Advanced Winter Weather Course

NWS State College

Photo Credits: NOAA Photo Library

Attendee Engagement

- Ask us a question!
  - You can type your questions in the Chat

- You can take notes if you wish, but we *will* be sending out a copy of the slides after the presentation

Brief Introduction - Who We Are

NWS State College
Central PA Weather Forecast Office

- 14 forecasters, 6 electronic technicians/IT support, 1 hydrologist, 1 science & operations officer, 1 observations program leader, 1 warning coordination meteorologist, 1 administrative assistant, and a meteorologist in charge
- Open 24x7x365 to provide forecasts and warnings, as well as maintain the Doppler radar and other observation

How to Find Us Online

@NWSStateCollege

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/NWSStateCollege

/NWSStateCollege

www.weather.gov/ctp

Poll Question:

How did you hear about this session?

A. Social Media
B. NWS Website
C. E-mail
D. Friends, Coworkers, Students, Teachers, Professors, etc.
E. Other

Poll Question:

What is your favorite Winter Weather Phenomena?

A. Large snow storms / Blizzards
B. Ice storms
C. Lake effect snow or snow squalls
D. Extreme cold (air temps or wind chill)
E. None of it!

Outline

- P-types and Soundings
- Synoptic Scale Storms & Mesoscale Snow bands
- Snow-to-Liquid Ratios
- Lake Effect/Upslope Snow
- Snow Squalls
- Radar Applications for Precipitation Type

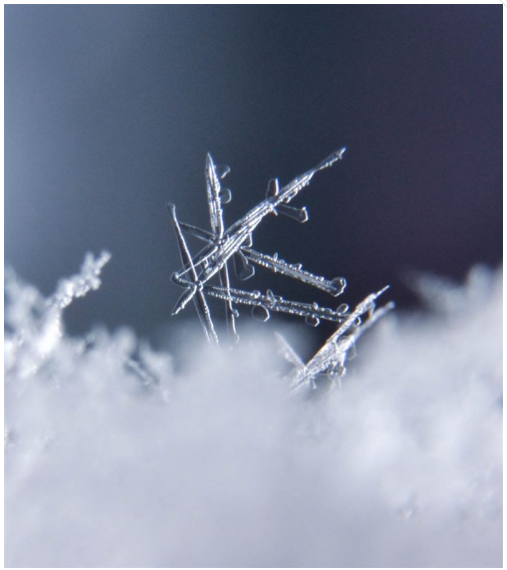


Photo Credits: NOAA Photo Library

1. Precipitation Types and Soundings

Photo Credits: Philly Voice, National Geographic, Met Office, and My New Orleans

P-Types and Soundings

* Most precipitation that forms in the wintertime starts out as snow in the clouds because the top layer of most storms is usually cold enough to generate ice crystals

* As the precipitation falls to the ground, it can pass through layers of warmer air that cause the ice crystals to partially or completely melt into liquid water

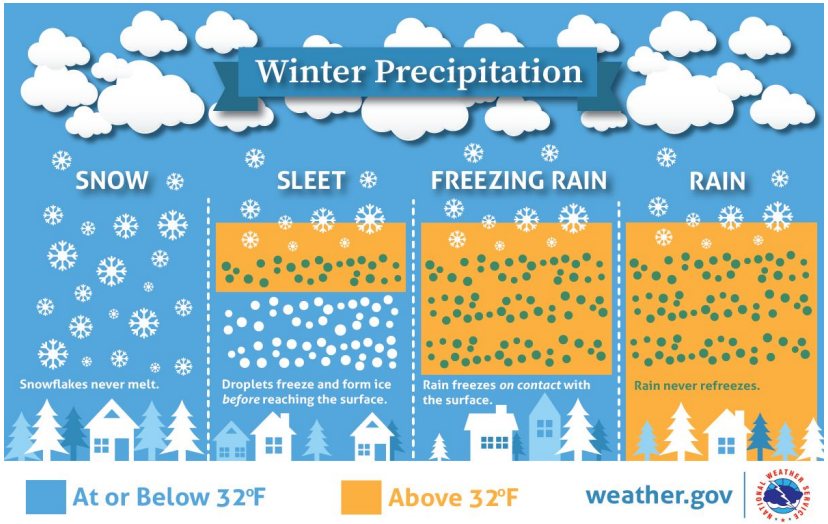


Image Credit: NWS Springfield, MO

Types of Winter Precipitation:

1. SNOW:

- Notice that the entire atmosphere is below or near freezing 32℉ (0℃)
- This ensures that no melting occurs as the water molecules drop through the atmosphere
- If the air in the lower troposphere starts off dry and slightly warmer than freezing, evaporative cooling can change precipitation that is initially rain to snow

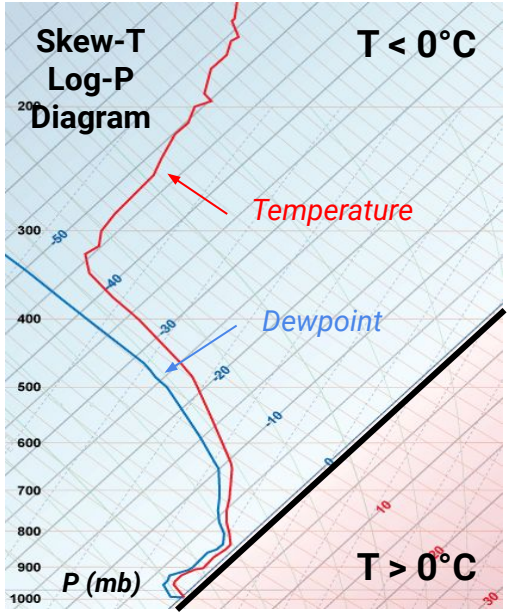


Image Credit: NWS/JetStream

Types of Winter Precipitation:

2. SLEET:

- Notice that the entire atmosphere is not below freezing. Sleet occurs when a snowflake partially melts and then refreezes before hitting the surface
- For partial melting to occur, the maximum temperature in the "melting layer" is typically between 33.8℉ and 37.4℉ (1℃ and 3℃)
- Typically the warm layer is less than 2,000 feet thick
- Sleet commonly occurs with a wintry mix of snow, freezing rain, and rain
- Rain may change to sleet through cooling processes in the lower troposphere

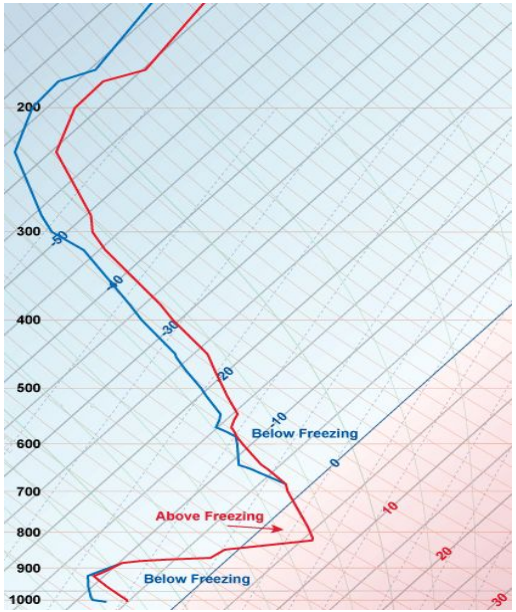


Image Credit: weather.gov

Types of Winter Precipitation:

3. FREEZING RAIN:

- Notice that there is a deep warm/melting layer and a very shallow freezing layer just above the surface
- Freezing rain occurs when a snowflake completely melts and the surface temperature is below freezing, but the cold air near the surface is not deep enough to allow the rain to refreeze into sleet before hitting the ground
- The maximum temperature in the melting layer will typically exceed 37.4℉ (3℃) causing the snowflake to completely melt and become a raindrop
- The raindrops freeze on contact with cold objects and the ground and create hazardous conditions

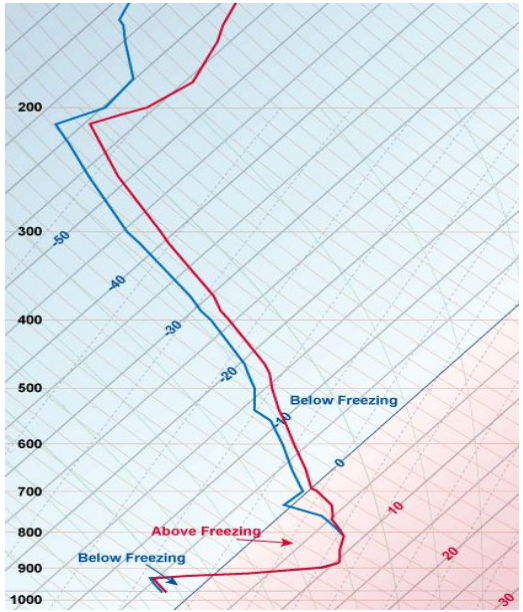


Image Credit: weather.gov

Types of Winter Precipitation:

4.STANDARD RAIN:

- In this case it is a “cold rain”
- Raindrops likely started out as snowflakes and melted in the thick above-freezing layer
- Since the air temperature at the surface is above freezing, freezing rain will typically not occur
  - There is one exception. If it has been very cold for several days and the air temperature only recently warmed to above 32°F, it is possible for the ground to still be cold enough for freezing rain to occur

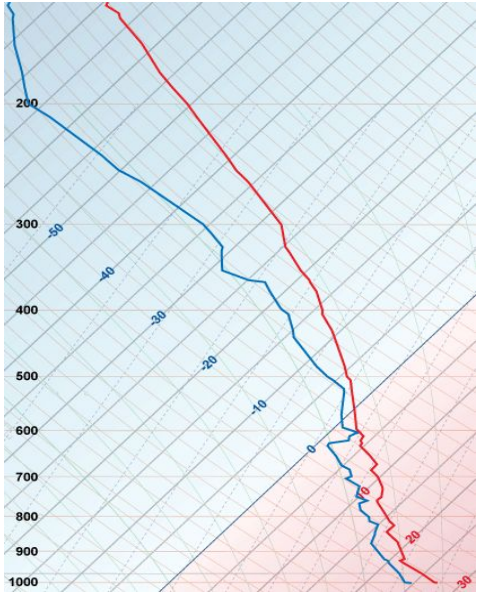
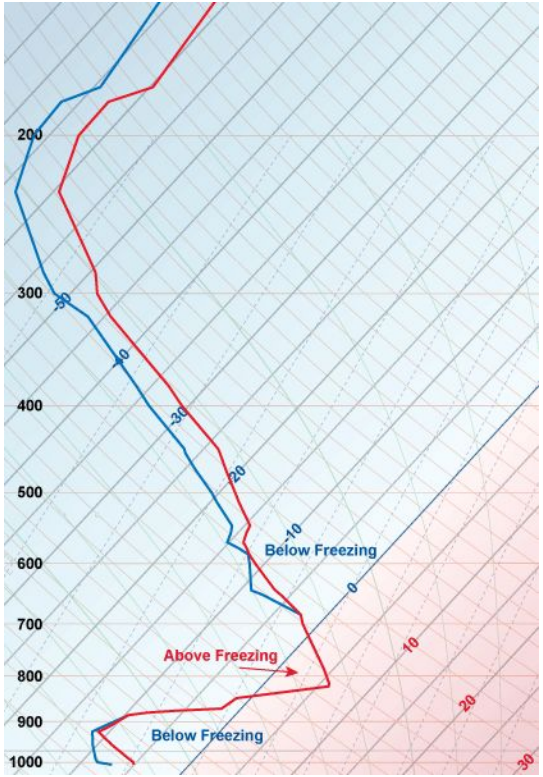


