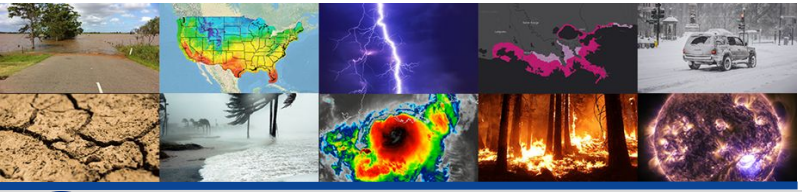
# National Weather Service Burlington Weather Forecast Office

## Virtual Skywarn Presentation - May 11th, 2023

Robert Haynes - NWS Burlington

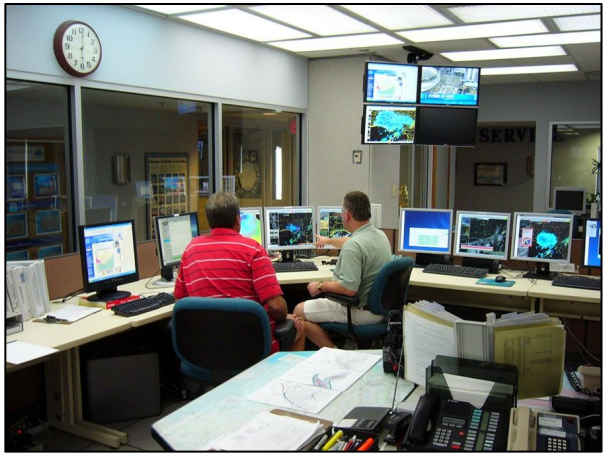


# Presentation Layout

- How Skywarn Operates and Why We Need It.
- Overview of the National Weather Service in Burlington
- Review of Storm Ingredients, Storm Types, and the National Weather Service's Warning System
- Safety and Reporting Severe Weather
- Increasing emphasis of Social Science in NOAA/NWS

# What is Skywarn?

A nearly 60 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?

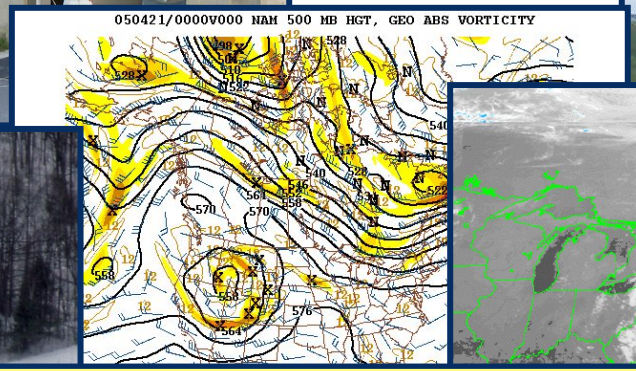
**The United States is the most severe weather prone country in the world**

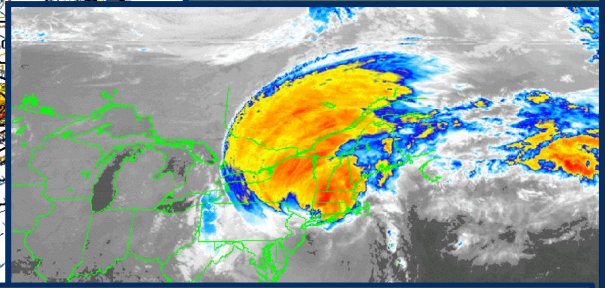
## A typical year brings:

- 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*

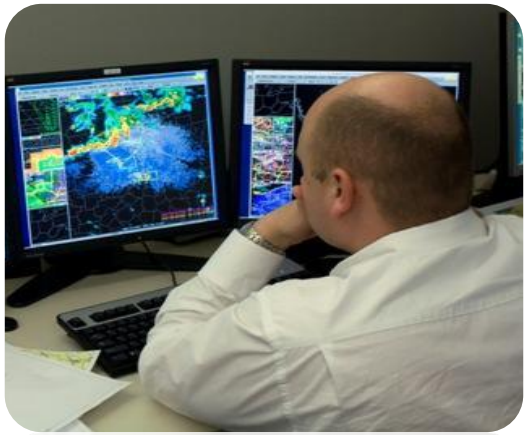


**But they all have limitations**

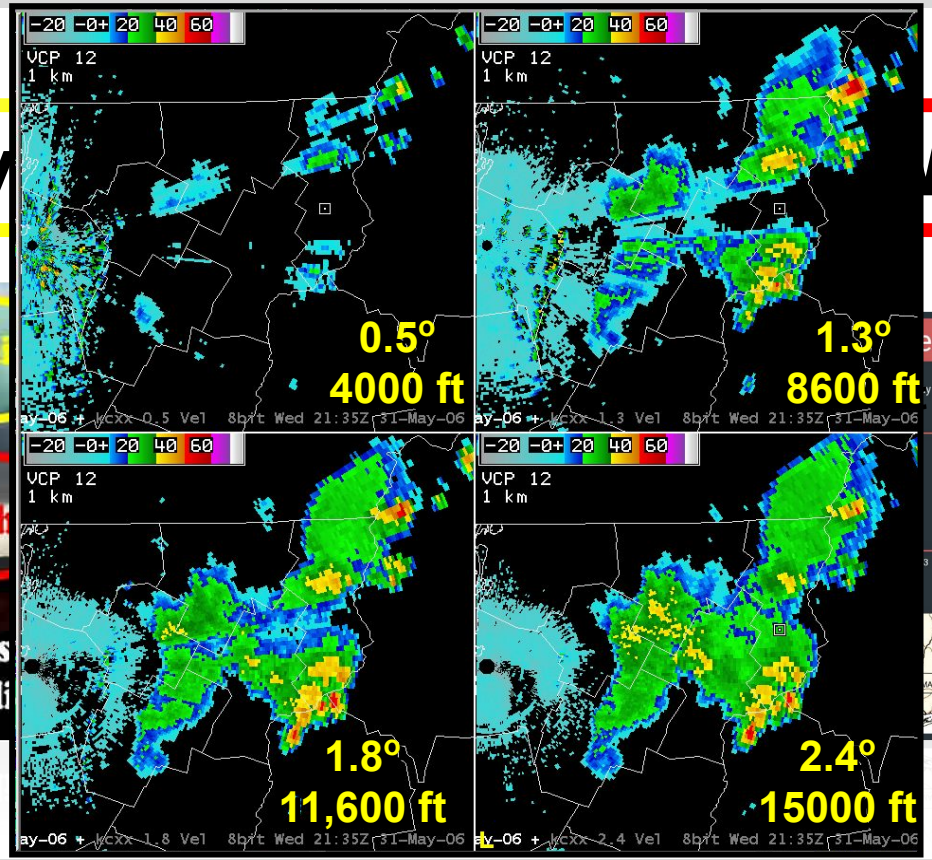
# Why Do We Need spotters?

**Observe** → **Report** → **Warning**

# Why Do We Need spotters?

Observ


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**

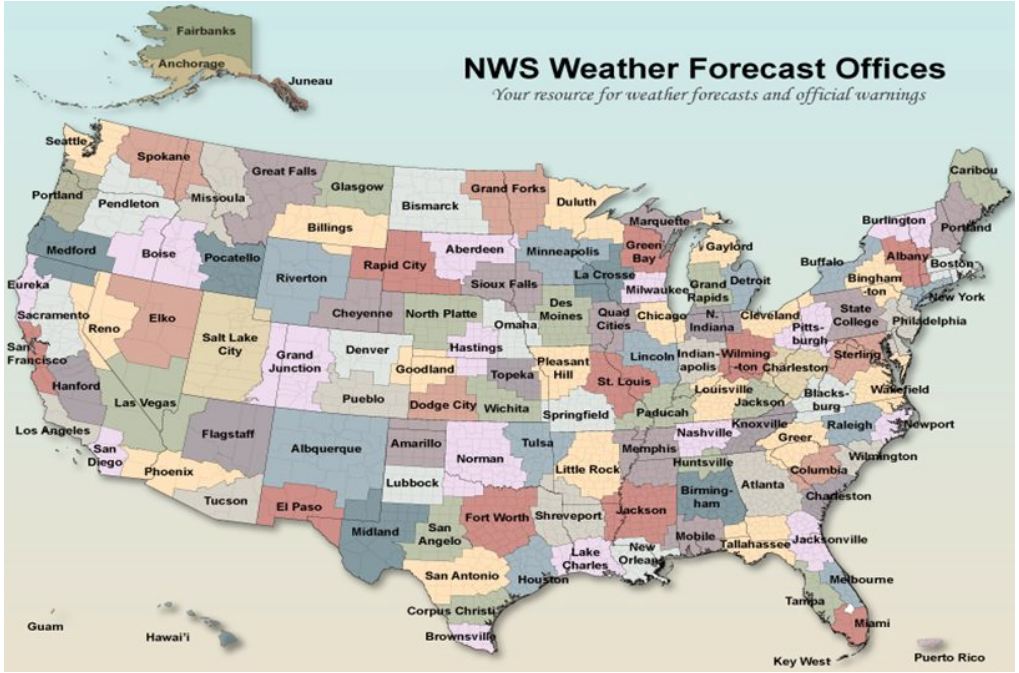
# What is the National Weather Service?

## NWS Mission

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

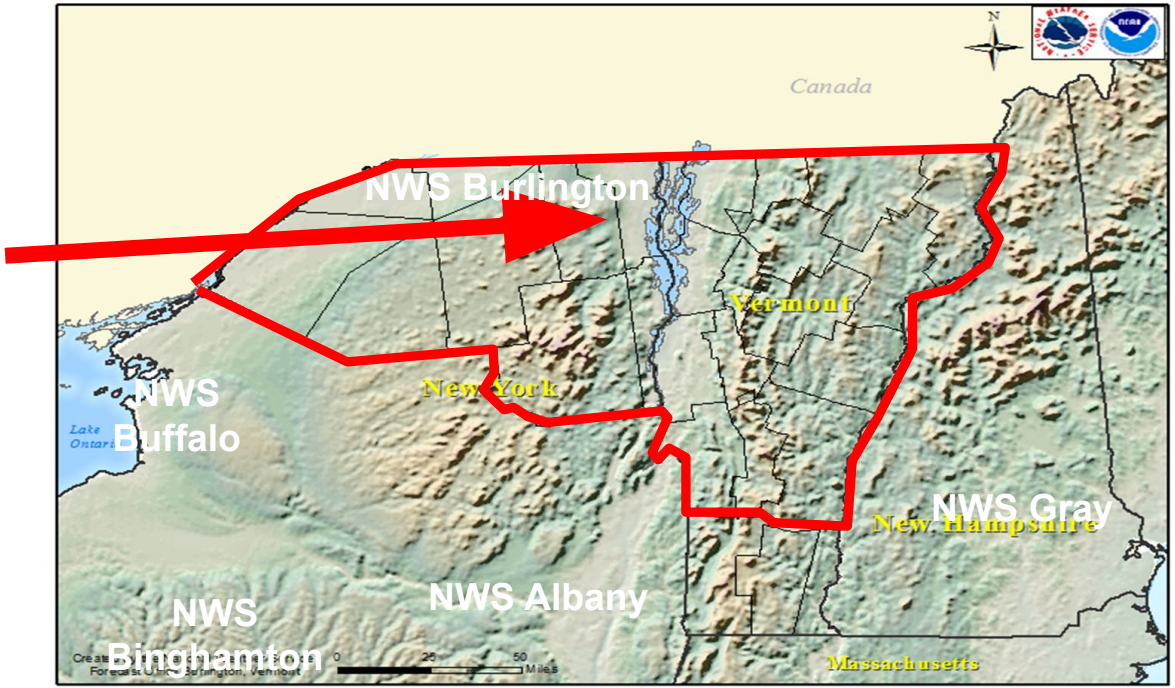
## NWS Vision

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.



# Hierarchy

Department of Commerce
~44,000 employees

National Oceanic & Atmospheric Administration
~12,000 employees

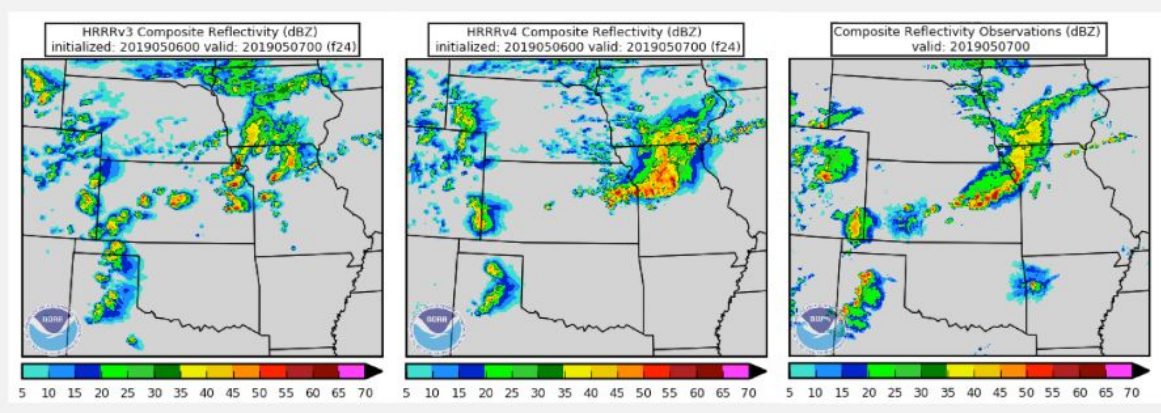
National Weather Service
~4,500 employees

# Hierarchy

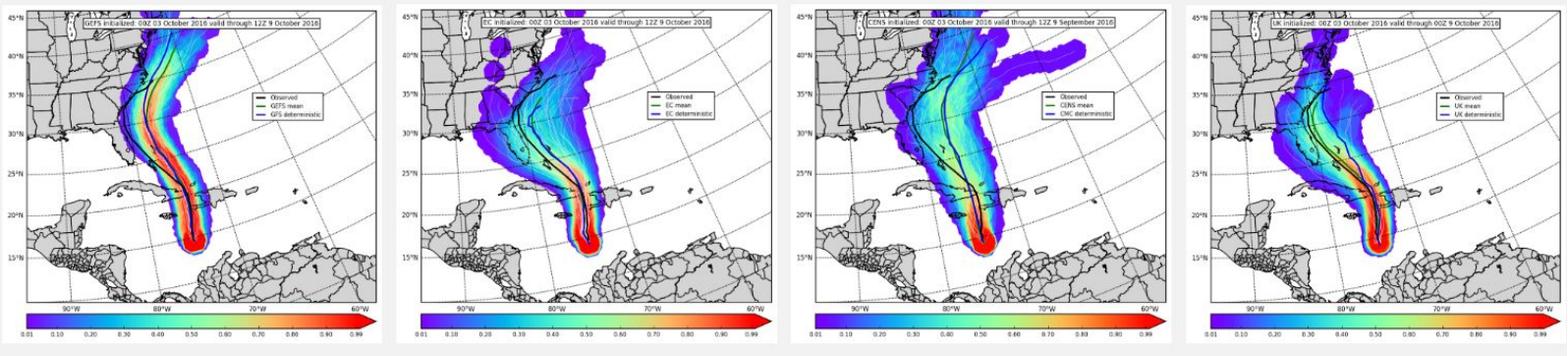

Western Region
Central Region
Eastern Region
Alaska Region
Southern Region
Pacific Region
Space Environment Center
Aviation Weather Center
Storm Prediction Center
NCEP Central Operations
Climate Prediction Center
Weather Prediction Center
Environmental Modeling Center
Ocean Prediction Center
Tropical Prediction Center
Puert Rico
Regional Offices
National Centers
River Forecast Centers
Weather Forecast Offices


DELL

# Weather Models Help Us Assess Ingredients




Weather models will tell us different things based on how they are set up. It's our work as meteorologists to filter all of this down to something you can understand.



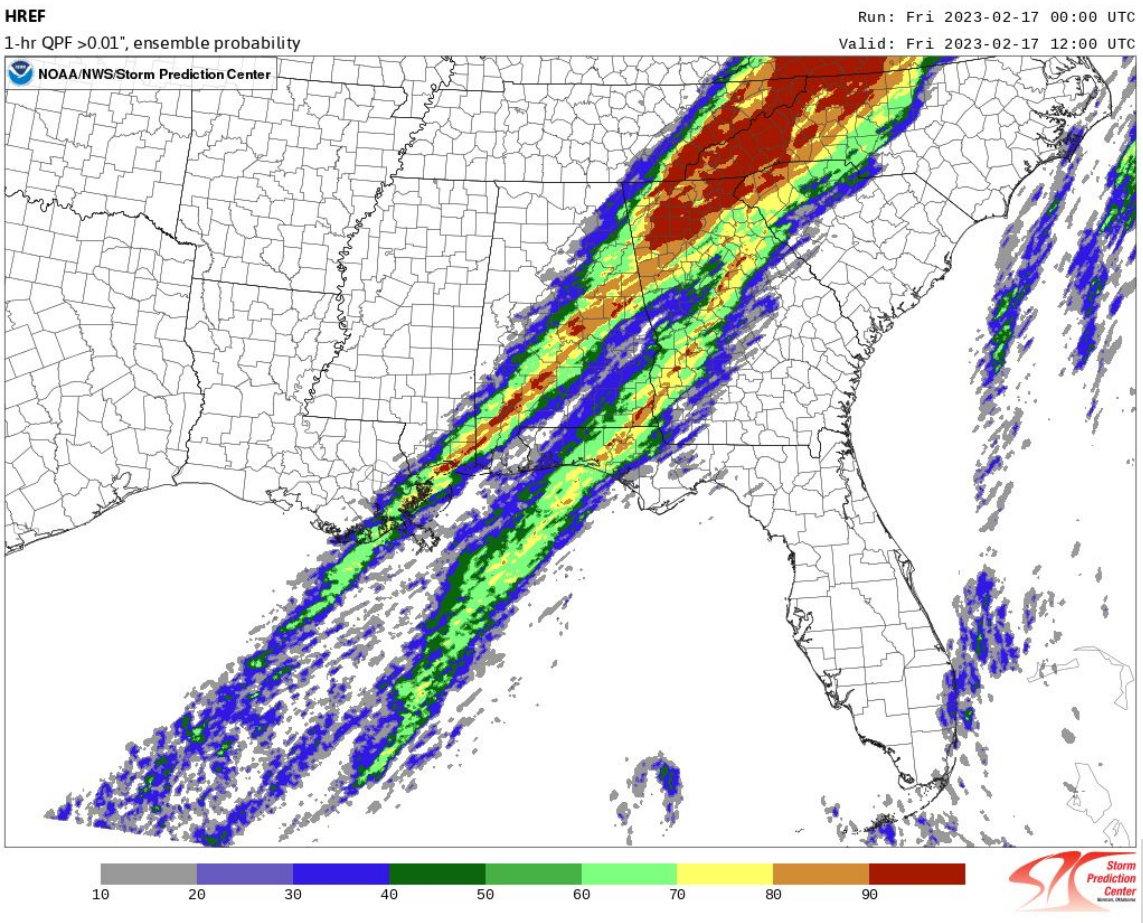
# What Does a 40% Chance of Rain Mean?

