



National Weather Service Burlington Weather Forecast Office

Robert Haynes - NWS Burlington

Warm Season 2025 Spotter Basics



SKYWARN
WEATHER.GOV®



National Oceanic and
Atmospheric Administration

U.S. Department of Commerce

Burlington Weather Forecast Office



Presentation Layout

- ☐ How Skywarn Operates and Why We Need It.
- ☐ Review of Storm Ingredients, Storm Types, and the National Weather Service's Warning System
- ☐ Safety and Reporting Severe Weather





Provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy.

A Weather-Ready Nation: Society is prepared for and responds to weather, water, and climate-dependent events.





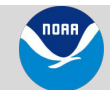
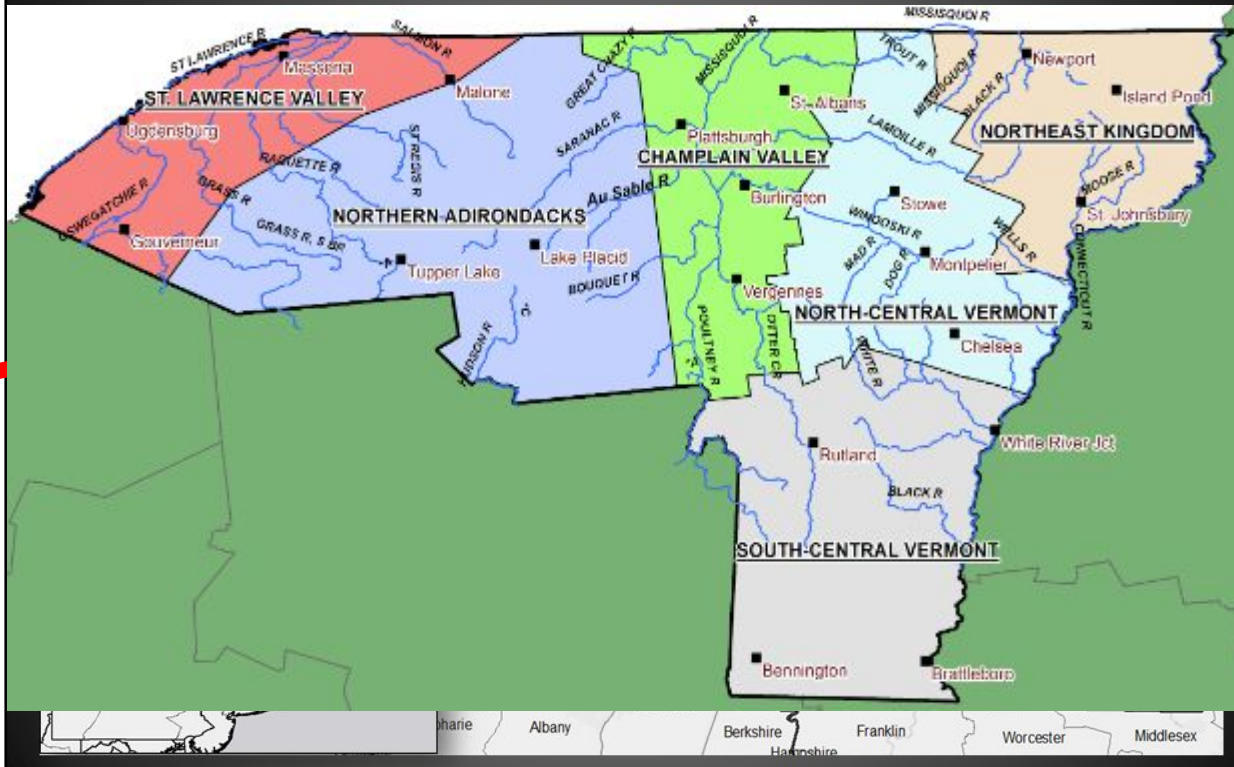
Where Do We Service?

- We service all of Vermont, except Bennington and Windham Counties and the 4 northernmost counties of New York.

NWS Burlington CWA

Northern New York and Central/Northern Vermont

Weather Forecast Office
Burlington, Vermont





What do we do?

Some of our Duties

- Watch/Warning/Advisory
- Public Forecasts
- Aviation
- Hydrology
- Fire Weather Forecasts
- Marine Forecasts
- Data Management
- Climate Services
- Upper Air
- Hazmat Support
- Systems Management
- Research and Training
- Outreach





What is Skywarn?

A 70 year old program that trains people to recognize and report severe/hazardous weather to help meteorologists make life-saving decisions





Why Do We Need Spotters?

The United States is the most severe weather prone country in the world



A typical year brings:

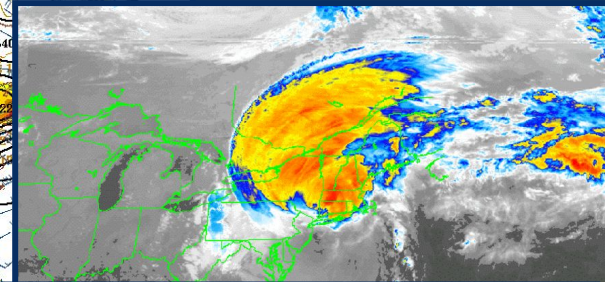
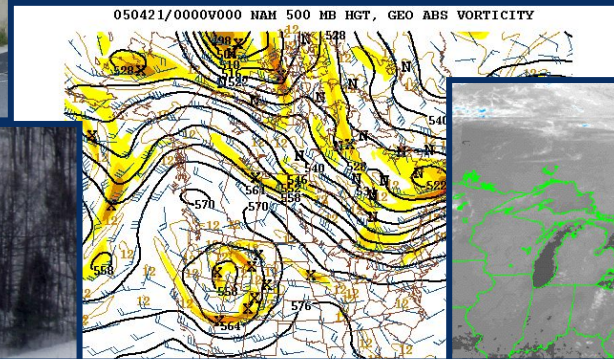
- 10,000 thunderstorms
- 5,000 floods
- 1,200 tornadoes
- 6 hurricanes
- 500 deaths and 5000 injuries
- \$15.0 Billion in Losses
- **98%** of all presidentially declared disasters are weather related



Why Do We Need Spotters?

✓ We use all kinds of methods to make weather observations.

- ✓ *Surface Observations*
- ✓ *Upper Air Observations*
- ✓ *Computer Models*
- ✓ *Satellite Imagery*
- ✓ *Radar*



But they all have limitations





Why Do We Need spotters?

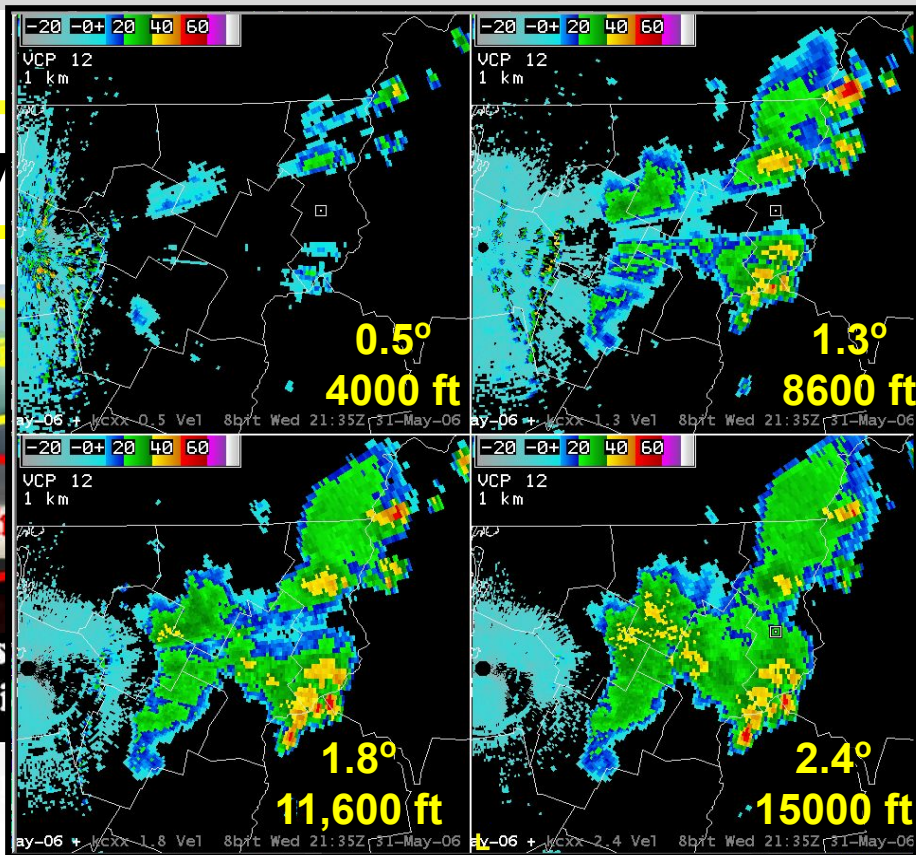
Observation

Radar sees this

Spotters see this

Why trained storm spotters are essential for public safety

Warning



Thunderstorm Warning





Who can be a Spotter?

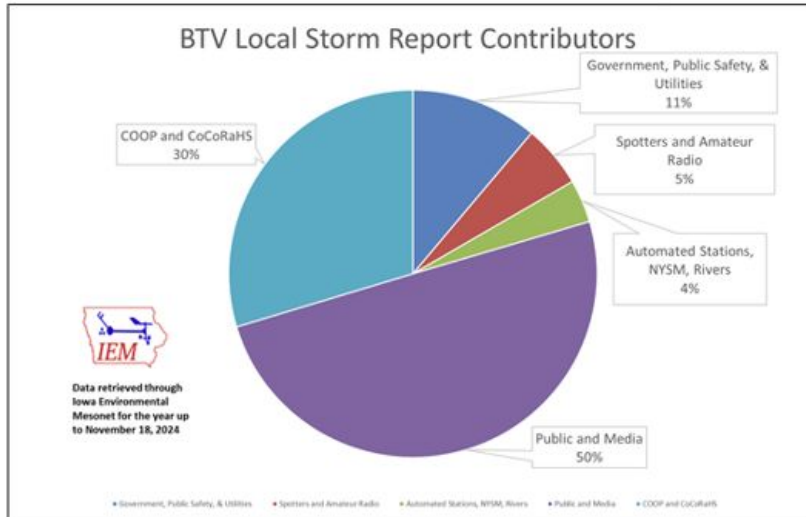
- ☐ Amateur Radio Operators (SKYWARN)
- ☐ Emergency Management Officials
- ☐ Firefighters
- ☐ Law Enforcement Officials
- ☐ Rescue Workers and EMTs
- ☐ Media
- ☐ Researchers
- ☐ Students
- ☐ General Public
- ☐ Storm Chasers
- ☐ COOP/CoCoRaHS

Anyone





Why Do We Need spotters?



- Lump in dedicated observers like COOP or CoCoRaHS, and you have roughly 35% of storm reports supplied from volunteers and citizen scientists!





Are there any questions?

- About Skywarn?
- About the National Weather Service in general?
- Anything else that comes to mind?



Awareness
Communication
Escape routes
Safety zones



Your Safety is ALWAYS #1

SEVERE WEATHER

HAZARDS



Over 280 fatalities
occur each year in the
U.S. from thunderstorm
related hazards.

weather.gov/safety

TORNADO
Take shelter
immediately in a
sturdy structure



LARGE HAIL
Move indoors away
from windows



SEVERE WIND
Move indoors away
from windows



FLOODING
Avoid rising
creeks and water
covered roads



LIGHTNING
Move indoors if
you hear thunder



Don't underestimate the power of water!



6 inches of fast-moving water can knock over and carry away an adult.

12 inches of fast-moving water can carry away a small car.

18-24 inches of fast-moving water can carry away most large SUVs, vans and trucks.





Heat Safety

Heat index is a measure of Temperature & Humidity - but know it's a broad measure

Heat Exhaustion		Heat Stroke
ACT FAST • Move to a cooler area • Loosen clothing • Sip cool water • Seek medical help if symptoms don't improve	<i>Dizziness</i> <i>Thirst</i> <i>Heavy Sweating</i> <i>Nausea</i> <i>Weakness</i>	<i>Confusion</i> <i>Dizziness</i> <i>Becomes Unconscious</i>
Heat exhaustion can lead to heat stroke.		ACT FAST CALL 911 • Move person to a cooler area • Loosen clothing and remove extra layers • Cool with water or ice Heat stroke can cause death or permanent disability if emergency treatment is not given.



Stay Cool, Stay Hydrated, Stay Informed!



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During **Extreme Heat**



Find air conditioning.

Avoid strenuous activities.

Wear light clothing.

Check on family members and neighbors.

Drink plenty of water.

Watch for heat cramps - exhaustion - stroke.

Never leave people or pets in a closed car.



weather.gov/heat



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Atmospheric Administration
U.S. Department of Commerce

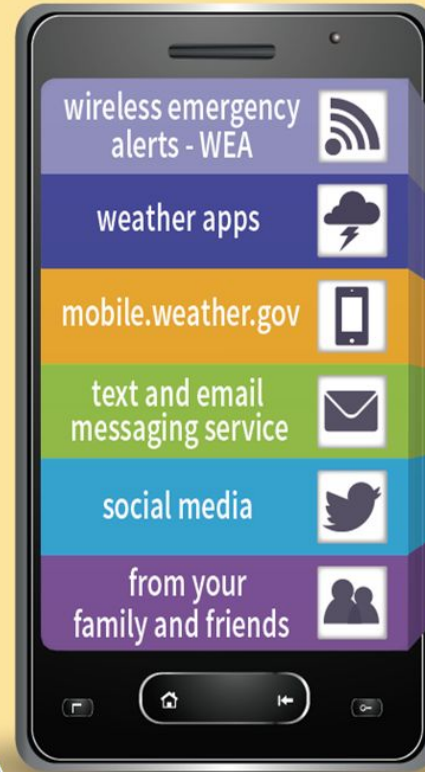
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Get Alerts To Stay Safe

- ❑ NOAA Weather Radio
- ❑ Alerts through your phone (WEA)
- ❑ TV Broadcasts/Media Outlets

Getting a warning could save **YOUR LIFE**



#01

#02

#03

#04

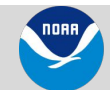
#05

#06

Use your **mobile device**
to get timely
weather warnings



mobile.weather.gov



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Know Resources for Warm Season Wx Hazards

- ❑ [Storm Prediction Center](#) for Severe Storms 
- ❑ [River Forecast Center](#), [National Water Prediction Service](#) - River Flooding 
- ❑ [River Forecast Center](#), [Weather Prediction Center](#) - Flash Flooding 
- ❑ [NWS HeatRisk](#) - Weather Prediction Center 
- ❑ [National Hurricane Center](#) - Tropical Weather 
- ❑ [Fire Weather](#) - National Weather Service page 
- ❑ [Local expertise](#) - Us at NWS Burlington! 