Image Credit: weather.gov

Poll Question:

Based on the following sounding, which type of precipitation is likely to fall at the surface?

a. Snow
b. Rain
c. Freezing Rain
d. Sleet
e. No Precipitation



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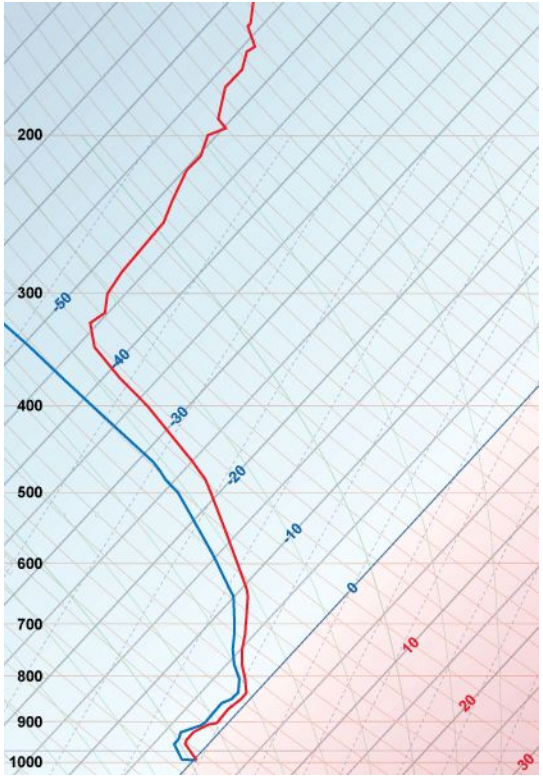

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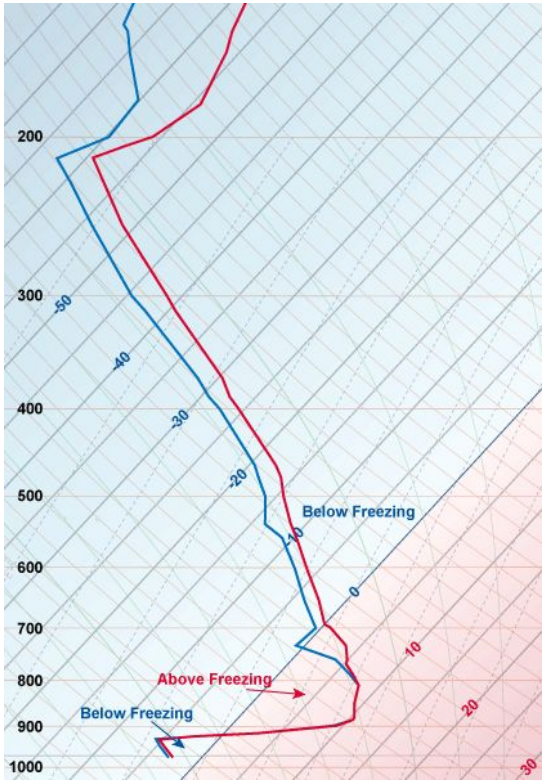


Image Credit: weather.gov

2. Synoptic Scale Winter Storms

Photo Credits: National Centers for Environmental Information

Synoptic Scale Storms

- The word **synoptic** refers to the use of meteorological data obtained over a **wide area** at a singular time, presenting a nearly instantaneous picture of the state of the atmosphere
- Atmospheric events on the “synoptic scale” span over 300 miles (500 kilometers) to around 1,500 miles (2.500 kilometers) and typically evolve over many hours or days, such as large-scale cyclones

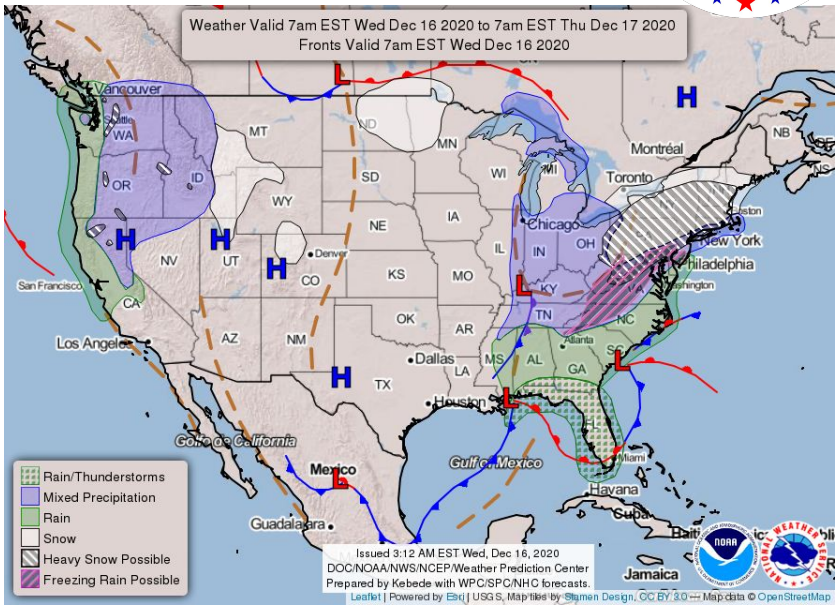


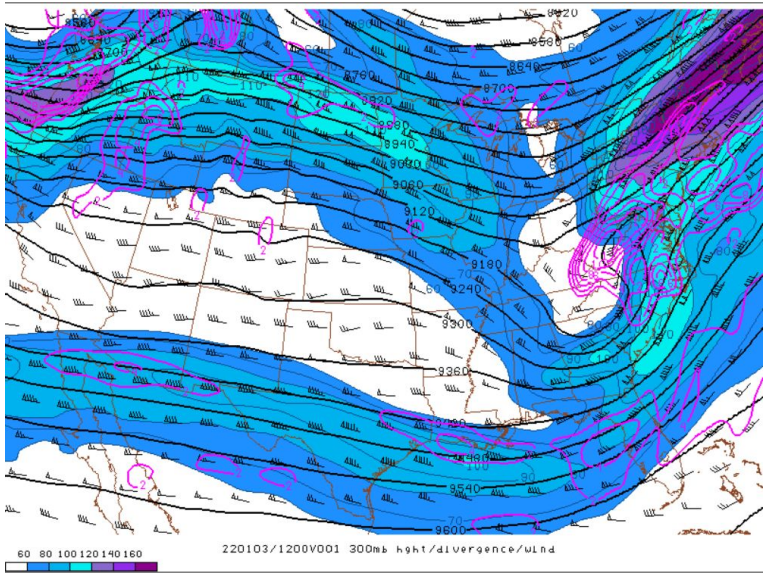
Image Credit: wpc.ncep.noaa.gov

Synoptic Scale Storms

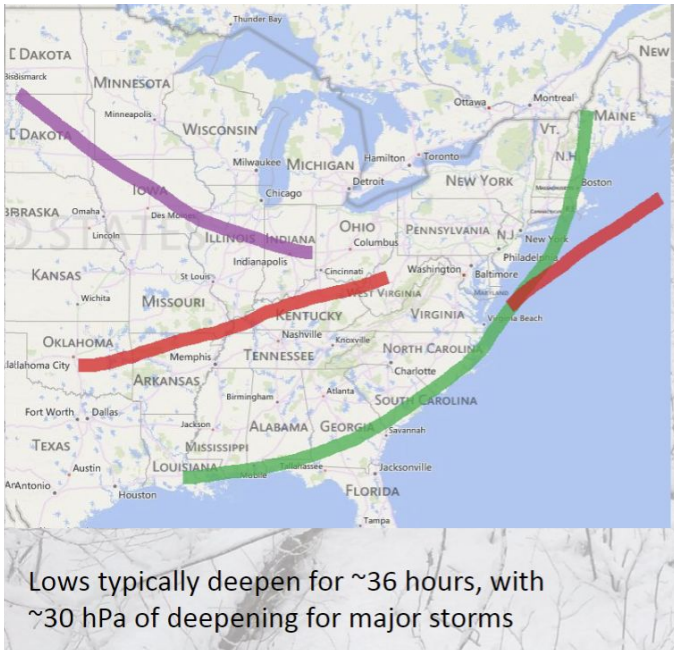
* The Eastern U.S. Coast is a breeding ground for cyclones, especially between the months of September and April

* Typically, East Coast storms develop when there is a large scale ridge or zonal pattern across the Western United States, and a trough in the Eastern US. When combined with the polar jet stream, cold Arctic air is transported towards the Atlantic Ocean, where it interacts with the warm ocean waters of the Gulf Stream.

* This sharp temperature difference (or *baroclinicity*) between the cold air over land and the warm ocean waters is what produces and amplifies cyclones in the Eastern US - especially the I-95 corridor.