## Modern Technology Let's Us Say This Literally

**We're not locked into 1 or 2 model like the 1980s or early 90s. Giving a 40% chance for rain might vary from forecaster to forecaster.**

**Now, we have multiple families of models – or ensembles. Like a musical orchestra, a weather ensemble has many parts that make up the whole that let us account for these differences.**

**If 4 of 10 models show precipitation, then we can say there's a 40% chance of rain.**

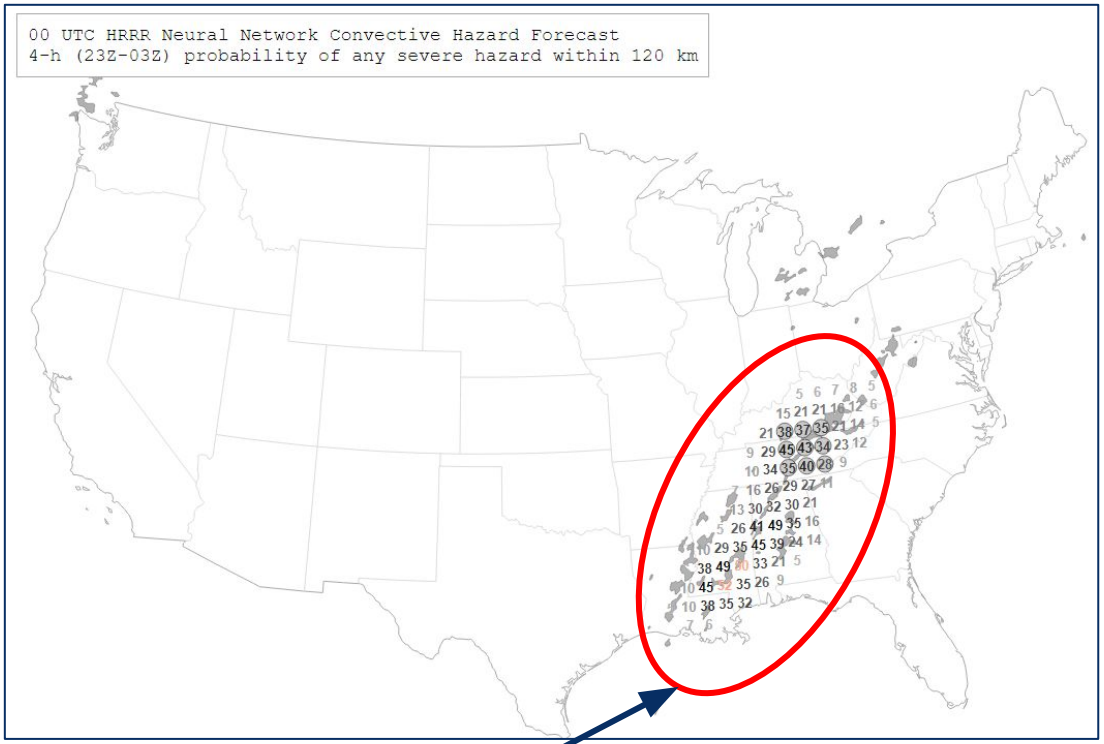



National Oceanic and Atmospheric Administration
U.S. Department of Commerce

# The Technology is Still Growing

**AI and Machine Learning will become a part of the weather forecasts of tomorrow.**

**They can use this model data and look back to the past to forecast the chances for severe weather in future cases.**



# NOAA Strategic Plan - Adjusting for Climate Change & Social Science


NOAA STRATEGIC GOAL 02

## MAKE EQUITY CENTRAL TO NOAA'S MISSION

*As NOAA tackles the climate crisis by building a Climate Ready Nation, it will strive to ensure the needs of the nation's underserved and vulnerable communities are met. To meet this challenge, NOAA is making equity central to every facet of its mission delivery services and is working internally to create a model agency that draws from the full diversity of the nation, where everyone is treated with dignity and respect.*

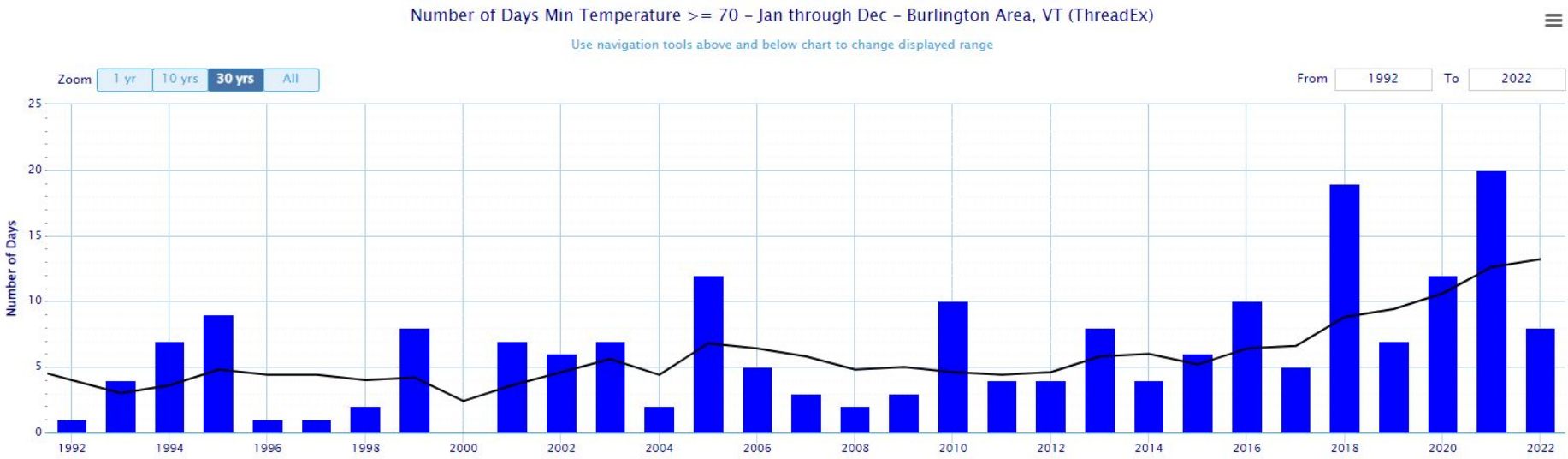
### 2.1 BUILD A MODEL WORKPLACE.

NOAA is firmly committed to increasing the diversity of its workforce and creating a more inclusive work environment where everyone feels valued, is treated fairly and experiences a true sense of belonging. A key outcome of this plan is to fully integrate diversity, equity, inclusion and accessibility (DEIA) into NOAA's business practices and organizational culture and thereby strengthening NOAA's ability to recruit, hire, develop, promote and retain diverse talent and remove barriers to equal opportunities.

### 2.2 SUPPORT UNDERSERVED AND VULNERABLE COMMUNITIES.

Underserved communities — those that have been systematically denied a full opportunity to participate in aspects of economic, social and civic life — are often disproportionately impacted by increasing extreme weather, water, ocean and climate events. NOAA will expand equity-focused products and tools to address these impacts by leveraging its deep experience in service delivery and regional collaboration and partnerships with underserved communities.

# Nights with overnight lows ≥ 70°F in Burlington area




More warm nights that doesn't cool below 70°F → Increase heat risk potential for people without AC or access to other cooling means

# Days with mean Max T ≥ 85°F in Burlington area

**Maximum 1-Year Mean Avg Temperature for Burlington Area, VT (ThreadEx)**

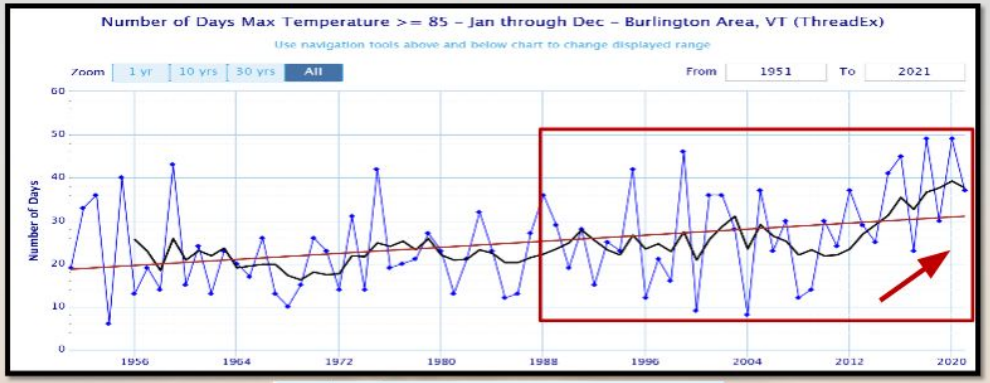
Click column heading to sort ascending, click again to sort descending.

| Rank | Value | Ending Date | Missing Days |
|---|---|---|---|
| 1 | 50.0 | 2012-12-31 | 0 |
| 2 | 49.5 | 2021-12-31 | 0 |
| 3 | 49.5 | 2020-12-31 | 0 |
| 4 | 49.3 | 2016-12-31 | 0 |
| 5 | 48.8 | 2017-12-31 | 0 |
| 6 | 48.7 | 2022-12-31 | 0 |
| 7 | 48.4 | 1998-12-31 | 0 |
| 8 | 48.2 | 2006-12-31 | 0 |
| 9 | 48.1 | 2018-12-31 | 0 |
| 10 | 48.1 | 1898-12-31 | 1 |
| 11 | 48.1 | 2010-12-31 | 0 |

9 of top 11 warmest years in Burlington's climate history have occurred in the 21st century. In fact, the top 6 warmest years have occurred after 2010.

## Trend of Summer Mean Maximum Temperatures

### # Days ≥ 85°




| Rank | Year | Number of Days Max Temperature >= 85 |
|---|---|---|
| 1 | 2020 | 49 |
| - | 2018 | 49 |
| 3 | 1999 | 46 |
| 4 | 2016 | 45 |
| 5 | 1959 | 43 |
| 6 | 1995 | 42 |
| - | 1975 | 42 |
| 8 | 2015 | 41 |
| 9 | 1955 | 40 |
| 10 | 2021 | 37 |
| - | 2012 | 37 |
| - | 2005 | 37 |

**6 of the Top 10** have occurred in the last 10 years and **8 out of 10** since 1995

# VT is getting more diverse

## The racial and ethnic makeup of Chittenden County

While non-Hispanic white residents remain the largest category, people of color represent an increasing percent of the population.

| Category | Population 2020 | Change since 2010 | Percent change since 2010 |
|---|---|---|---|
| White non-Hispanic | 142,880 | 32 | 0.0% |
| Hispanic or Latino | 4,751 | 1,895 | 66.4% |
| Black or African American | 4,757 | 1,585 | 50.0% |
| Asian | 7,203 | 2,835 | 64.9% |
| Some Other Race* | 762 | 590 | 343.0% |
| Two or more races* | 7,630 | 4,914 | 180.9% |

** changes to how the Census asked about and reported "other race" and multiracial people led to nationwide increases in these two categories.*

Table: Erin Petenko • Source: 2010 and 2010 Dicennial Census • Get the data • Created with Datawrapper

# VT Heat Vulnerability Index

VERMONT
DEPARTMENT OF HEALTH

**Heat Vulnerability Measures**

Population Characteristics:

1. % population less than 5 years old
2. % population 65 years old or older

Socioeconomic Characteristics:

3. % population living below Federal Poverty Line
4. % adult population with no high school diploma
5. % adults 65 and older living alone
6. % adult population with no health insurance

Health Conditions:

7. % adults with diabetes
8. % adults with asthma
9. % adults with hypertension
10. % adults who are obese
11. % adults in fair or poor health
12. All-cause mortality, warm season deaths

Environmental Characteristics:

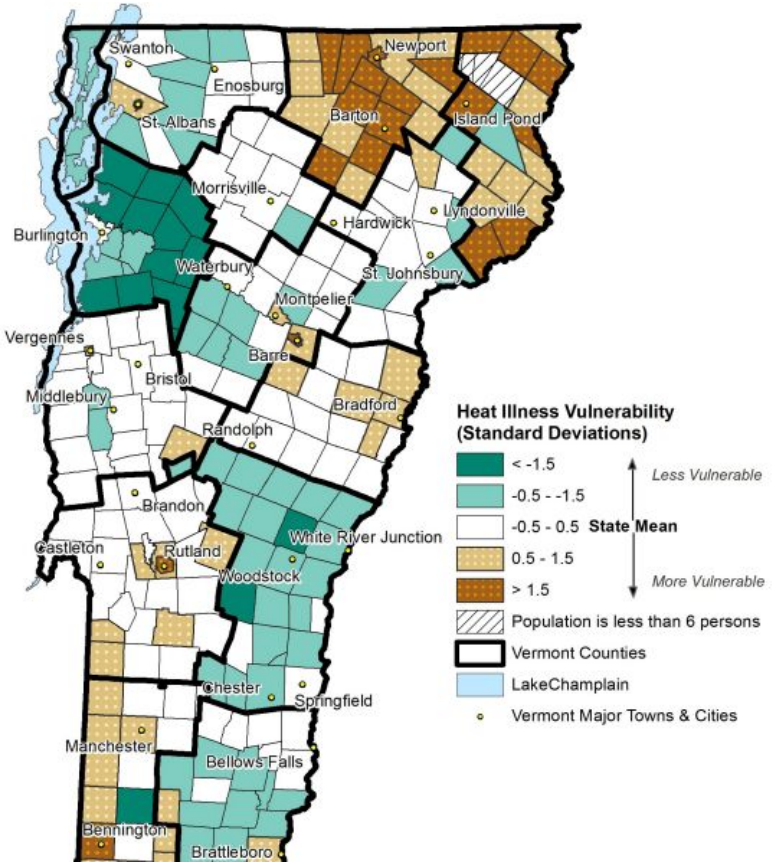
13. Housing units per square mile
14. % covered with Impervious surface
15. % covered by forest canopy

Climate Characteristics:

16. Average number of days per year 87° F or hotter

Observed Heat Illness:

17. Heat-related emergency department visits



# Weather Impact Matrix

Table 7. Currently Utilized Risk Scale Comparisons in Products and Paradigms

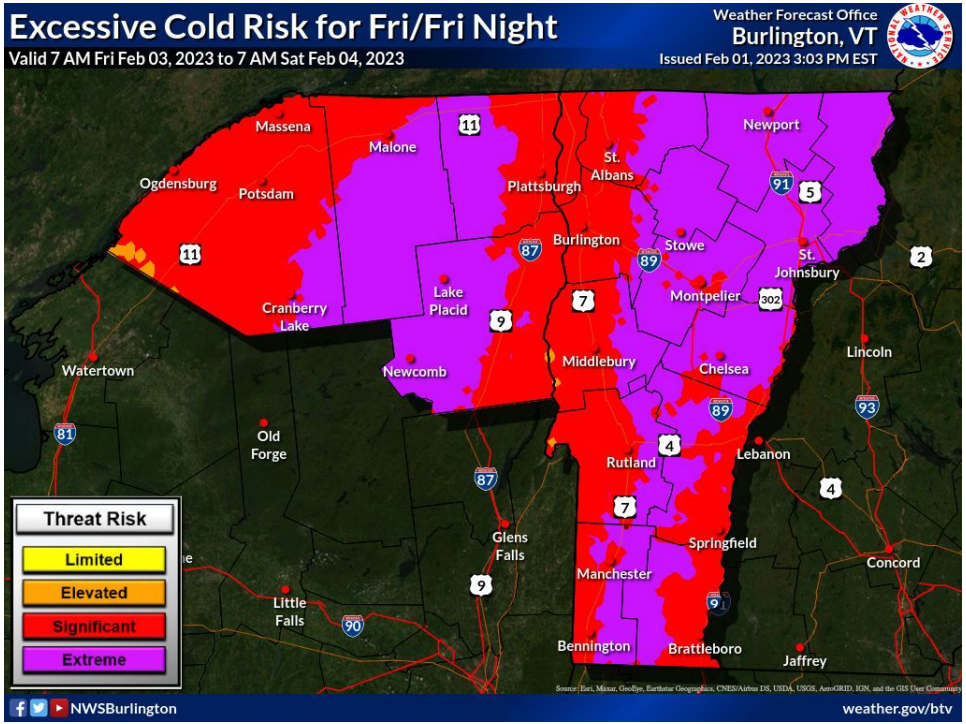
| Product/Scale | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|---|
| NWS WWA | None | Watch/ Sub-Advisory "Be Alert" | Advisory "Caution Advised" | Warning "Take Action" | N/A (no categorization) |
| GHWO** | None | Limited "Be Aware" | Elevated "Be Prepared" | Significant "Take Action" | Extreme "Take Action" |
| Outlooks (SPC) | General (T-storm) / Marginal | Slight | Enhanced | Moderate | High |
| WSSI** | None / Limited | Minor | Moderate | Major | Extreme |
| ERO (WPC) | Marginal | Slight | N/A (no categorization) | Moderate | High |
| NWS Haz Simp* | None | Be Prepared | Take Precaution | Warning / Take Action | Extreme Warning / Emergency |
| HTI | None | Hazard Specific (previously "Elevated") | Hazard Specific (previously "Moderate") | Hazard Specific (previously "High") | Hazard Specific (previously "Extreme") |
| WR Heat Risk** | None | Low | Moderate | High | Very High |
| UK Met | No Severe Wx | Be Aware | Be Prepared | Take Action | N/A (no categorization) |
| EU Met | None | Potentially Dangerous | Dangerous | Very Dangerous | N/A (no categorization) |

* NWS Hazard Simplification ("Haz Simp"). As of mid-2020, all categorizations and terms are in proposal form.
** Experimental NWS Products
*Colors are hues are not exact representations of the colors used in each product.*

At the national level, there has been a significant push in ensuring consistent depiction of risk using universal color scales per best practices of social science research.

- Consistent color scheme to depict severity of hazards

# Graphical Hazardous Weather Outlook (GHWO)




| 24 Hr Hazard Risks | Tonight | Thu | Fri | Sat | Sun | Mon | Tue |
|---|---|---|---|---|---|---|---|
| Severe Thunderstorm | | | | | | | |
| Tornado | | | | | | | |
| Thunderstorm Wind | | | | | | | |
| Hail | | | | | | | |
| Lightning | | | | | | | |
| Excessive Rainfall | | | | | | | |
| Wind | | | | | | | |
| Fog | | | | | | | |
| Excessive Cold | | | | | | | |
| Ice Accumulation | | | | | | | |
| Snow/Sleet | | | | | | | |

# Mar 14 2023 - A Good Showcase in Probability

Social science research has shown that most partners and the public are receptive to probabilistic information, especially in winter weather situations.

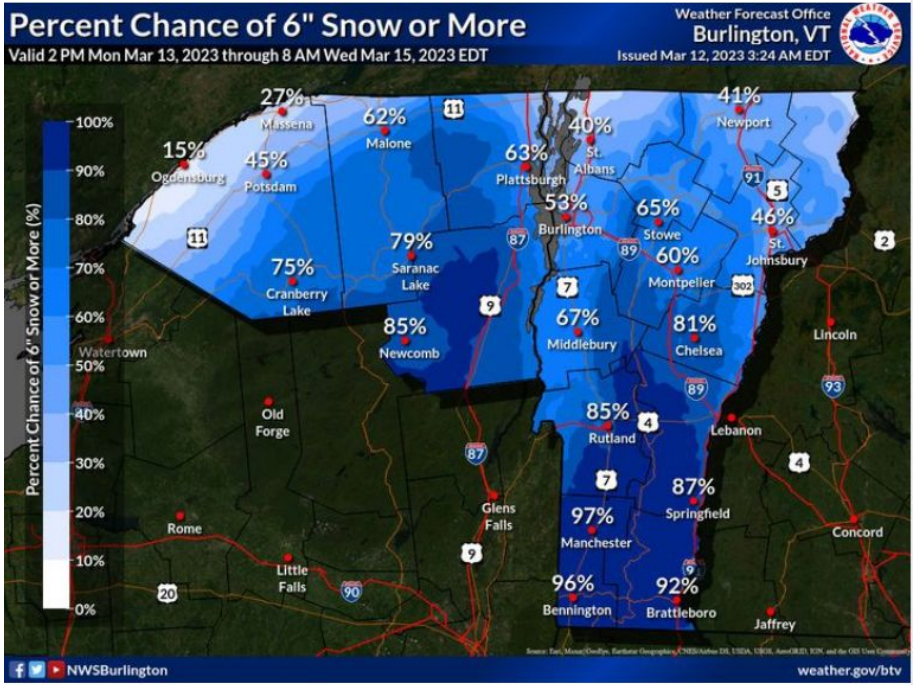
Using probability of exceedance, 90th percentile (reasonable worst case scenario) have shown to be particularly useful for core partners' operations.

It also helps the public understand inherent uncertainty around forecast amounts.

User can determine if they're willing to risk a 50% chance of exceeding snowfall amounts.

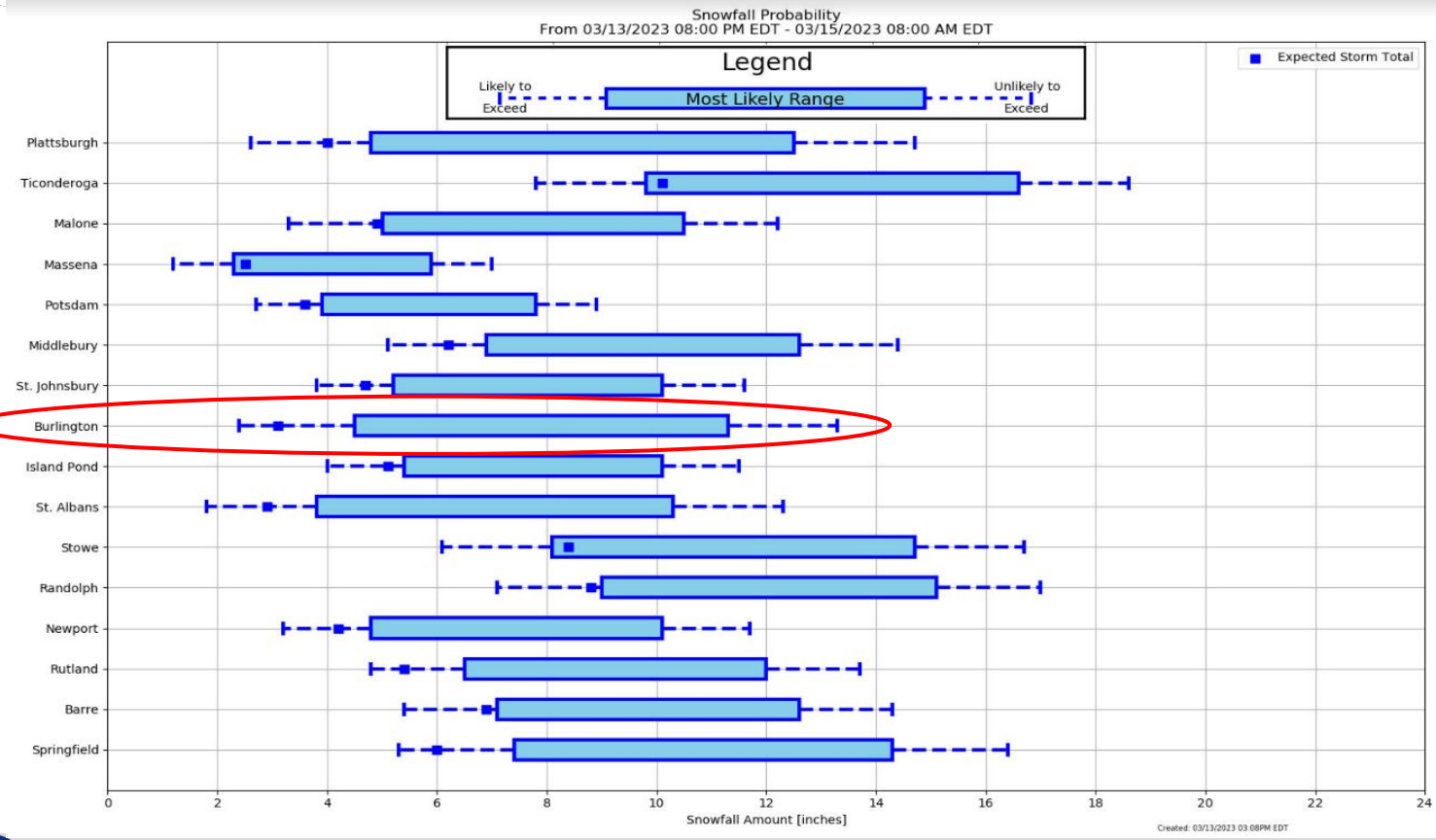
US National Weather Service Burlington VT
3d ·

There is a moderate degree of uncertainty with the track of the next storm, expected to bring snow to our area Monday afternoon into Wednesday. With such a wide spread of potential snow totals, here is the percent chance of 6 inches or more. #VTwx #NYwx




78 5 comments 49 shares

# Box and whisker plots/10-90th percentile snowfall




The relatively large “most likely range” indicates greater than usual forecast **uncertainty**.

