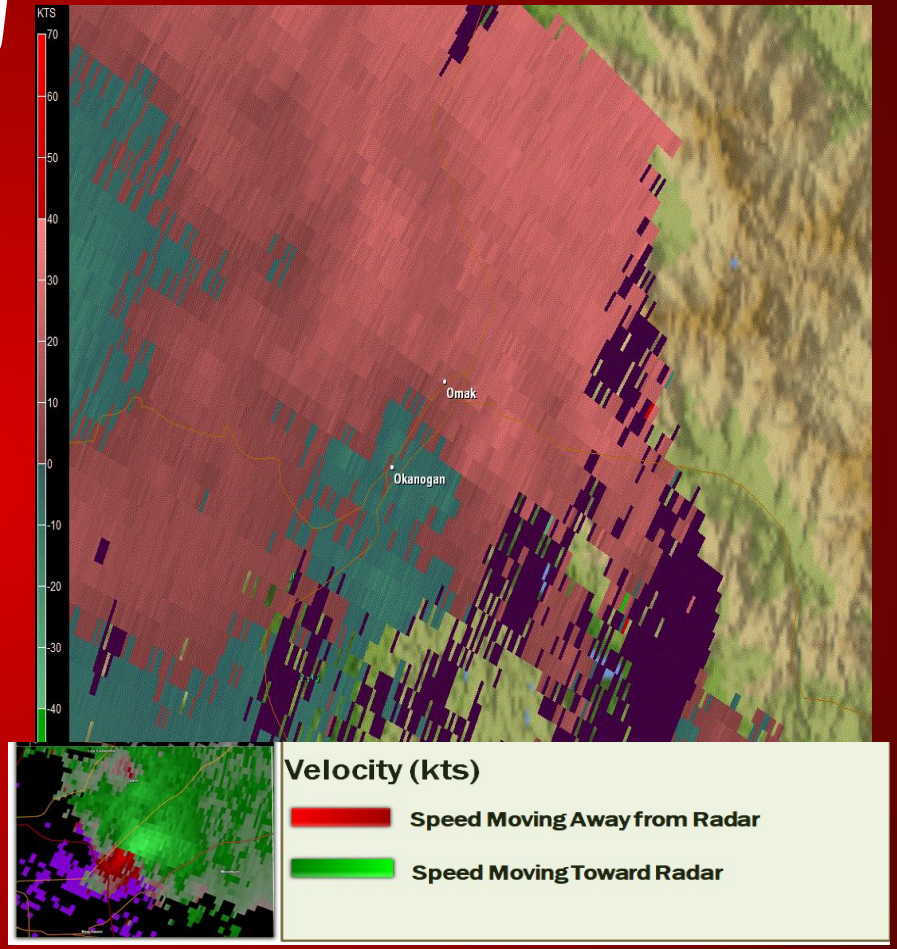


Radar Products - Velocity

Speed and direction of targets - rain, snow, hail, debris or other biological particles. Measured in knots.

Reds = outbound motion
Green = inbound motion

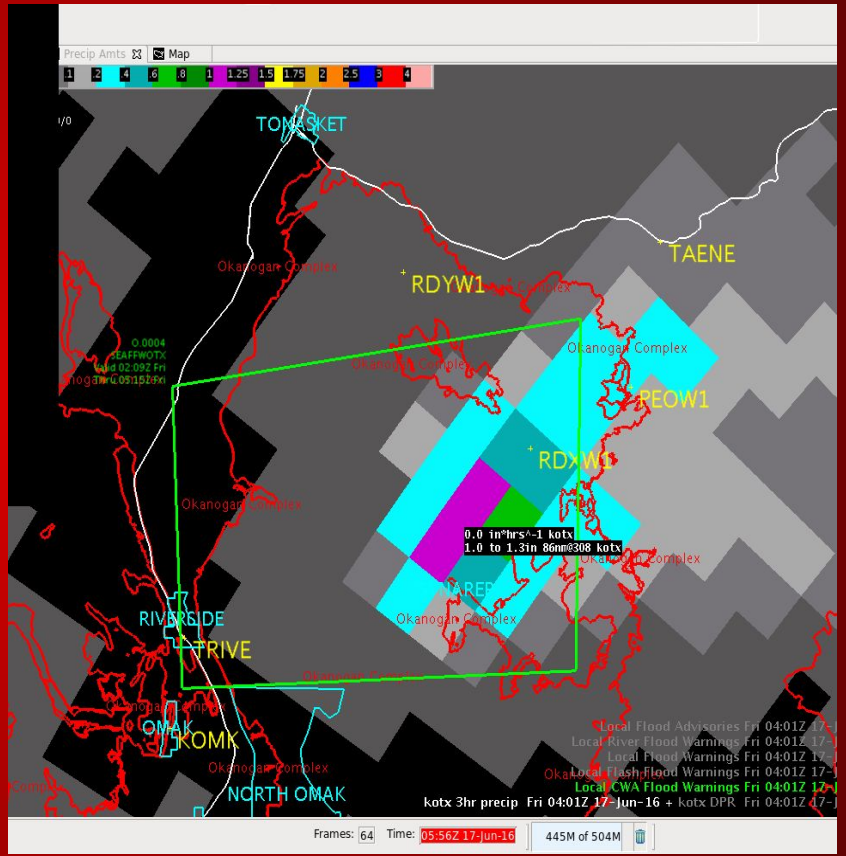
“Base” = ground relative motion
    Good for straight line winds
“Storm Relative” = storm motion removed
    Good for rotation in storms



Radar Products - Precipitation

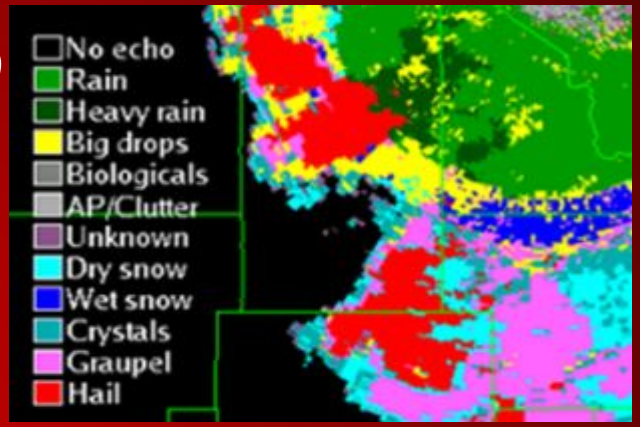
Radar estimate of precipitation reaching the ground. This can be overestimated from hail contamination

Hourly - 1 hour precipitation
Storm Total - total precipitation through the storm



Radar Products - More Products

- Precipitation Type
  - Estimate of type of precipitation
- Echo Tops
  - Estimate of height above ground of the 18 dBz echo or storm top
- Vertically Integrated Liquid - VIL
  - Estimate of the liquid water content - hail size



Stay Informed

Do you have the time?