Synoptic Scale Storms



Gulf of Mexico to Eastern Seaboard (Miller A Coastal Storm)

Ohio Valley to Atlantic Coastal Redevelopment Path (Miller B Coastal Storm)

Alberta Clippers

Synoptic Scale Storms

* A **Nor'easter** is a synoptic scale extratropical cyclone in the western North Atlantic Ocean that tracks along the US East Coast (also known as a Coastal Storm)

* These winter events are notorious for heavy snow, rain, big waves storm surges crashing into the Atlantic coastline, and strong wind gusts that can even exceed hurricane force in intensity

* A **Nor'easter** gets its name from the continuously strong northeasterly winds blowing from the ocean ahead of the storm

Synoptic Scale Storms

Forecasting Dynamics of East Coast Storms via Top-Down Approach to Weather Maps

* 200 mb - Jet streams and jet streaks

* 500 mb - Vorticity advection, trough axis tilt

* 700 mb - Moisture streams and frontogenesis

* 850 mb - Temperatures; rain/snow line

* Surface - Low pressure tracks and winds

Synoptic Scale Storms

Ingredients

* Potent shortwave energy, upper level troughs and ridges

* Upper level jet streak: upper level divergence

* Low level jet: moisture and low level convergence

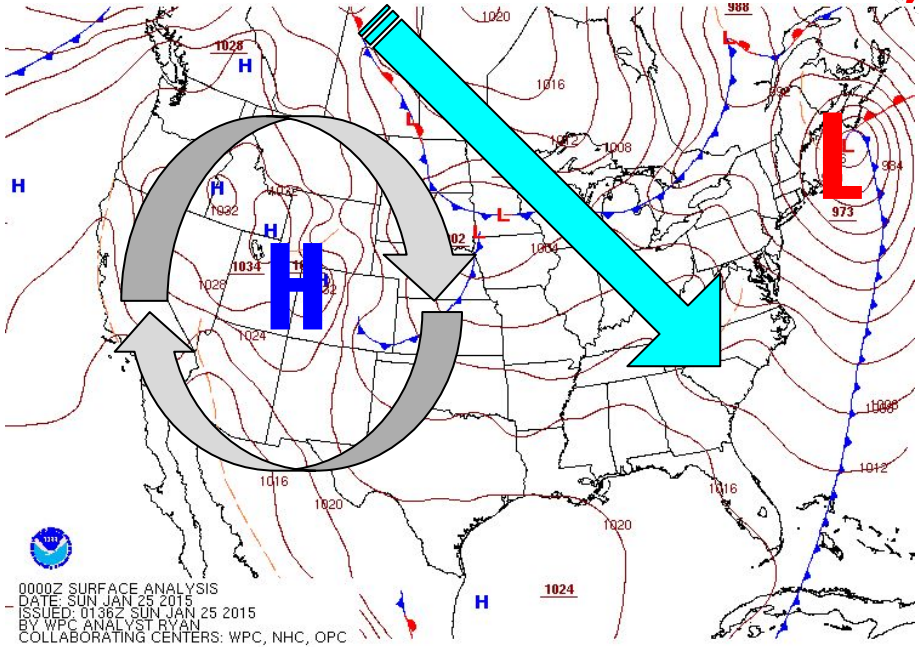
* Arctic anticyclone: cold air

* Favorable track for surface low pressure systems

Synoptic Scale Storms

- Example: “January 2015 North American Blizzard”
- Brought 30”+ to New England

✓ Western U.S. ridge
✓ Eastern U.S. trough
✓ Southward plunge of the polar jet stream
✓ Low pressure travels up East Coast



Synoptic Scale Storms

- Conveyor belt model visualizes three air streams of a mature cyclone
  - The Warm Conveyor Belt transports warm, moist air northward
  - The Cold Conveyor Belt transports cool, moist air westward
  - The Dry Conveyor Belt streams dry air towards the low's center, producing the comma-shape

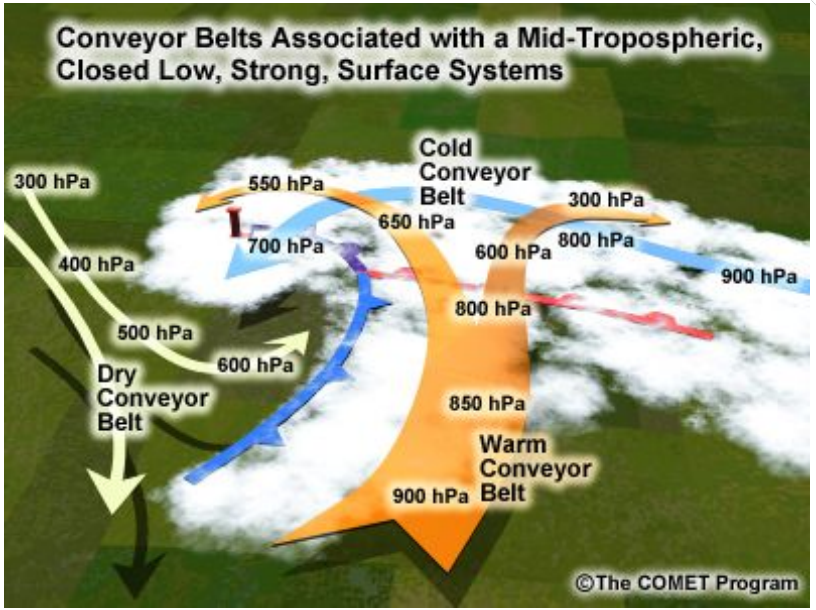
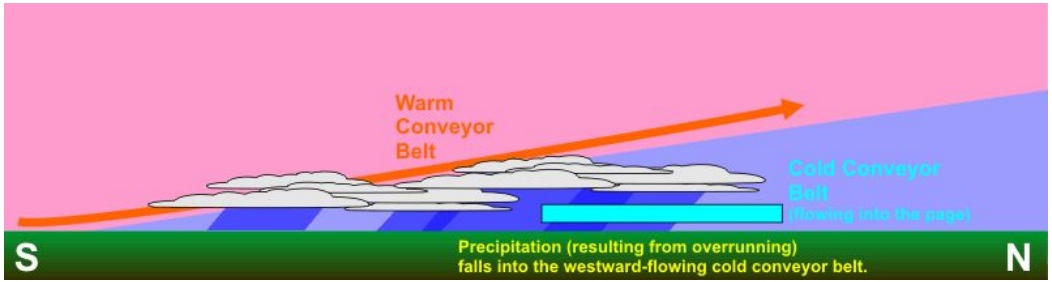


Image Credit: The COMET Program

Synoptic Scale Storms

The Warm Conveyor Belt and Isentropic Ascent:

- The Warm Conveyor Belt transports warm, moist air northwards from lower latitudes
- It eventually overruns cold air to the north of the low's warm front, aiding in producing stratiform clouds and precipitation (often snow or wintry mix)



Synoptic Scale Storms

- The track of a low pressure system can heavily influence precipitation types, often bringing an array of precipitation across the Commonwealth of Pennsylvania
    - Generally, southeastern PA favors the best chance of mixed precipitation
- Storms that track well to the east typically bring mostly snow accumulations to Pennsylvania
- Storms that track closer, often right over the area, will bring a snow → rain/mix to Pennsylvania

Synoptic Scale Storms

Eastern Low Track - All Snow:

- Typically fast-moving “clipper systems” originating from Central Canadian Provinces
  - Alberta Clipper, Saskatchewan Screamer, Manitoba Mauler
- Almost always pure snow
- Cold air already in place + low water content means light and fluffy snow

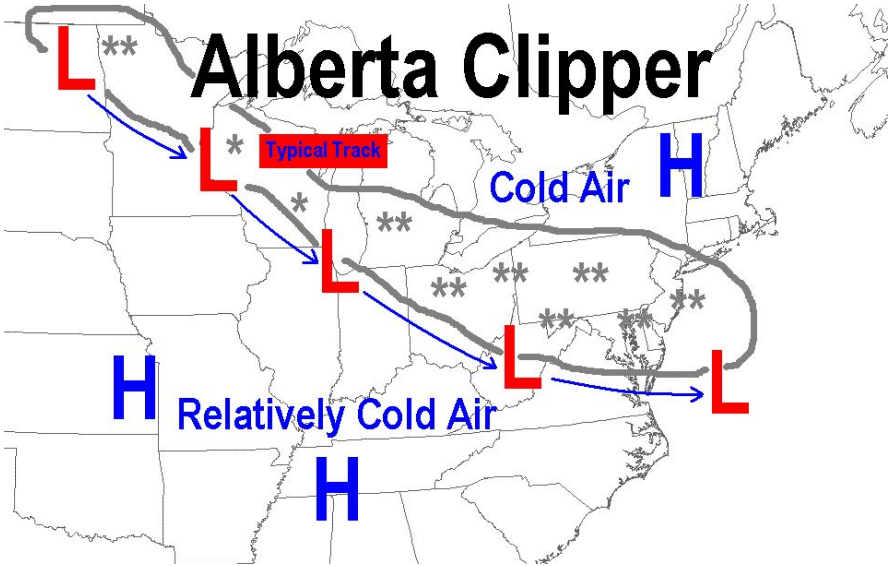


Image Credit: NWS CTP

Synoptic Scale Storms

Western Low Track - Mixed Precipitation:

- Systems that track through Pennsylvania typically bring a snow → rain/mix to Pennsylvania
- There is usually a clear distinction between rain, mixed precipitation, and snow which moves along with the storm
- Most Nor'easters tend to produce mixed precipitation in some part of PA, mainly in the Southeast, but the "Miller Type-B" storms have a better chance to do so due to warm, marine air closer to PA

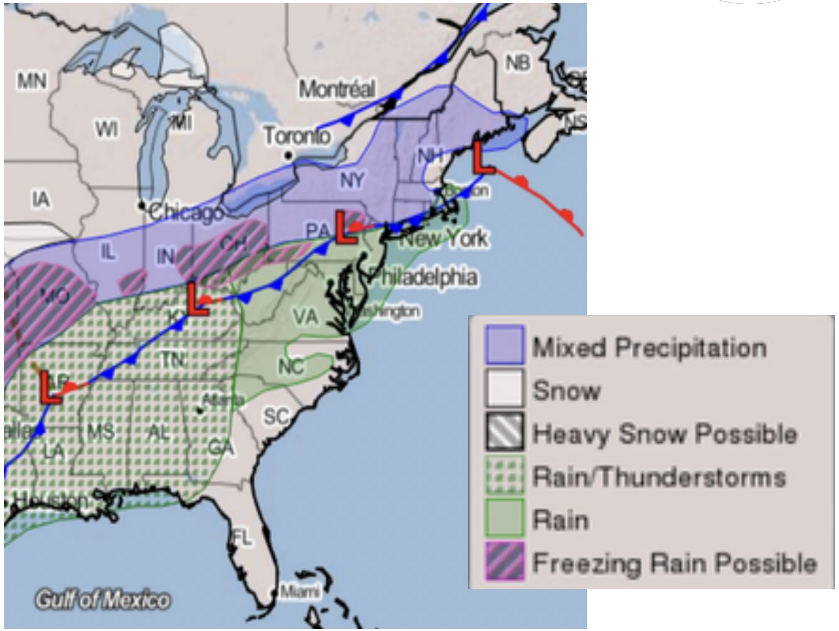


Image Credit: Storm Prediction Center

Mesoscale Snow Bands

What is Frontogenesis?

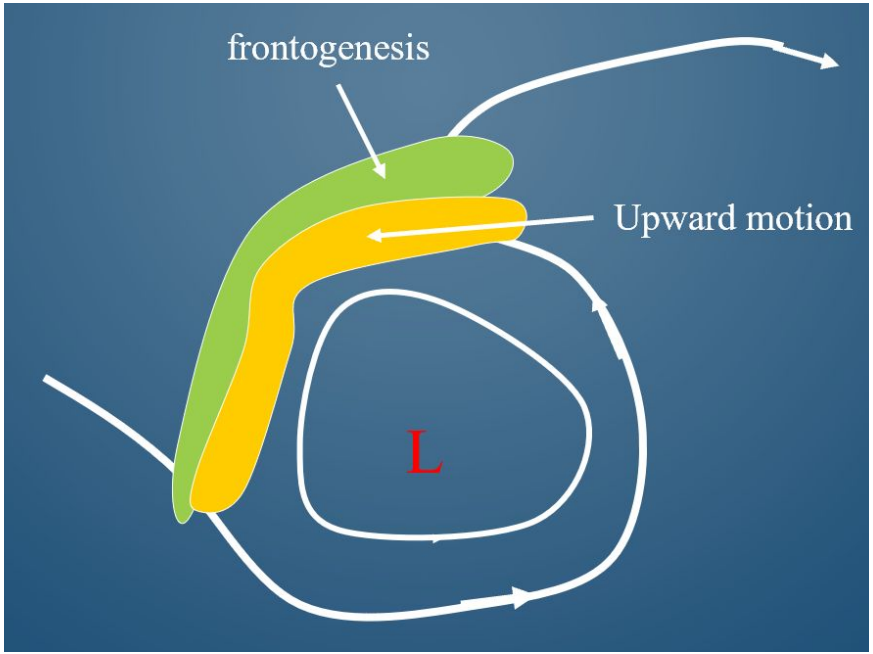
- An increase over time of the horizontal density (temperature) gradient associated with a front, time change in gradient of potential temperature following a parcel
- Parcels moving through an area of frontogenesis will experience an increasingly strong temperature gradient

Mesoscale Snow Bands

What Processes Lead Up To Frontogenesis?