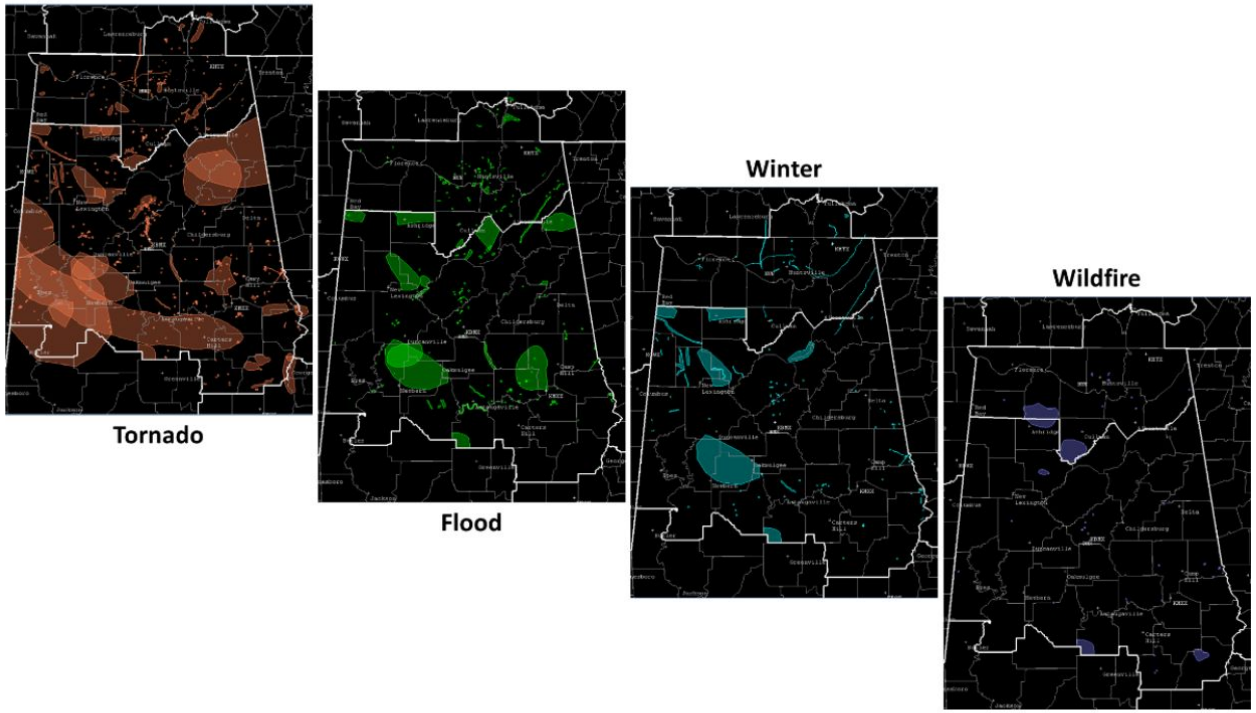
For example, Burlington’s most likely range is between **4 and 11** inches, i.e. borderline Advisory vs. Warning criteria snowfall!

# Brief Vulnerability Overview Tool (BVOT)

## The BVOT Vulnerability Categories

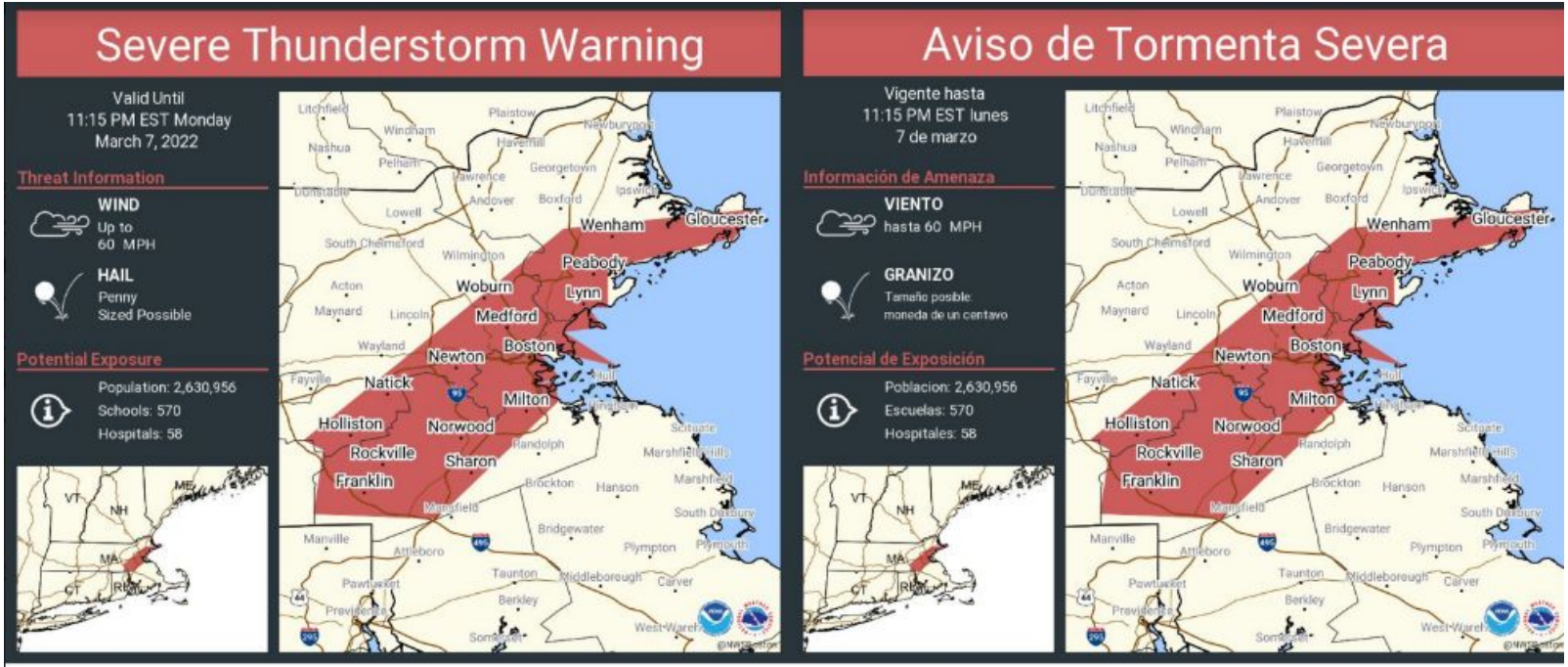
Give NWS mets a tool to find areas most recently impacted by events like tornadoes → Craft specialized message for safety in previously ravaged regions.

Help us quickly determine a region's vulnerability.




The BVOT is composed of four separate geographic files that display the vulnerable areas within a Weather Forecast Office's County Warning Area. Currently, the four vulnerability categories are Tornado, Flood, Winter, and Wildfire, but, individual offices could add specific hazard categories of particular concern in their geographic regions.

# Spanish Auto tweets for Severe Weather Warnings




Example of Graphics Included with Tweets For Severe Thunderstorm Warnings

# Motivation for Climate Ready Nation and Social Science

- Extreme/excessive heat impacts vulnerable communities disproportionately.
- Climate change means that VT climate is becoming warmer and wetter, with the potential for more frequent and prolonged heat waves and associated health impacts (heat stokes, dehydration, heat-related ED visits).
- Drawing from the lessons of NYC during Hurricane Ida, there is an increasing need to engage vulnerable communities and build resilience in the face of a warming climate.
- NWS is increasingly emphasizing the importance of social science in communication of important and potentially life-saving messages.
- It is increasingly important to develop an effective coalition with our partners to 1) Identify at risk communities and 2) Ensure that the message is effectively communicated to them
- One of the many ways is to increase availability of translated preparedness messages and weather alerts.

# Are there any questions?

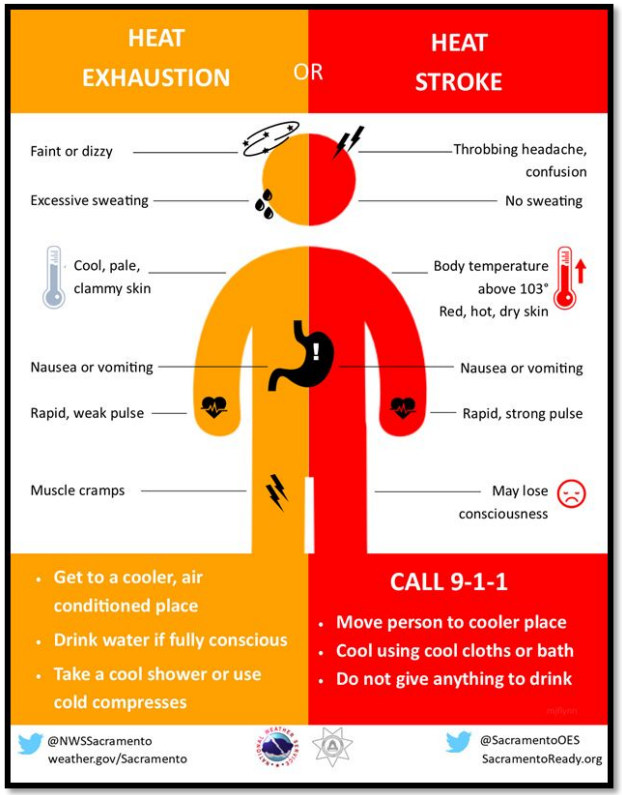
- About Skywarn?
- About the National Weather Service in general?
- Anything else that comes to mind?


Awareness
Communication
Escape routes
Safety zones
SAFETY
FIRST
Your Safety is ALWAYS #1

# Heat Safety

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






Heat Advisories issued for heat index of 95 or higher for at least 2 hrs.

Excessive Heat Warnings for heat index of or higher than 105 for at least 2 hrs.

- ✓ Slow Down
- ✓ Dress Appropriately
- ✓ Drink Plenty of Water
- ✓ Air Conditioning
- ✓ Sun Safety

# SEVERE WEATHER

## HAZARDS

**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

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

weather.gov/safety

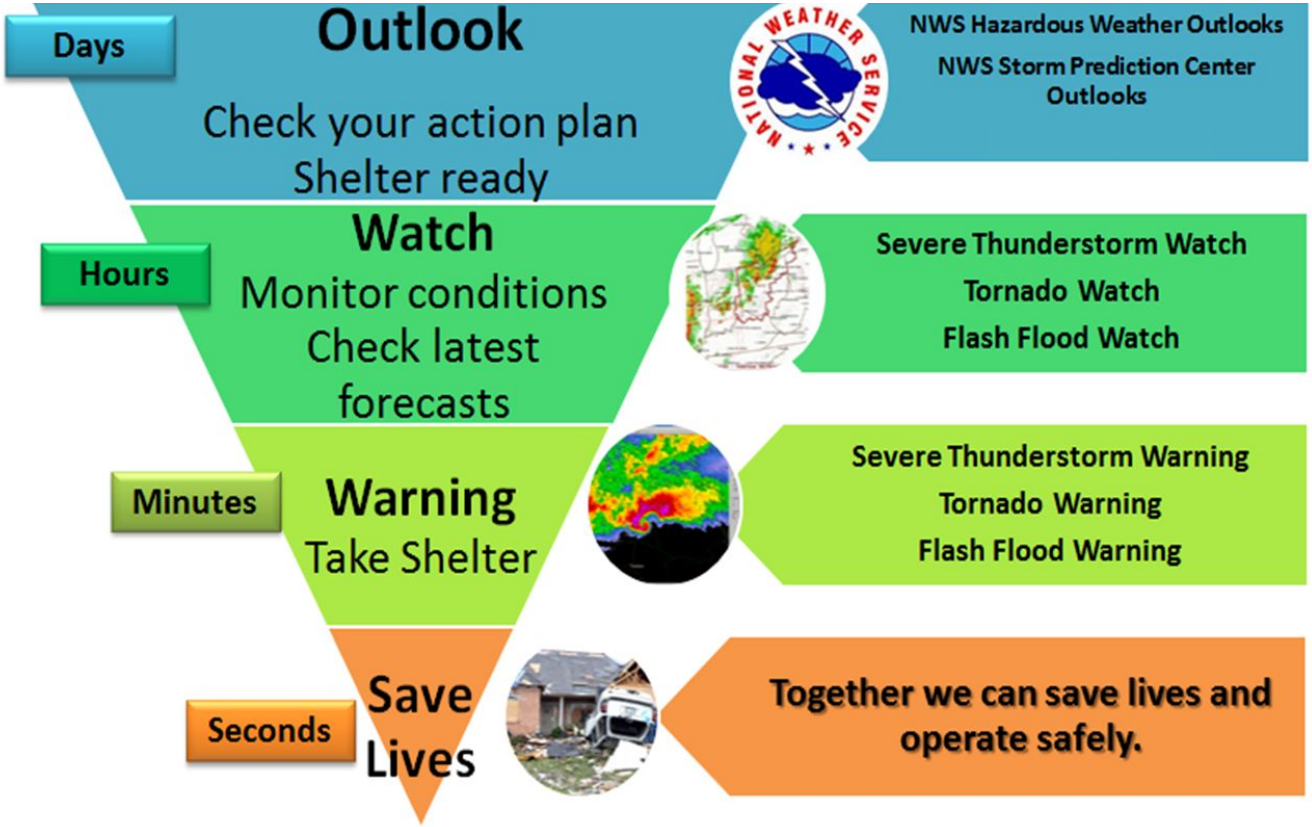
# Don't underestimate the power of water!

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.

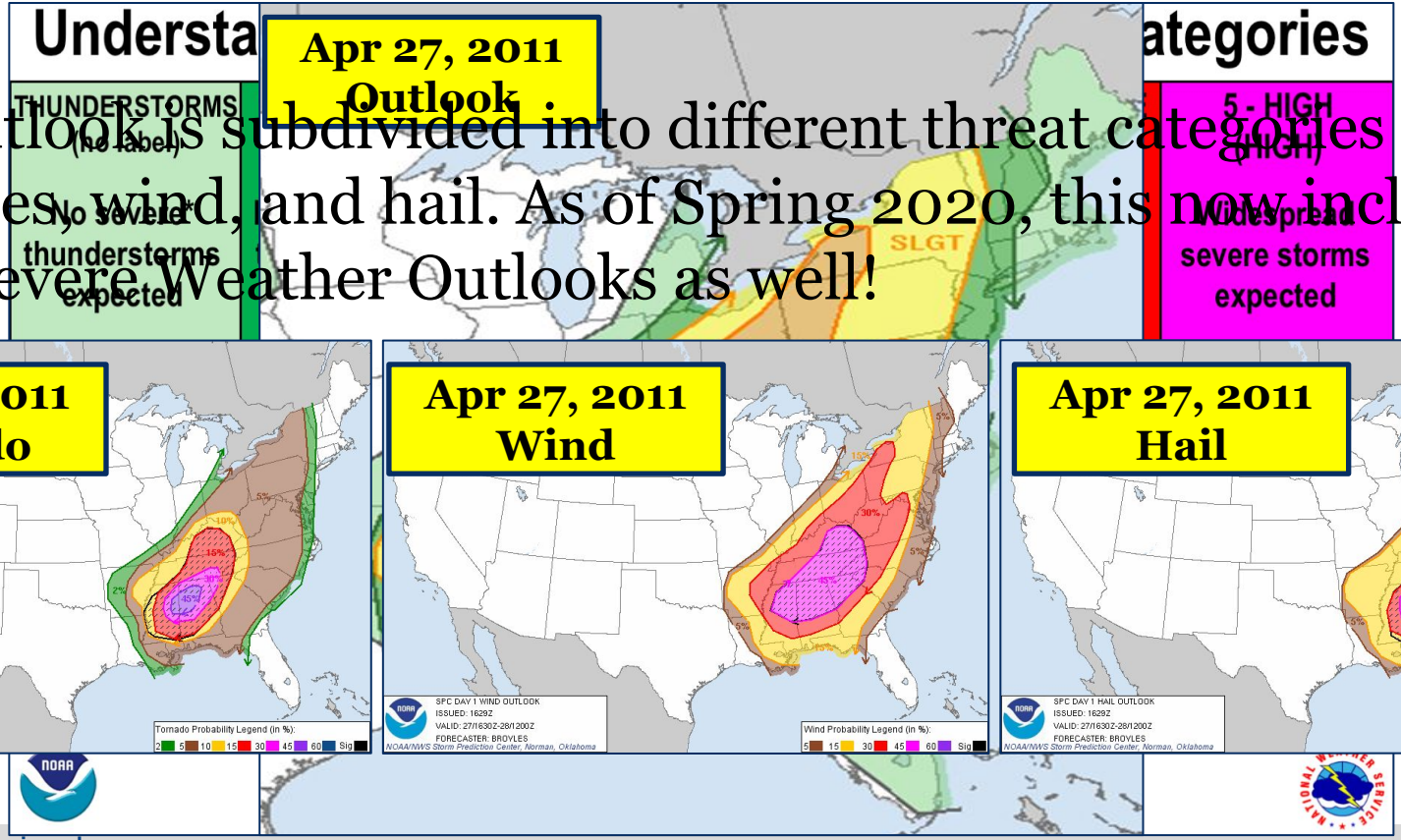
18-24 inches of fast-moving water can carry away most large SUVs, vans and trucks.

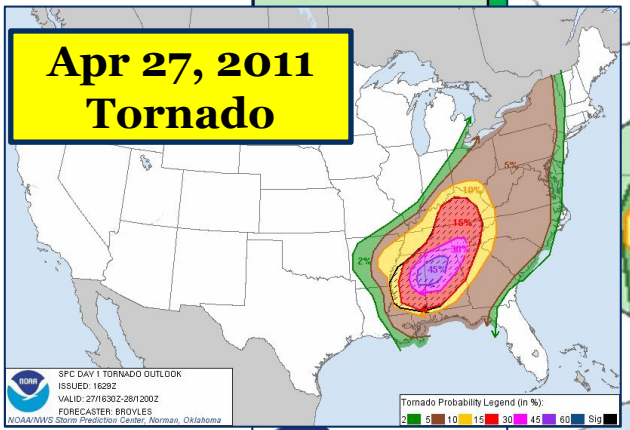
# Messaging Evolves As We Get Closer to Severe Weather Events



# Storm Prediction Center Outlooks

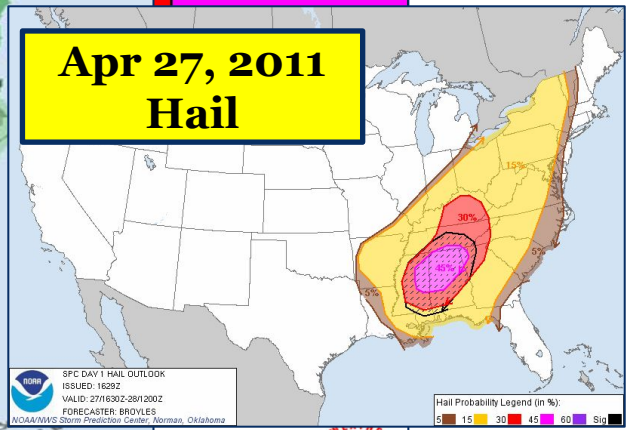
Each outlook is subdivided into different threat categories for tornadoes, wind, and hail. As of Spring 2020, this now includes Day 2 Severe Weather Outlooks as well!