Watch vs Warning



"Cupcake" Ingredients Are Present



"Cupcake" is imminent or already occurring



EXTREME HEAT WATCH

An Extreme Heat Watch is issued when **dangerous heat is possible**.

Reschedule outdoor activities in the coming days. Make sure that children, the elderly, and pets have a place to cool off during the heat.

Be Prepared.



weather.gov

EXTREME HEAT WARNING

An Extreme Heat Warning is issued when **dangerous heat is happening or about to happen**.

Avoid heavy activity & direct sunlight. Stay hydrated, find a cool indoor place, and check on children, elderly & pets.

Take Action!

FLOOD WATCH

A Flood Watch is issued when **flooding is *possible***.

Stay tuned to trusted news sources and be ready to seek higher ground.

Be Prepared.



weather.gov

FLOOD WARNING

A Flood Warning is issued when **flooding is *happening or about to happen***.

Move to higher ground immediately!
Never drive or walk through floodwaters.

Take Action!



Watch vs Warning

Unlike most of our Watches/Warnings, these operate on the shortest time frame

Watch

-Conditions are favorable for severe weather development over the coming hours.

Warning

-Severe weather is **imminent or ongoing**
-**Take immediate action!**

WATCH VS. WARNING

Do YOU know the difference?

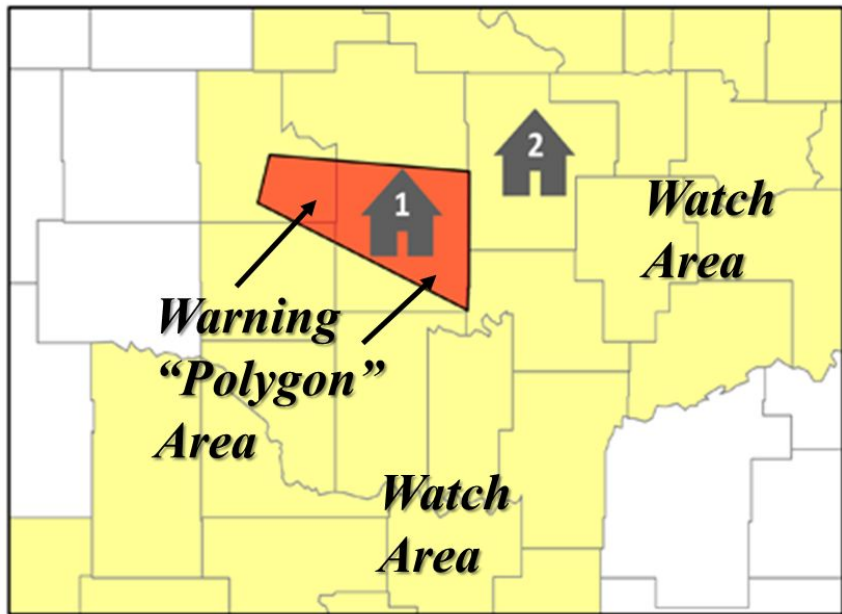
WATCH

BE ALERT. Severe storms or tornadoes **MIGHT** form and affect your area.



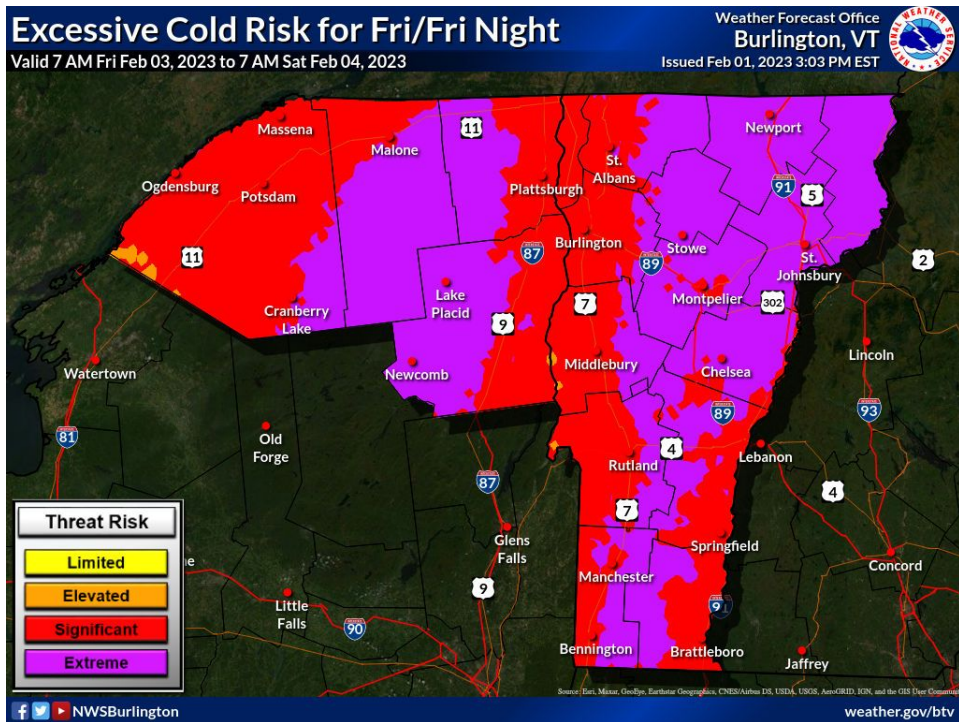
WARNING

TAKE ACTION! A severe storm or tornado is **expected** in your area.





Graphical Hazardous Weather Outlook (GHWO)



24 Hr Hazard Risks

- Severe Thunderstorm
- Tornado
- Thunderstorm Wind
- Hail
- Lightning
- Excessive Rainfall
- Wind
- Fog
- Excessive Cold
- Ice Accumulation
- Snow/Sleet

Tonight

Thu

Fri

Sat

Sun

Mon

Tue

Severe Thunderstorm						
Tornado						
Thunderstorm Wind						
Hail						
Lightning						
Excessive Rainfall						
Wind						
Fog						
Excessive Cold						
Ice Accumulation						
Snow/Sleet						





Storm Prediction Center Outlooks

Understand

Apr 27, 2011

Outlook

Categories

THUNDERSTORMS

(no label)

No severe
thunderstorms
expected

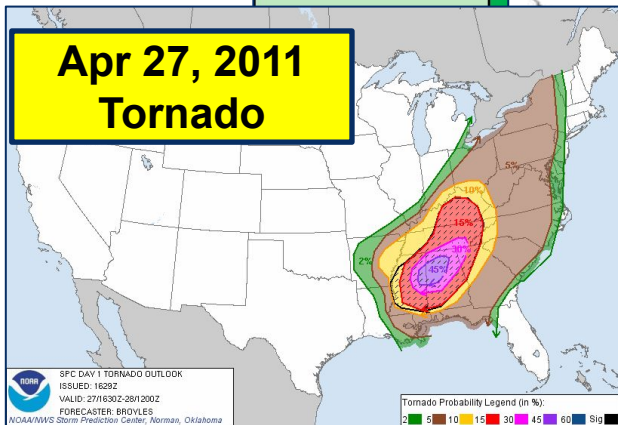
5+ HIGH

(HIGH)

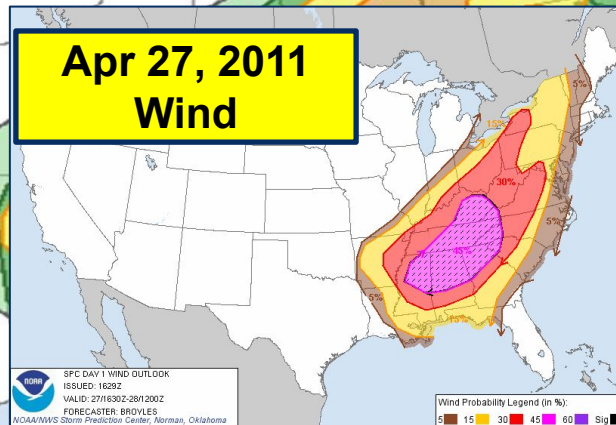
Widespread
severe storms
expected

Each outlook is subdivided into different threat categories for tornadoes, wind, and hail. As of Spring 2020, this now includes Day 2 Severe Weather Outlooks as well!

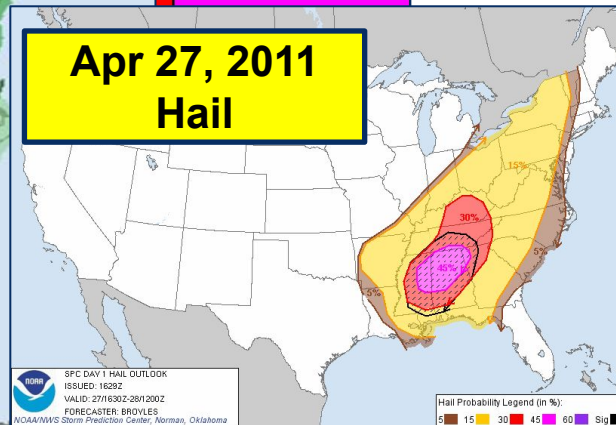
Apr 27, 2011
Tornado



Apr 27, 2011
Wind



Apr 27, 2011
Hail



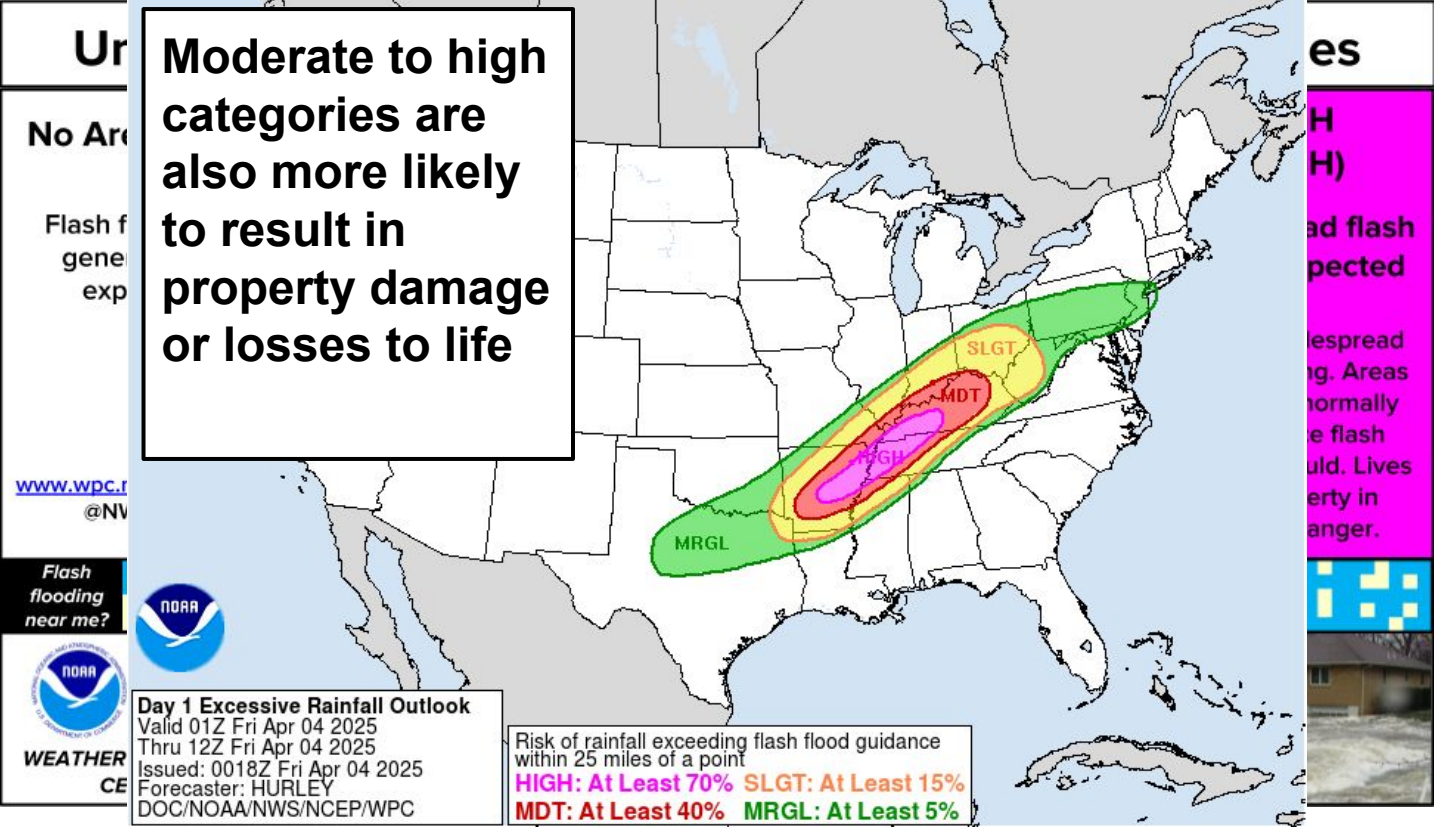
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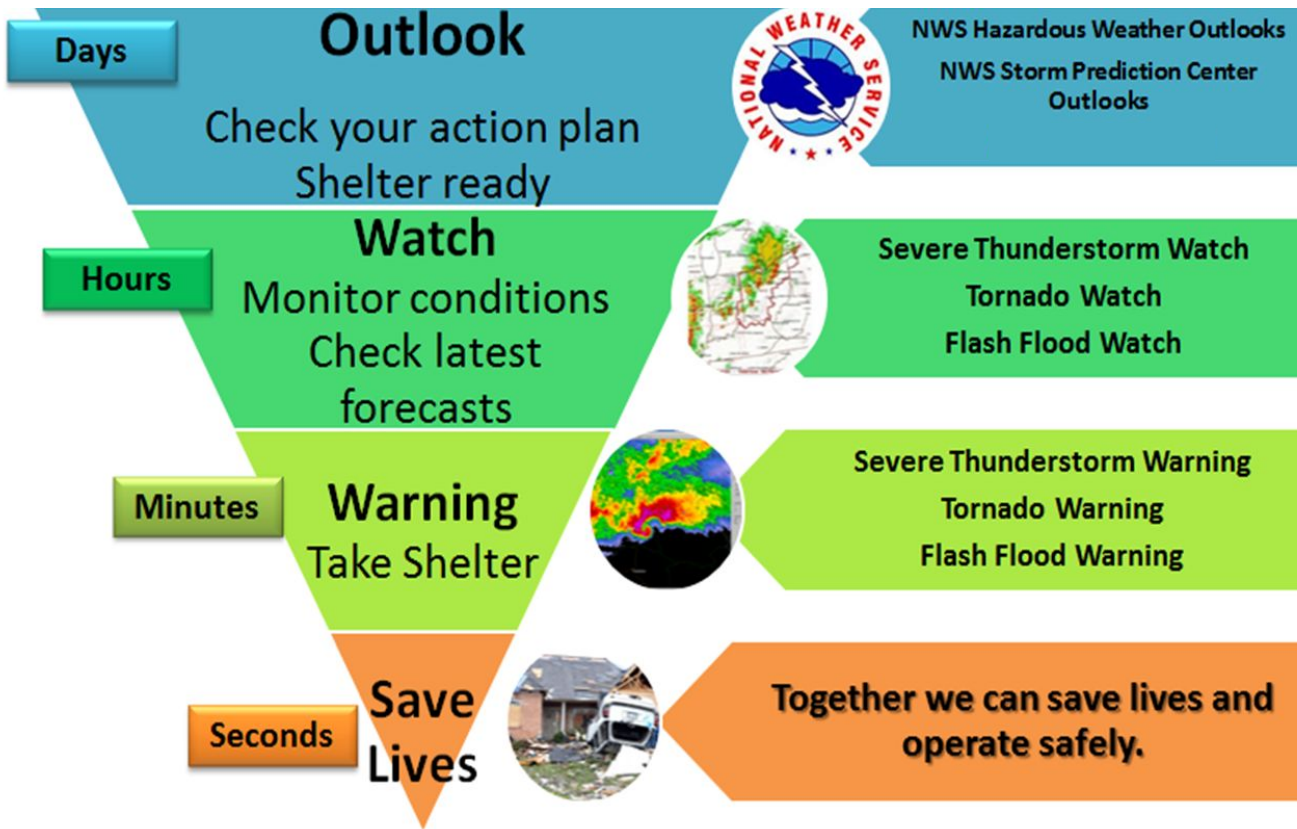