- Shearing Deformation
- Stretching Deformation
- Differential Heating
- Tilting

Mesoscale Snow Bands

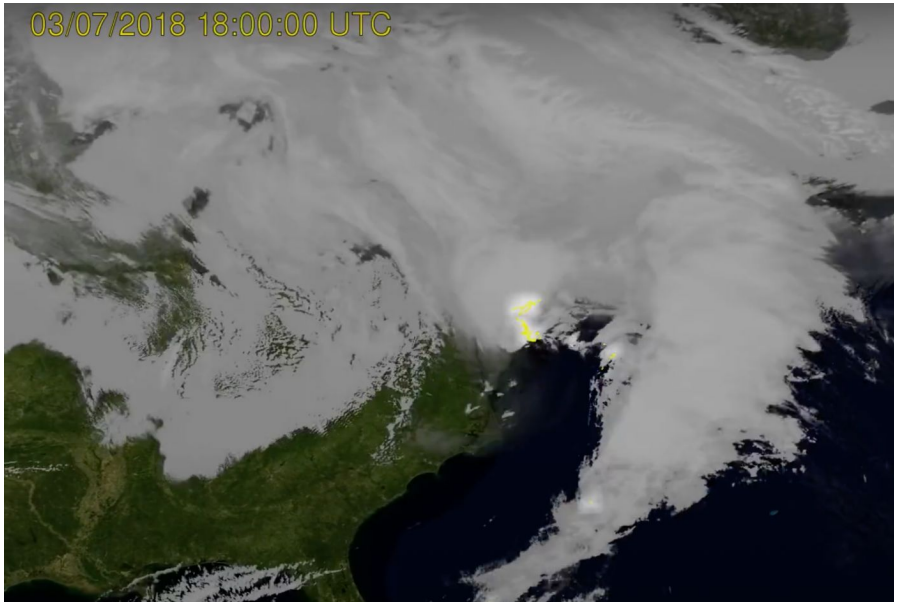


* **Frontogenesis** often occurs northwest of a mid-level closed low. Upward motion is forced on the warm side of the frontogenesis

Image Credit: NWS State College Winter Workshop Review

Thundersnow

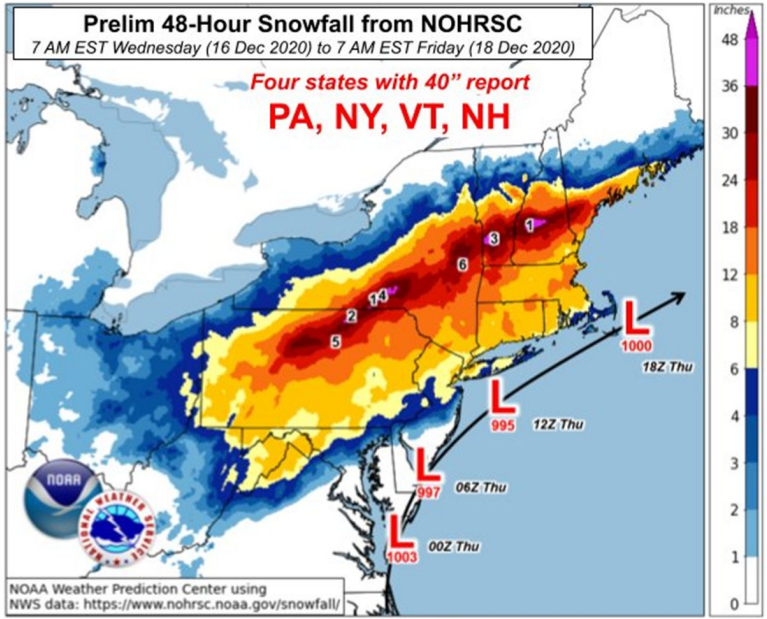
- A rare weather phenomenon found when thunder and lightning occur within snowstorms
- Ingredients very similar to that of a typical summer-time thunderstorm:
  - Sufficient instability
  - Moisture
  - Lifting mechanism
- Typically observed downstream of the Great Lakes (lake-effect snow)
- Heavy snowfall rates (~2-4” / hour)



Synoptic Storm Case Study:

- Case Study - December 16-17 2020 Winter Storm

Record-Setting Snowstorm in the Interior Northeast

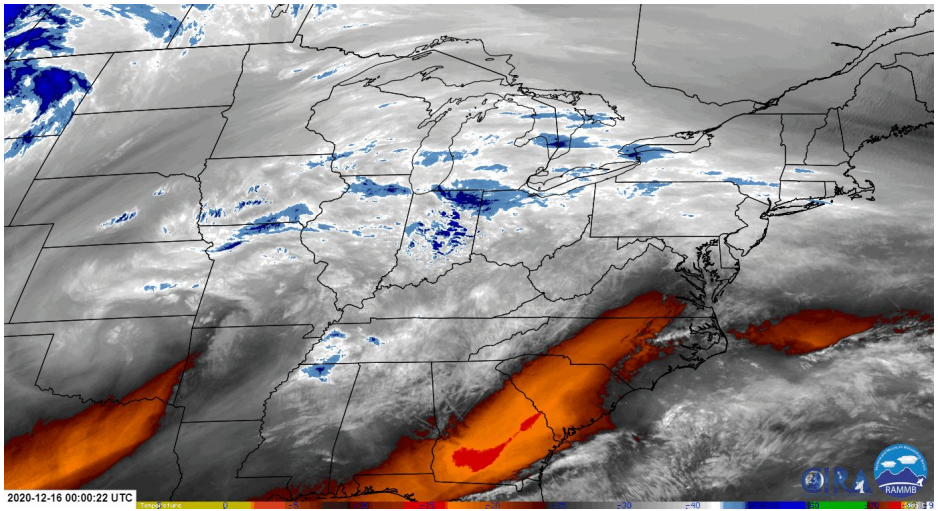


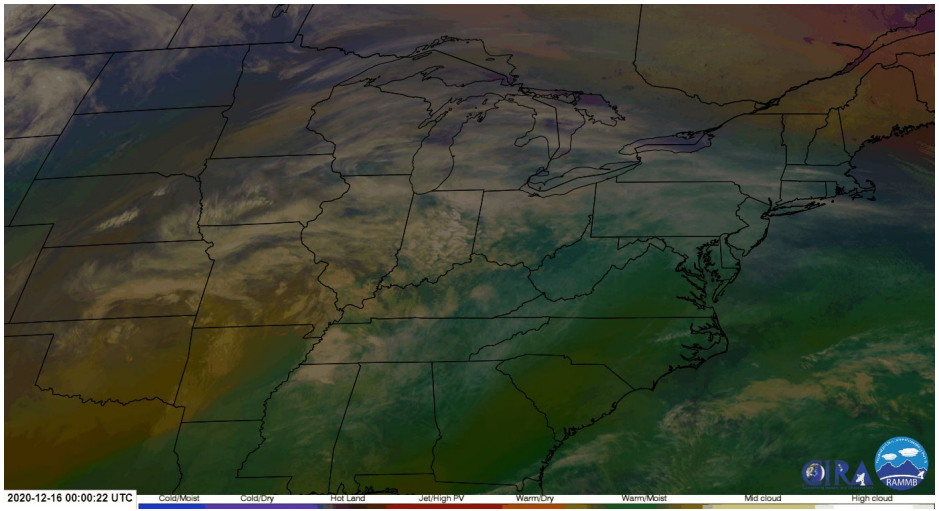
1. **Event Maximum: 44" near Newark Valley, NY and near Croydon, NH** *(Croydon report is only 5" shy of the 24-hr record for NH set on Mount Washington!)*
2. **Potential 24-Hour Pennsylvania State Record: 43.3" near Alba, PA** *(current 38"; requires validation from State Climate Extremes Committee)*
3. **Potential 24-Hour Vermont State Record: 42" near Landgrove, VT** *(current 42"; would tie; requires validation from State Climate Extremes Committee)*
4. **Two-day snowfall record (40.0") at Binghamton, NY** *(69y p.o.r.)*. **Snow depth was 39"** *breaking the record from the Blizzard of '93.*
5. **Two-day snowfall record (24.7") at Williamsport, PA** *(125y p.o.r)*
6. **8th largest snowstorm on record (22.9") at Albany, NY**. *4th largest in the month of December.*

Image Credit: NWS State College Winter Workshop Review

Synoptic Storm Case Study:

Mid-level water vapor and air mass RGB at 00Z on December 17th 2020





Synoptic Storm Case Study:

HREF total accumulated snowfall on the 12Z run, as of 12Z, 17 Dec.