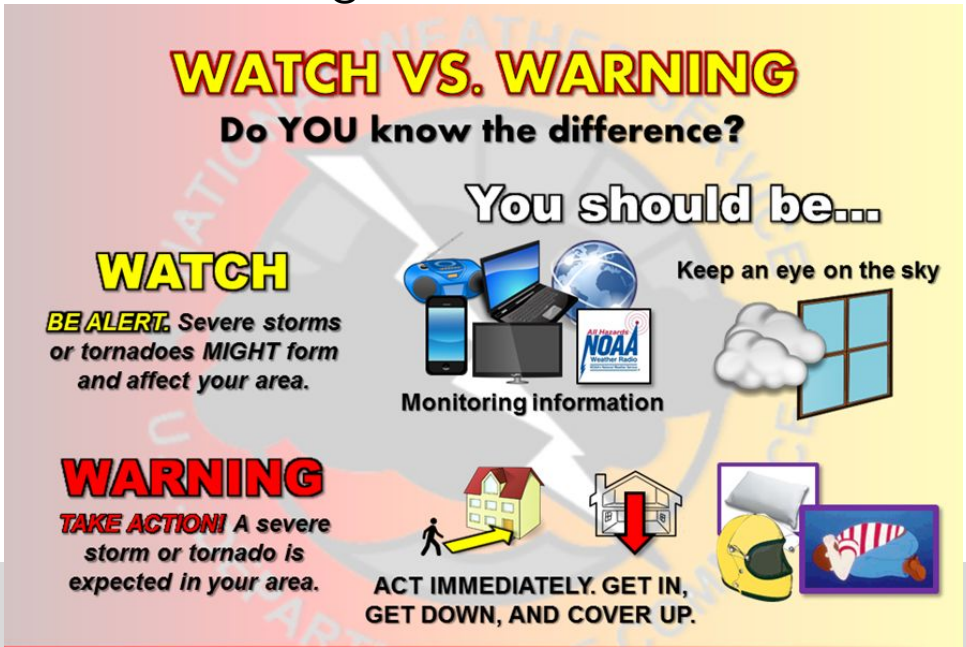




# Watch vs Warning

## Watch

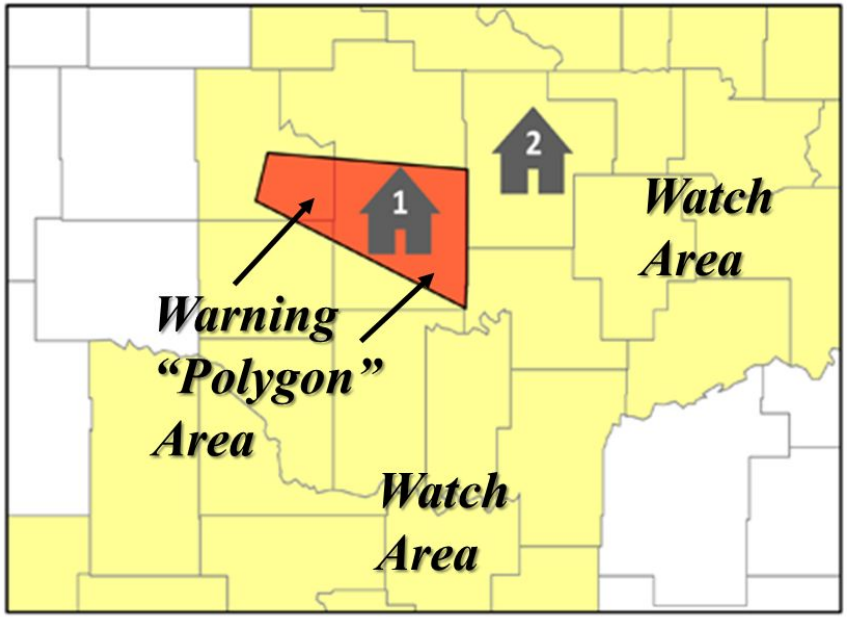
-Conditions are favorable for severe weather development over the coming **hours.**




## Warning

-Severe weather is **imminent or ongoing**

-***Take immediate action!***

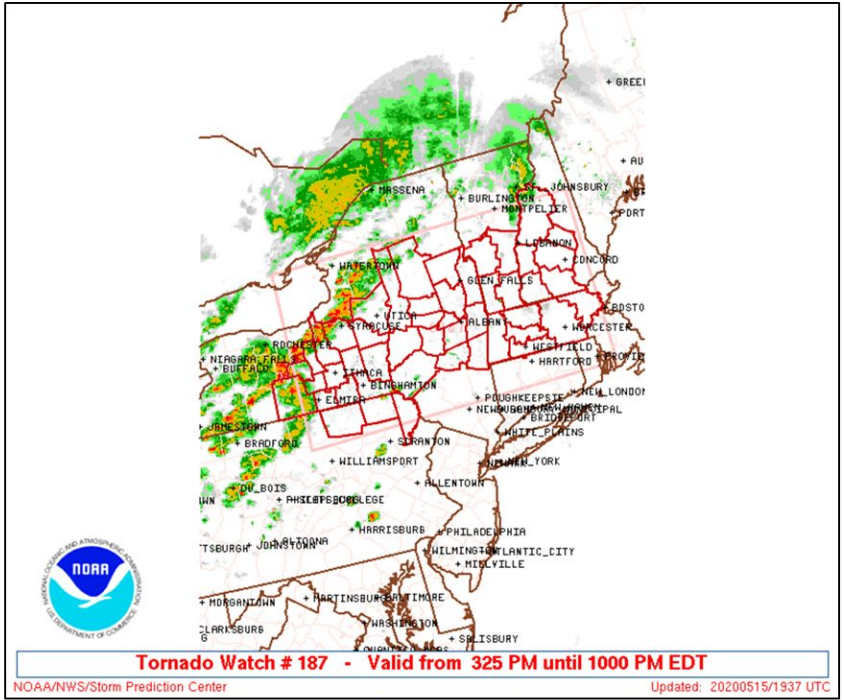


# Watch vs Warning

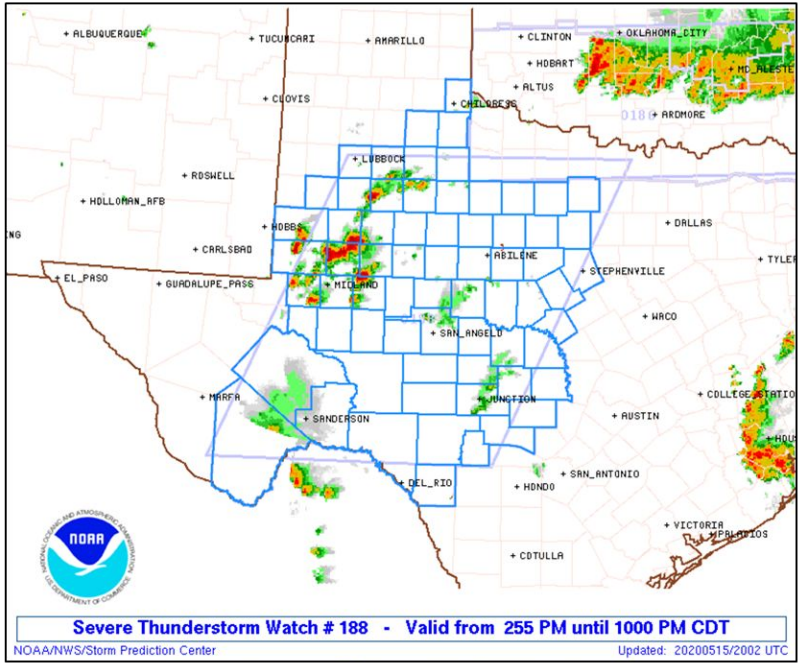

“Cupcake” Ingredients Are Present


“Cupcake” is imminent or already occurring

# 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!

# 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

# Convective Warnings - Severe, Flash Flood, & Tornado

| WIND SPEED ESTIMATE | DESCRIPTION |
|---|---|
| 25-31 mph | Large branches in motion; whistling heard in telephone wires |
| 32-38 mph | Whole trees in motion; inconvenience felt walking against the wind |
| 39-54 mph | Twigs break off trees; wind generally impedes progress |
| 55-72 mph | Damage to chimneys and TV antennas; pushes over shallow rooted trees |
| 73-112 mph | Peels surfaces off roofs; windows broken; light mobile homes pushed or overturned; moving cars pushed off road |
| 113-157 mph | Roofs torn off houses; cars lifted off ground |

| | |
|---|---|
| Dime/Penny | 0.75 inches |
| Nickel | 0.88 inches |
| Quarter | 1.00 inches |
| Half Dollar | 1.25 inches |
| Ping Pong Ball | 1.50 inches |
| Golf Ball | 1.75 inches |
| Hen Egg | 2.00 inches |
| Tennis Ball | 2.50 inches |
| Baseball | 2.75 inches |
| Tea Cup | 3.00 inches |
| Grapefruit | 4.00 inches |
| Softball | 4.50 inches |

# Tiered Impact Based System

Wording gets stronger the greater the threat to life.

Also includes:

- Tornadoes
- Flash Floods
- Snow Squalls

## Thunderstorm
## Damage Threat Categories

### Considerable / Destructive Tags

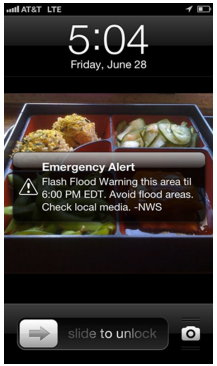
| Thunderstorm Damage Threat (tag category) | Wind | Hail diameter | WEA? |
|---|---|---|---|
| **Base** (no tag; default) | 58 mph (60 mph will appear in the warning) | 1.00 inch (U.S. quarter) | NO |
| **Considerable** | 70 mph | 1.75 inch (golfball) | NO |
| **Destructive** | 80 mph | 2.75 inch (baseball)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

WIRELESS EMERGENCY ALERTS CAPABLE



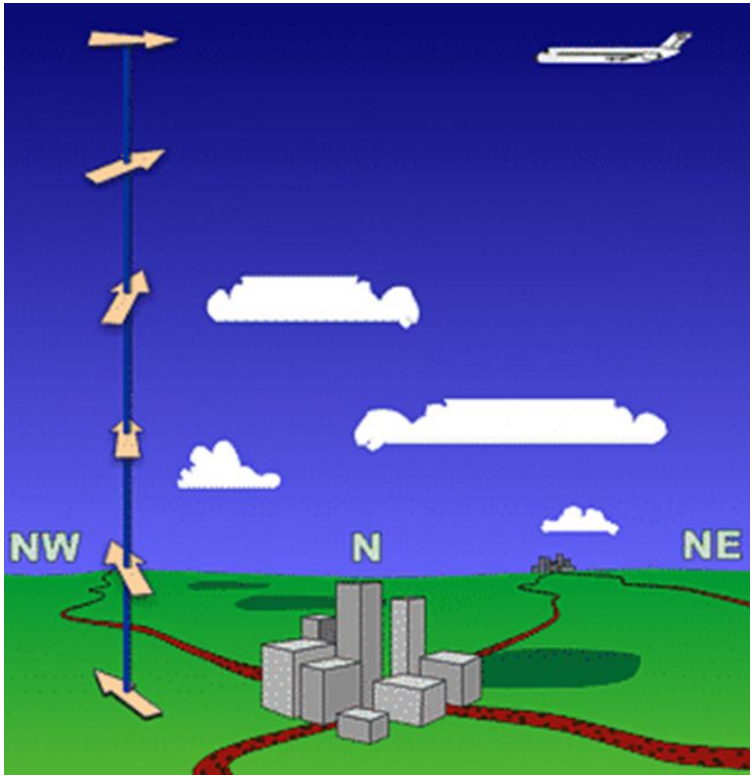
# Thunderstorm Ingredients

At the minimum, thunderstorms need **3** things

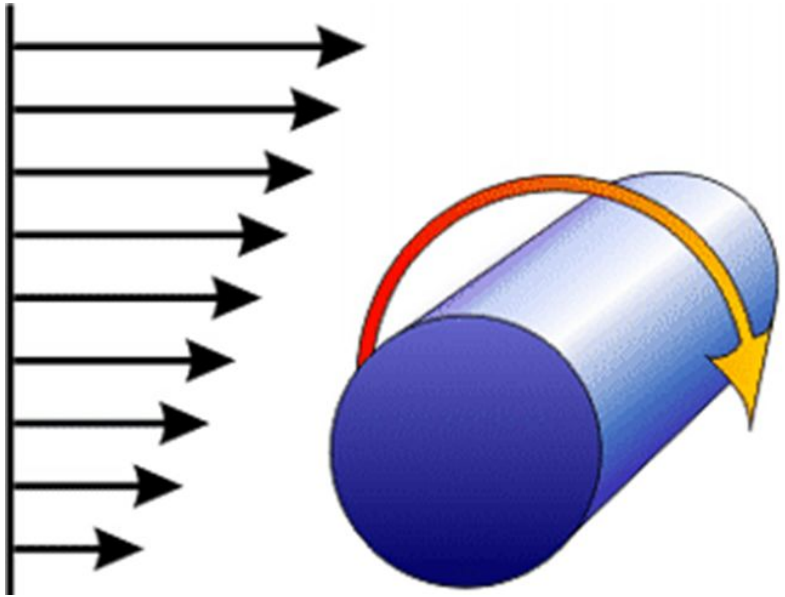
1. Moisture
2. Atmospheric Instability
3. Forcing mechanism (less needed in summer)
4. *To become severe, storms need something extra*


- A variety of other factors can combine to make storms more or less organized
- Generally, the more organized, the greater the severe threat.

# What is Wind Shear



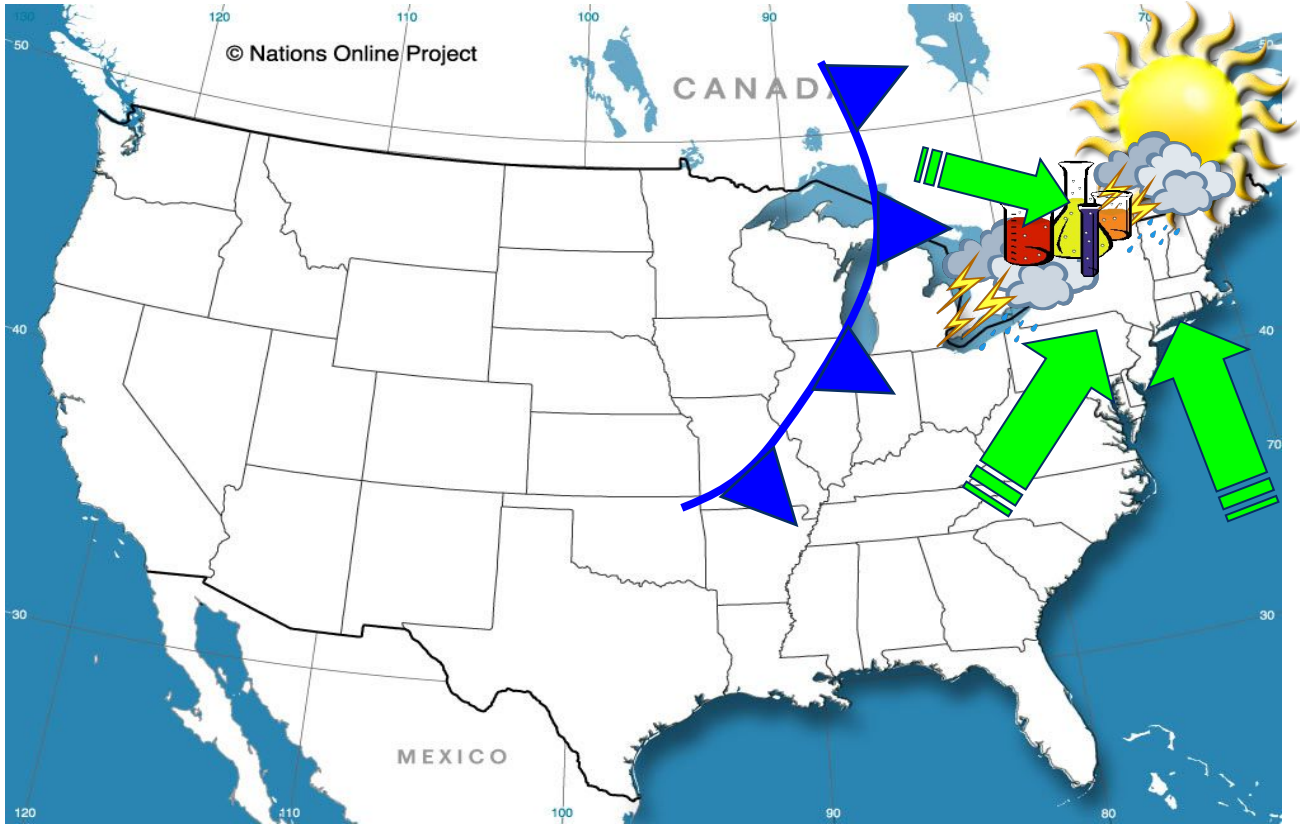

Directional Shear - Ideal for supercells



Unidirectional shear or “Speed Shear”

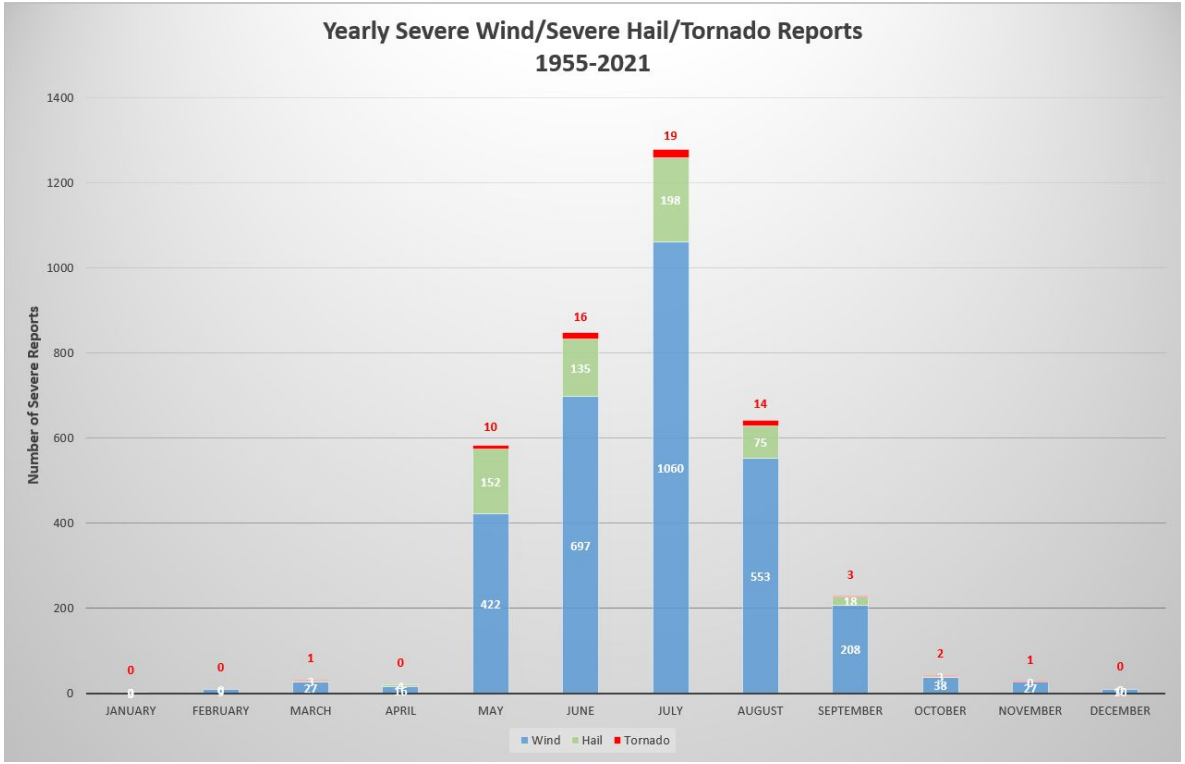
Ideal for producing squall lines

# Thunderstorm Development 101



# Any Questions?

# Brief Overview of Thunderstorm Types and Hazards



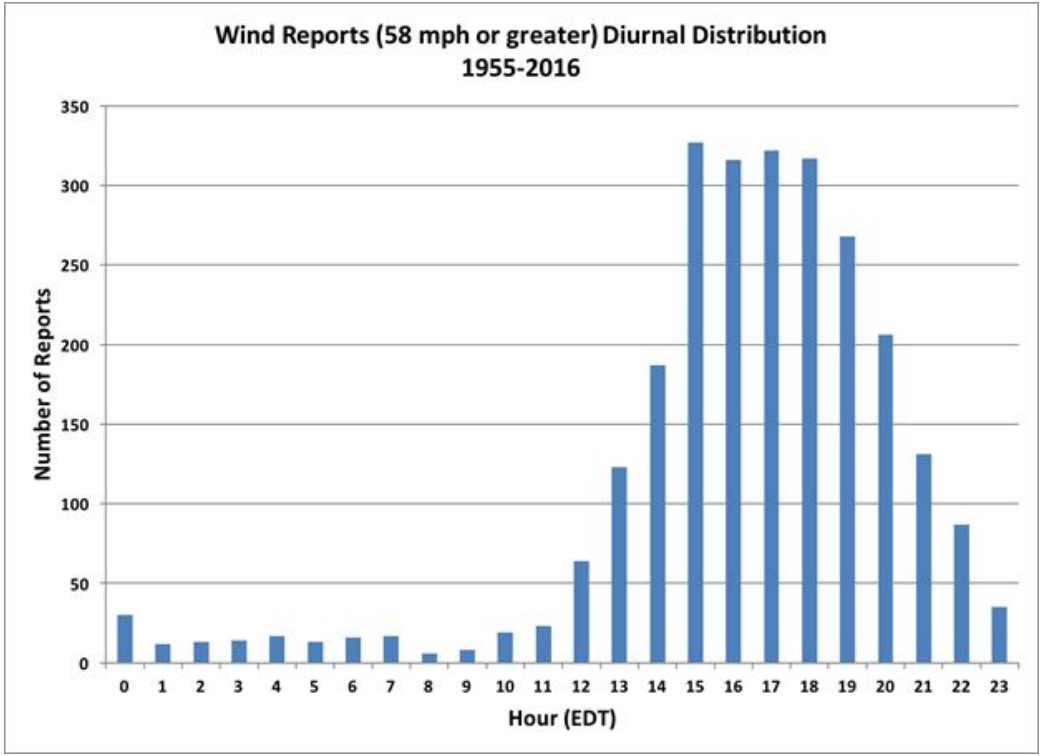

Climatological period of Severe Weather is the height of summer

Why is this so?

