Advanced Weather Spotting for the Inland Northwest

Spring 2021
National Weather Service - Spokane

Clyde, WA - Dave Brock
May 2020
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…
June 24, 2020 - Severe Thunderstorm Event
May 30, 2020 - Severe Thunderstorm Event
May 2, 2020 - Thunderstorm & Dust Event

Post Falls, ID

North of Tri Cities

Pullman

Colfax
To our current Weather Spotters….

THANK YOU!

Eyes and Ears of the National Weather Service with a count of over 1200 across the Inland NW!
National Weather Service (NWS)

• Part of the Federal Government – Dept of Commerce
• Responsible for all weather/water Watches & Warnings
• 126 offices across the country
• Work 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

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

Photo courtesy of Earth to Sky Calculus
Weather Satellites

GOES 17 - 16 different channels
IR, Water Vapor & Visible
New images every 5 minutes
Aids in early detection
Thunderstorms & Wildfires
Surface Observations & Web Cams

Automated Surface Observation Station

No Snow depth
No Hail size – Wind damage
No Tornadoses or funnel clouds
Supercomputers & 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
- Goal - maximize Warning effectiveness and lead times
- Add Credibility to NWS Warnings - Leads to Public Action!
#1 Poll Question

Why are weather spotters important?
Main weather concerns change with the season & include:
- Winter storms – snow, ice, rain and wind
- Flooding – river flooding and flash flooding
- Fire weather – wind and dryness, lightning and smoke
- Thunderstorms – hail, wind, rain and lightning
Terrain Makes ALL the Difference

Topography Map

Average Annual Precipitation Map
What’s in a Spotter Report?

- Specifics...Tell us the story!
  - Who...What...and Where
  - When the event began and/or ended
  - Estimate of wind speed and/or hail size
  - Damage and injury reports

- If unsure - report your uncertainty

- Include reports while traveling & 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
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

If ARES/RACES Hams, relay report to your central collection point.

National Weather Service - Spokane, WA
www.weather.gov/Spokane
Examples of Spotter Reports

Good Spotter Report

This is Tom Smith, Spotter Spokane #25 calling from my home on the South Hill. There is currently large hail falling. I measured one stone and it’s about the size of a quarter. It began about 30 minutes ago.

Needs Improvement

Hi there, how are you doing? Who is this? ....Well hi Steve! I’m a spotter in Okanogan County. I see lightning to the north and it rained here a little bit ago. The news is saying it’s much worse to the south. Are we going to get another thunderstorm? ....How long is it supposed to last? How’s your evening going?
Keep in Mind – We 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 and get information on what you are experiencing (ground truth) based on what is seen on radar.
Emails are Important

Besides a phone number, it’s important to keep emails current.

You will likely be notified the day before/day of by email when there is a WIDESPREAD Severe Weather Risk/Thunderstorm Outbreak.

We send periodic emails to alert you of the quarterly newsletter and upcoming training opportunities.
#3 Poll question

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

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

- “Front” side of storm
- Dark area of storm
- Rainfall region
- Downward motion
- Downburst/hail threat
- Leading edge marked by shelf cloud

- “Back” side of storm
- Cumulus tower
- Rainfree Base
- Upward motion that can reach > 100 mph
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
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?
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

July 2016 - Omak
Flooding and Flash Flooding
Rising water on rivers, streams & low lying areas
Give specific locations of streams & streets

Wenatchee - Sept 2019

Moscow - April 2019

Williams Flats Fire Flood - Aug 11, 2019

April 9, 2019 - Pullman

Turn Around, Don’t Drown
Mud and Debris Flows

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

Give specific locations, roadways or intersections

Post-fire Floods

June 27, 2019 Wenatchee

May 16, 2019 Spokane

Kamiah - April 2019
Multicell Thunderstorms

Overall Severe Weather Threat Level:

**Low - Moderate**

- Wind
- Hail
- Heavy Rain
- Tornado

- Flash flooding due to slow movement
- Downbursts, straight-line winds, small-med sized hail, lightning
Evaporative cooling causes the air parcels to become heavy/more dense.
Dust Storms

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

April 11, 2020 - Ritzville

April 27, 2020 - Dusty

Harrington - Aug 2014
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.

Naples, ID - May 2020

Spokane - July 2016

NATIONAL WEATHER SERVICE
Supercell Thunderstorms

Reflectivity

Velocity

Overall Severe Weather Threat Level:

High

NWS

Hail

Wind

Heavy Rain

Tornado

National Weather Service
Supercell Thunderstorm Clues

Overshooting Tops
Cauliflower shaped towers

Mesocyclone or Wall Cloud

Kamiah, ID July 2016
Cloud Types

- Scud clouds - ragged
- Stratus clouds - stable, hugs mountains
- Cumulus
- Wall Cloud - lowering cloud with rotation
- Mammatus clouds
- 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

Mold - July 2016

Airway Heights - July 2016

Spokane - July 2016

Airway Heights - May 2004
How are tornadoes measured?