Excessive Rainfall Outlooks



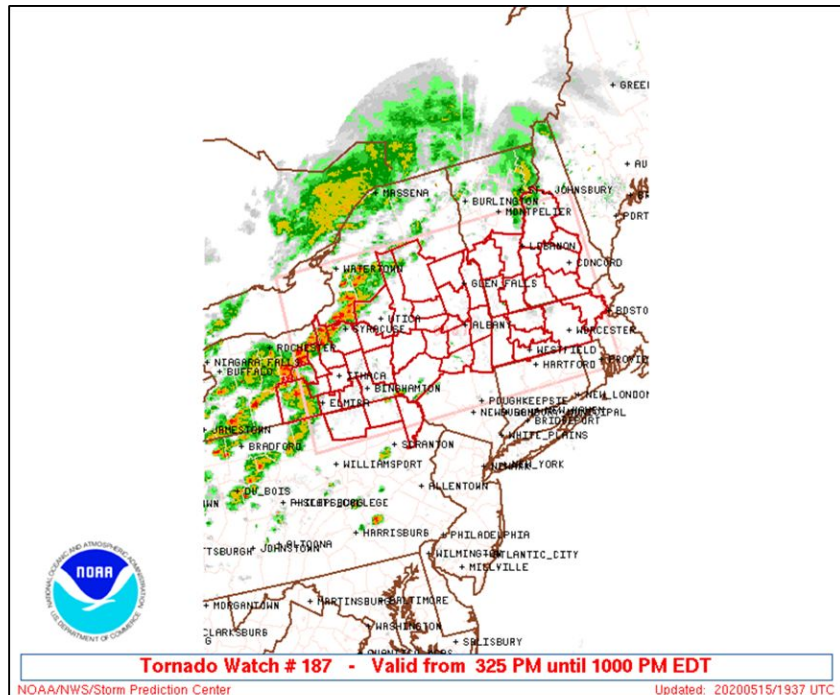


Messaging Evolves As We Get Closer To Severe Storms

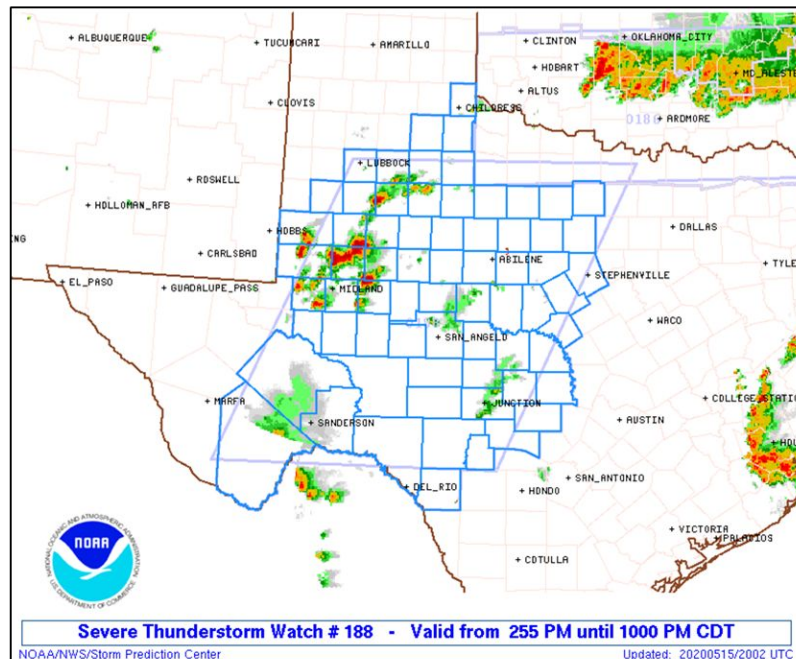




Tornado Watch vs Severe Thunderstorm Watch



Hazard	Tornadoes	EF2+ Tornadoes	Severe Wind	65 kt+ Wind	Severe Hail	2"+ Hail
Likelihood	Moderate	Low	High	Low	Moderate	Low



Hazard	Tornadoes	EF2+ Tornadoes	Severe Wind	65 kt+ Wind	Severe Hail	2"+ Hail
Likelihood	Low	Very Low	High	Moderate	Moderate	Moderate

The main difference is whether tornado threat is moderate or low. Other hazards may be more important!





Poll Time

What is the expert agency that initiates tornado or severe thunderstorm watch coordination across the country?





Convective Warning Criteria

Severe Thunderstorm Warning

- Thunderstorm wind gusts ≥ 58 mph & or:
- Hail ≥ 1 inch in diameter



Tornado Warning

- Doppler Radar indicated rotation
- Confirmed reports of a tornado



Flash Flood Warning

- 6 inches or more of flowing water over roadways
- A rapid rise in water that is a threat to life & property





Tiered Impact Based System

Thunderstorm Damage Threat Categories

Wording gets stronger
the greater the threat
to life.

Also includes:

- Tornadoes
- Flash Floods
- Snow Squalls

Considerable / Destructive Tags

Thunderstorm Damage Threat (tag category)	Wind	Hail diameter	WEA?
Base (no tag; default)	58 mph (60 mph will appear in the warning)	1.00 inch (U.S. quarter)	NO
Considerable	70 mph	1.75 inch (golfball)	NO
Destructive	80 mph	2.75 inch (baseball)	YES

Impact Based Severe
Thunderstorm Warning
Example

**Tag Information at the
end of the warning**

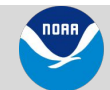
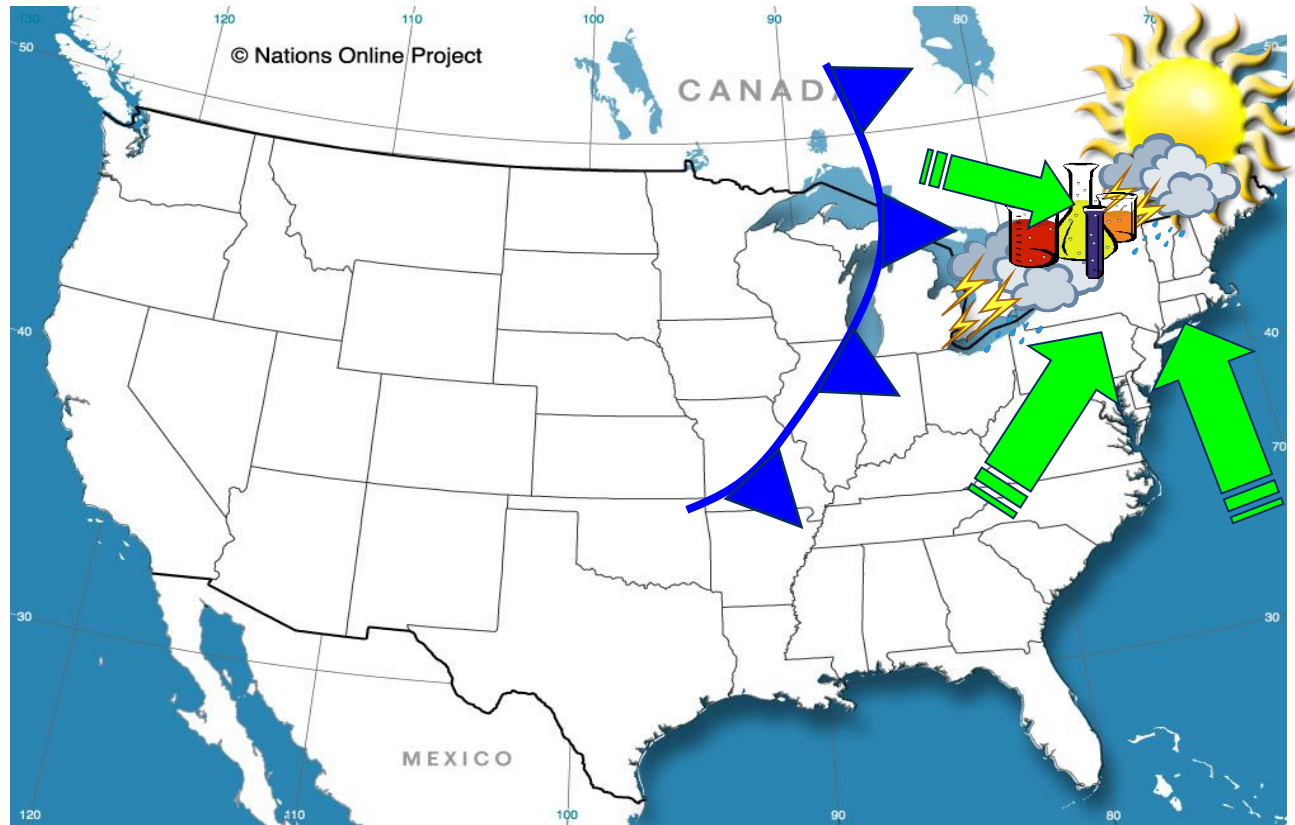
TORNADO...POSSIBLE
THUNDERSTORM DAMAGE THREAT...CONSIDERABLE
HAIL THREAT...RADAR INDICATED
MAX HAIL SIZE...1.00 IN
WIND THREAT...OBSERVED
MAX WIND GUST...70 MPH





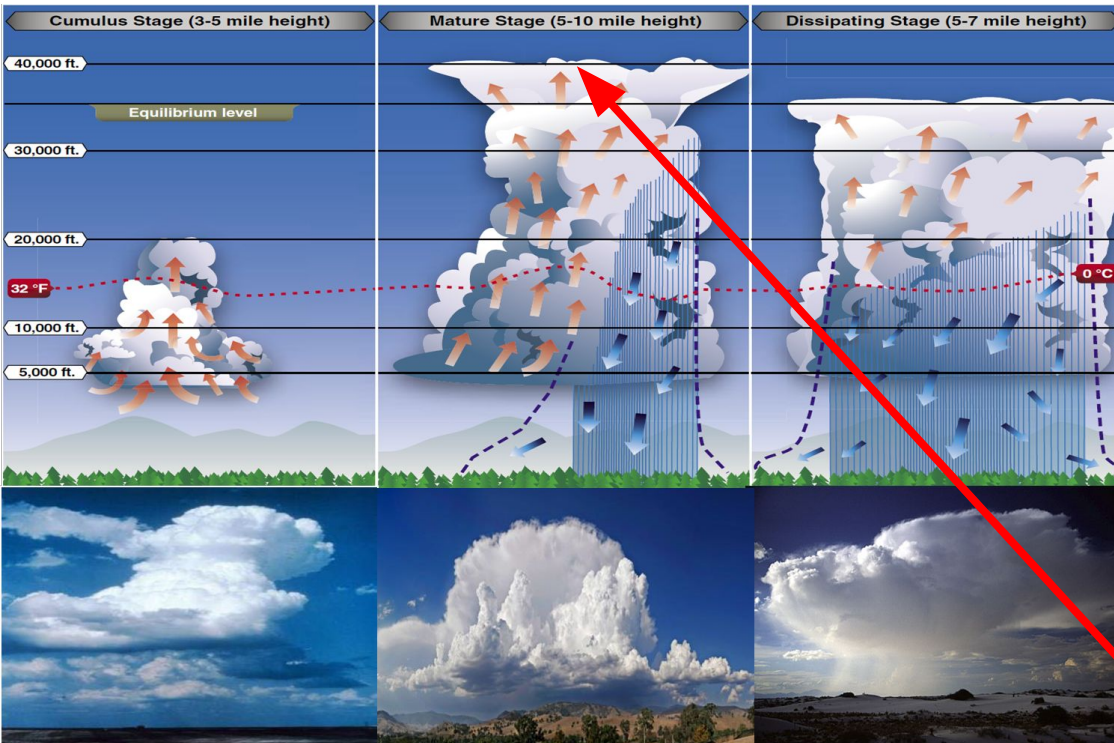
Thunderstorm Development 101

- Instability
- A lifting mechanism, like a front or mountains
- Moisture - Lakes and oceans are the best resource





Typical Thunderstorm Lifecycle



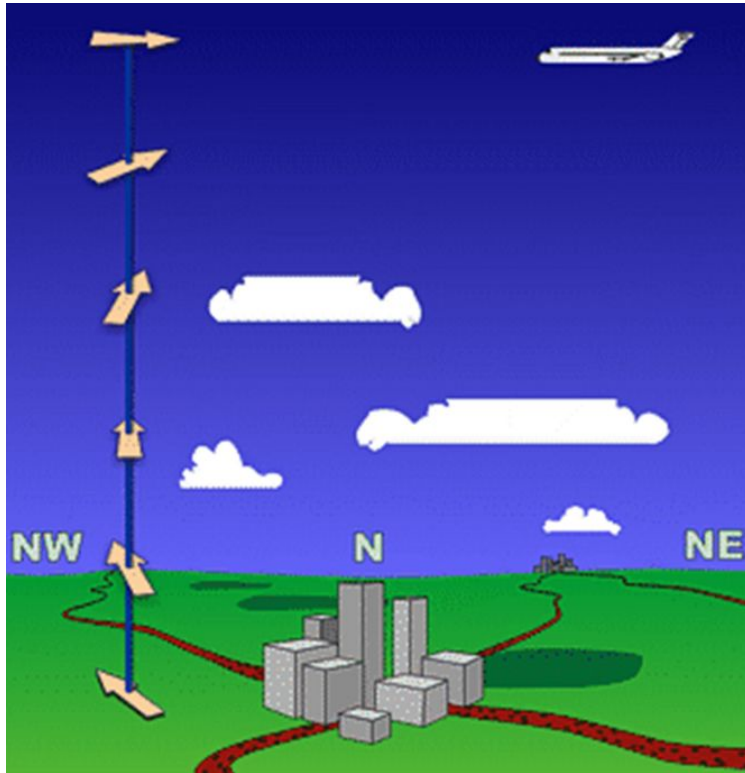
- ❑ Downdraft overtakes the convective updraft.
- ❑ Causes the storm to dissipate, usually within an hour.
- ❑ Severe weather impacts are most likely once a storm has reached maturity or transitioning in the dissipation stage
- ❑ Overshooting tops suggest stronger storms