- More daytime heating – greater atmospheric instability
- Bermuda high usually allows moisture from the Gulf of Mexico 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



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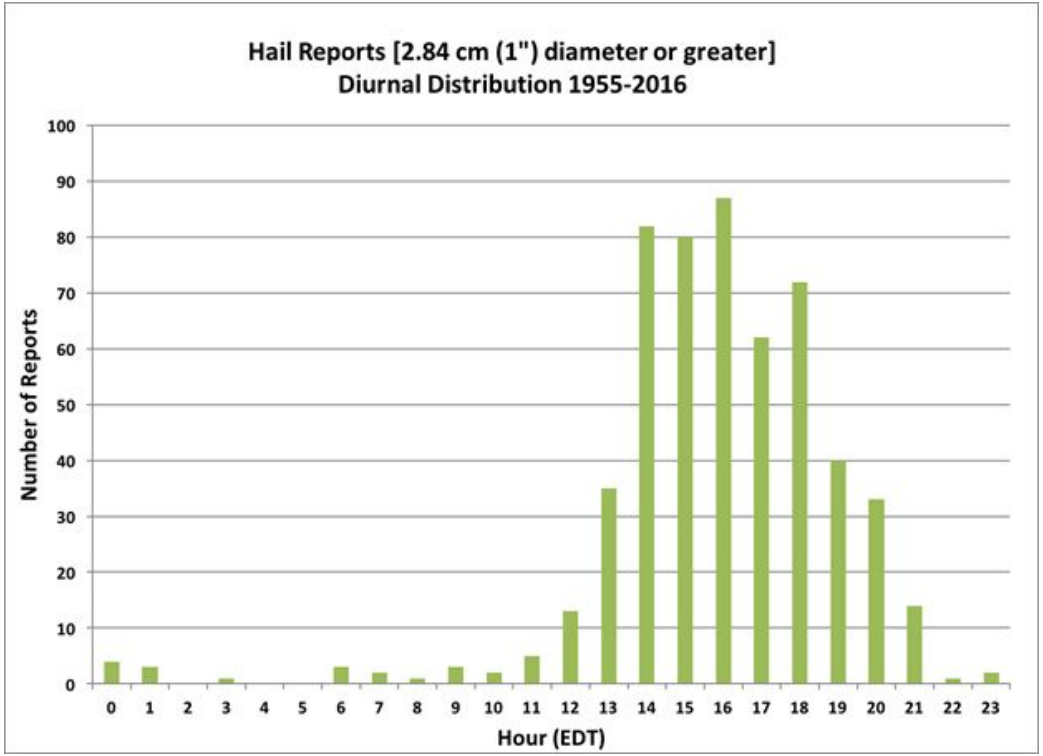

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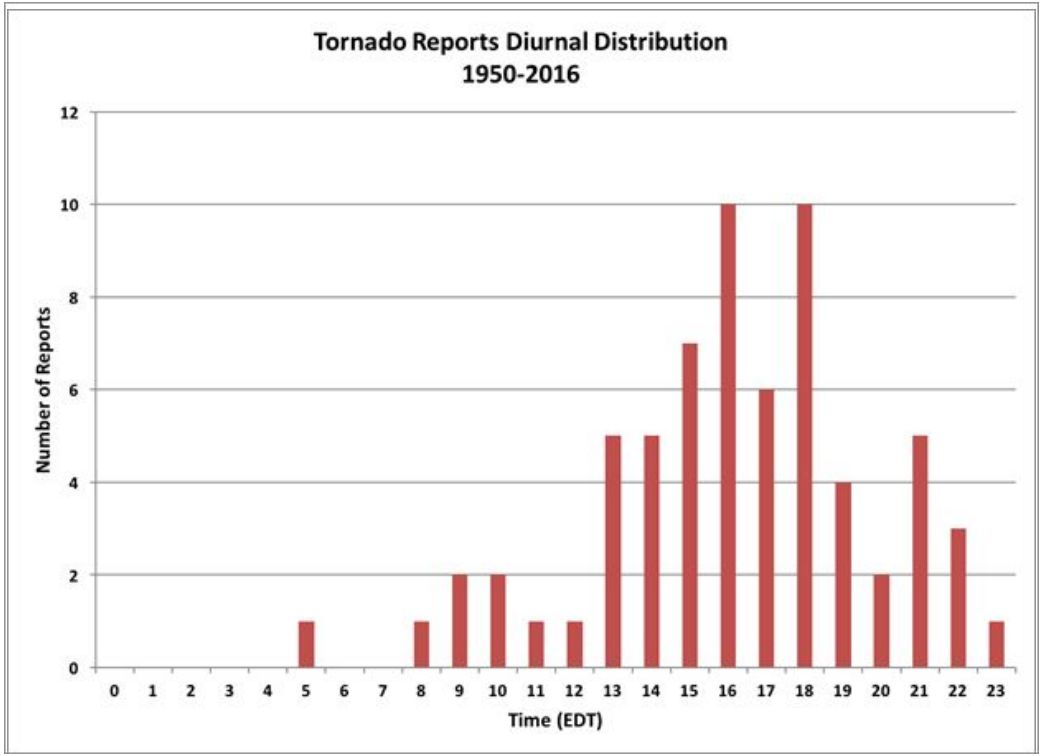
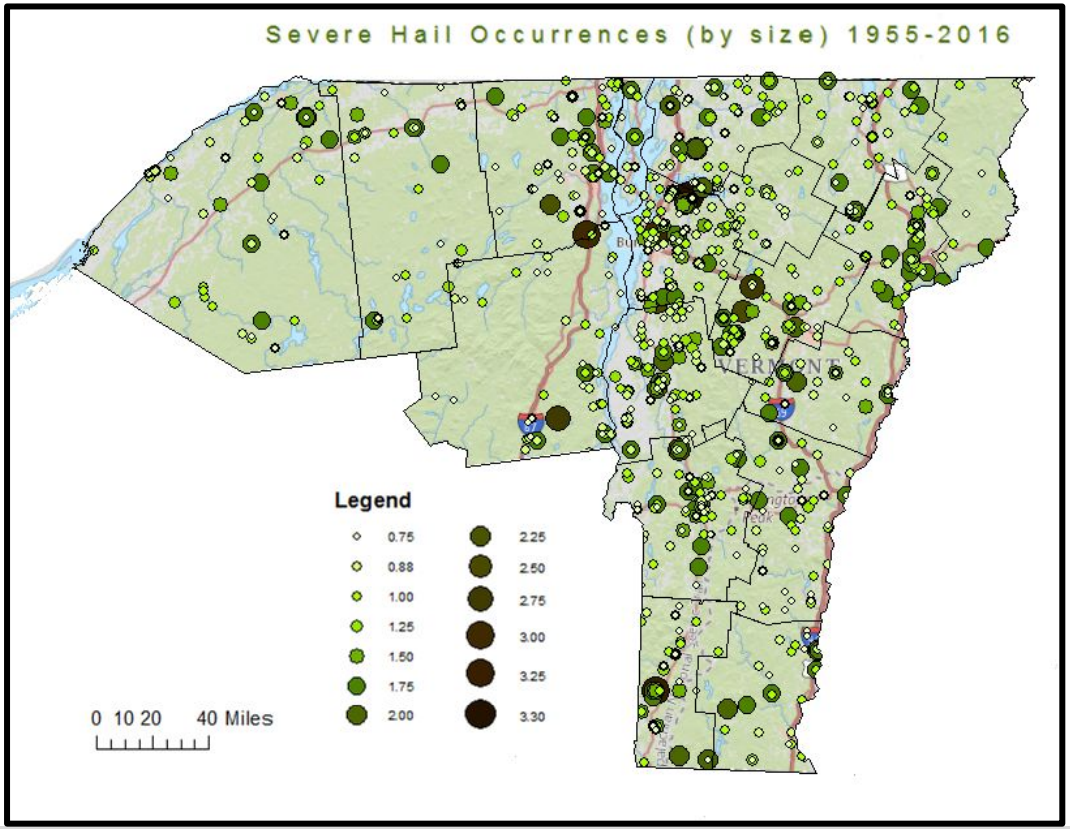


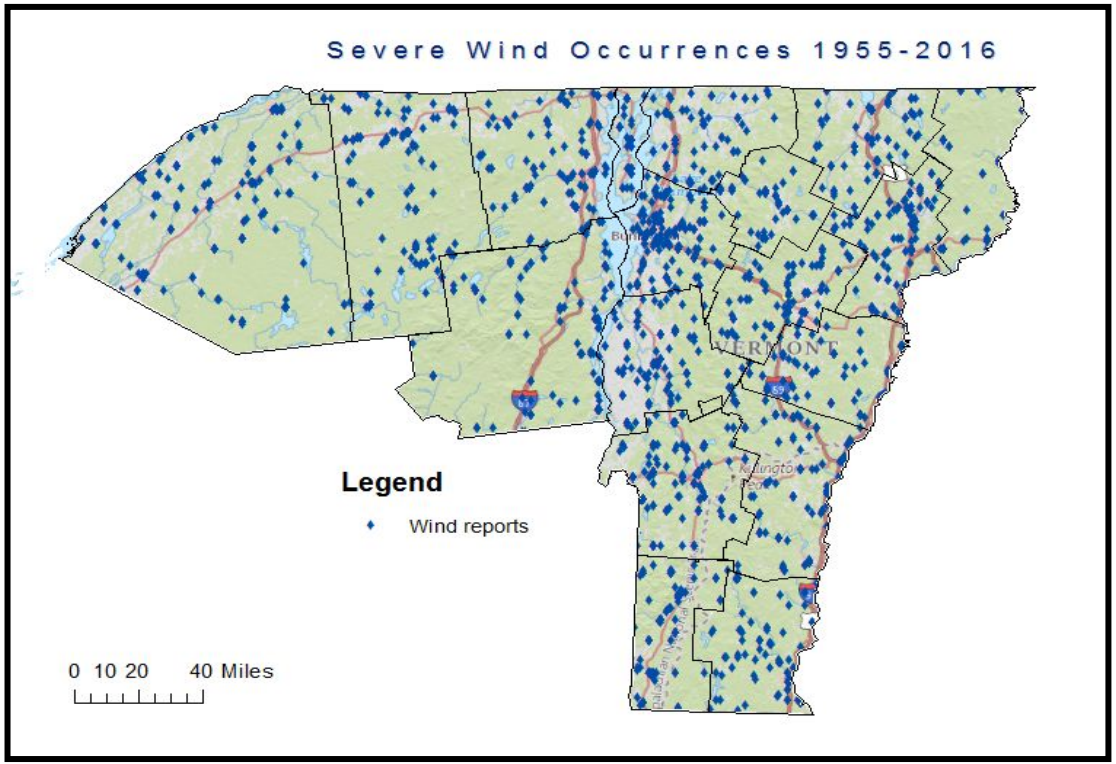
# North Country Severe Weather - Hail

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



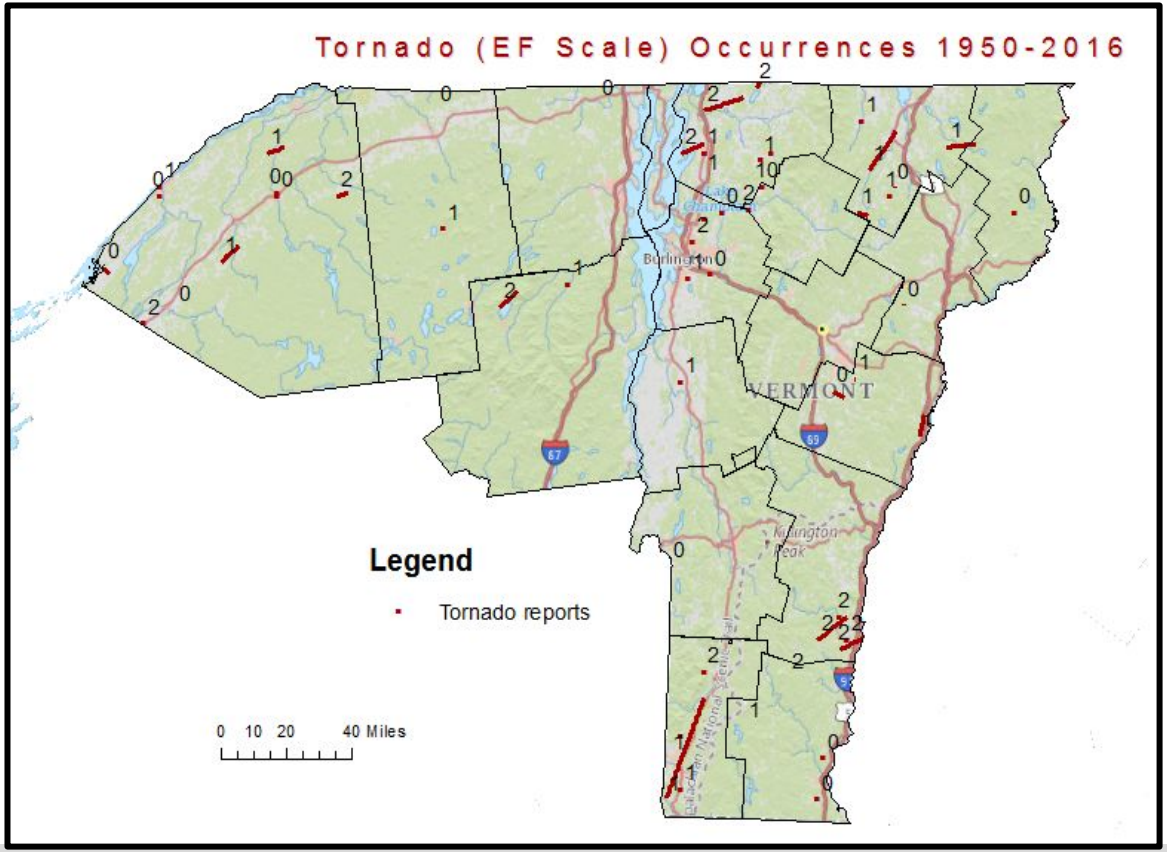
# North Country Severe Weather - Wind

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

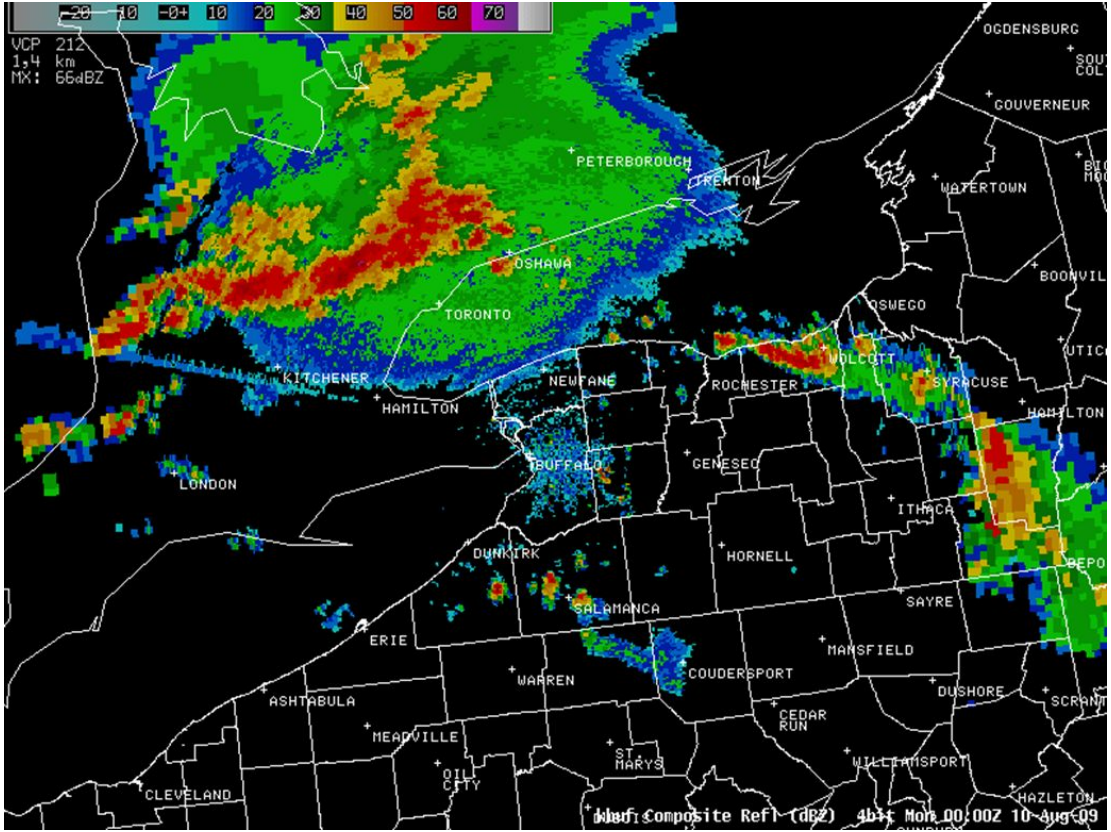


# North Country Severe Weather - Tornadoes

- 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

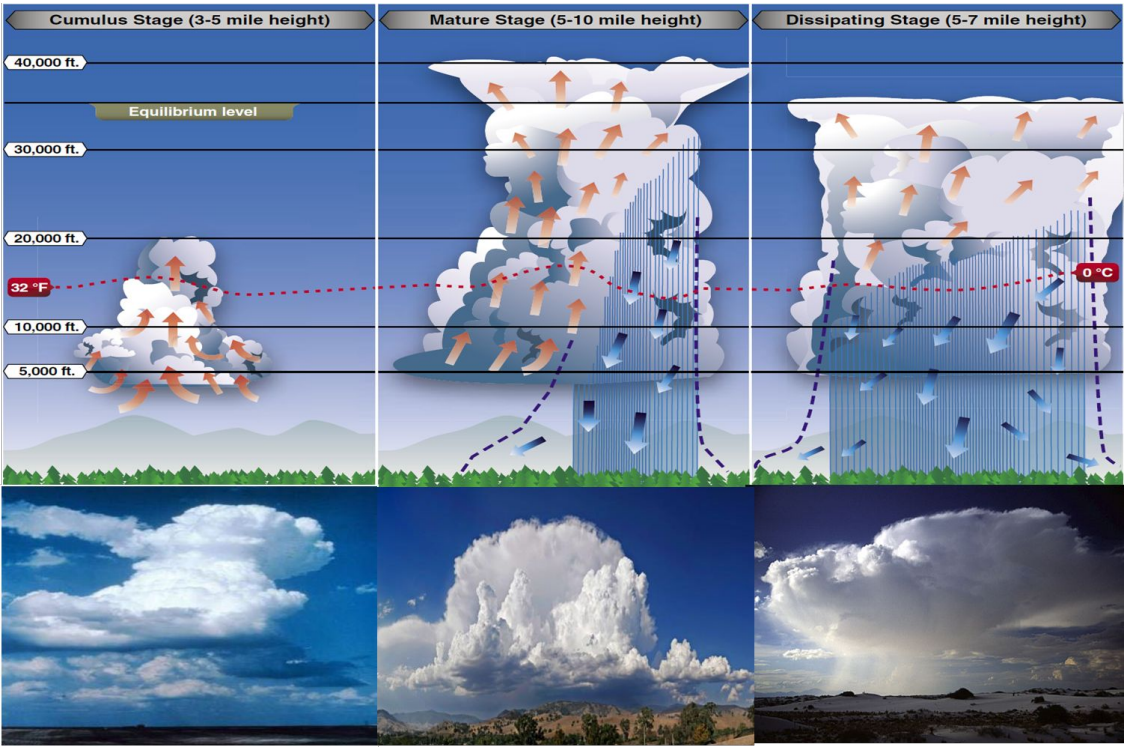


# Radar Reflectivity




- **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**

# The Single Cell




- Downdraft overtakes the convective updraft.
- Causes the storm to dissipate, usually within an hour.
- Sometimes, the downdraft wind is strong enough to do minor damage.
- Look for an overshooting top above the anvil – indicates more vigorous updraft and likelihood for damaging winds.


Super Slow-Mo……..

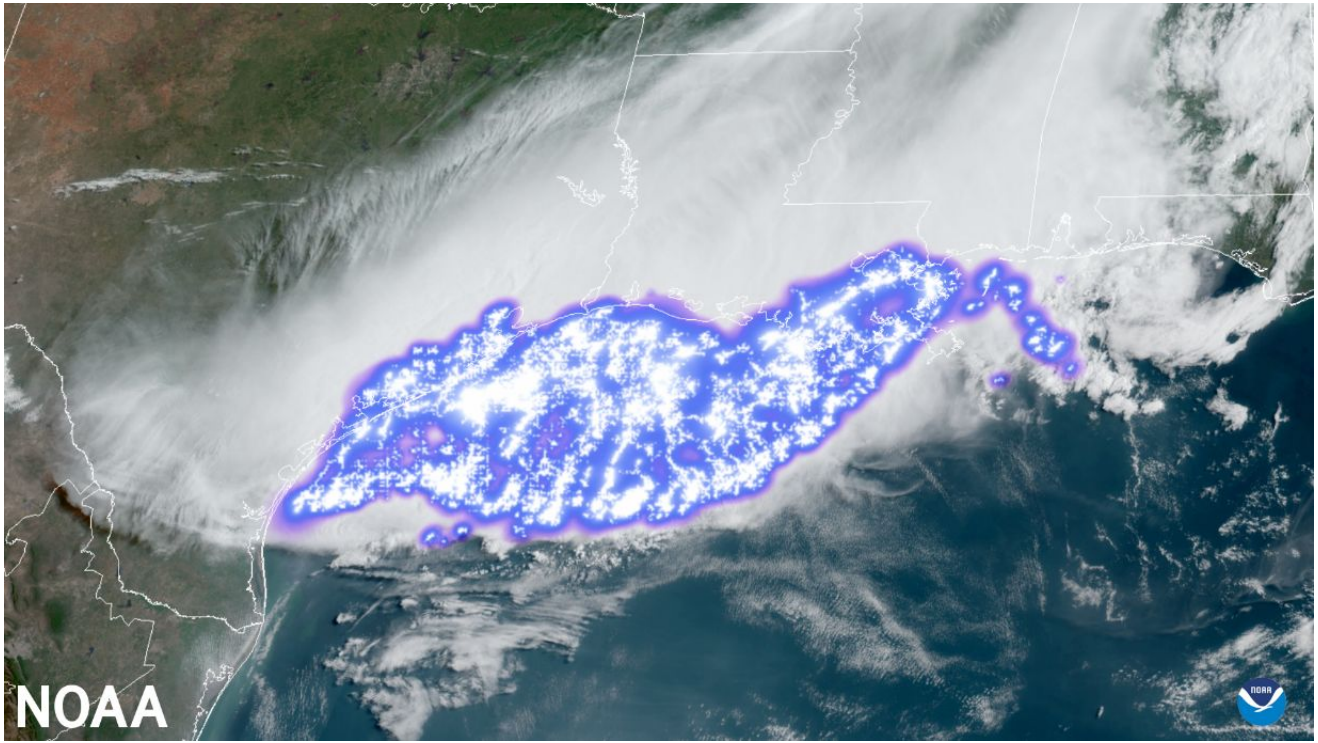
# What is Thunder

The sound of air expanding as lightning bolt heats the air around it. After the flash, the air cools and quickly contracts. Hence the name thunder “clap”.

Usually the distance you can hear thunder is about 10 miles from the strike.

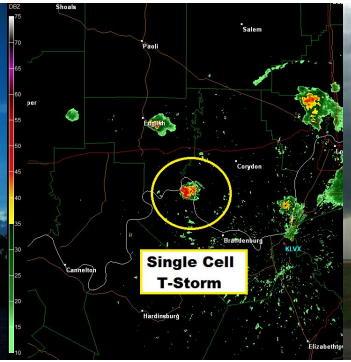
**The world’s longest observed strike is 477 miles!**

So when “thunder roars, go indoors”!