- Many weather products use the UTC/GMT/Z time zone
- UTC = PDT + 7 or PST +8
  - 10:00 AM PDT is 17:00 UTC
  - 10:00 AM PST is 18:00 UTC
- 00z and 12z are common times for models, weather balloons and other important weather information

00z = evening
12z = morning
24 hour clock is used for UTC/Z
Based off the lines of longitude
0 degrees = Greenwich, England

Cold Air Funnel

- Circulation on Radar near I-90 where it was seen around 4:45 pm TO 4:50 pm May 26th
- "Red Shading" moving away from radar
- "Green Shading" moving away from radar

What is a "Cold Air Funnel"?

A funnel cloud that can develop from a small shower or thunderstorm when the air aloft is unusually cold (hence the name). They typically do NOT touch the ground and do not cause damage. But always be alert if you see one.

www.weather.gov/spokane

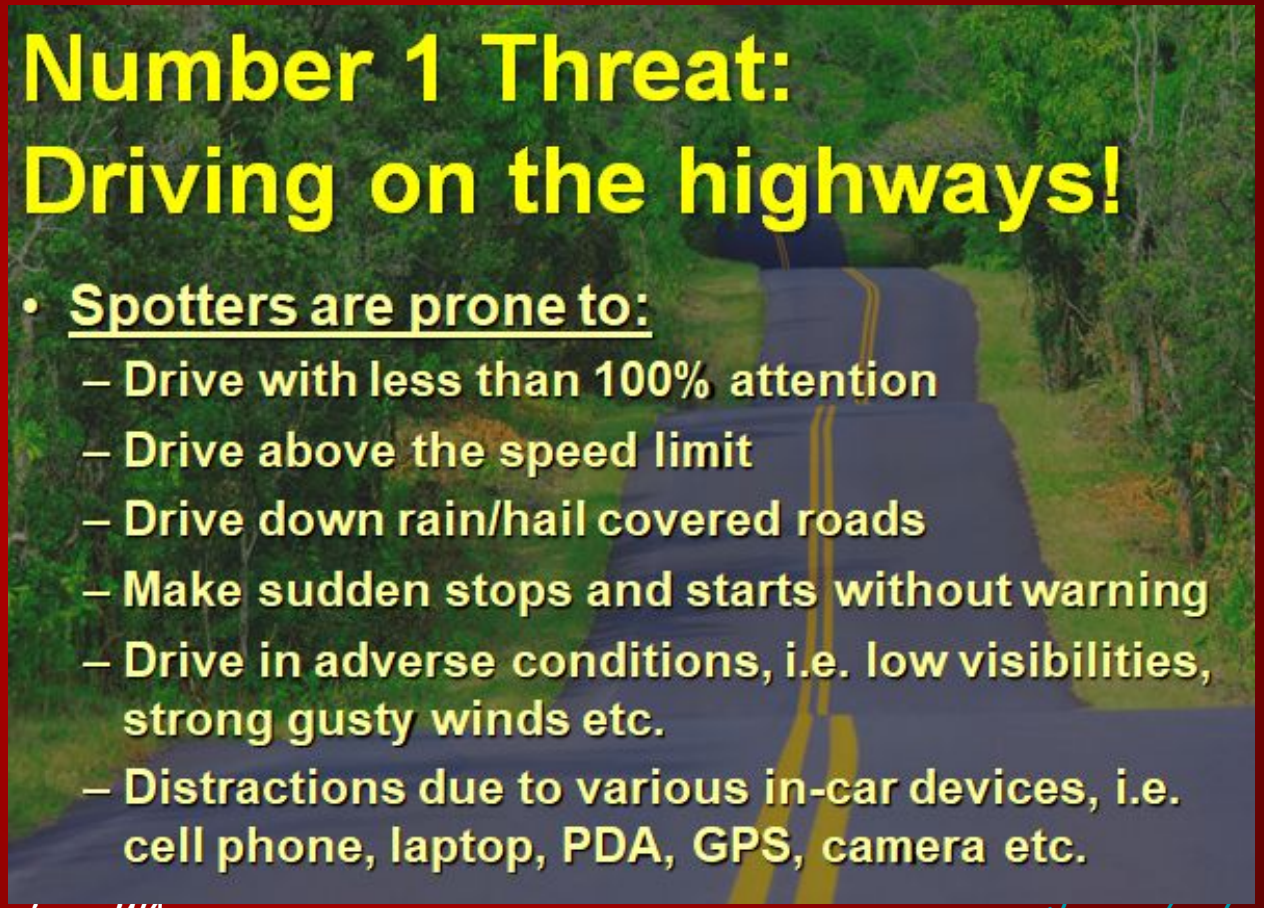
#7 Poll question

What are some useful radar products?

Spotter Safety

Even the most careful and conscientious driver may have problems under severe weather conditions

Sadly 3 OU students were killed in a traffic accident while storm chasing



Spotter Safety - Lightning

Close Enough to Hear Thunder,-
Close Enough to be Struck!

- Lightning can strike as far as 10 miles from the thunderstorm.
- More than 50% of lightning deaths occur AFTER the storm has passed

When Thunder Roars, Go Indoors

Seek Safe Shelter indoors - or vehicle if needed
Stay away from windows & doors
Don't use a corded phone or take a bath/shower