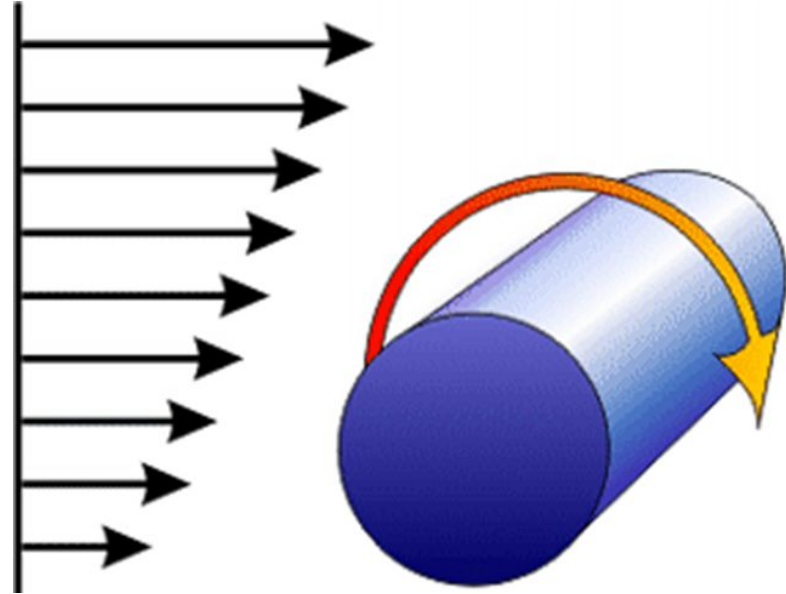
Super Slow-Mo.....



What is Wind Shear



Directional Shear - Ideal for supercells



Unidirectional shear or "Speed Shear"

Ideal for producing squall lines

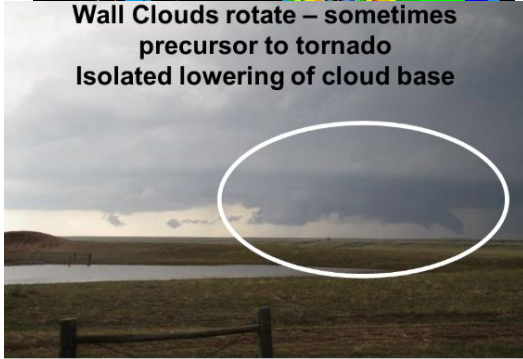


What is Wind Shear

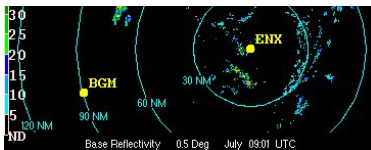
Directional Shear



Wall Clouds rotate – sometimes precursor to tornado
Isolated lowering of cloud base



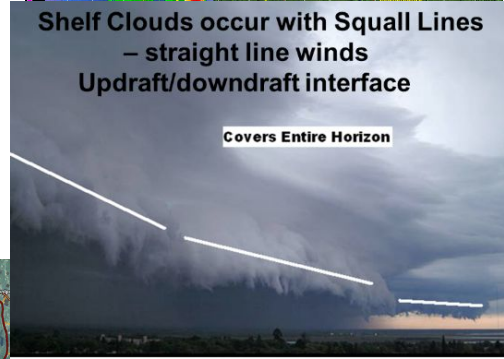
Wall cloud near Cheyenne, WY.
Photo courtesy of NWS Meteorologist Christina Speciale.



“Speed Shear”

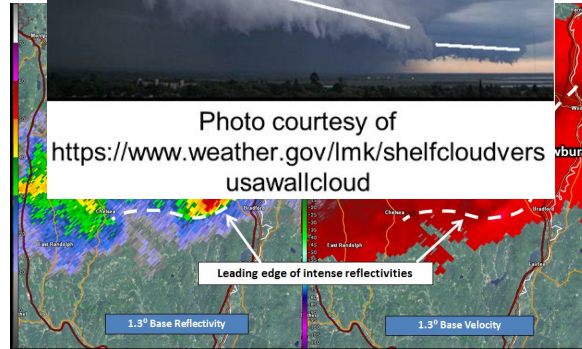


Shelf Clouds occur with Squall Lines – straight line winds
Updraft/downdraft interface



Covers Entire Horizon

Photo courtesy of
<https://www.weather.gov/lmk/shelfcloudversusawallcloud>

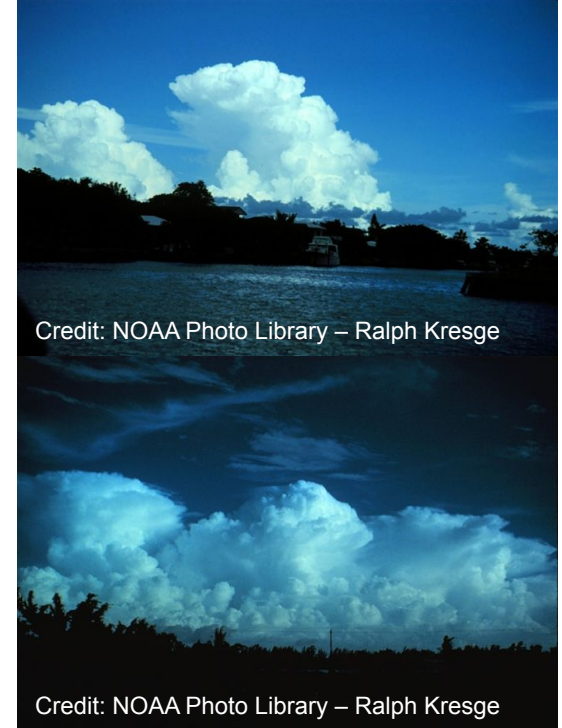


Leading edge of intense reflectivities

1.3" Base Reflectivity

1.3" Base Velocity

Little Shear



Credit: NOAA Photo Library – Ralph Kresge

Credit: NOAA Photo Library – Ralph Kresge



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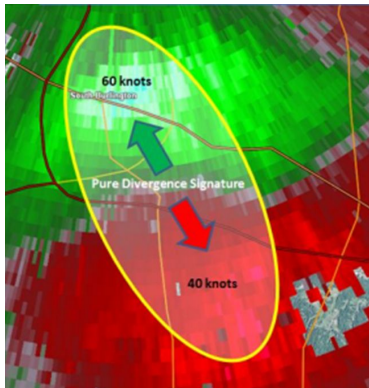


How Does Radar Work?

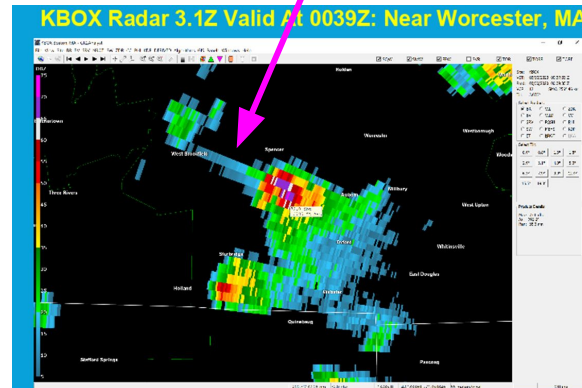


Look for changes in intensity and movement of reflectivities to identify weather hazards.