The Enhanced Fujita Scale

<table>
<thead>
<tr>
<th>EF-Scale</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
</tr>
</tbody>
</table>
Inland NW Tornado Stats ~ 64 reports (1936-2016)
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!
#5 Poll Question

Identify this cloud.
Stay Informed
National Storm Prediction Center  www.spc.noaa.gov

Understanding Severe Thunderstorm Risk Categories

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

* NWS defines a severe thunderstorm as measured wind gusts to at least 64 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
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
Stay Informed
NWS Spokane Web Page  www.weather.gov/Spokane
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Important NWS products to follow

- Hazardous Weather Outlook (HWO)
  - Daily updates on weather hazards 1-7 days out
- Forecast Computer Models
  - HRRR, GFS, ECMWF
- Radar Data
- River and Lake - forecasts
Stay Informed
NWS Spokane Web Page

www.weather.gov/Spokane

Important NWS products to follow

- Area Forecast Discussion (AFD)
  - Forecasters thinking/confidence
- Radar images
- Satellite Images
- Current Observations
- Submit a Spotter Reports
- View Storm Reports
Basic Radar Interpretation

Doppler Weather Radar

Reflectivity – A picture of the weather based on energy reflected back to the radar.

Velocity – The average speed and direction of travel of objects detected by radar.

Precipitation Amount Estimates

Updated Radar Map
Local Radar - Select Site

Select the radar product:
- Super Resolution Base Reflectivity
- Super Resolution Base Velocity
- Dual-Pol Precipitation Type
- Dual-Pol Differential Reflectivity
- High Resolution Echo Tops
- One Hour Precipitation Accumulation
- Storm Relative Motion
- Digital Storm Total
- Storm Total Precipitation
- Base Velocity
- Composite Reflectivity
- High Resolution VIL
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 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
Cold Air Funnels - May 2020 Pullman

- No reports of damage or touchdowns
- Additional reports in Ritzville & Columbia Basin
- Weather pattern - upper level trough
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.
#6 Poll question

What are some useful radar products?
Lightning

- 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.

Close Enough to Hear Thunder,-
Close Enough to be Struck!
Even the most careful and conscientious driver may have problems under severe weather conditions.
Spotter Safety - Watch for 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 - Watch for Night Spotting

Be extra cautious at night

Obviously, it is more dangerous to deal with something you cannot clearly see. Storms at night present special problems for spotters and you should be extremely cautious when observing storms after dark.
Spotter Safety - Watch for Storm Damage

Stay out of damage areas

- Damage paths are full of hazards; downed power lines, jagged pieces of sheet metal, broken boards, etc.
- Avoid such places unless you have been asked to participate with cleanup or rescue efforts.
- Hindering cleanup – too many people in the way.
- Folks who have been hit by storm damage tend to be suspicious of strangers in their area.
- Gawkers are usually not appreciated and you could be taken for a potential looter.
Spotter Safety

Responsible Spotting...

- Effective spotting is a constant learning process, and responsible spotters should always be aware of the latest science relating to severe thunderstorms and tornadoes.
  - Attend as many storm spotting classes as you can.
  - Each time you attend, you WILL learn something new.
  - Do additional research on your own (join blogs, forums etc)
Additional Training

Role of the SKYWARN® Spotter

SKYWARN® Spotter Convective Basics

Spotter Resources
www.weather.gov/Spokane/Spotter_Resources

JetStream - An Online School for Weather

JetStream’s Topics
- The Atmosphere
- The Ocean
- Global Weather
- Clouds
- The Upper Air
- Upper Air Charts
- Synoptic Meteorology
- Thunderstorms
- Lightning
- Derechos
- Tropical Weather
- Doppler Radar
- Remote Sensing
- Tsunamis
- The National Weather
#7 poll question

What would be a SAFE weather spotting scenario?
Seasonal Outlook 2021
So far this year...

wrcc.dri.edu/

January - Mild and Wet in the north
February - Cold and Wet in the south
March - Seasonal and Dry
April - Dry and near seasonal
Seasonal Outlook 2021

Mountain Snowpack

www.wcc.nrcs.usda.gov
Seasonal Outlook 2021
Wildland Fire Potential

www.nifc.gov
Seasonal Outlook 2021
8-14 Day Outlook

www.cpc.noaa.gov
Seasonal Outlook 2021
3 Month Outlook

www.cpc.noaa.gov
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.