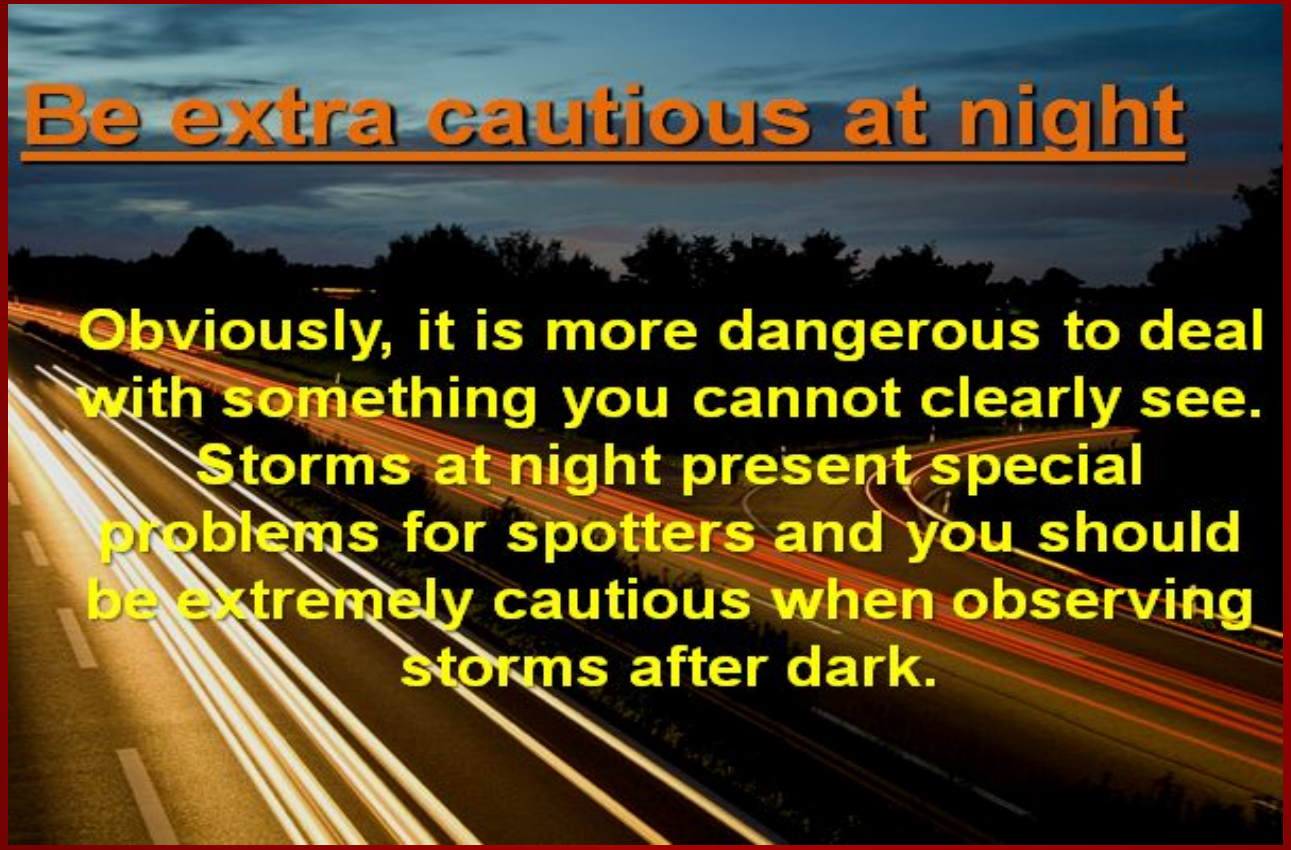
Lightning Safety

1. Be Aware of your Surroundings!

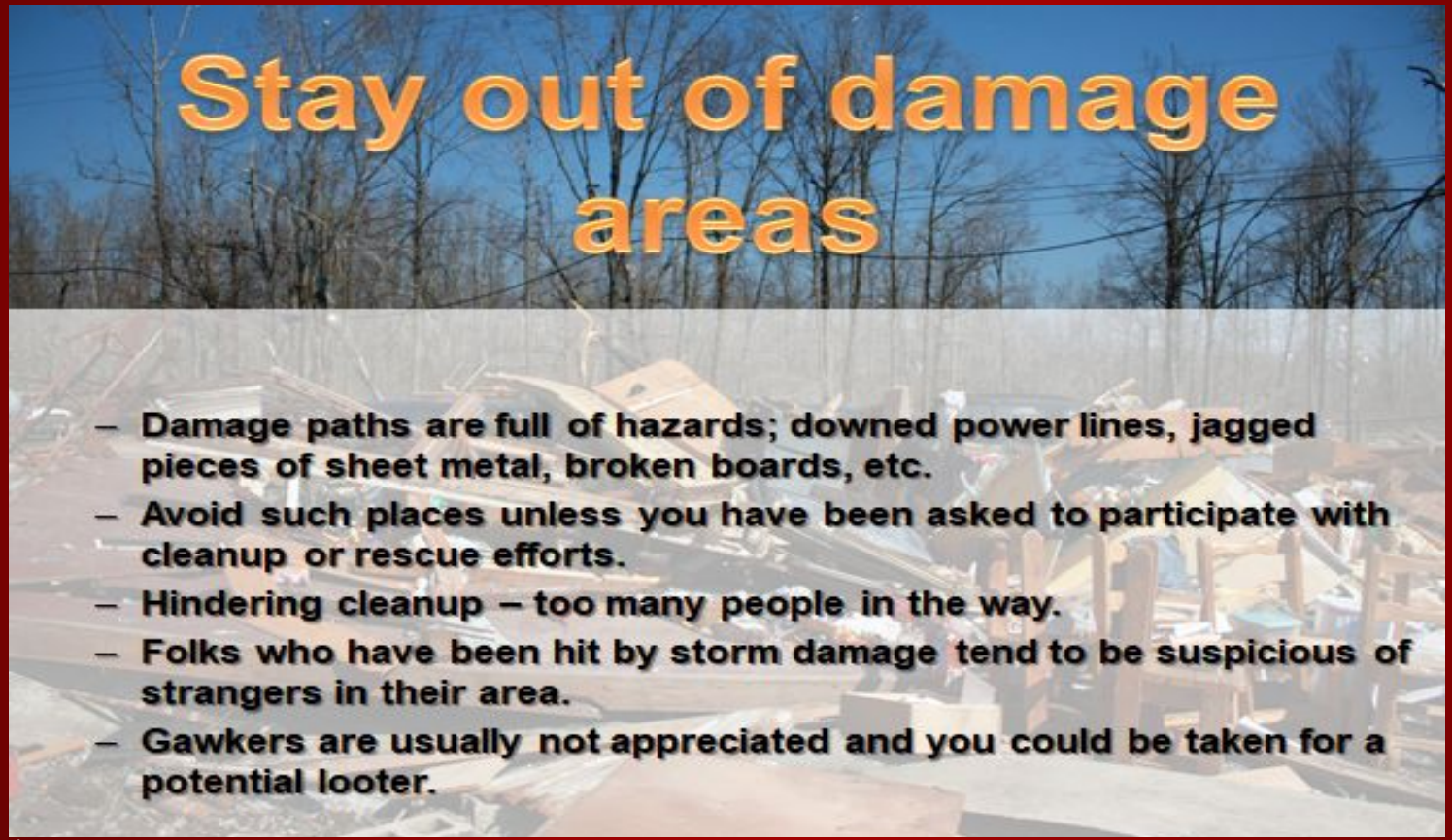
Spotter Safety - Standing Water on Roads

- Hydroplaning is a serious threat.
- During a storm, water will likely collect along the tire paths.
- If you are hearing water splashing under your car, then you are on the verge of hydroplaning, if you are not doing so already.
- Use your headlights.