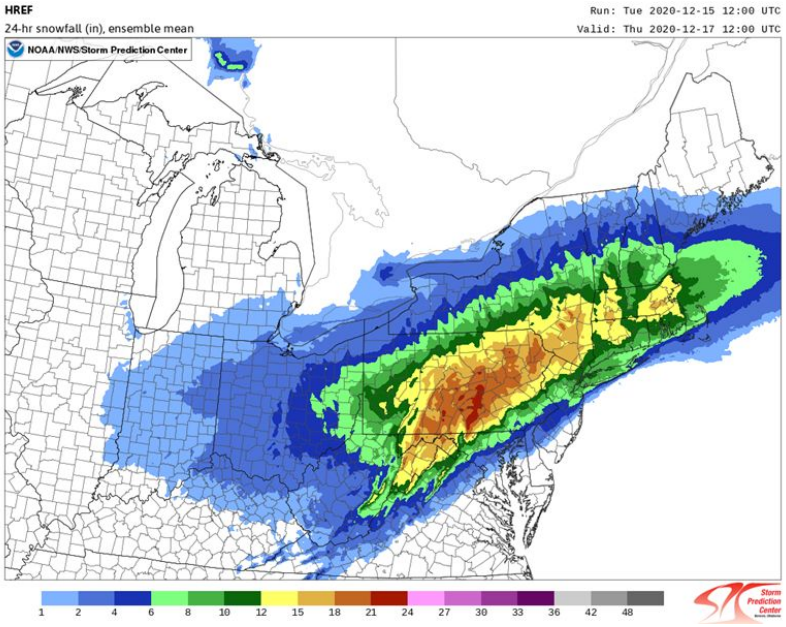
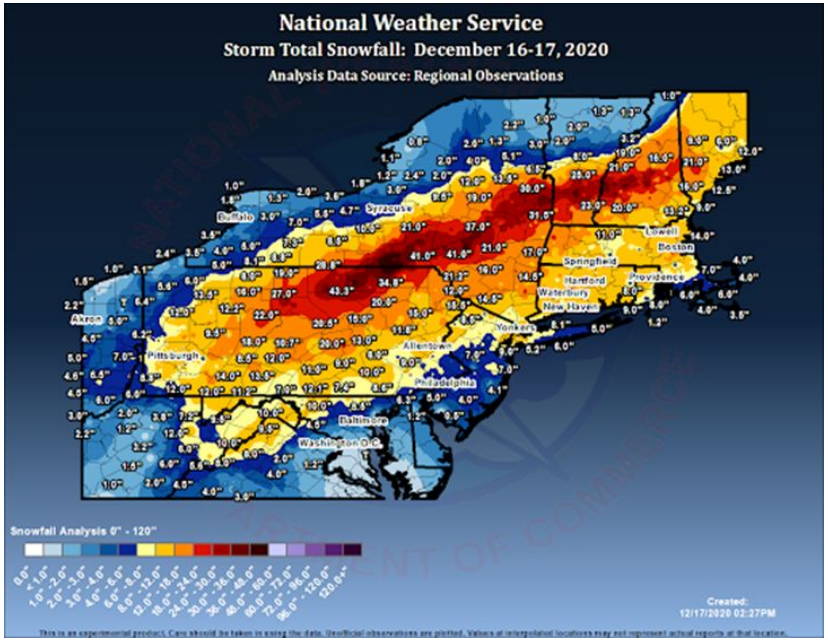


Image Credit: NWS State College Winter Workshop Review

Observed Totals:



Synoptic Storm Case Study:

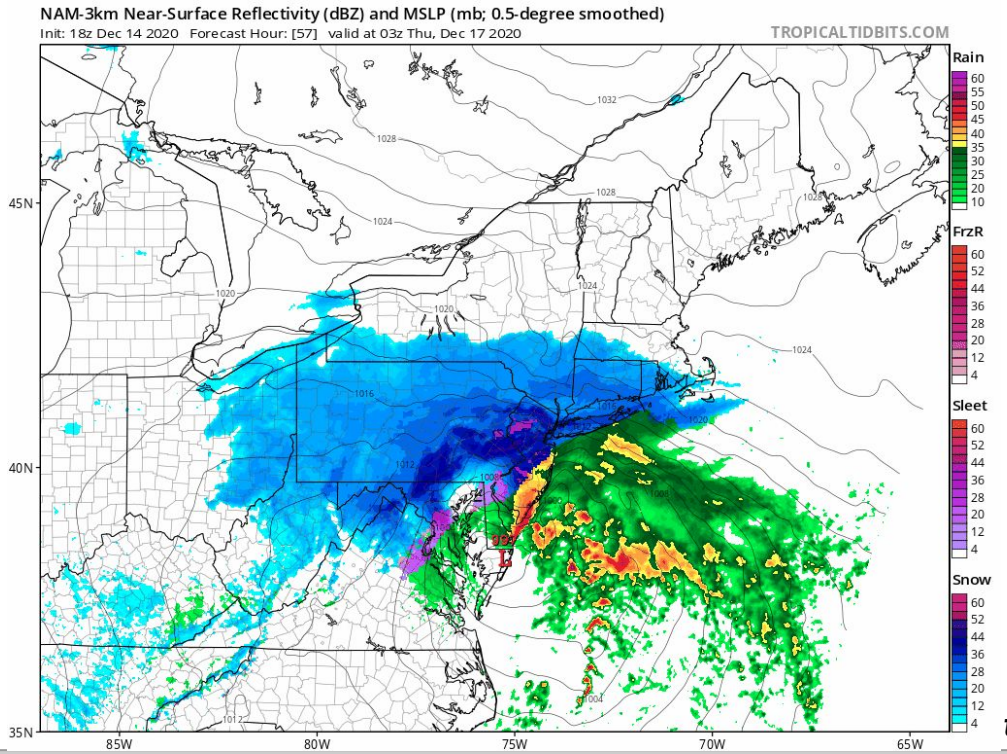


Image Credit: tropicaltidbits.com

Synoptic Storm Case Study:

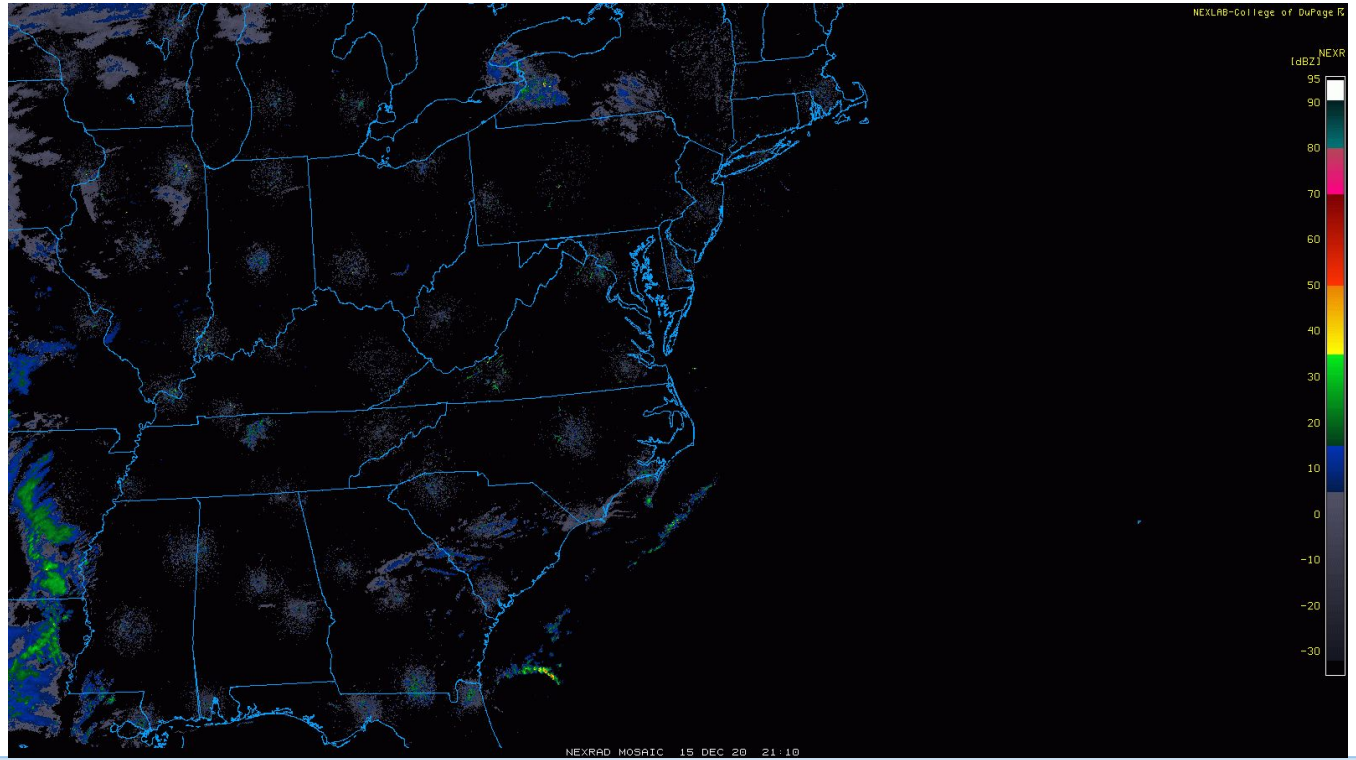
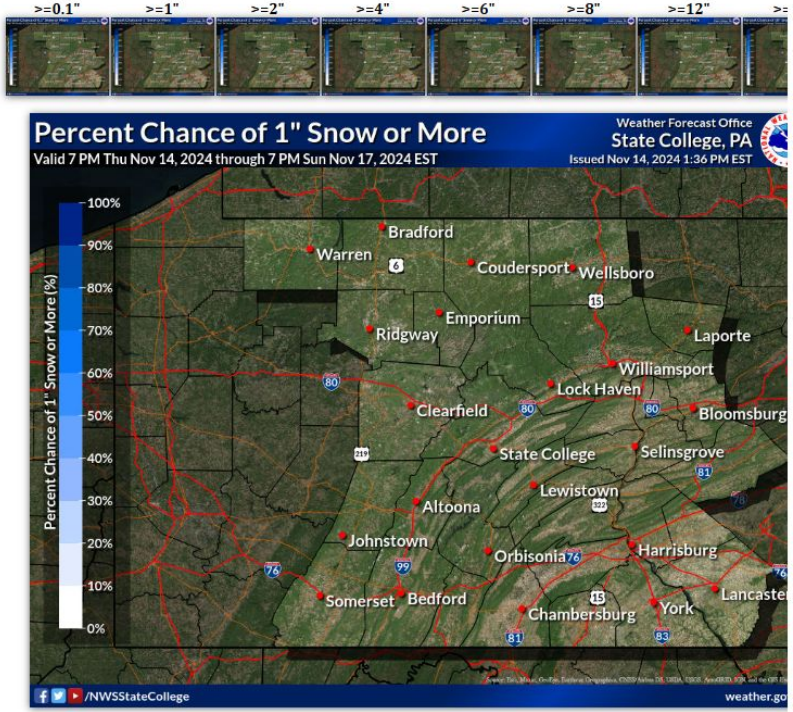


Image Credit: College of Dupage

Probabilistic Snow Forecasts

Available At:
https://www.weather.gov/ctp/winter

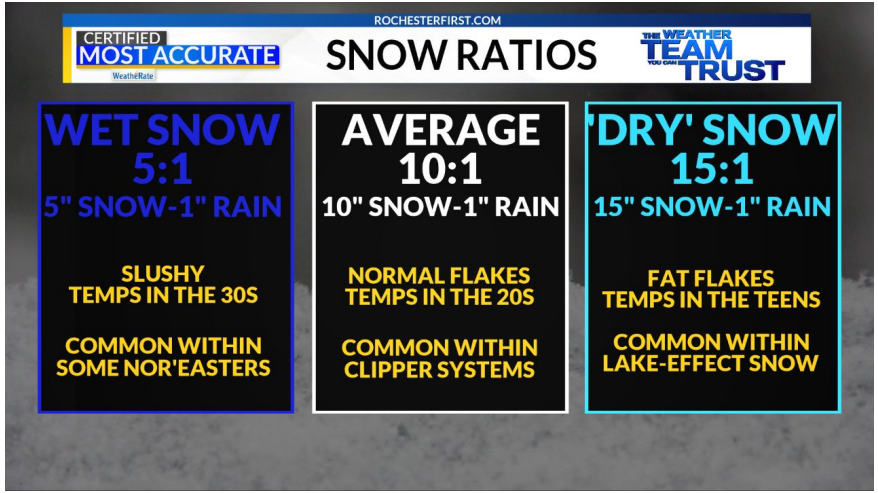


3. Snow Ratios

Image Credit: KFSM News

Snow Ratios

- The “snow ratio” lets you know how much snow accumulation to expect from 1 inch of liquid falling as snow
- Old rule of thumb...for every 10 inches of snow, there would be 1 inch of water (10:1)
- Heavy wet snow, slushy snow, fluffy snow, etc.