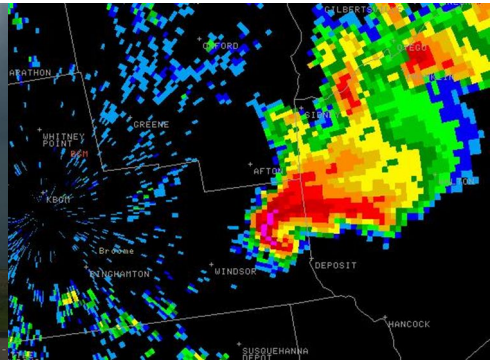


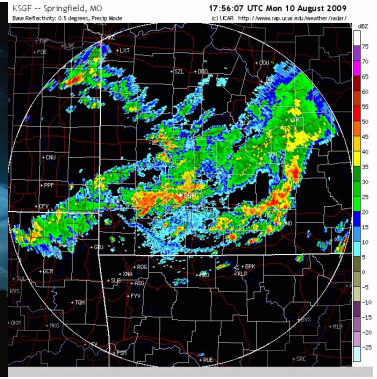

https://www.noaa.gov/stories/worlds-longest-lightning-flash-on-record-captured-by-noaa-satellites

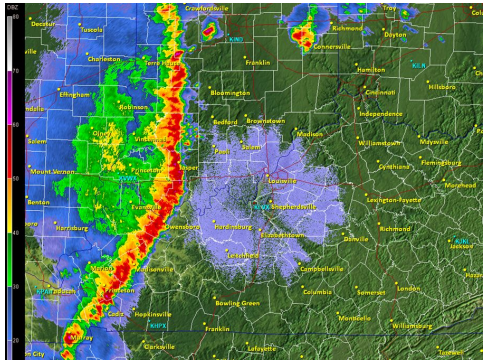
# Environment Gives Storm Many Shapes and Sizes

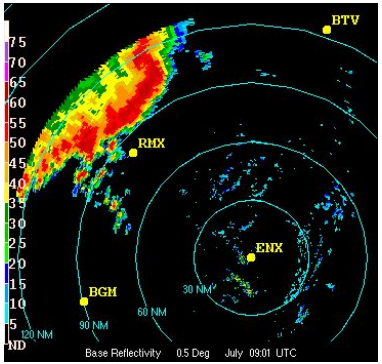







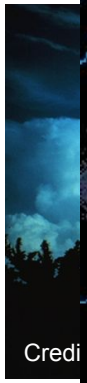






A storm's structure on radar gives us a general clue of what it's capable of.

# Storm Structure Will Often Change Over Time

Credi



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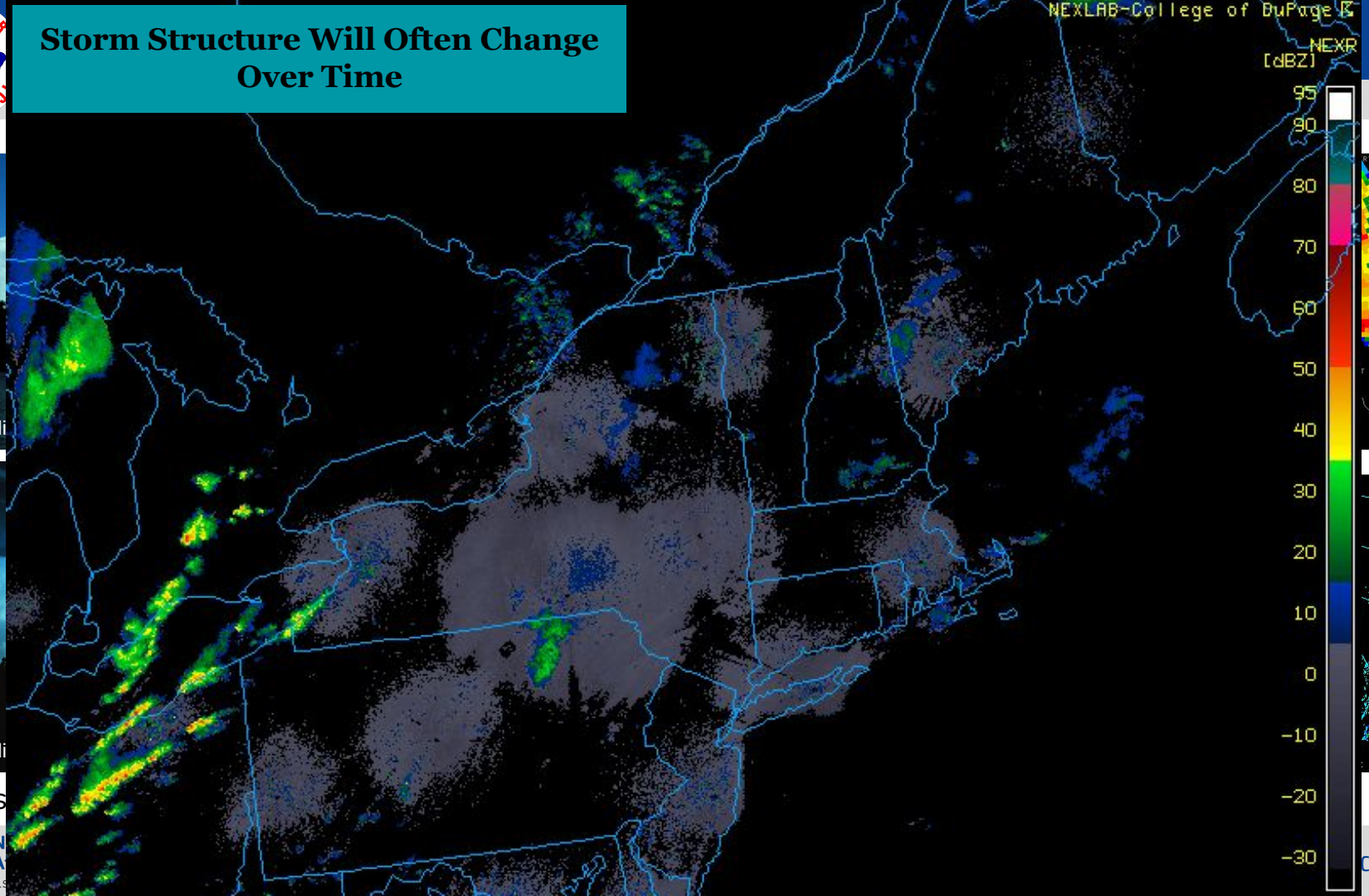
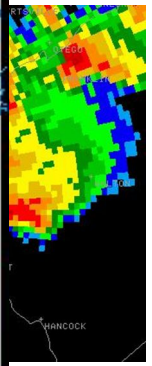
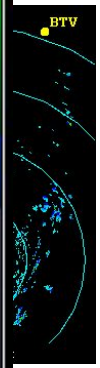


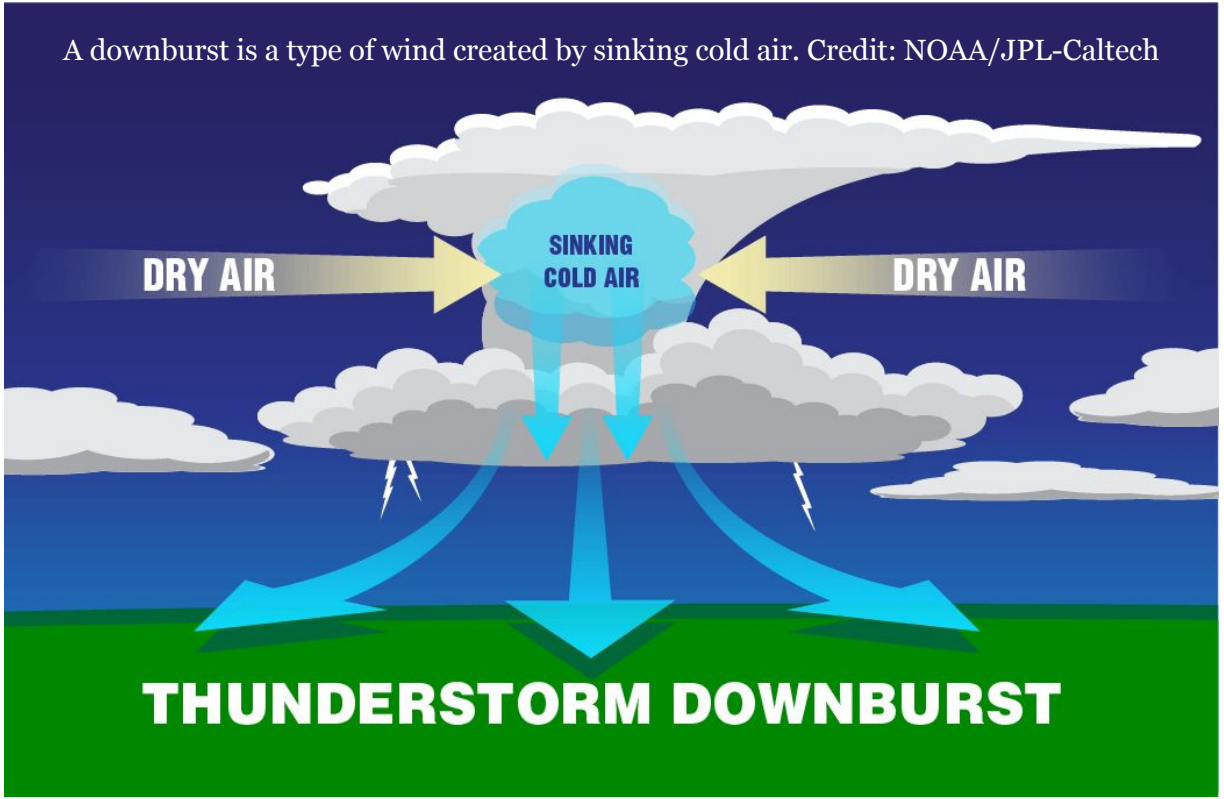



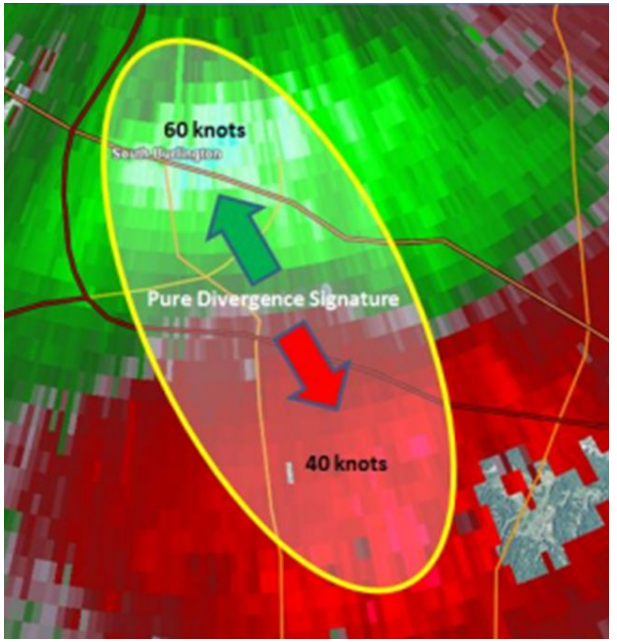



A s

cast Office

# Microburst Visual Appearance



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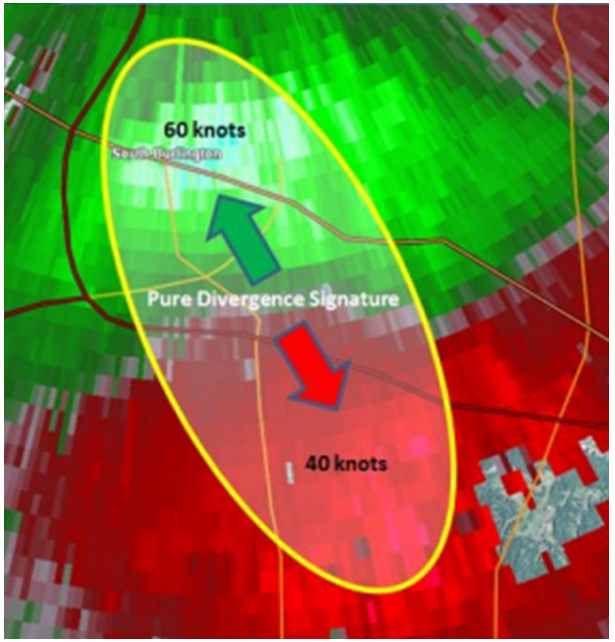
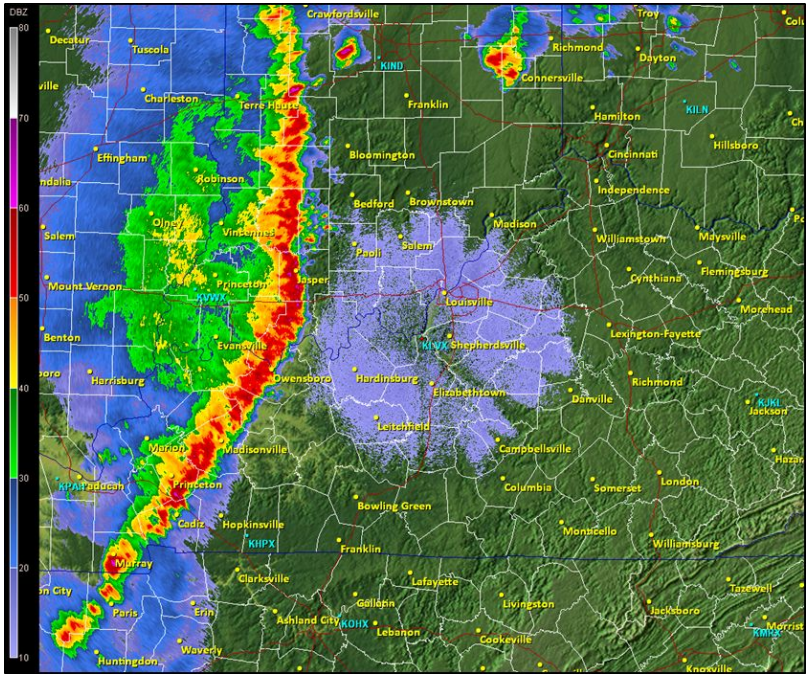
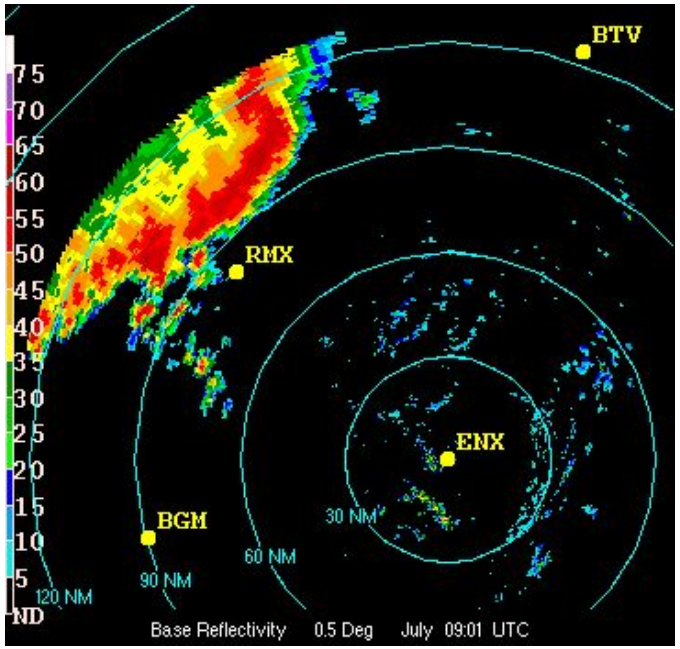


# Straight-Line Winds

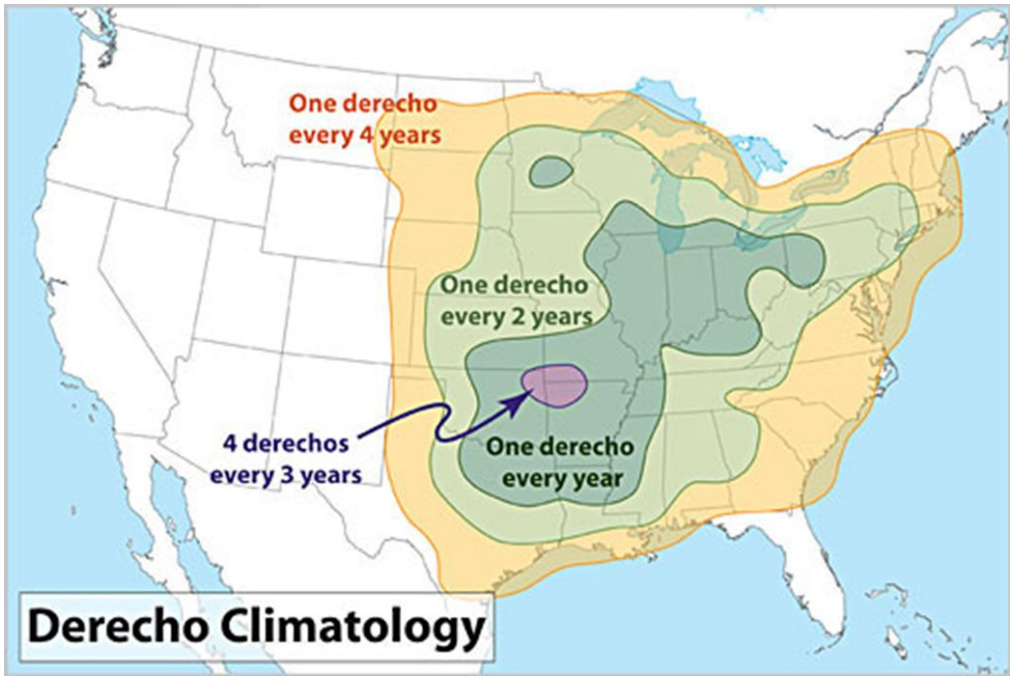



Squall Line (*Jargon term Quasi Linear Convective System: QLCS*) - Group of thunderstorms that are often accompanied by high winds and heavy rain, occasionally with tornadoes (along breaks). Can be hundreds of miles long. Fast winds can be enhanced by convection and create powerful winds behind the front.

# Derecho

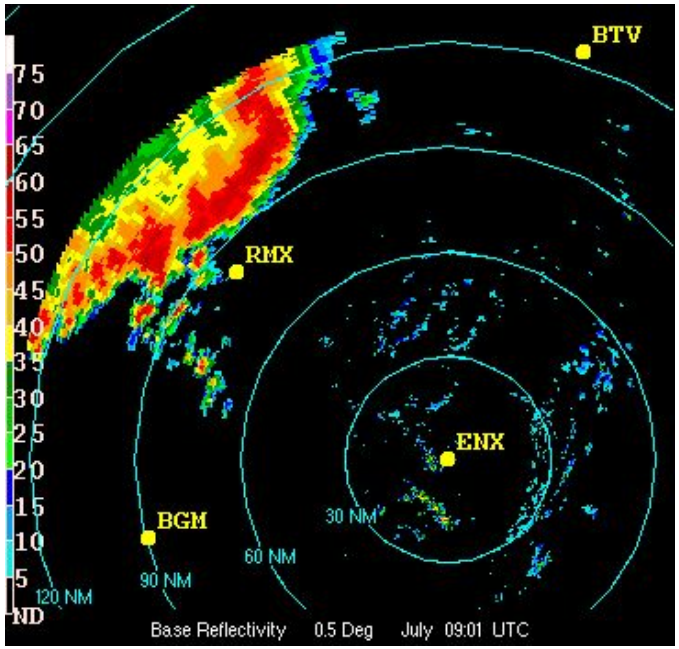



July 14-15, 1995
"The Ontario/Adirondacks Derecho"




When winds are sufficiently strong (handful of hurricane force gusts) and extensive, then the event qualifies as a "derecho".