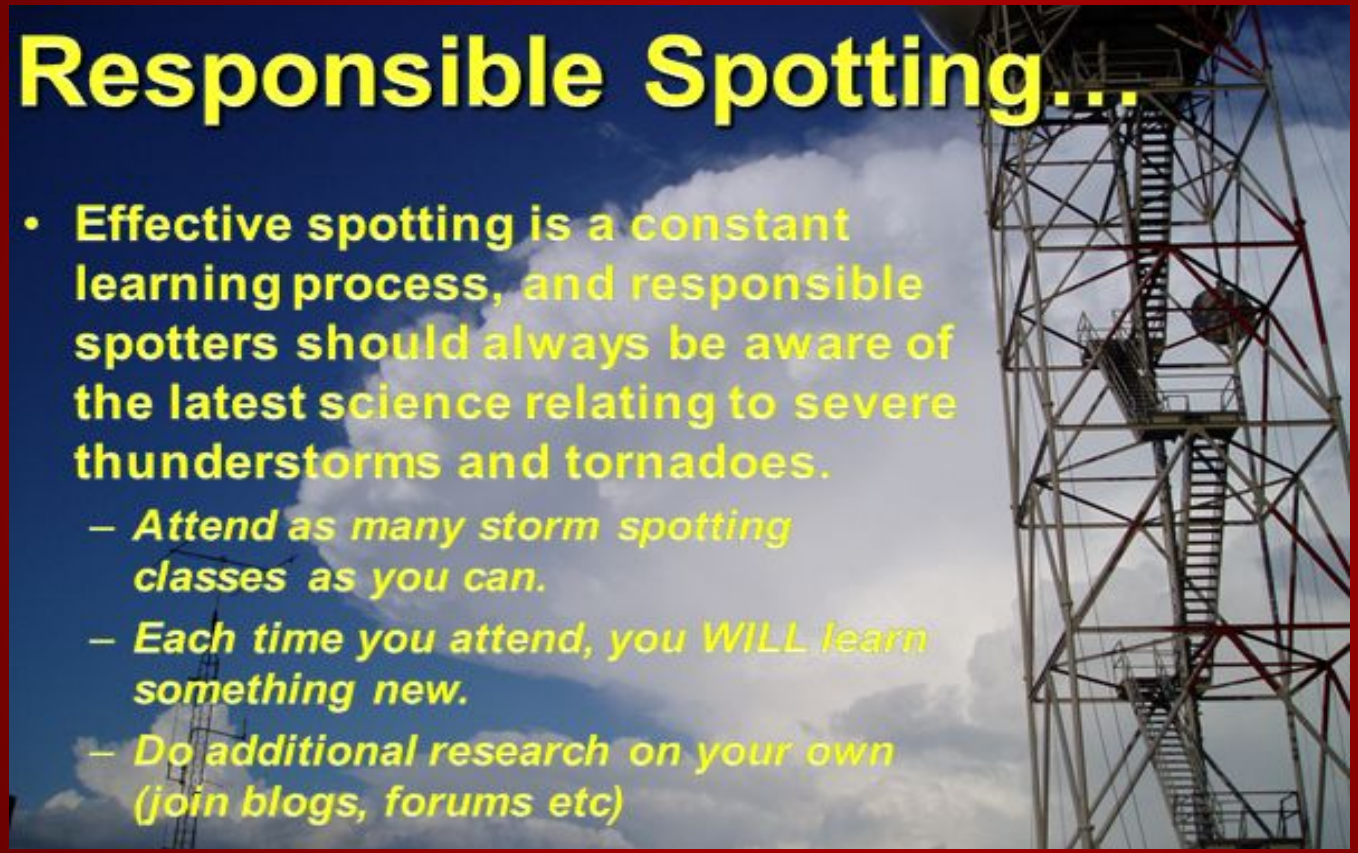
Spotter Safety - Night Spotting



Spotter Safety - Storm Damage



Spotter Safety



Additional Training

Spotter Resources

www.weather.gov/Spokane/Spotter_Resources

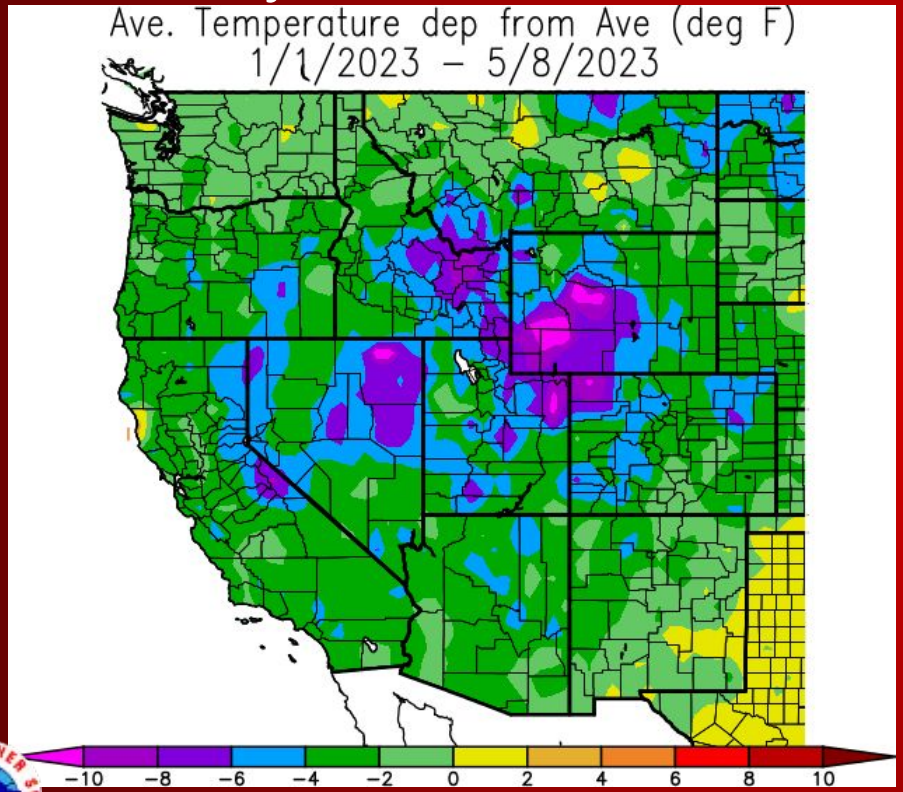
#8 poll question

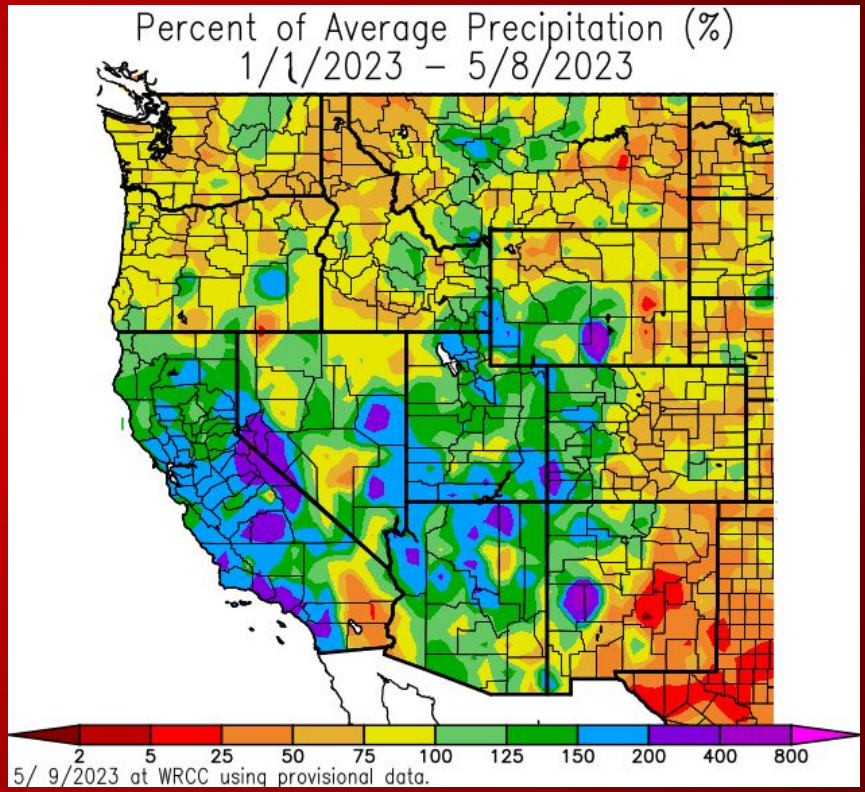
What would be a SAFE weather spotting scenario?