Snow Ratios

Variables that come into play include…

- ❏ Depth of warm layer in the cloud (warmer it is, closer to freezing...the lower the ratio will be)
- ❏ Fraction of supercooled liquid water in the cloud. If there are more supercooled water droplets in the cloud, ratios will be lower. If there are more ice crystals in the clouds, snow ratios will be higher.
- ❏ Windy? Snowflakes can fracture and lose structure leading to lower ratios

Snow Ratios

Types of crystals:

- Notice in the diagram the peak of the graph is between -12℃ and -18 ℃
- This temperature range is known as the “**Dendritic Growth Zone**”
- Dendritic growth is favored under these conditions because the saturation vapor pressure with respect to ice is lower than the saturation vapor pressure with respect to liquid

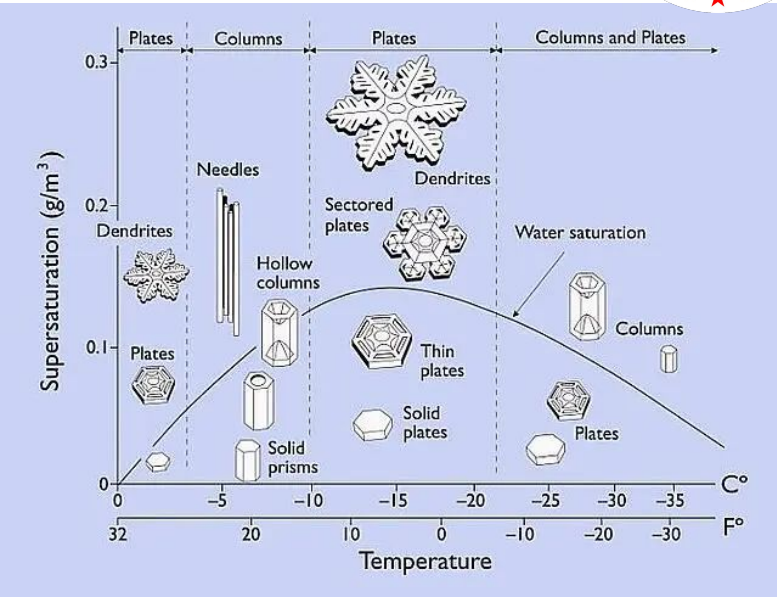
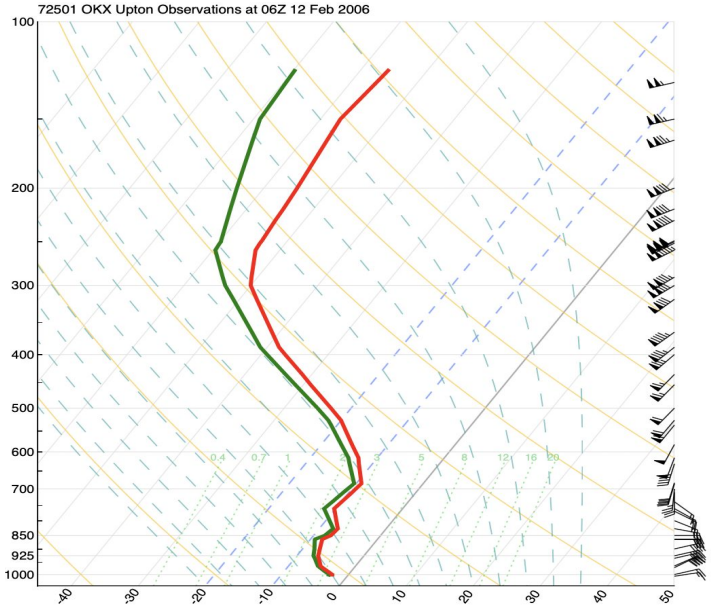


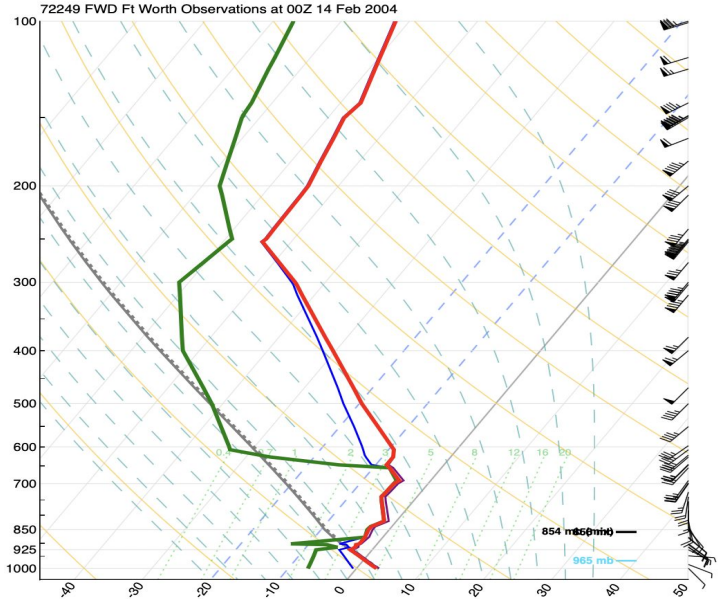
Image Credit: snowcrystals.com

Snow Ratios

High Snow:Liquid Ratio



Low Snow:Liquid Ratio



NWSStateCollege

Image Credit:
meted.ucar.edu

weather.gov/ctp

SNOW:RATIO

The percentage of water within a sample of snow is called "snow ratio". An old rule of thumb was that for every 10 inches of snow, there would be 1 inch of water (10:1).

However, snow ratios can vary dramatically around the country and from event to event.

Variables that affect snow ratio

Depth of the "warm" layer from the surface into the snow-producing cloud.

Amount of ice in the snow-producing cloud.

If its windy, snowflakes can fracture, losing their "lacy" structure.

Deep cold leads to higher snow ratios.

Image Credit: NWS Infographics

Image Credit: NOAA Photo Library

4. Snow Squalls

Photo Credits: NWS


SNOW SQUALLS STRIKE QUICKLY

Snow Squalls

A **snow squall** is an intense, short-lived burst of heavy snow and strong, gusty winds resulting in whiteout conditions. They are often associated with strong cold fronts that bring Arctic air into the region. They may be characterized by one main squall or multiple squalls.

NATIONAL WEATHER SERVICE
STATE COLLEGE, PA

#SnowSquallSafetyPA

SNOW SQUALLS

WHAT ARE THEY?

- Intense short-lived moderate to heavy snowfall bursts
- Quick reduction in visibility and whiteout conditions from gusty winds
- Associated with strong cold fronts which bring Arctic air during winter

WHAT ARE THE IMPACTS?

- Rapidly deteriorating conditions can cause roads to become icy and slick in a matter of minutes; "Flash Freeze"
- Often lead to chain-reaction accidents and treacherous travel

SAFETY:

- There is no safe place on a highway during a snow squall event
- Consider an alternate route or delaying travel, reduce speed and turn on headlights
- STAY ALERT AND WEATHER AWARE!

Snow Squalls

- Similar to summertime thunderstorms, snow squalls often happen on days with partly cloudy skies

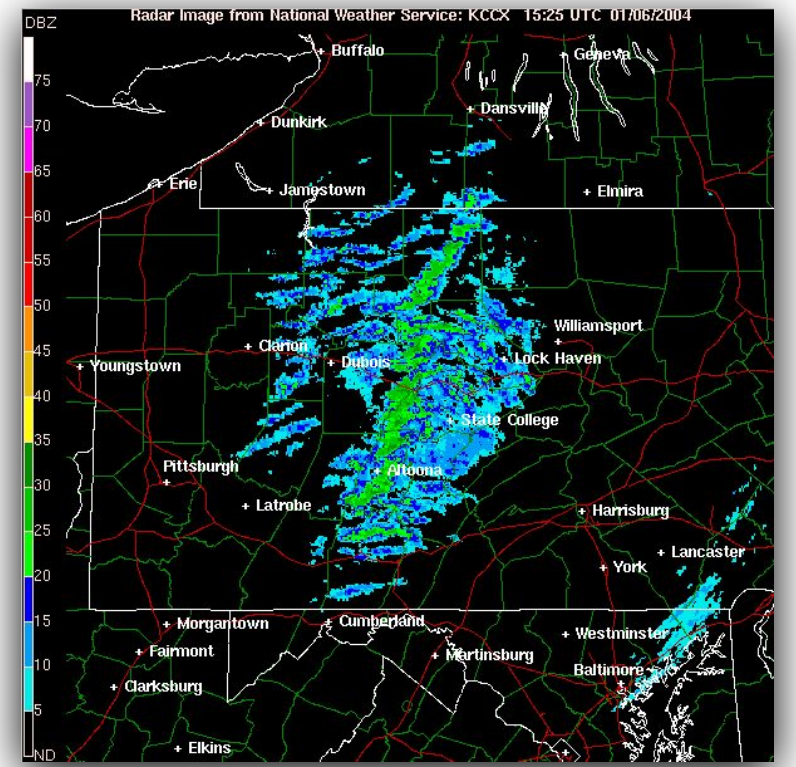
- In a matter of minutes, a pleasant day with sunny skies can change to whiteout conditions