# Derecho

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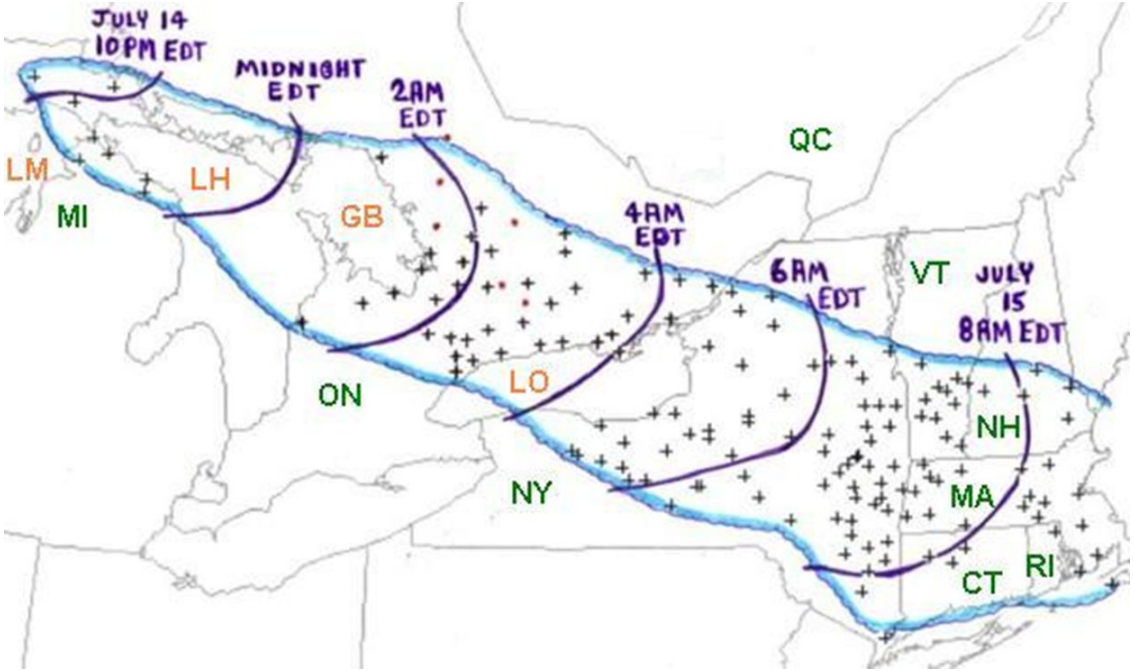


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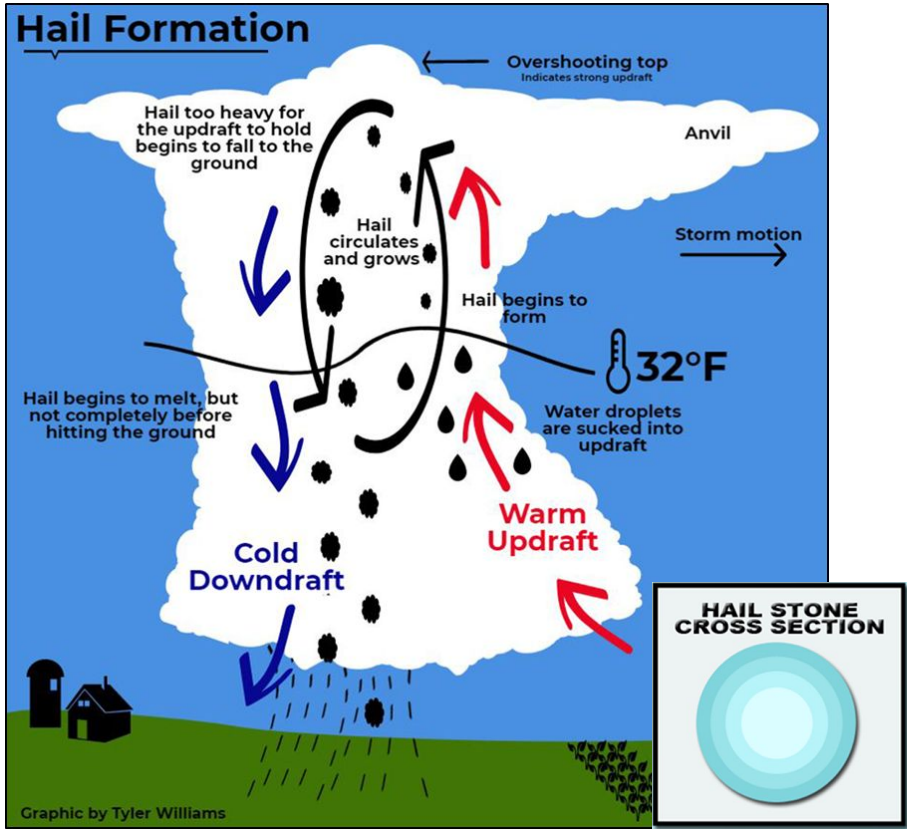
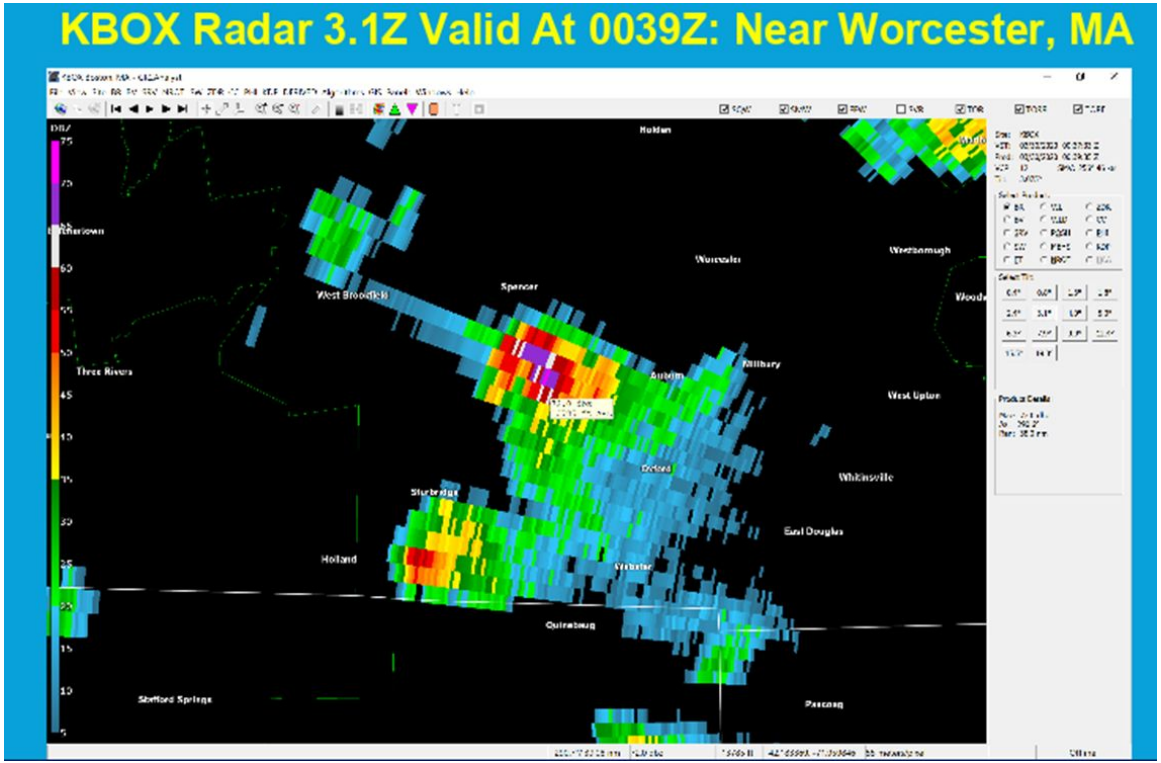
# Hail Formation and Growth



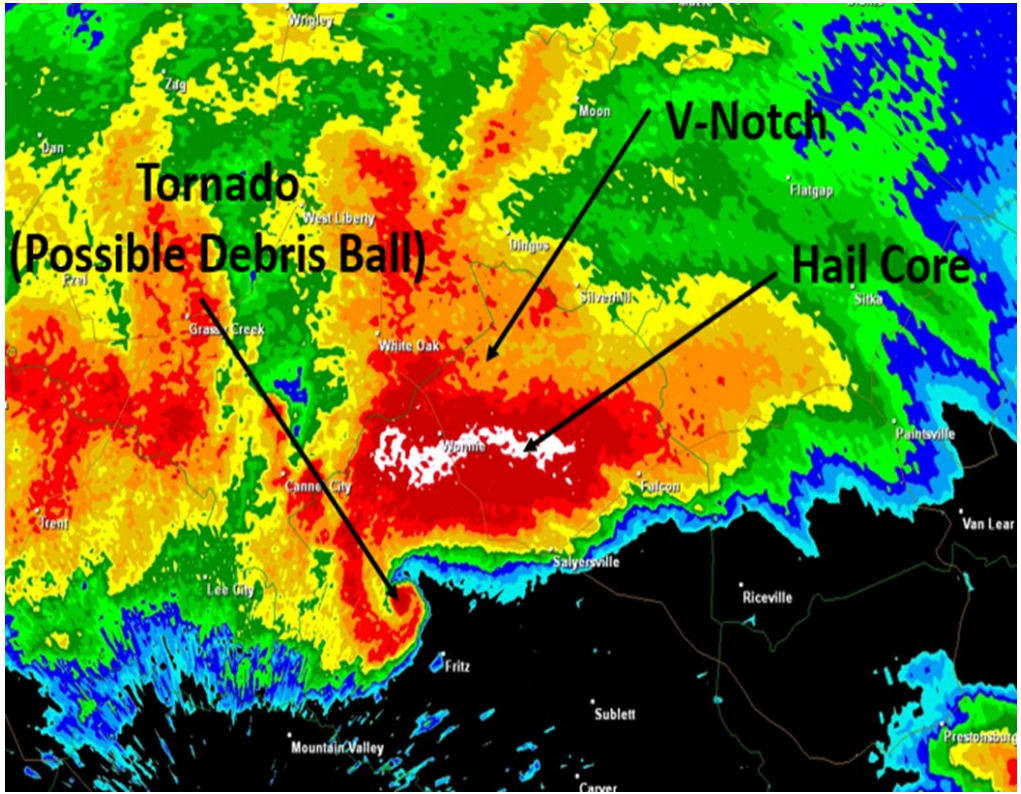

- Hail is more likely when updrafts are strong and the freezing level is low in the atmosphere.
- Hail is more likely when your updraft and downdraft are separate.
- Hail is more likely if the storm has been around a long time.

# Hail on Radar




- 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.

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May 2022 - Spotter Jon O'Connor in Williston

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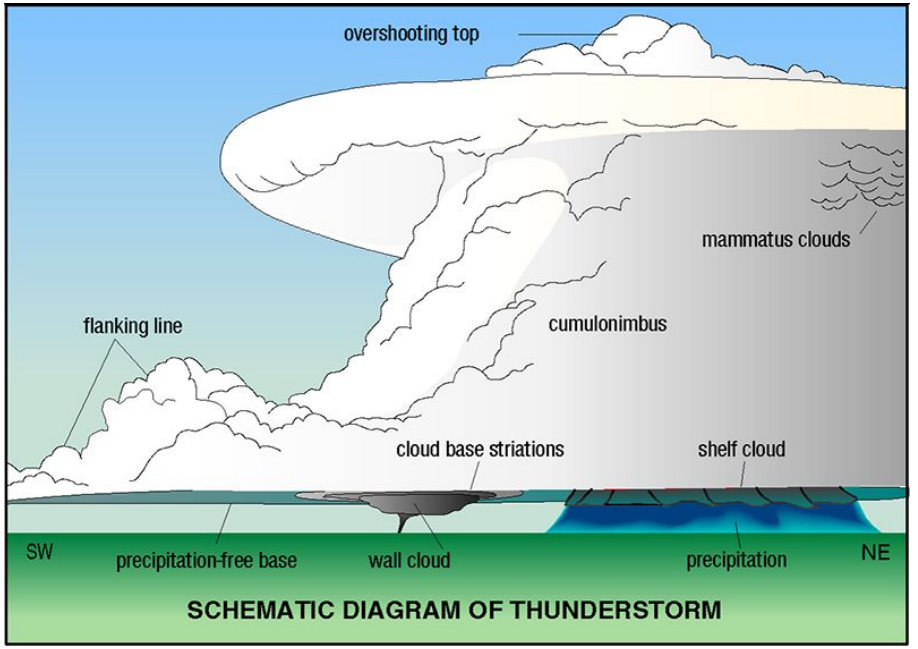
# Wall Cloud




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 Cloud vs Wall Clouds

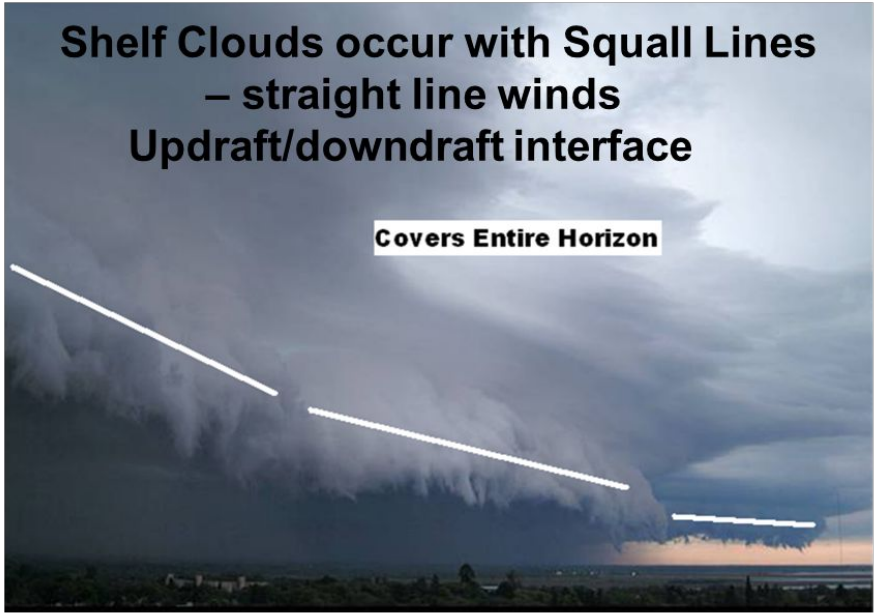
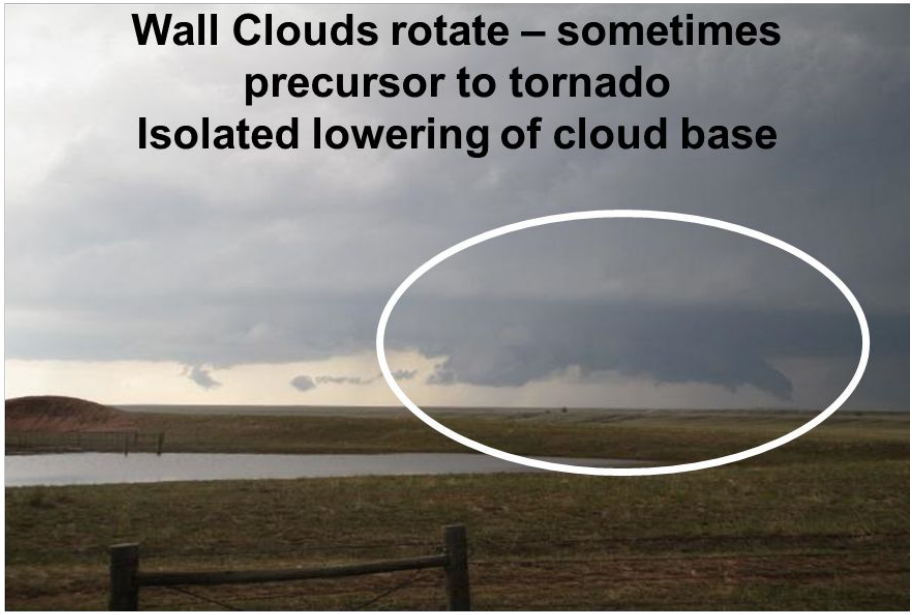
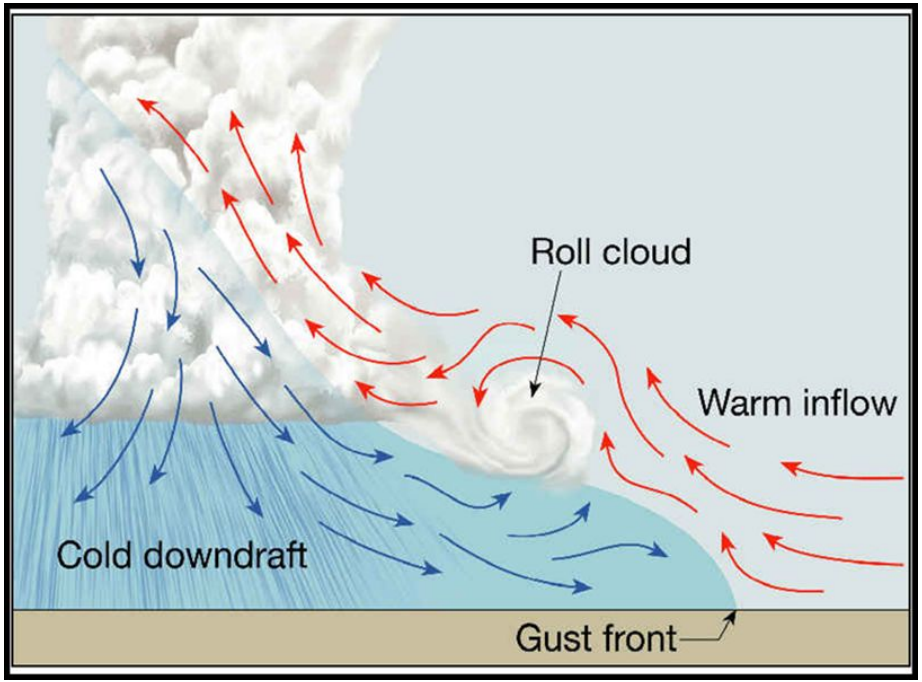



Photo courtesy of
https://www.weather.gov/lmk/shelfcloudversusawallcloud



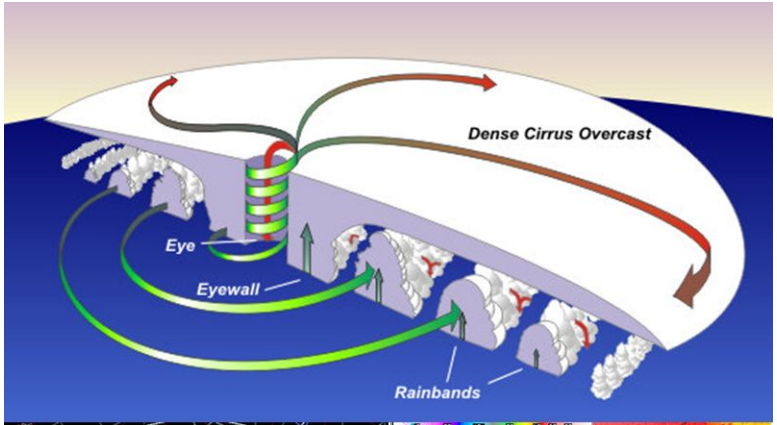

Wall cloud near Cheyenne, WY.
Photo courtesy of NWS Meteorologist Christina Speciale.

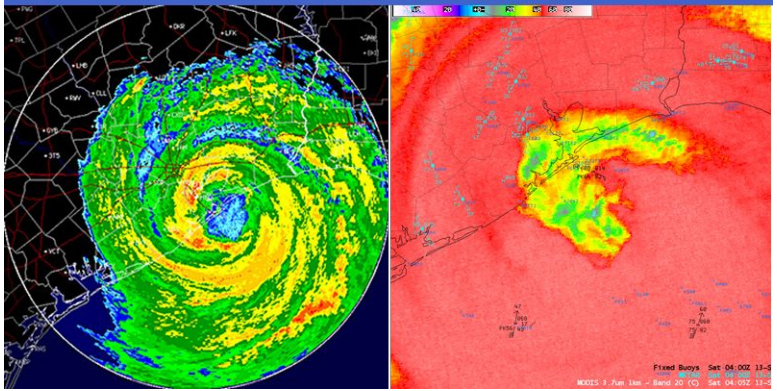
# Shelf/Roll Cloud




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

# Tropical Cyclones



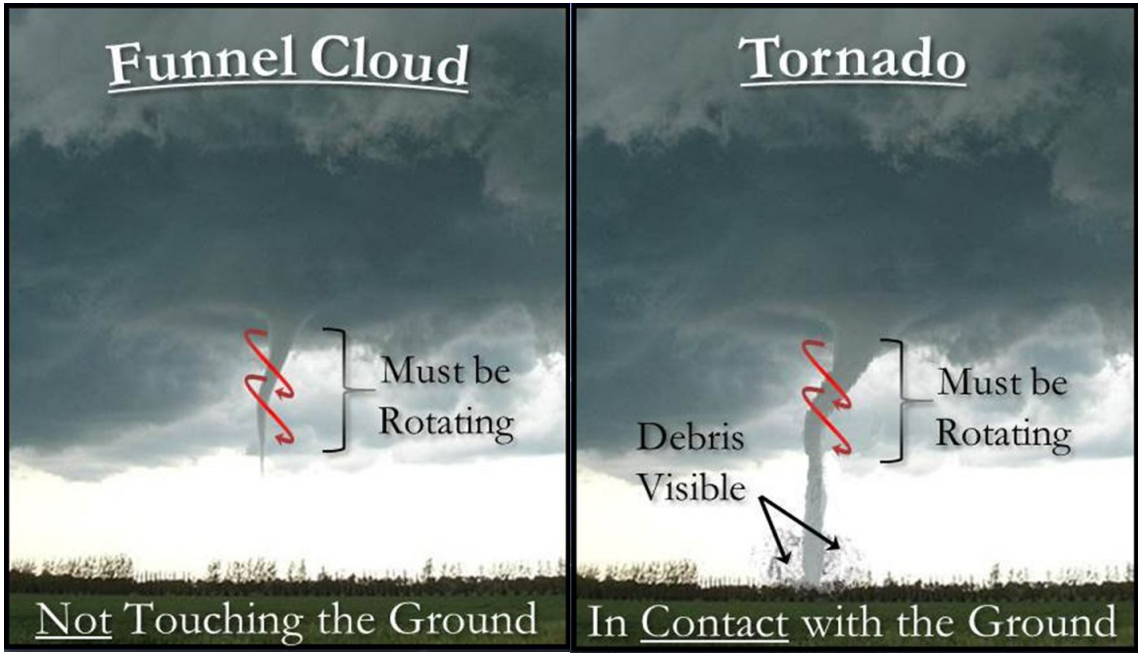
Radar and IR Satellite image of Ike before landfall

- Concentrated areas of thunderstorms over warm ocean waters results in falling pressures, that in the right environment becomes an organized, convectively driven area of low pressure (hurricane - see image to the left).
- When over land, greater friction and lack of warm, ocean waters causes these systems to quickly decay.
- Warm rain processes (small drops, but numerous in count) results in high rainfall rates, especially if the system is moving slowly or quite large.
- Can cause isolated tornadoes
- Often causes wind damage and storm surge (coastline only)

# Any Questions?

# Let's Talk About Tornadoes

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



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# Tornado look alikes

- 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).