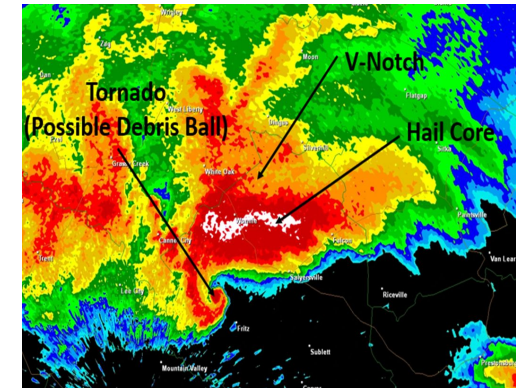
Downburst winds



Hail



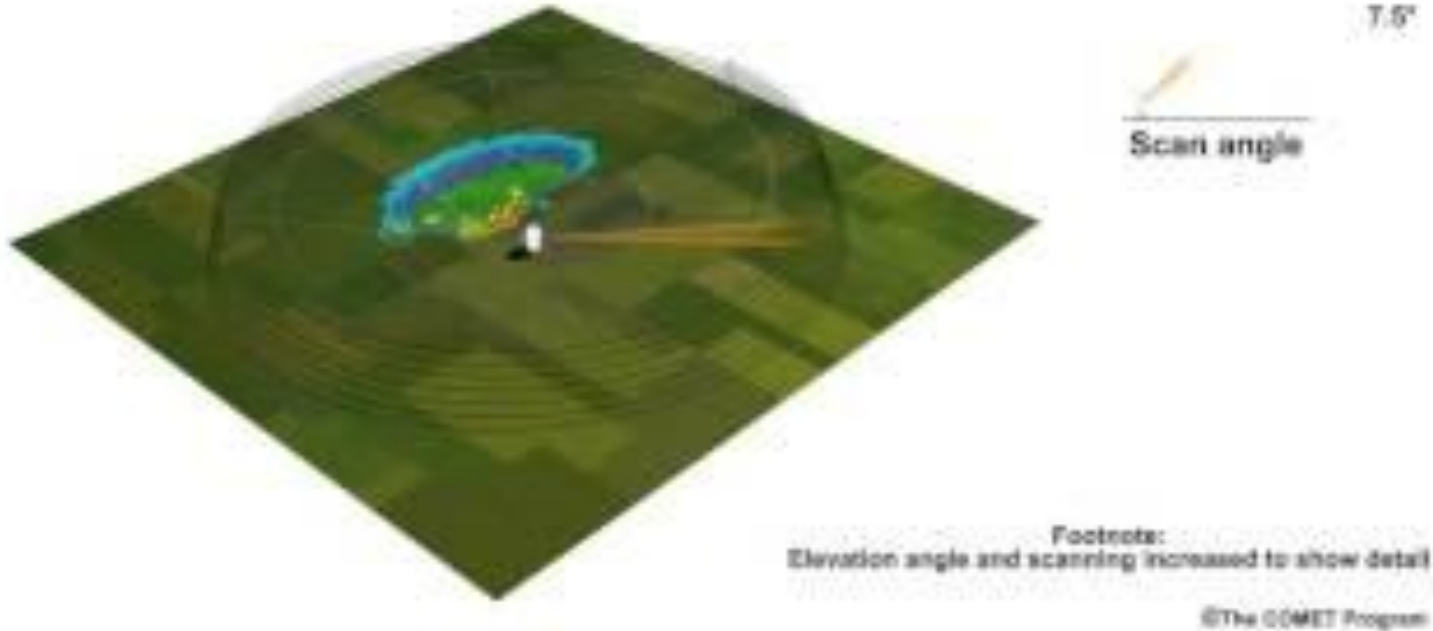
Supercells





Observing Local Weather: Radar

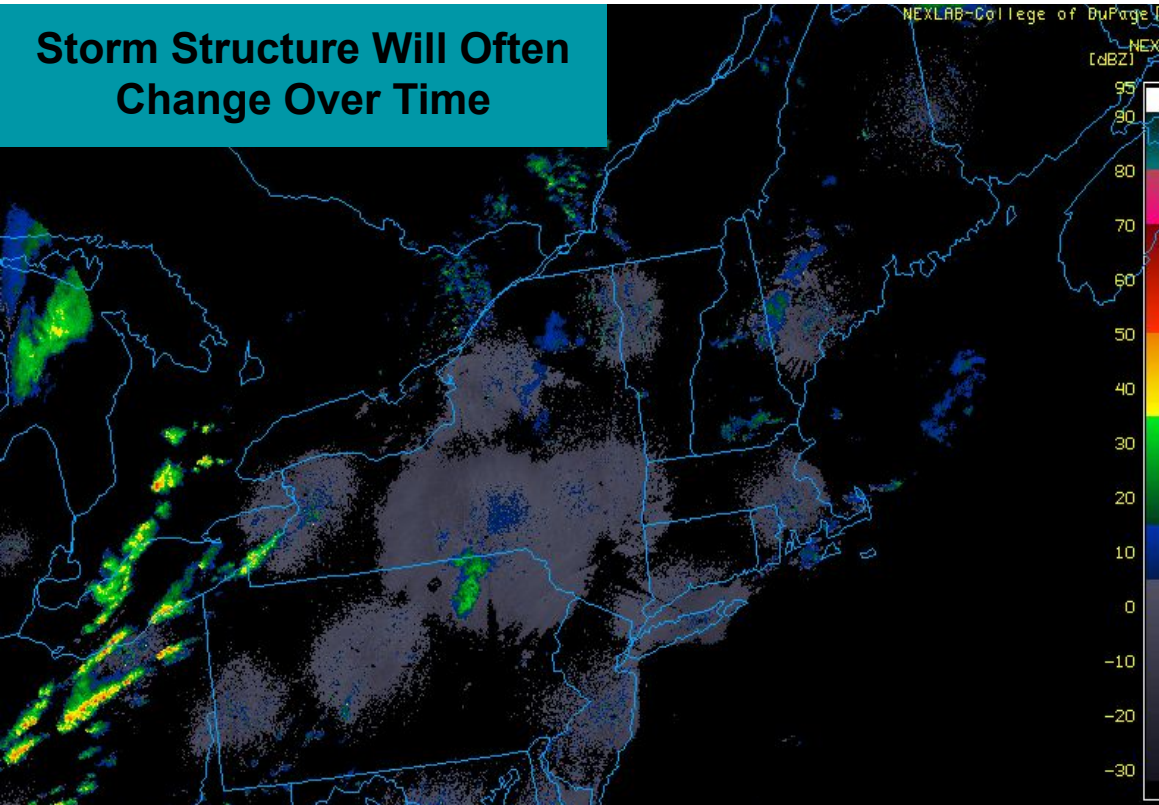
Radar Scanning Pattern





Radar Reflectivity

Storm Structure Will Often Change Over Time



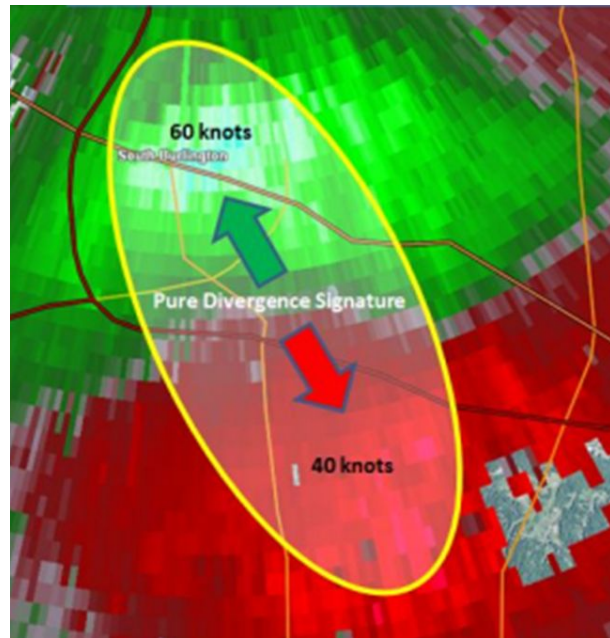
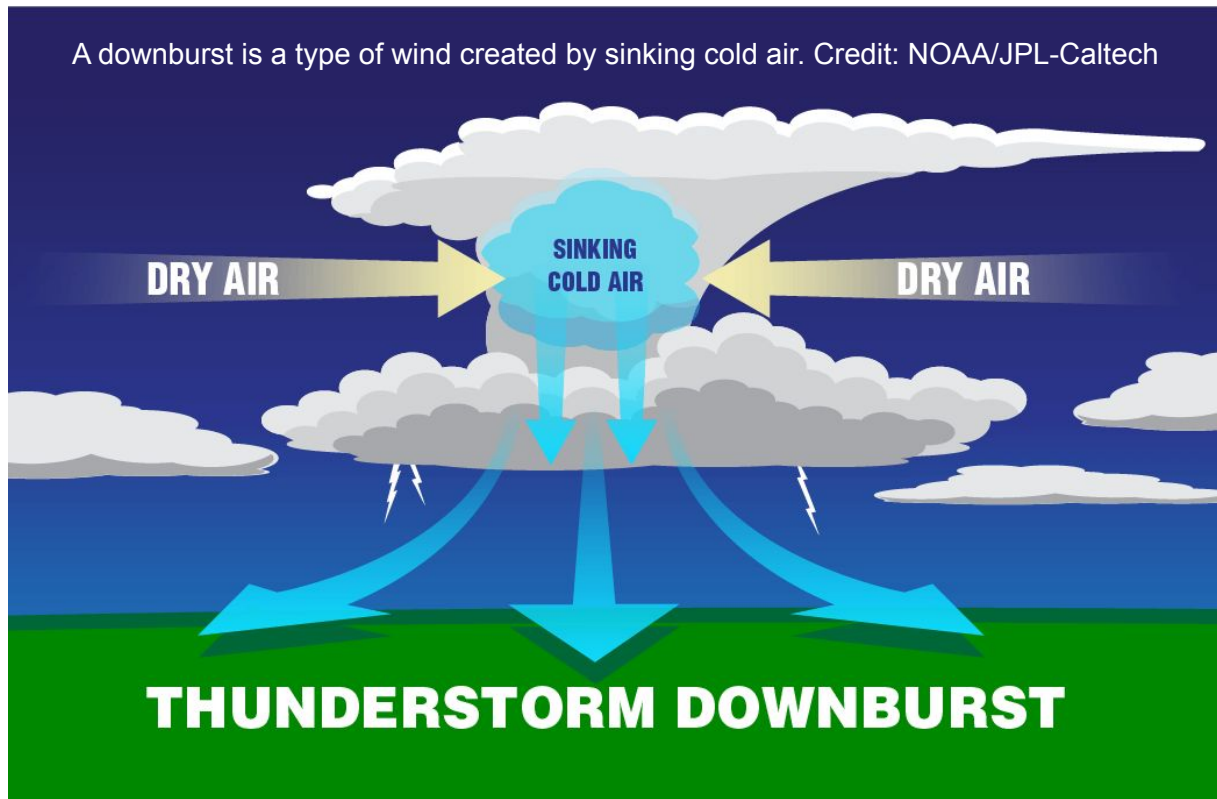
- **Displays energy reflected back to the radar**
- **Shows location and movement of rain, snow, hail, etc.**
- **Radar energy can also reflect back off birds, insects, and ground targets**





Microburst Visual Appearance

A downburst is a type of wind created by sinking cold air. Credit: NOAA/JPL-Caltech



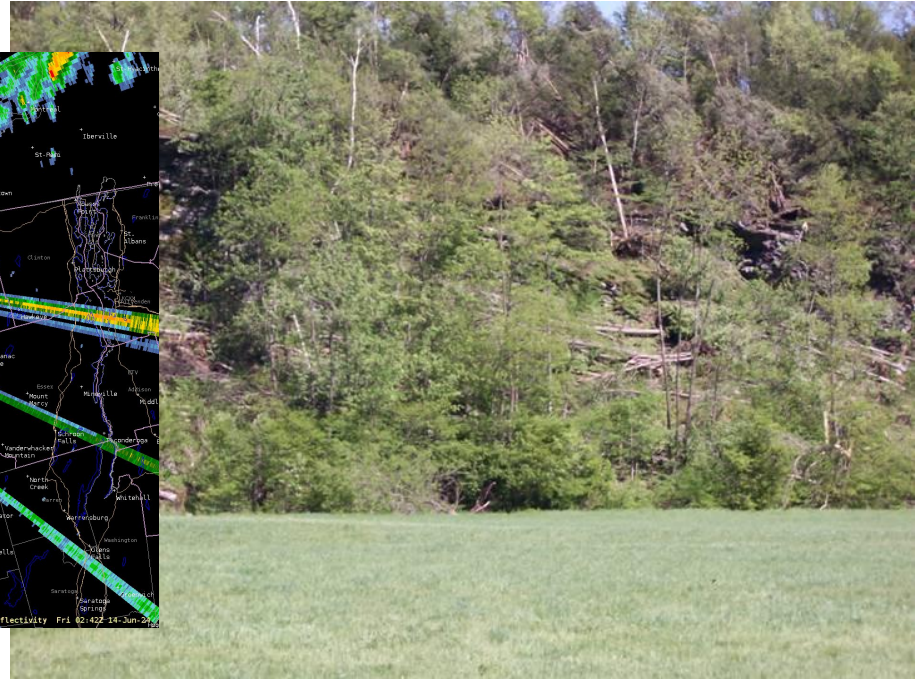
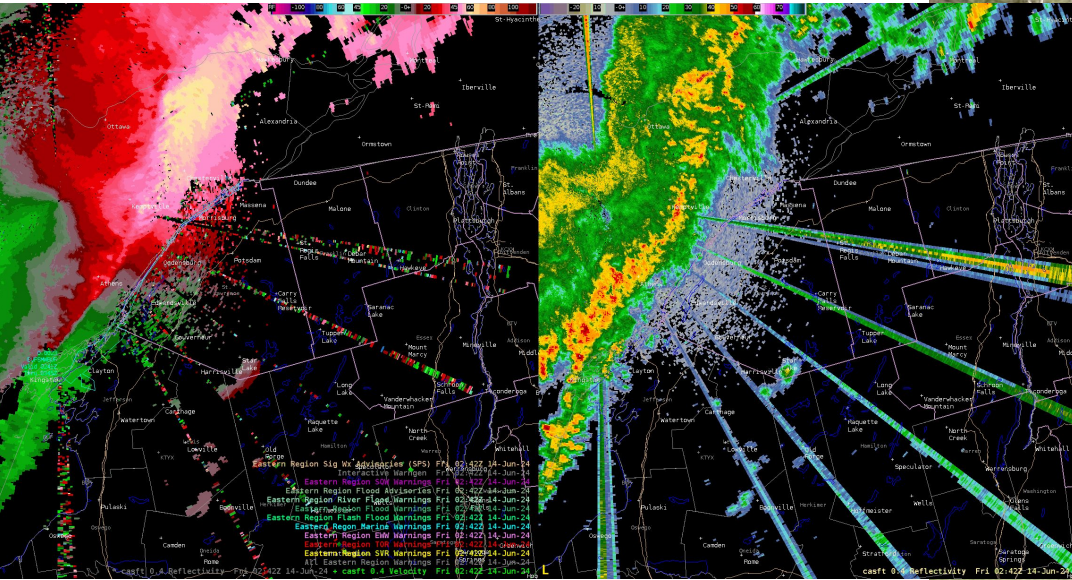


Downburst - From Mike Oblinski





Straight-Line Winds

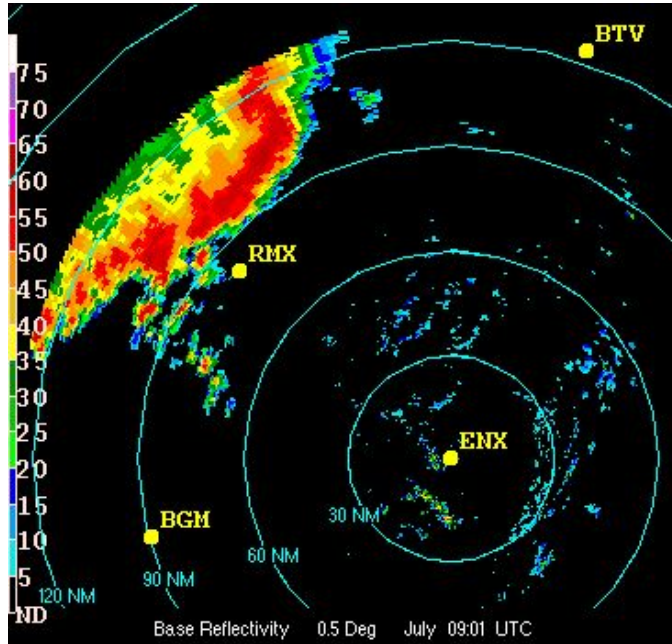


Squall Line (*Jargon term - Quasi Linear Convective System: QLCS*) - Group of thunderstorms that are often accompanied by high winds and heavy rain, occasionally with tornadoes (along breaks). It gets its name because the line of red is very distinguishable.



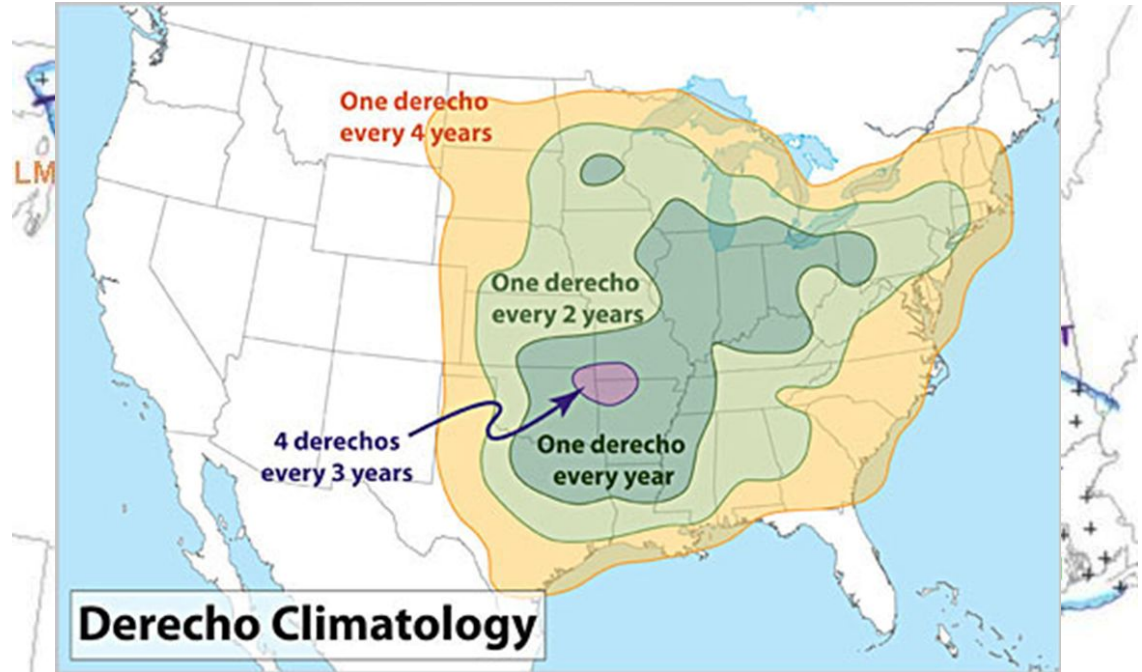


Derecho



July 14-15, 1995

“The Ontario/Adirondacks Derecho”

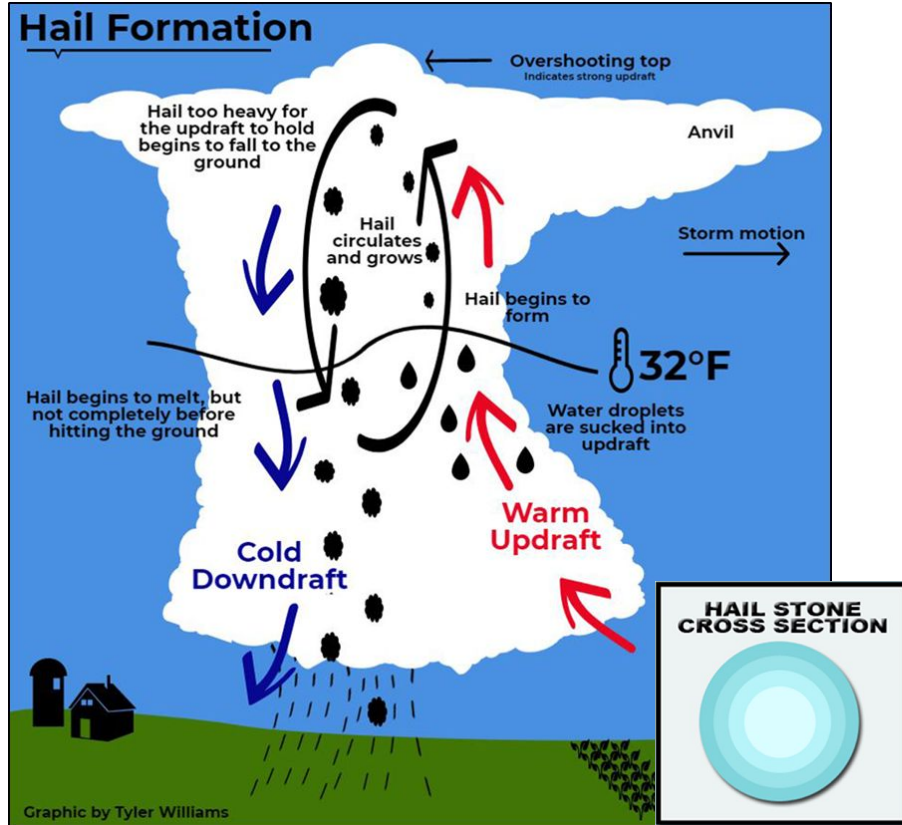


When winds are sufficiently strong (handful of hurricane force gusts) and extensive (400 mile path that’s at least 60 miles wide), then the event qualifies as a “derecho”.