- This is part of what makes snow squalls so dangerous

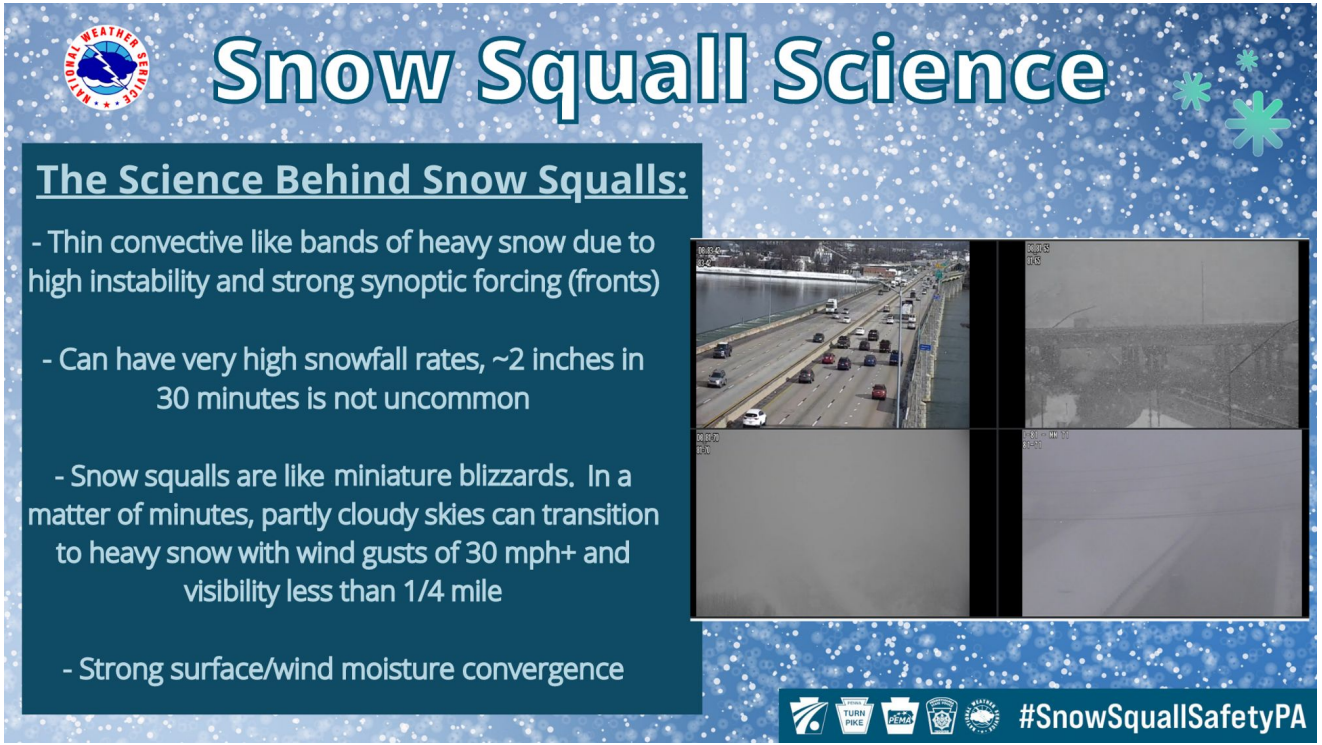
Snow Squalls

January 6, 2004 Event

- Arctic front with snow showers/squalls anticipated more than 2 days in advance
- Morning radar depicts arctic front and line of snow squalls
- Pre-frontal temperatures upper 30s
- Post-frontal temperatures mid to upper teens



Snow Squalls



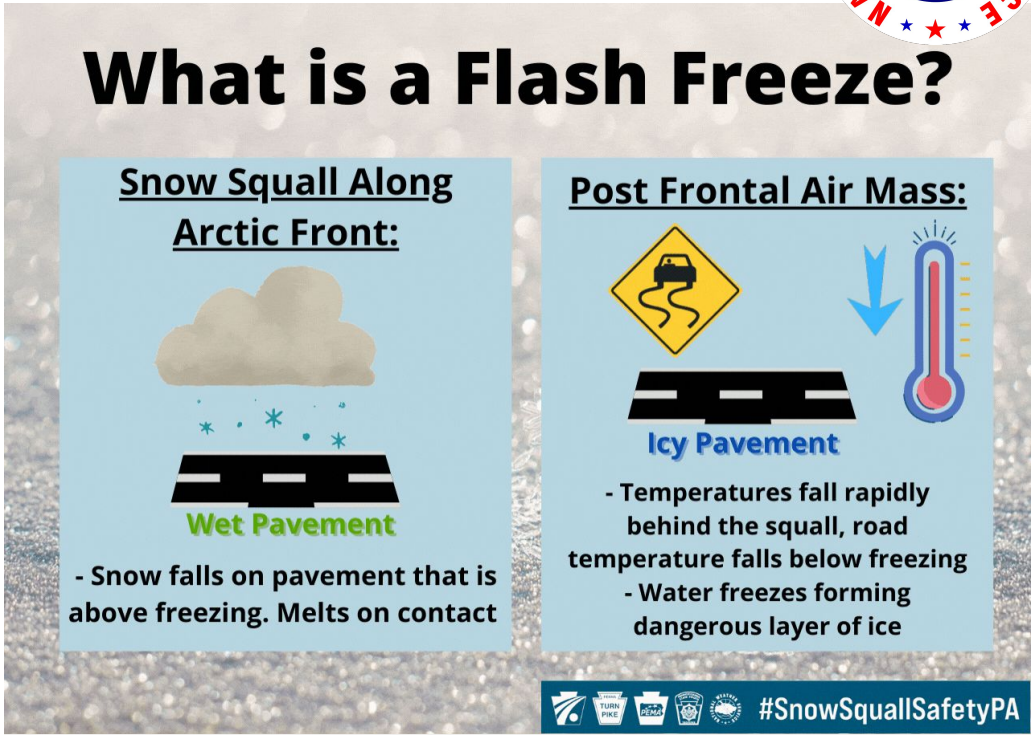
* Not just a typical snow shower

* Most common between November and March

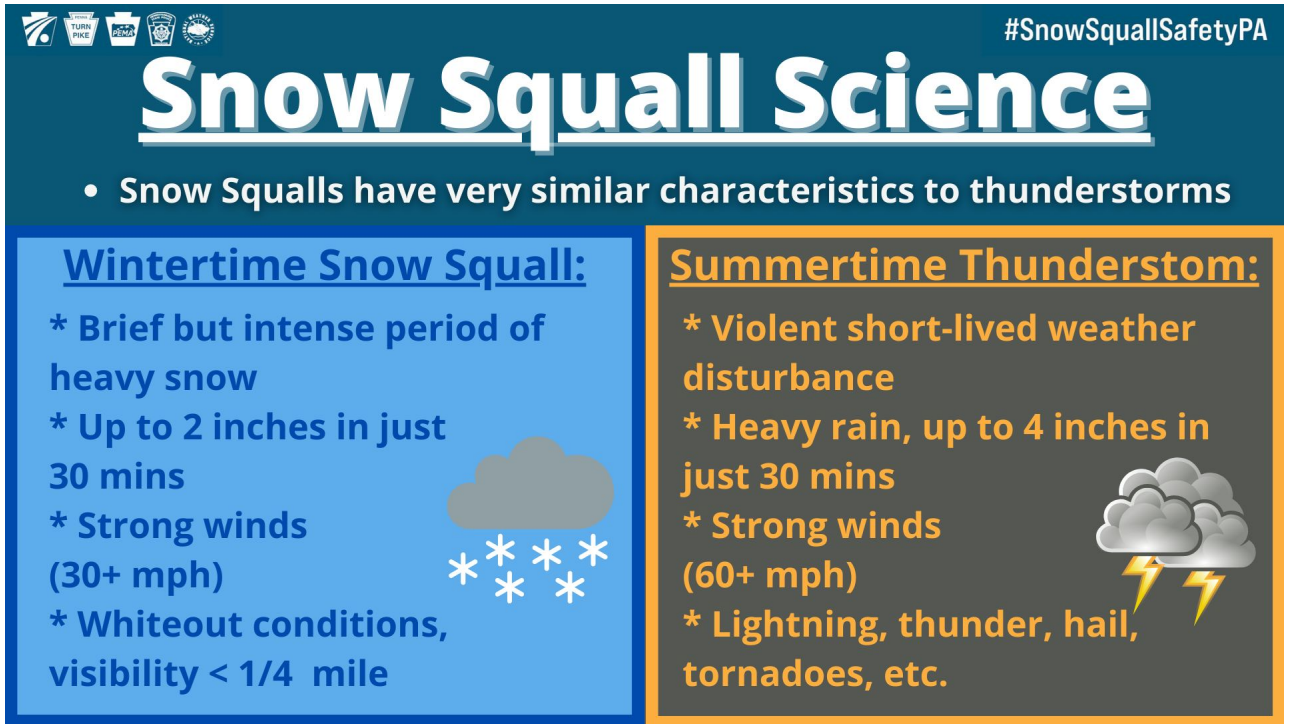
* Dangerous weather hazard

Snow Squalls

- Road temperatures often plunge to below freezing in snow squalls, even if they start out well above freezing. This can lead to flash-freezing of ice on roadways
- Road chemicals mitigate flash freeze potential on *treated* roadways
- High traffic volume promotes partial melting and refreezing of fallen snow on roadways when surface temperatures are below freezing



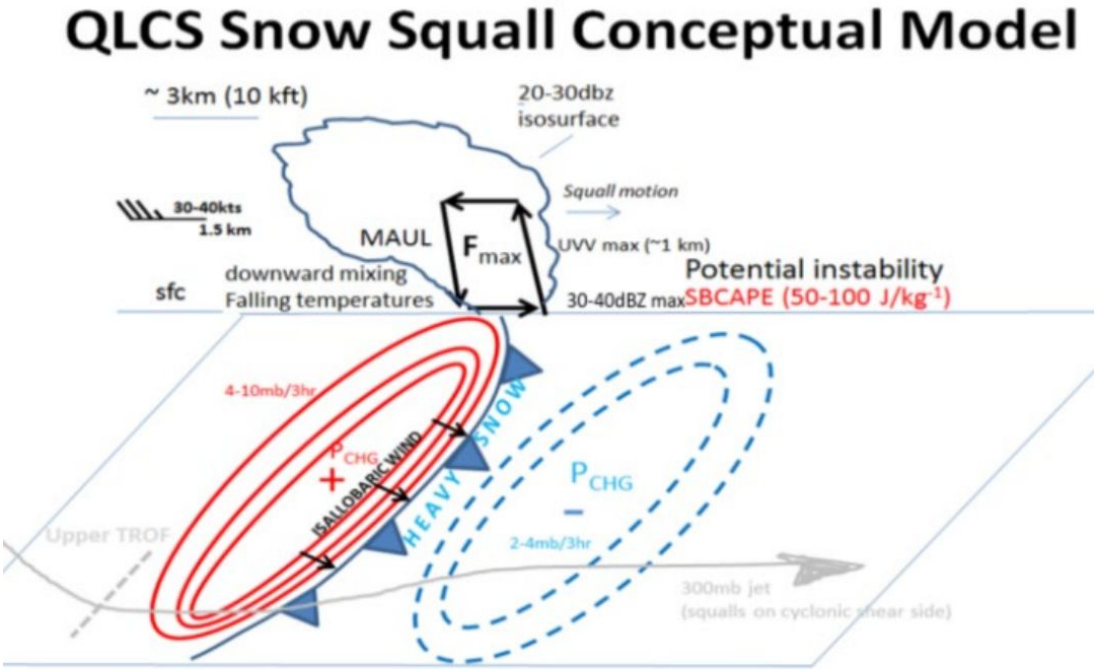
Snow Squalls



- A snow squall is similar to a summertime thunderstorm with heavy precipitation in a short amount of time and strong winds
- Thunderstorms can produce flooding from heavy rain, but the icy roads that result from snow squalls are often much more dangerous