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# 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

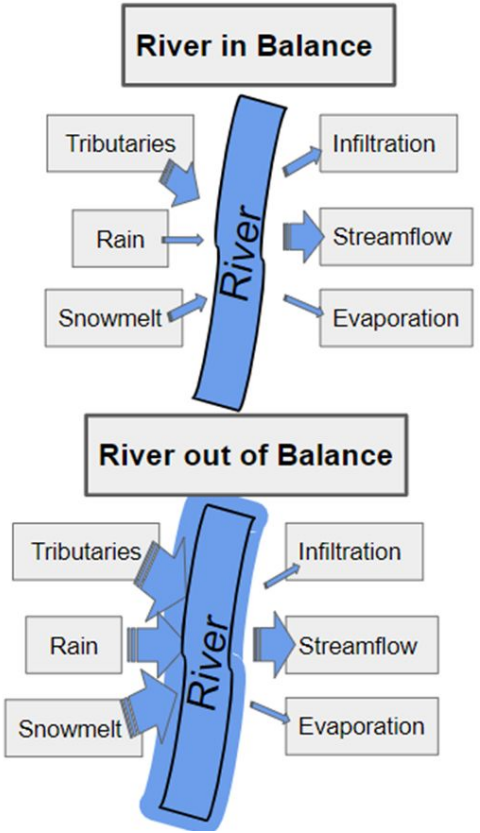
# Violent Tornadoes

## (EF4 and EF5)

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

# What causes flooding to take place?

- Several factors affect how easily water comes in and moves out with common regions of common characteristics grouped into basins
- When flooding occurs, the input into the river is greater than water flowing out
  - This can be gradual (flooding)
  - Or this can be rapid (flash flooding)



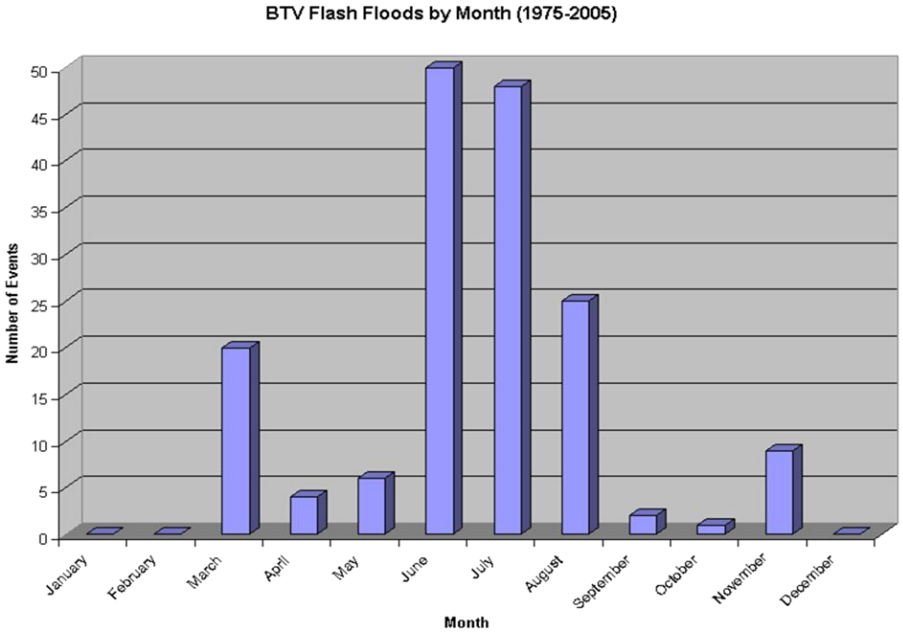
# Flood vs Flash Flood

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)
- ***Flash Floods*** can readily transition into areal or river floods if water remains in place
- ***Floods*** arise from many gradual contributions to river rises.

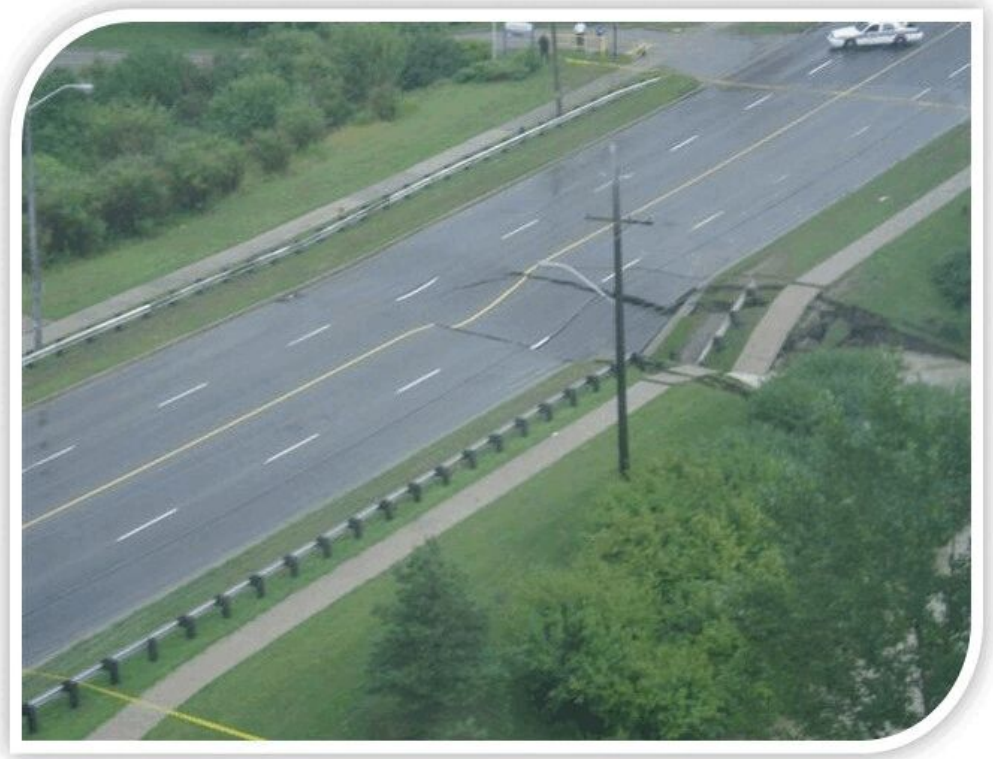
# When is Flooding Common in the North Country

- Spring snowmelt saturates soils and produces run-off into rivers and tributaries
  - Causes river levels to rise which may produce ice jams on ice covered rivers
    - Water has difficulty efficiently moving due to jam
- In fall, vegetation goes into dormancy and vegetation collects less water
  - Leads to greater runoff
- Atmospheric pattern can produce strong, moisture laden storms
  - 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 more localized



# Safety Message!

- Don’t underestimate the power of running water
- You may not see the road below flood waters or what’s in the water (more of an issue down South)!
- Nearly two-thirds of flood-related deaths are from driving into floodwaters
- Turn around, don’t drown



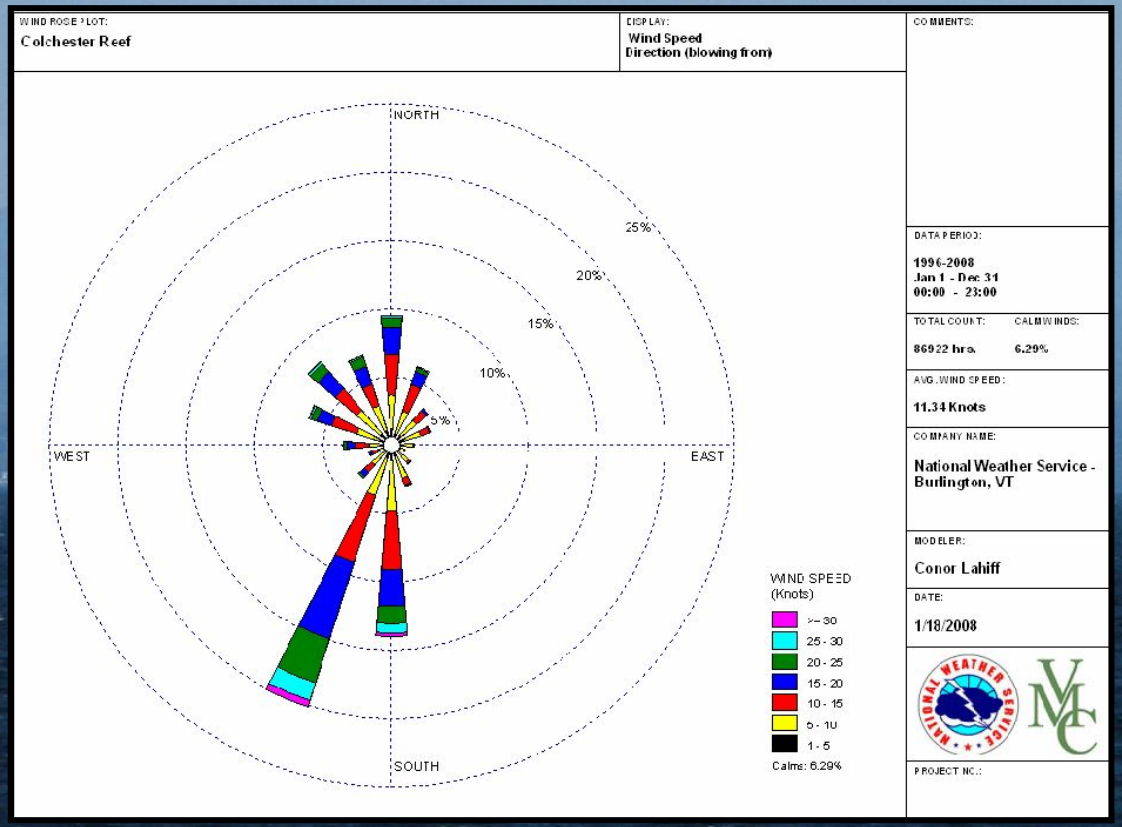
# Forecasting Winds for Lake Champlain

- Marine forecasting  It's all about mixing potential

1. Less friction over water  winds greater
2. Is water temperature warmer or colder than air?
   A. Water/air temperature profile governs mixing
   B. Cool air atop warm air  more unstable
3. Channeled flow  Winds accelerate through the Champlain Valley (Bernoulli Principle)

# Forecasting Winds for Lake Champlain

- Channeled flow
  - Winds tend to blow north/south due to valley topography
  - Winds become channeled and stronger in the valley than surrounding areas



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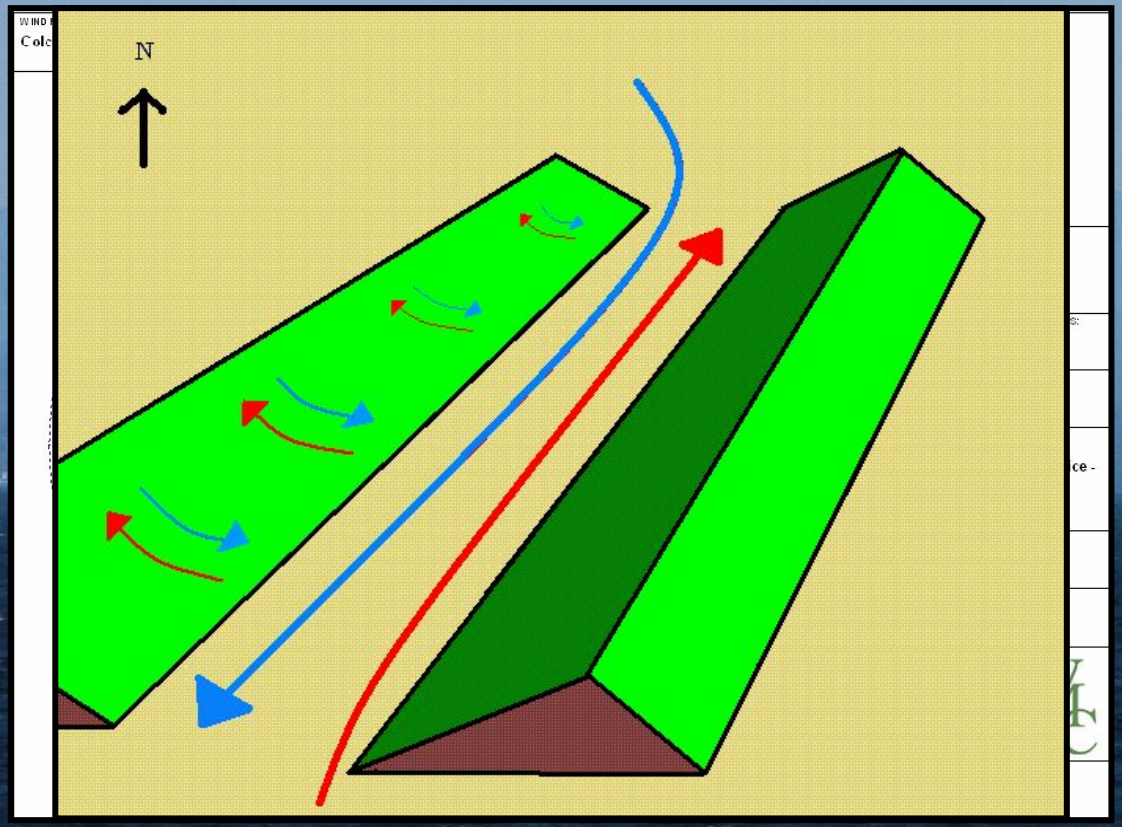
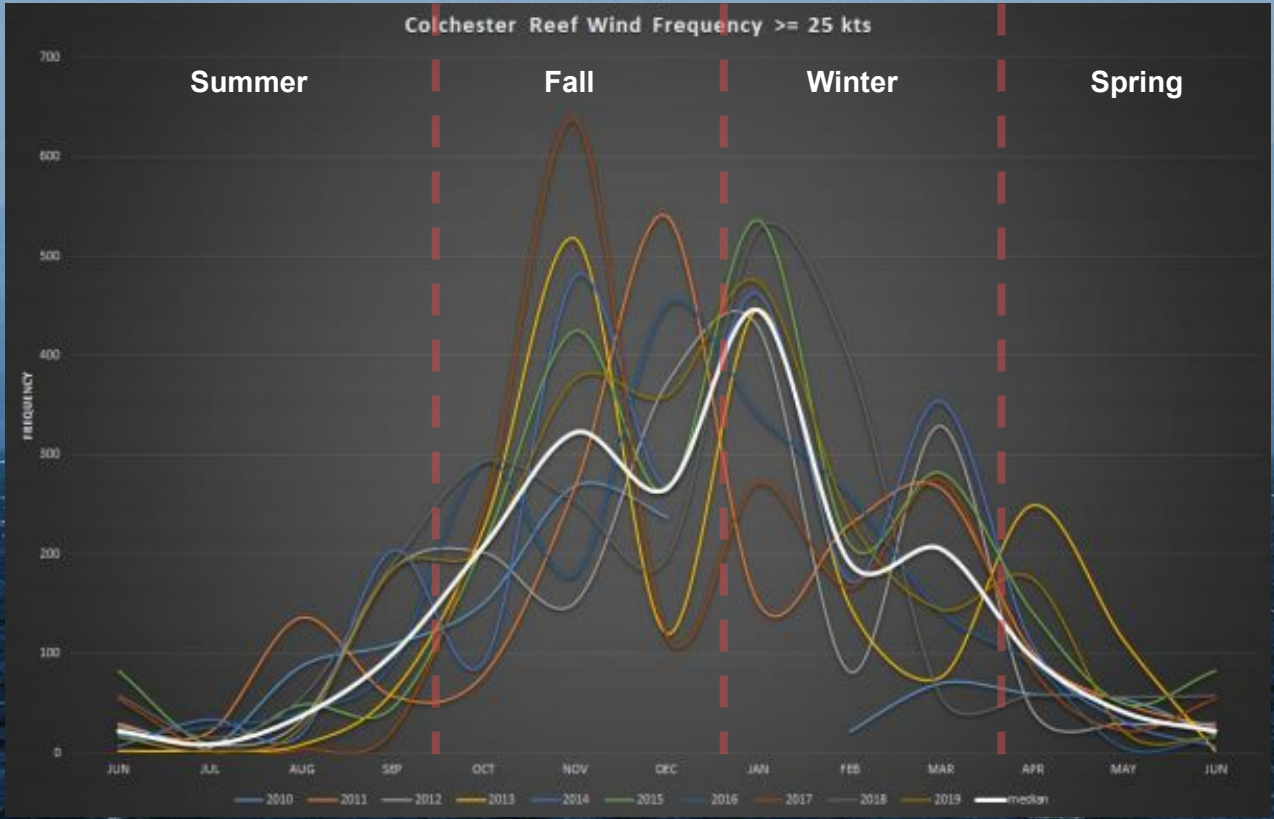


# Forecasting Winds for Lake Champlain

| Seasonal Temperature and Stability Profiles Near Large Bodies of Water | | | |
|---|---|---|---|
| **Season** | **Relative Sea Surface Temperature** | **Relative Air Temperature** | **Boundary Layer Stability** |
| Winter | Cool | Cold | Unstable (Strong Winds) |
| Spring | Cold | Cool | Stable (Weak Winds) |
| Summer | Cool | Warm | Stable (Weak Winds) |
| Fall | Warm | Cool | Unstable (Strong Winds) |

# Forecasting Winds for Lake Champlain



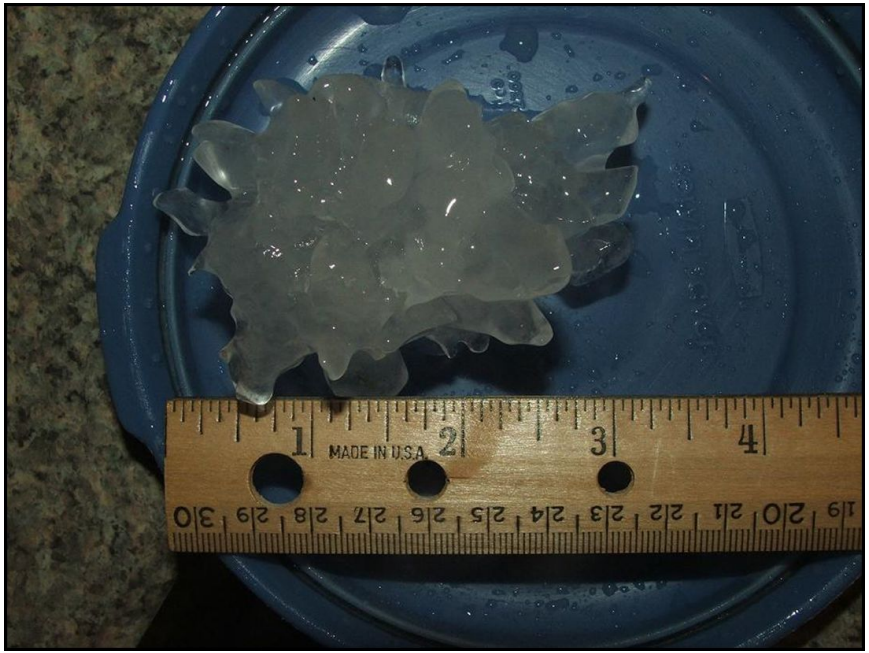
# Any Questions?

# 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

# Vermont Record Hail Westford, VT July 16, 2009

**3.25” diameter**




**Took place in one of our employee’s own backyard!**

- 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.

# 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!

NWS Burlington

# 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

SKYWARN
WEATHER.GOV

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

For more info, contact marlon.verasamy@noaa.gov, seth.kutikoff@noaa.gov, robert.d.haynes@noaa.gov, or scott.whittier@noaa.gov

# How to get alerts

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

# mPING

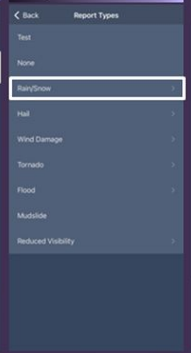
## Submit reports with the tap of your finger!

*Use the mPING App to record the weather at your location*

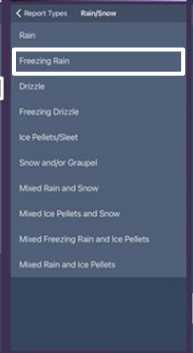
- Download the free app
- Tell us when precipitation begins, changes, or ends where you're at!
- Support research as a citizen scientist – report as often as you would like
- Below is how to report freezing rain

**Step 1: Select "Report Type"**

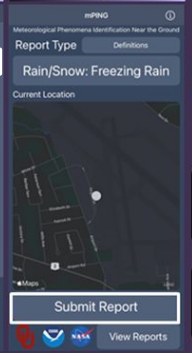

**Step 2: Select "Rain and/or Snow"**




**Step 3: Choose what's falling**



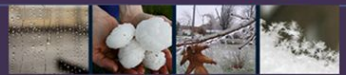

**Step 4: Select "Submit Report"**




https://mping.ou.edu

Download on the App Store

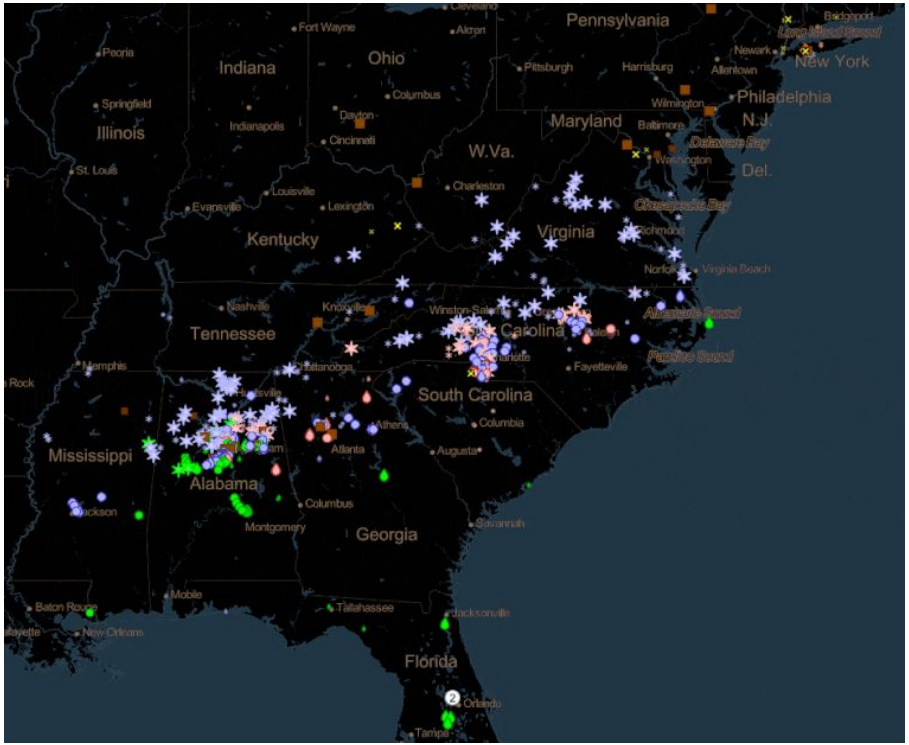
GET IT ON Google play



National Weather Service Burlington

Follow Us:

www.weather.gov/btv



# 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
Rodney Chai - rodney.chai@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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https://www.youtube.com/NWSBurlington