Hail Formation and Growth



- Hail is more likely when updrafts are strong and the freezing level is low in the atmosphere.
- Hail is more likely when your updraft and downdraft are separate.
- Hail is more likely if the storm has been around a long time.



Vermont Record Hail Westford, VT July 16, 2009

3.25" diameter



- Measure hailstone from tip-to-tip
- And do it fast! That hail is melting.
- And if you get record hail, make sure to back it up with a photo.

Took place in one of our employee's own backyard!



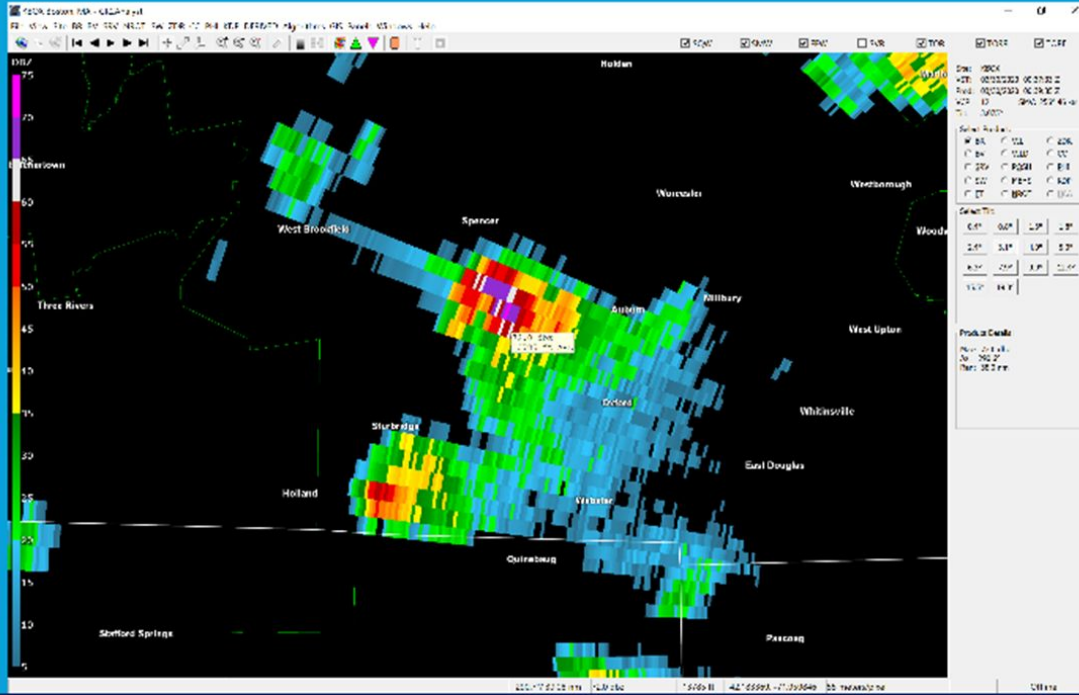
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Hail on Radar

KBOX Radar 3.1Z Valid At 0039Z: Near Worcester, MA

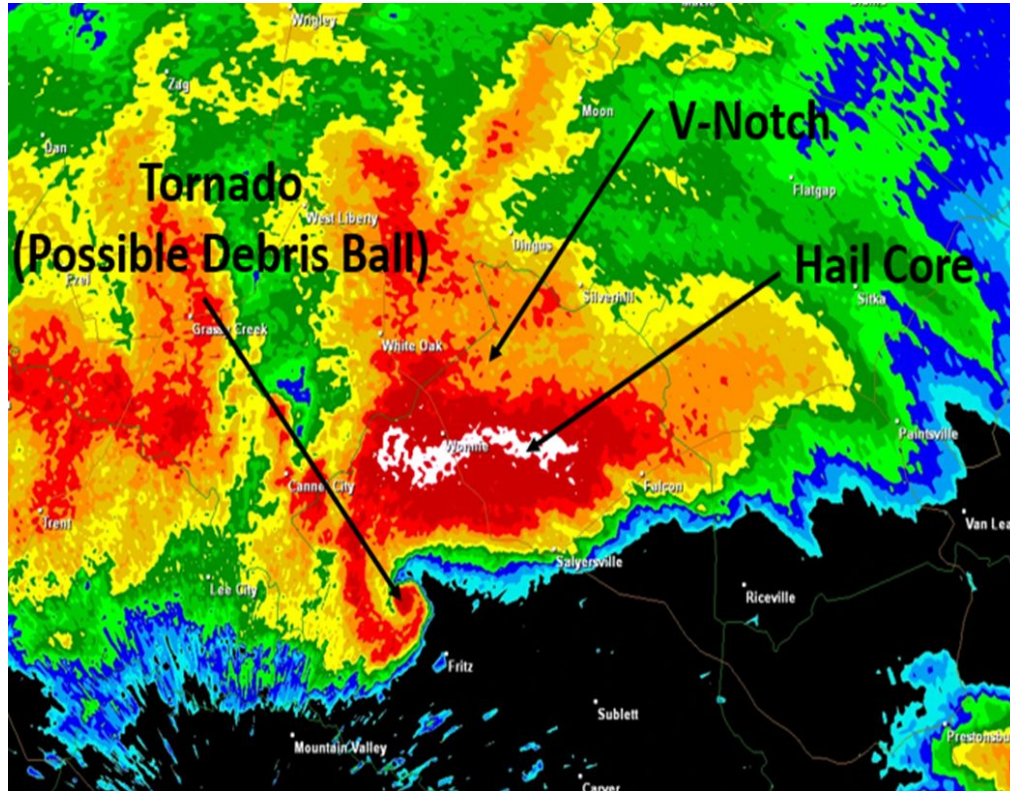


- Hail scatters the radar beam quite differently from rain.
- Most commonly you'll see a “three body scatter spike” – or simply hail spike – when dealing with large hail.





Supercells



- ❑ Named “Supercell” when they display strong mid-level rotation.
- ❑ Has a longer life-cycle (separation of updraft + downdraft from wind shear)
- ❑ Also capable of dropping very large hail up to 2-4 inches in diameter (Look for blues/green colors within clouds).
- ❑ Can last 20-60 minutes but can also persist longer in a favorable environment.
- ❑ About 1 out of 5 produce tornadoes.





Shelf Cloud vs Wall Clouds

**Shelf Clouds occur with Squall Lines
– straight line winds
Updraft/downdraft interface**

Covers Entire Horizon



Photo courtesy of
<https://www.weather.gov/lmk/shelfcloudversusawallcloud>

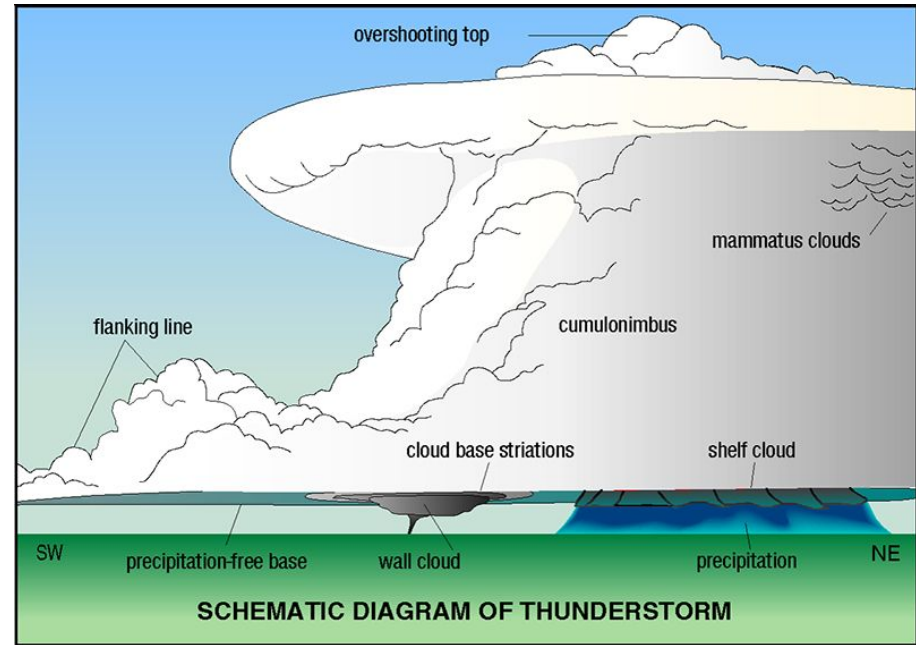
**Wall Clouds rotate – sometimes
precursor to tornado
Isolated lowering of cloud base**



Wall cloud near Cheyenne, WY.
Photo courtesy of NWS Meteorologist
Christina Speciale.



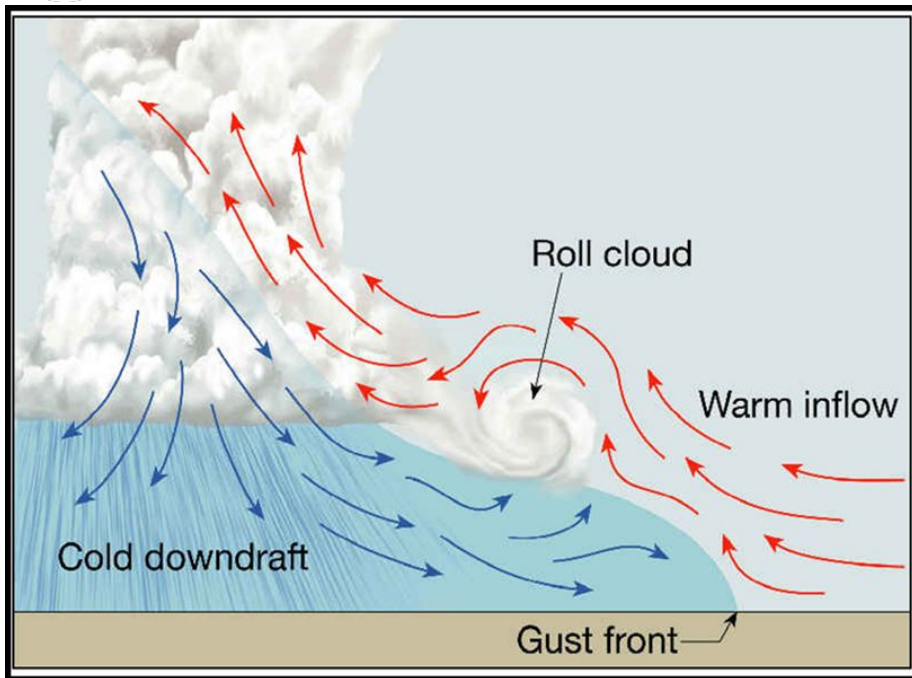
Wall Cloud



It will usually be rain free, where downdraft and intense updraft meet and interact, which helps give it the iconic hook on radar. Look for entire wall cloud to rotate.



Shelf/Roll Cloud



Often, squalls are accompanied by shelf or roll clouds. When you see these, you are likely in for very heavy rain and damaging winds.





Poll Time

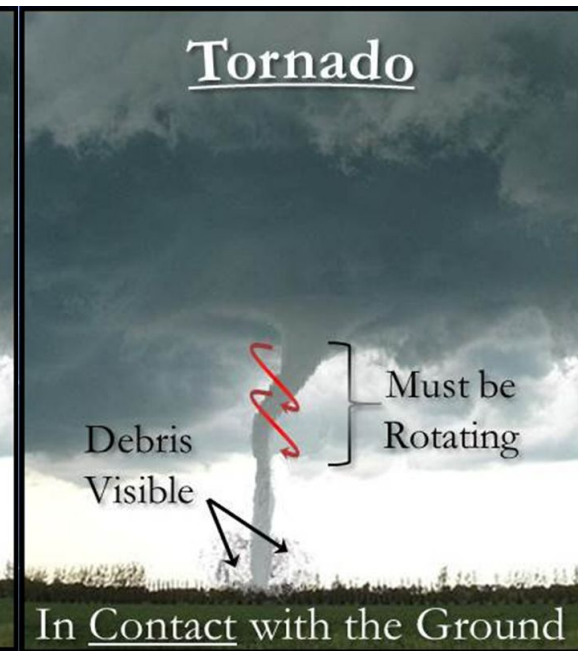
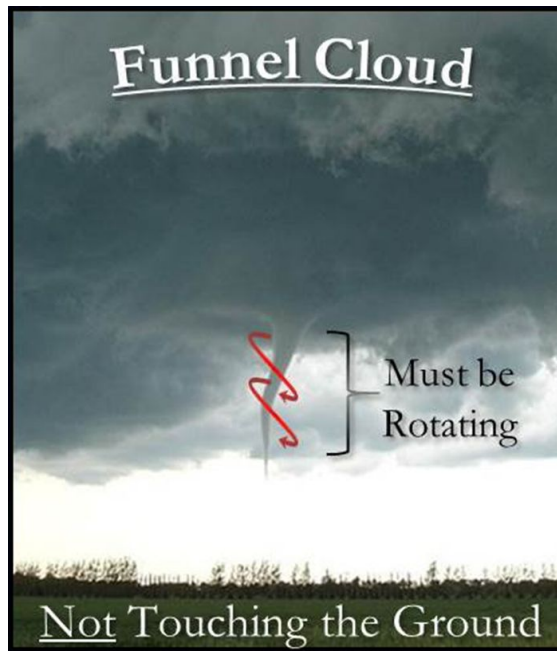
What distinguishes the “Supercell” from other storms?





Let's Talk About Tornadoes

- Tornado: A violently rotating column of air in contact with the ground
- Rare, 1 every 2 years in Burlington's area





Tornado look alike

- Scud/Convective Debris
- Ask is it attached to the cloud? Are you mistaking a rain shaft for a cloud?
- Is it moving up into the cloud (funnels descend) or is it rotating?
- If asking us to evaluate, these questions are hard to answer without video or time of occurrence (helps us match to what we see on radar).





Weak Tornadoes

(EF0 and EF1)

- 80% of all tornadoes
- Less than 5% of tornado deaths
- Lifetime: 1 - 15 minutes
- Path: Up to 3 miles
- Wind speed: 65 - 109 mph
- Most North Country tornadoes





Strong Tornadoes

(EF2 and EF3)

- 19% of all tornadoes
- Less than 30% of tornado deaths
- Lifetime: 20 minutes or longer
- Path: 15+ miles
- Wind speed: 110 - 167 mph





Violent Tornadoes

(EF4 and EF5)

- 1% of all tornadoes
- 70% of tornado deaths
- Lifetime: One hour or longer
- Path: 50+ miles
- Wind speed: 168 -234 mph





Flood vs Flash Flood

The key difference is whether waters rise quickly (**FLASH FLOOD**) or do waters rise gradually (**FLOOD**)?