Seasonal Outlook 2023

wrcc.dri.edu/

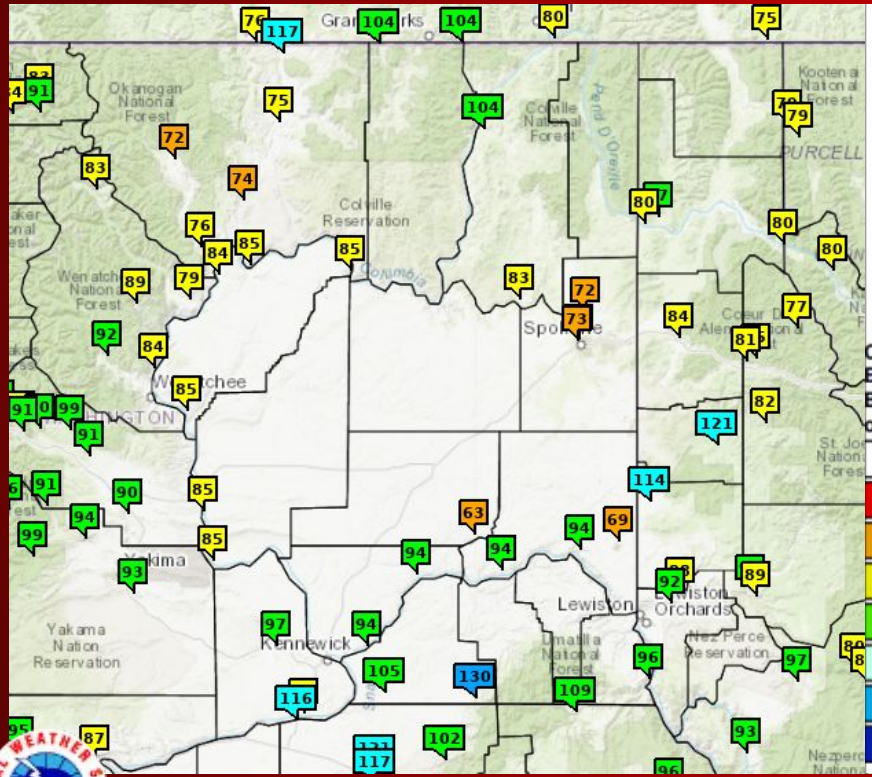
So far this year…



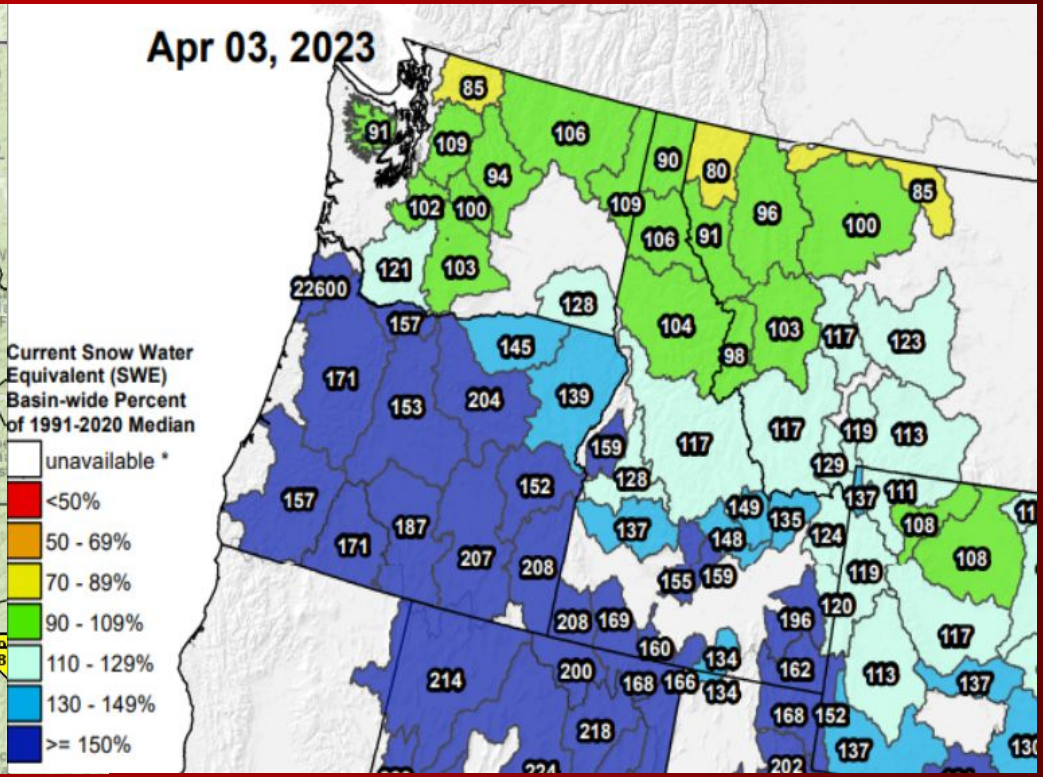


Seasonal Outlook 2023

Water Supply Outlook



Mountain Snowpack



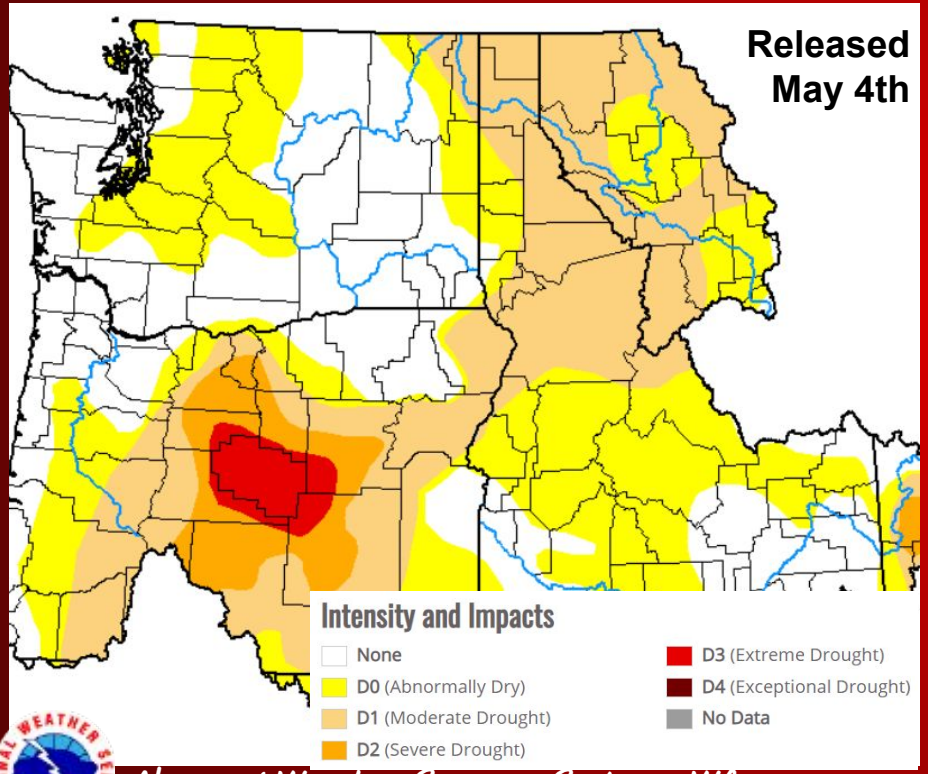
National Weather Service - Spokane, WA

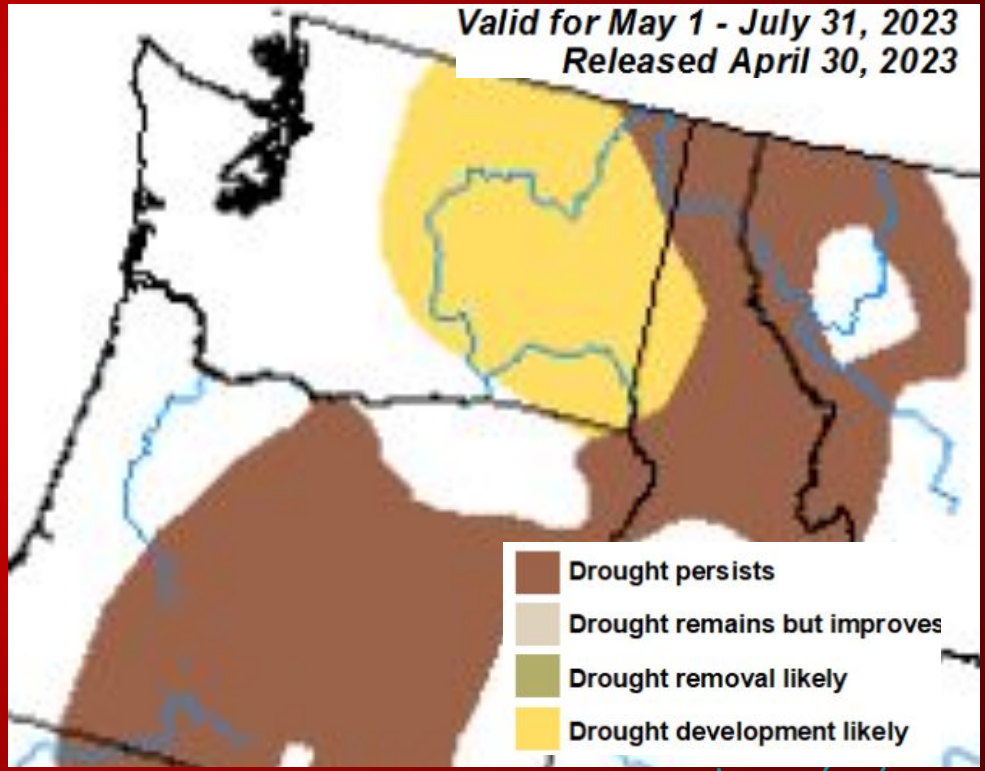