- **Flash Floods** are most often caused from excessive rain in a short window of time (< 6 hrs)
- **Floods** arise from many gradual contributions to river rises or standing water

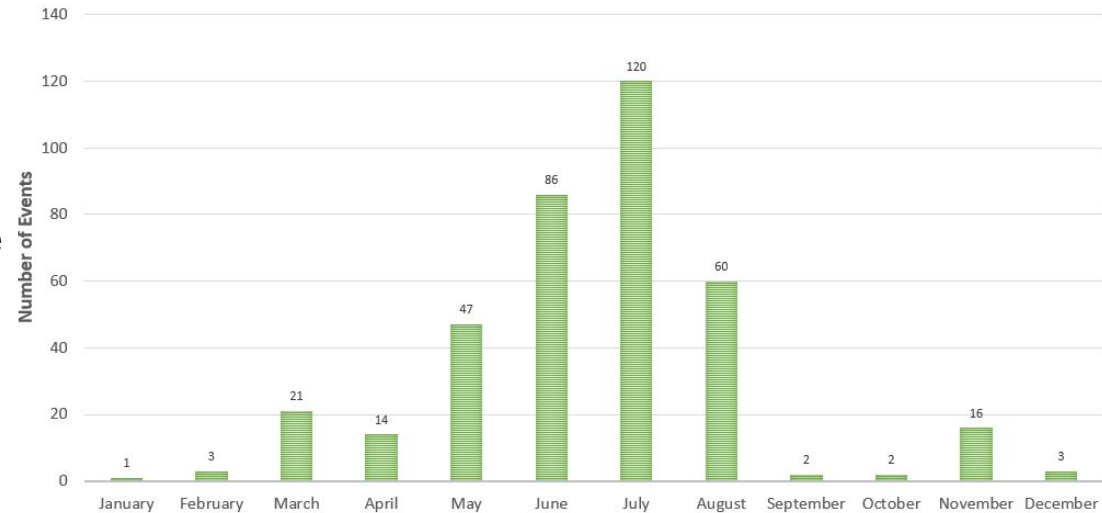




When is Flooding Common in the North Country

- Spring snowmelt saturates soils and produces runoff into waterways and contributes to ice jams in thaws
 - Jam stops flow of water
- In fall, vegetation goes into dormancy and vegetation collects less water
 - Leads to greater runoff
- Atmospheric flows with tropical moisture feeds
 - September and October, non-tropical cyclones (October 2017 storm/1927 Flood) or recurving tropical cyclones (Floyd/Irene)
- During the summer, training thunderstorms tends to be localized, but produces majority of flash floods

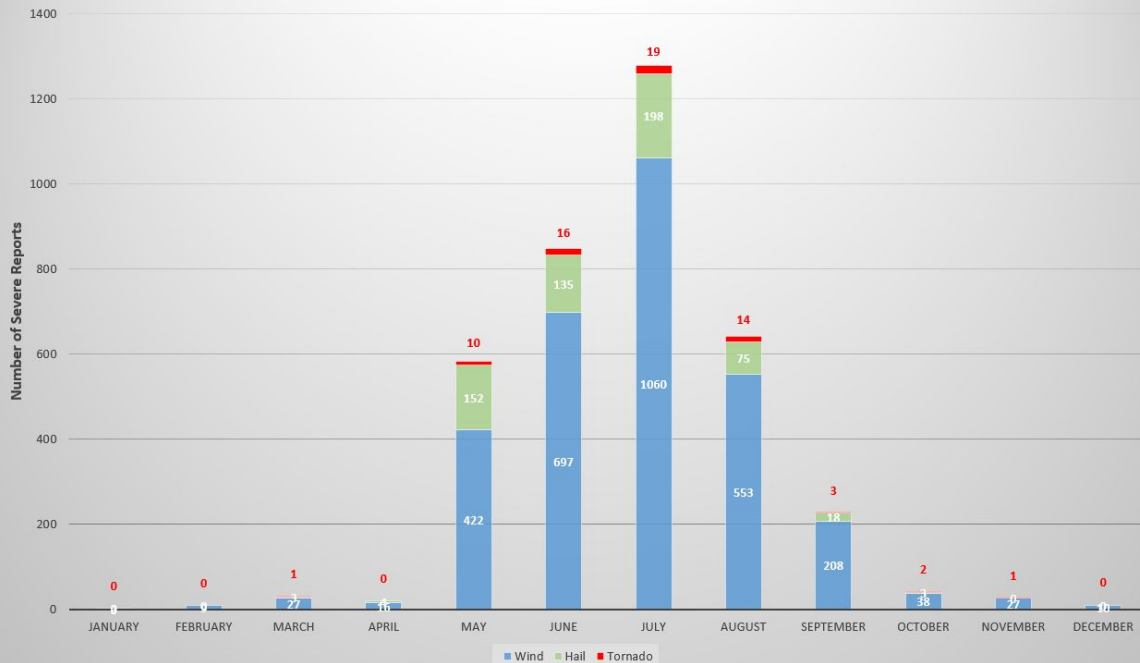
BTV FLASH FLOODS BY MONTH (1975-2022)





Brief Overview of Thunderstorm Types and Hazards

Yearly Severe Wind/Severe Hail/Tornado Reports
1955-2021



Climatological period of Severe Weather is the height of summer

Why is this so?

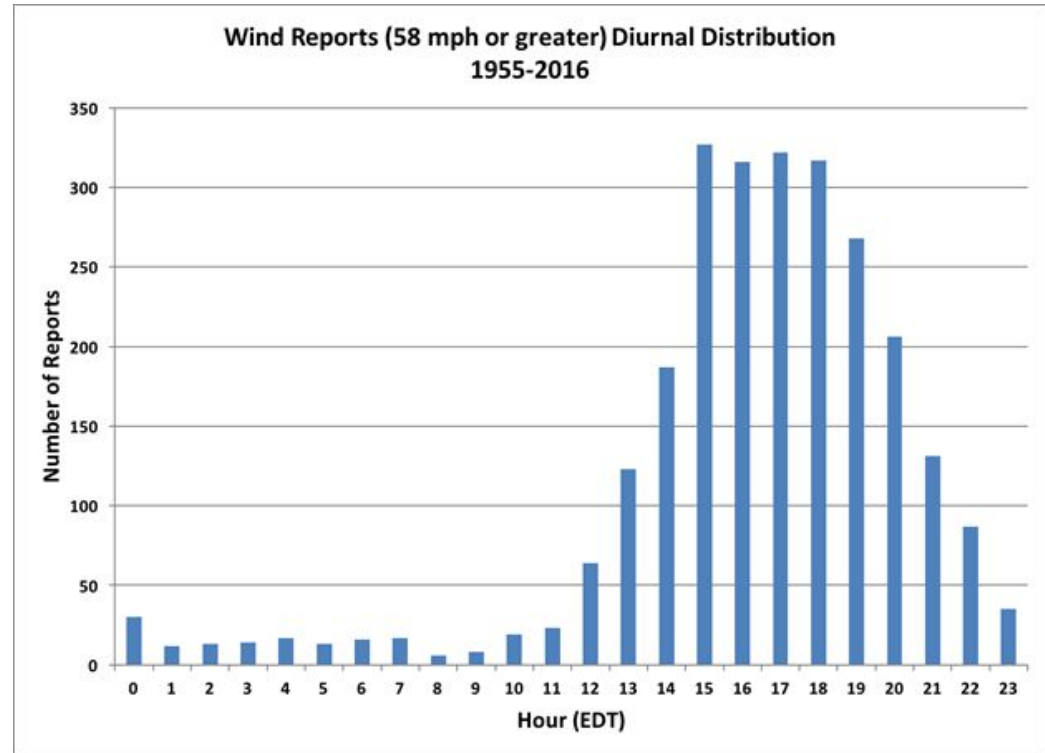
- More daytime heating – greater atmospheric instability
- Bermuda high usually allows moisture from the Gulf advance northwards.
- While areas like Florida don't get fronts in the summer, we can still get weak frontal boundaries that help storms develop.





North Country Severe Weather Climatology

- ❑ In general, severe weather occurs between 1 PM and 10 PM EDT in the North Country

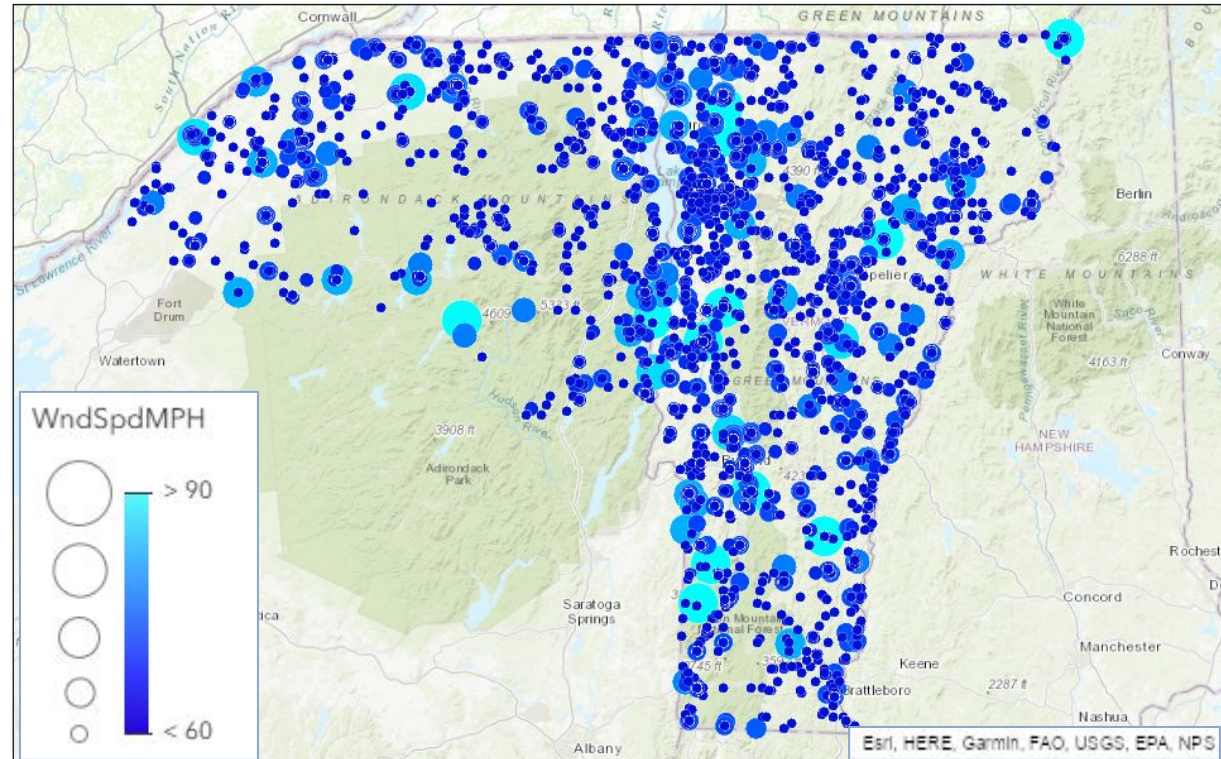




North Country Severe Weather - Wind

- ❑ Noticeable concentrations of reports around
 - ❑ Burlington, VT
 - ❑ Middlebury, VT
 - Rutland, VT
- ❑ Also note clusters along road networks

Severe Wind Reports 1955-2024

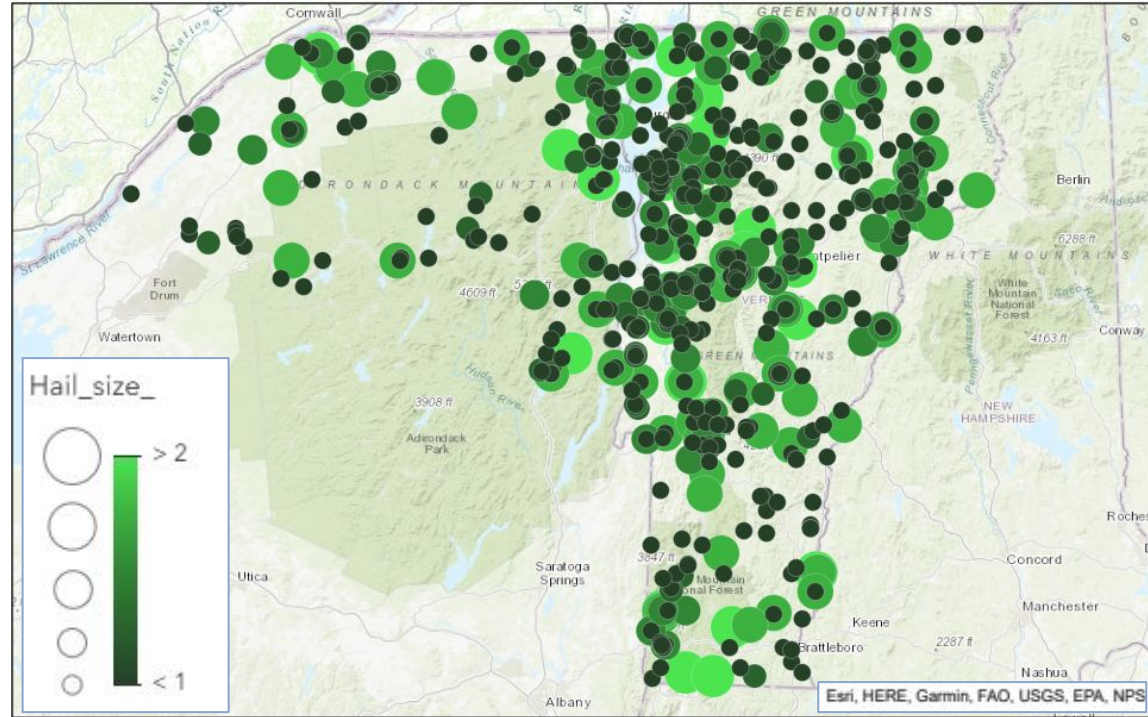




North Country Severe Weather - Hail

- ❑ Less noticeable association between wind reports and population
- ❑ Large cluster still around Burlington area
- ❑ More wind reports over St. Lawrence valley compared to hail