www.weather.gov/spokane

Seasonal Outlook 2023

US Drought Monitor & Seasonal Outlook

www.cpc.noaa.gov

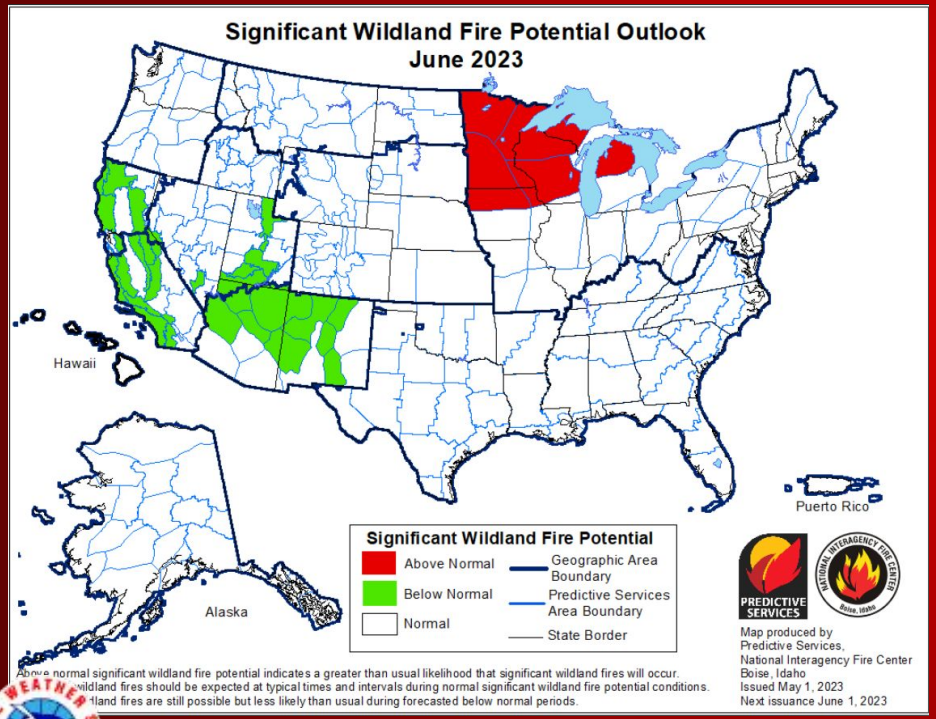


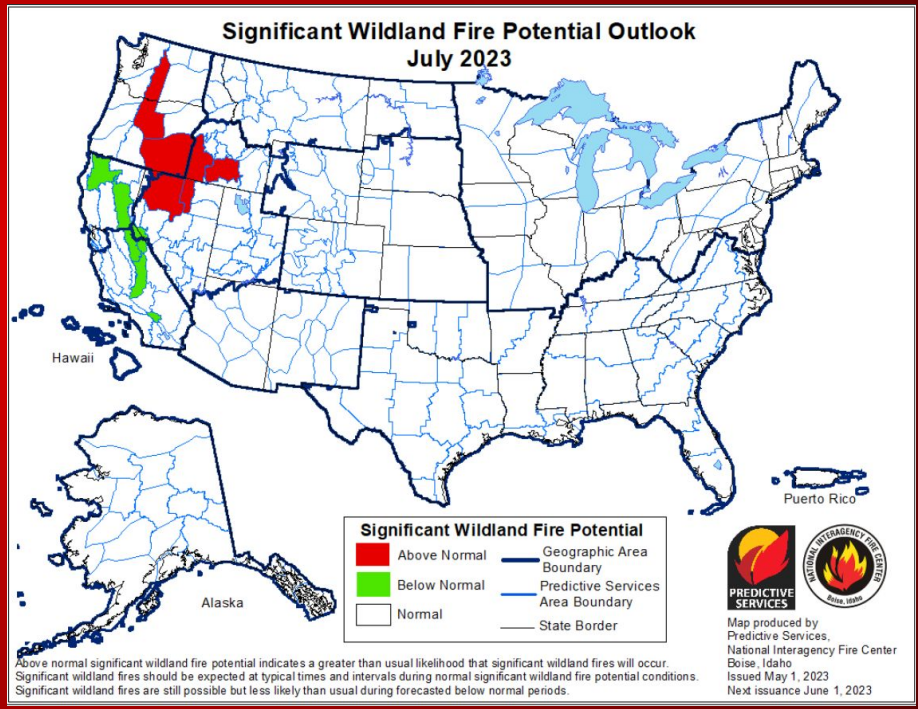


Seasonal Outlook 2023

Wildland Fire Potential

www.nifc.gov

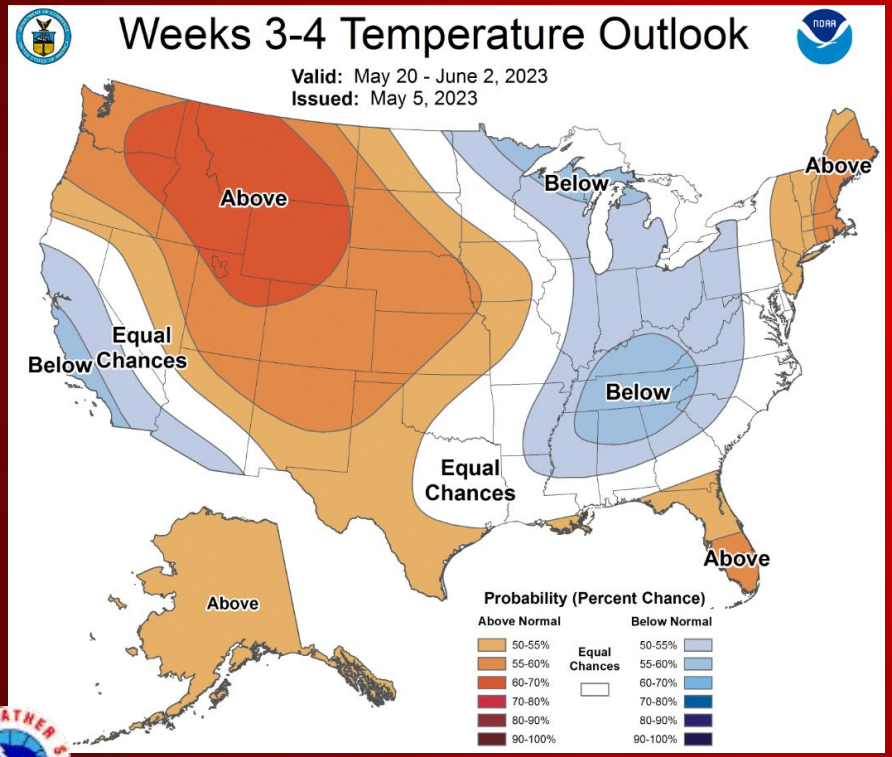