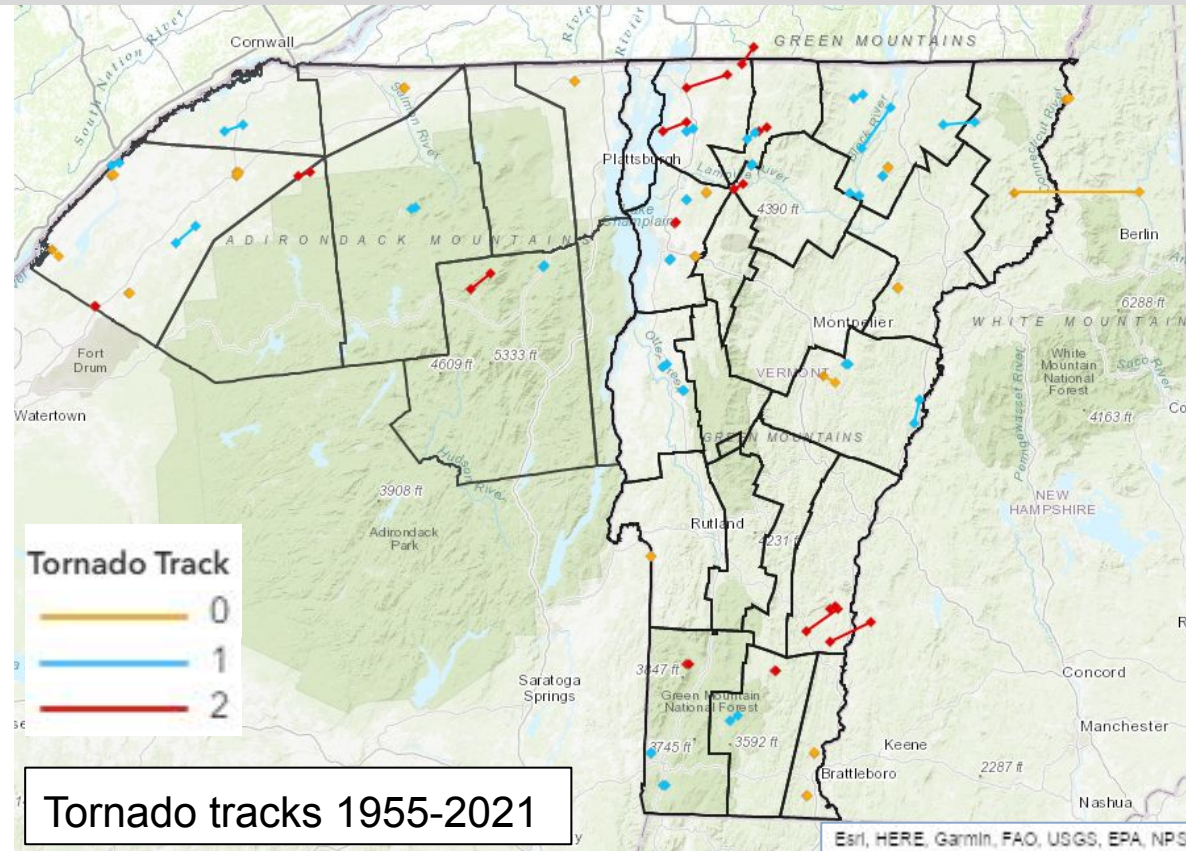
Severe Hail Reports 1955-2024





North Country Severe Weather - Tornadoes

- ❑ No noticeable correlation between population and tornado reports
- ❑ More terrain influenced
- ❑ Wasula et al. (2002) noted N-S oriented river valleys important in veering profiles during tornado occurrences





Poll Time

The month with the most severe weather and flood observations in Vermont and northern New York is...





Reporting Methods

- ☐ By Phone (1-800-863-4279) - unlisted
- ☐ By Social Media (FB/Twitter)
- ☐ By Amateur Radio (WX1BTV - 145.110 MHz Whiteface Repeater)
- ☐ By our storm report page (<https://www.weather.gov/btv/stormreport>)
- ☐ By mPING (<https://mping.ou.edu/static/mping/access.html>) - access via iPhone or Google Store - and select your weather observation.
- ☐ Share with us your photos!



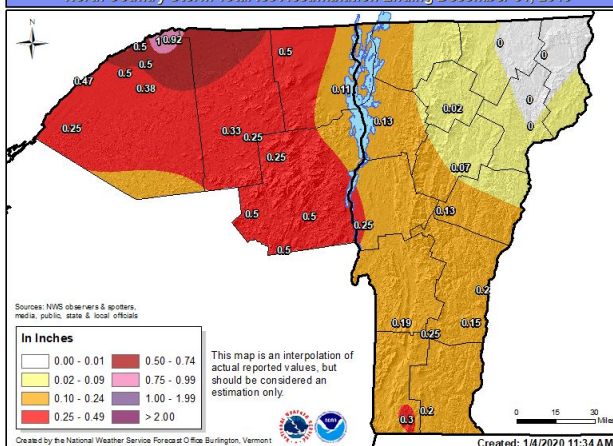


Reporting Severe Weather

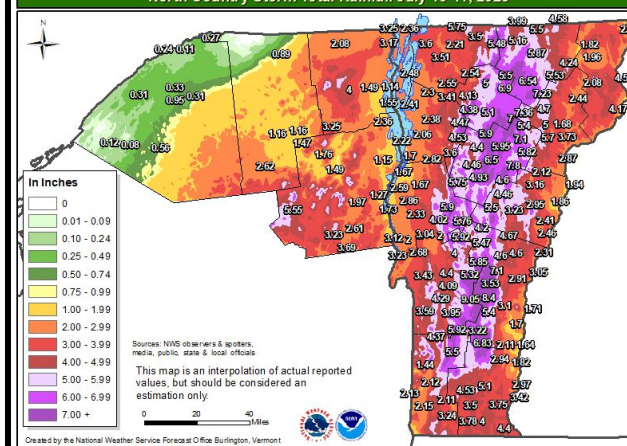
- Funnel Clouds and Wall Clouds
- Tornado or Waterspout
- Heavy Rain (> 1 inch per hour)
- Hail
- Damaging Winds
- Flooding
- Weather Related Injuries or Deaths



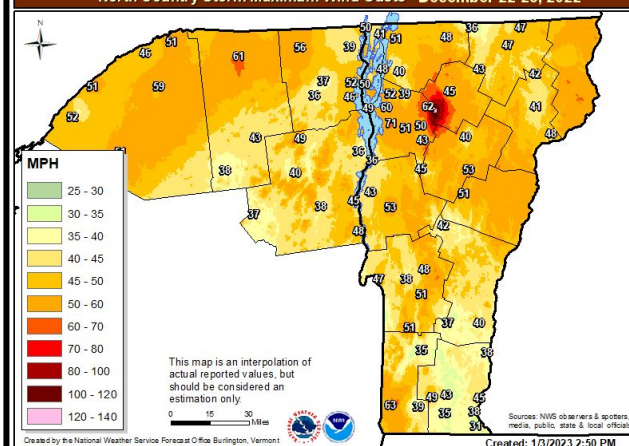
North Country Storm Total Ice Accumulation Ending December 31, 2019



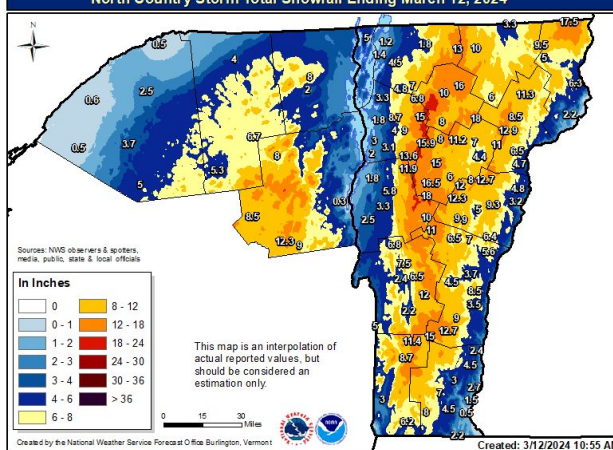
North Country Storm Total Rainfall July 10-11, 2023



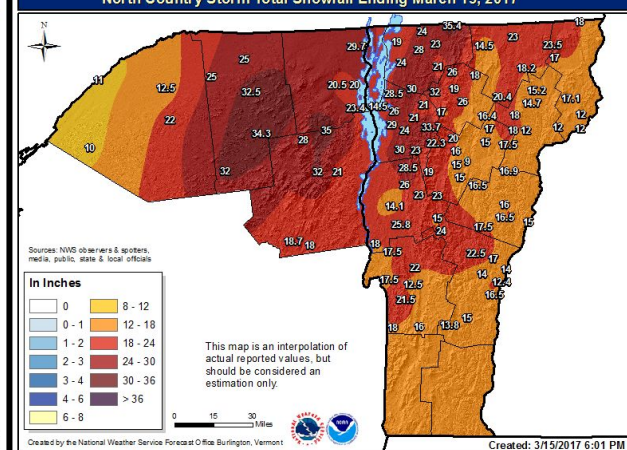
North Country Storm Maximum Wind Gusts - December 22-23, 2022



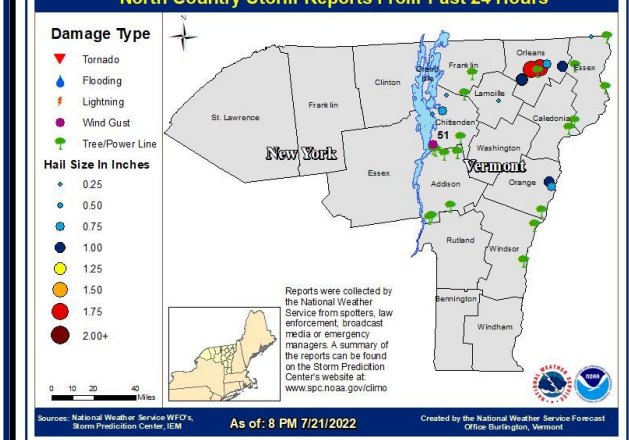
North Country Storm Total Snowfall Ending March 12, 2024



North Country Storm Total Snowfall Ending March 15, 2017



North Country Storm Reports From Past 24 Hours





mPING



Submit reports with the tap of your finger!

Use the mPING App to record the weather at your location

- Download the free app
- Tell us when precipitation begins, changes, or ends where you're at!
- Support research as a citizen scientist – report as often as you would like
- Below is how to report freezing rain

Step 1: Select "Report Type"

mPING

Report Type Definitions

Select Report Type

Current Location

Submit Report

View Reports

Step 2: Select "Rain and/or Snow"

Report Types

None

Rain/Snow

Hail

Wind Damage

Tornado

Flood

Mudslide

Reduced Visibility

Step 3: Choose what's falling

Report Types Rain/Snow

Rain

Freezing Rain

Drizzle

Freezing Drizzle

Ice Pellets/Sleet

Snow and/or Graupel

Mixed Rain and Snow

Mixed Ice Pellets and Snow

Mixed Freezing Rain and Ice Pellets

Mixed Rain and Ice Pellets

Step 4: Select "Submit Report"

mPING

Report Type Definitions

Rain/Snow: Freezing Rain

Current Location

Submit Report

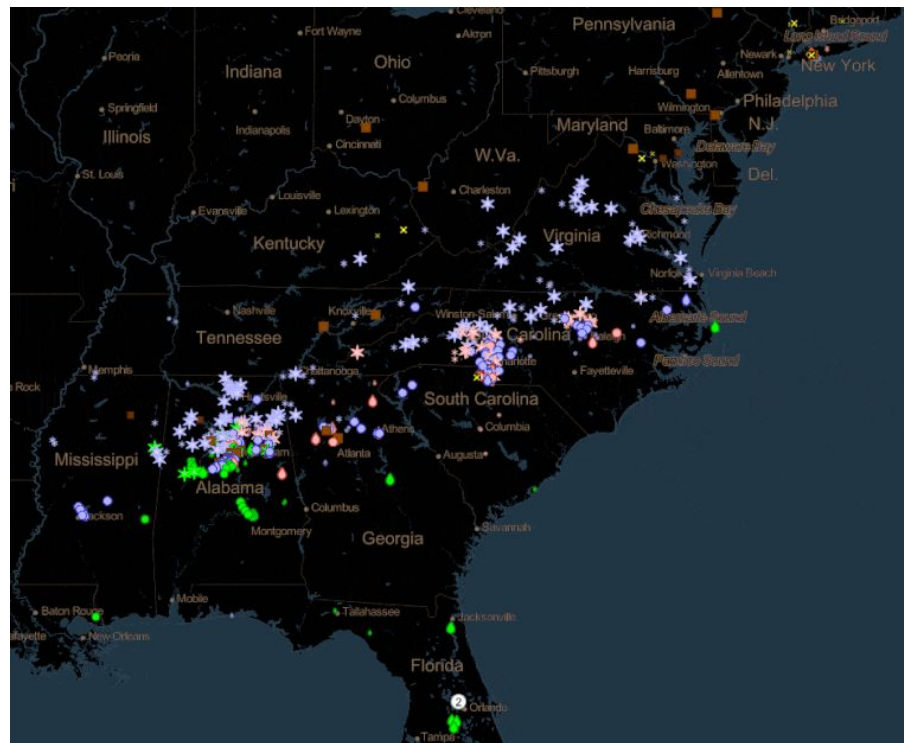
View Reports

<https://mping.ou.edu>

 Download on the App Store

 GET IT ON Google play



National Weather Service
Burlington



Follow Us:   
www.weather.gov/btv



National Oceanic and
Atmospheric Administration
U.S. Department of Commerce

Burlington Weather Forecast Office

COOP vs CoCoRaHS vs Skywarn

The Cooperative Observer Network (COOP)



Who: Dedicated volunteers or contractors able to report daily

What: Provide long-running daily climate reports, managing station records, equipment requirements

How often: Daily

Where: Siting is critical

Community Collaborative Rain, Hail, and Snow Network



Who: Community volunteers eager to report weather

What: Focus on rain, snow, and hail with specific gauge equipment

How often: Daily

Where: Siting is important

Skywarn Spotter Network



Who: Volunteer network trained by the NWS

What: Focus on severe weather spotting, but also measuring other weather phenomena

How often: As often as desired

Where: Wherever you are



Summary

- ❑ A reliable Skywarn Spotter provides ground truth and potentially life-saving information (downed trees or lines/funnel clouds/heavy rain/wind damage)
- ❑ Storms come in various flavors. The more organized, the more likely severe impacts will occur
 - Wall clouds, shelf clouds, overshooting tops
 - Lines or bow echoes on radar
- ❑ Severe weather in the North Country is most common in June, July, and August.
- ❑ Your safety should come first. Never put yourself in harms way to provide us info.
- ❑ Be as specific as possible! We may not be as familiar with your roads/cities. Referencing nearby intersections, landmarks, or even your latitude/longitude will help us pinpoint where active weather is occurring.





Thanks for your attendance!

Robert Haynes – robert.d.haynes@noaa.gov

If you are interested in becoming a Spotter – email me or call our office to inform us that you have completed the course. You will be given our unlisted Spotter Number.

Please provide a: Name, Address (or lat/lon), Phone Number



Web:

<http://www.weather.gov/btv/stormreport>



Toll-Free Spotter Line
1-800-863-4279



E-mail:

nws.er.btv.operations@noaa.gov



Facebook:

<https://www.facebook.com/NWSBurlington>



Twitter:

<https://twitter.com/NWSBurlington>



YouTube:

<https://www.youtube.com/NWSBurlington>