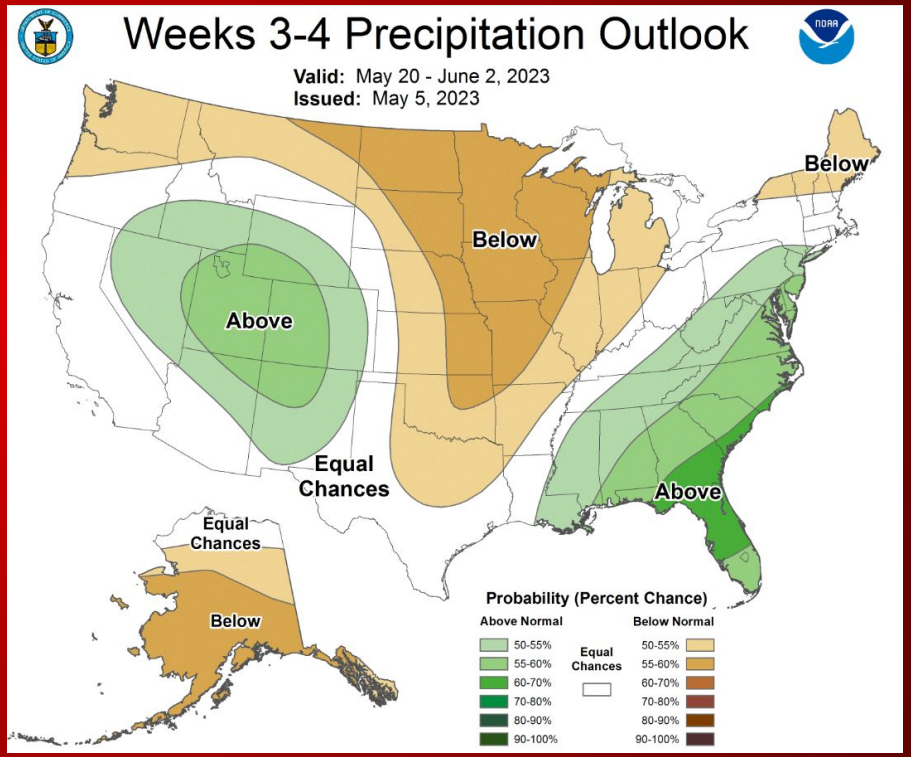


Seasonal Outlook 2023 - May

3-4 Week Outlook

www.cpc.noaa.gov



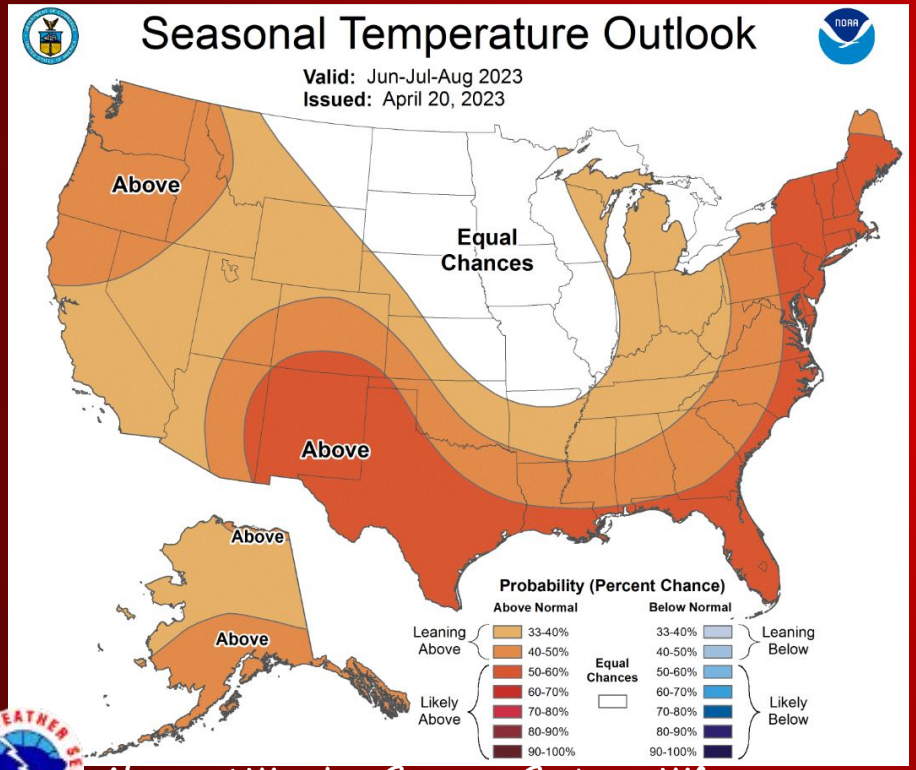


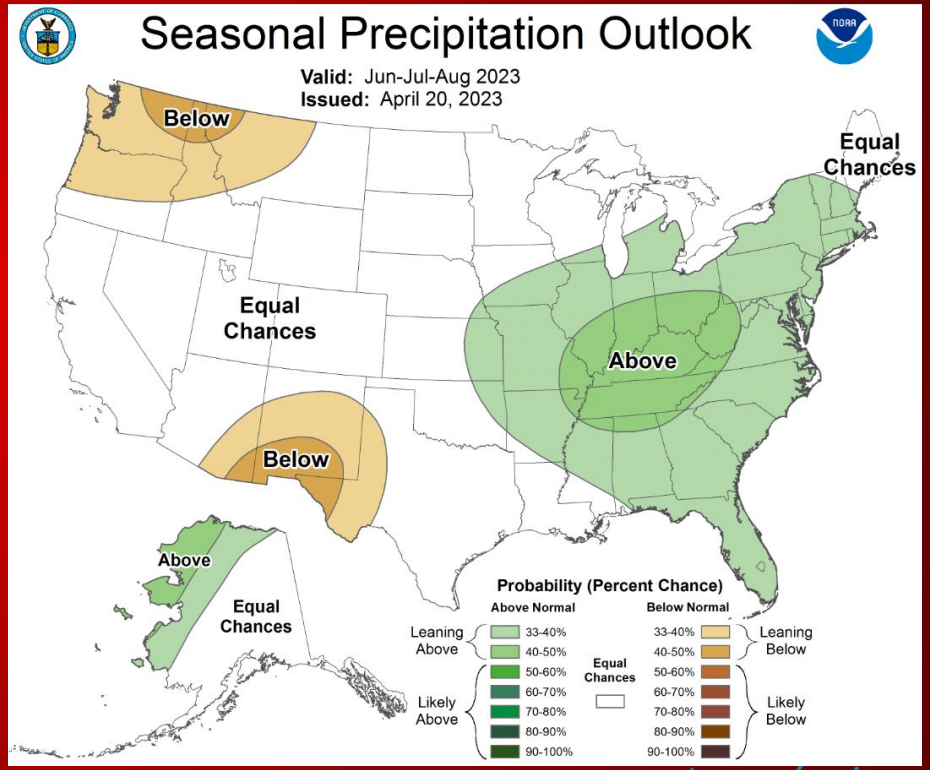
Seasonal Outlook 2022 - May thru July

El Nino Coming!

3 Month Outlook

www.cpc.noaa.gov





National Weather Service - Spokane, WA

www.weather.gov/spokane

NWS + Weather Spotters = Saved Lives

nws.spokane@noaa.gov

THANK YOU!

What's Next?

You will receive a follow-up email

- register as a weather spotter
- Spotter ID
- Spotter training certificate

Any Questions?

I will unmute you - then you unmute yourself to talk.