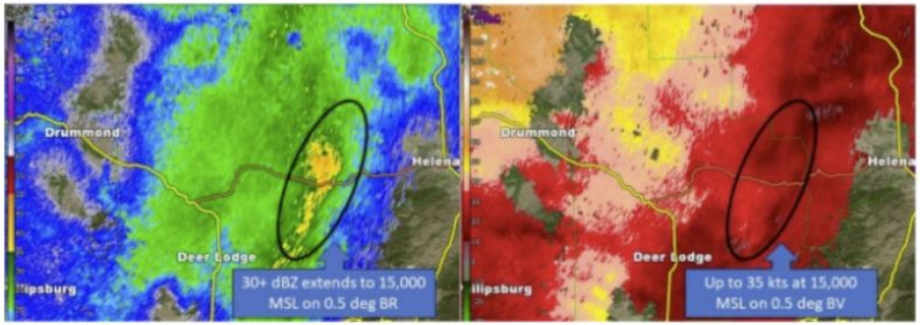
Snow Squalls

- Strongest upward motion typically centered from 1-2 miles above the ground, just ahead of a cold front
- SBCAPE values of 50-100 J/kg or greater commonly found with snow squalls
- Strong surface wind/moisture convergence



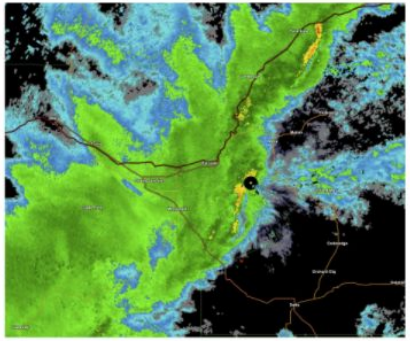
Snow Squalls

SIGNIFICANT EVENTS



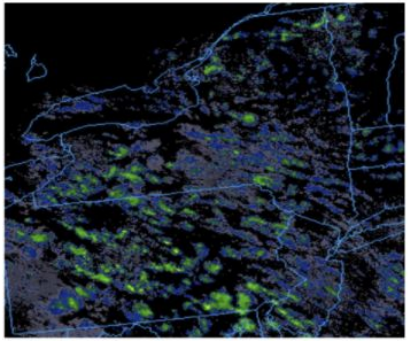
- Max dBZ values typically exceed **30 dbZ**
- Max radial velocities typically in excess of **30 knots**
- Forward motion of the band can serve as a proxy for maximum wind gusts

CONVECTIVE MODE: LINEAR VS. CELLULAR



LINEAR

- Most organized & intense
- Low level frontogenesis maximum
- Well defined pressure rise/fall couplet



CELLULAR

- Less organized & less intense
- Absence of frontogenesis maximum
- Absence of defined pressure rise/fall couplet

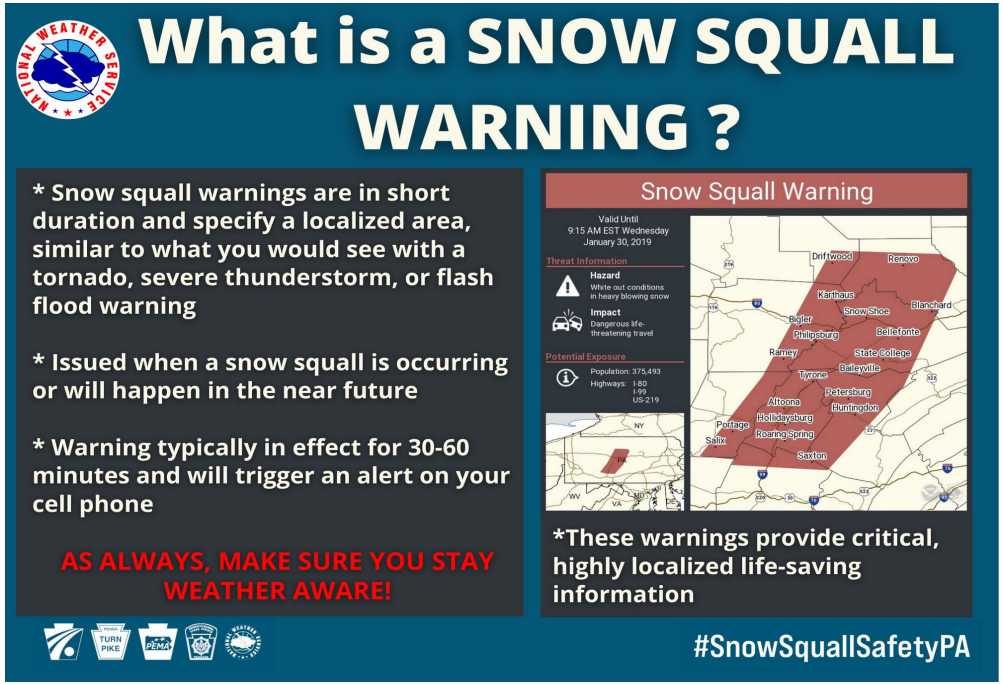
Snow Squall Warnings

- **Impacts:** Snow Squall Warnings are reserved for the **most intense events** where the **risk for significant traffic pile-ups** is greatest, road conditions support a **flash freeze**

- **Location:** Warnings are focused on areas with **high speed highways**

- **Timing:** Warnings typically last about 1 hour. Rarely issued at night because they do set off Wireless Emergency Alerts on smartphones

- **Detection:** Radar data & surface obs



NATIONAL WEATHER SERVICE
STATE COLLEGE, PA

#SnowSquallSafetyPA

There is no safe place on the highway during a SNOW SQUALL

If you are on the highway during a snow squall...

- Reduce speed
- Turn on lights and hazards
- Avoid slamming on your brakes

Snow Squalls

THERE IS NO SAFE PLACE ON A HIGHWAY DURING A SNOW SQUALL

What is a snow squall?

- A brief but intense period of heavy snow, strong winds, and whiteout conditions.
- Can cause roads to become icy.

What is a snow squall warning?

- Issued for areas that will be impacted by snow squalls.
- Will trigger an alert on your cell phone.

penndot.gov/winter

weather.gov/ctp/snowsquall

If a snow squall warning is issued, what should I do?

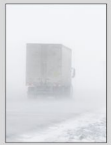
Avoid or delay motor travel until the squall passes through your location.

What if I am already traveling?

Safely exit the road at the next opportunity.

What if I cannot exit the road in time?

- Slow down gradually.
- Turn on your headlights and hazard lights.
- Stay in your lane.
- Increase your following distance.
- **Avoid** slamming on your brakes.



511PA App

iPhone Android

Download this **FREE** app to get:

- Traffic conditions
- Traffic speeds
- Live traffic camera images
- Highway construction updates
- **Weather conditions and alerts**

5. Lake Effect and Upslope Snow

Image Credit: Lake Superior Wordpress

Image Credit: Wikipedia

Lake Effect/Upslope Snow

* Common across the Great Lakes region during late fall and winter

* Occurs when cold air, often originating from Canada, moves across the wam open waters of the Great Lakes

* As the cold air passes over the unfrozen relatively warm waters, warmth and moisture are transferred into the lowest portion of the atmosphere

* As moist air rises, snow-producing clouds form and organize into narrow snow bands that can produce heavy snow with accumulation rates sometimes in excess of 3 inches per hour

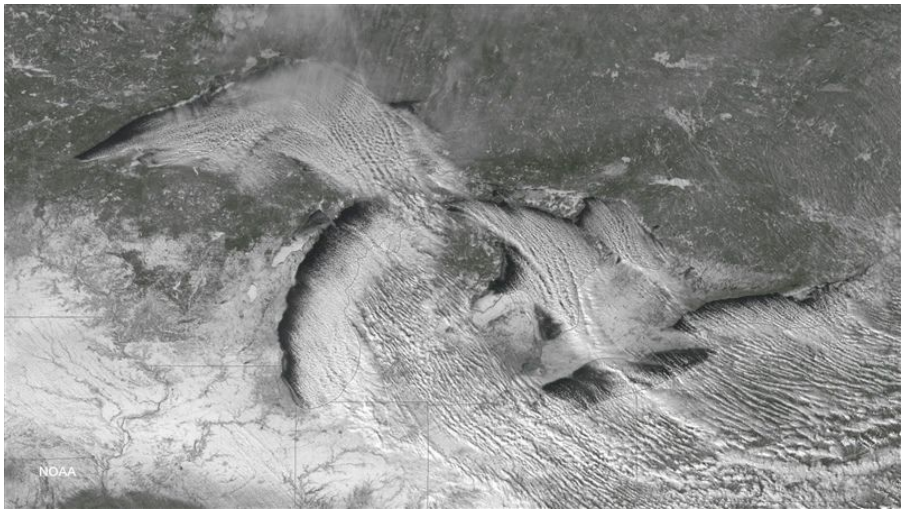
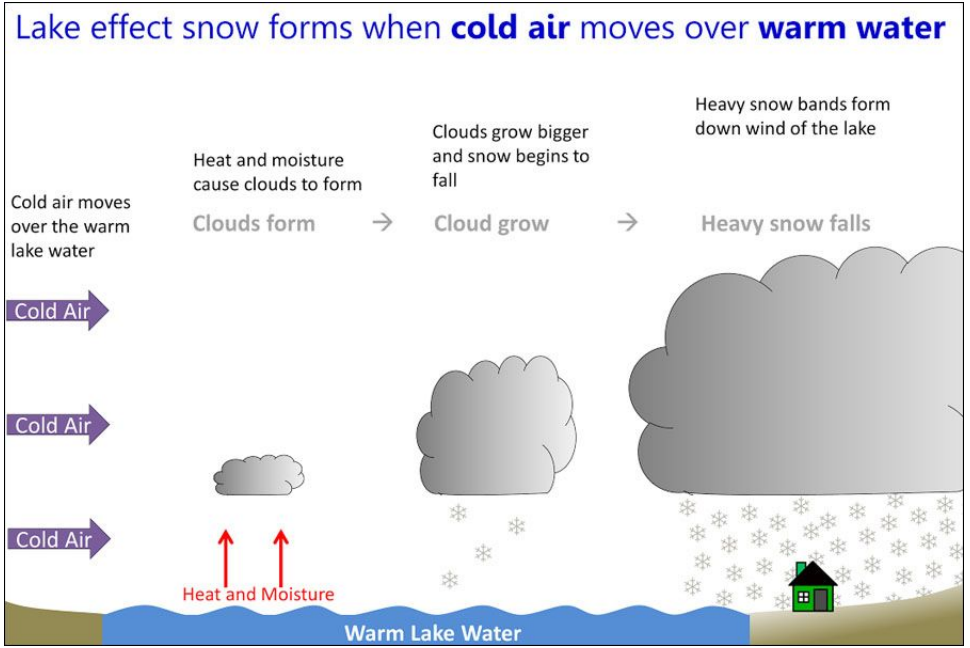


Image Credit:
NOAA Photo Library

Lake Effect/Upslope Snow

- Wind direction is a key component in determining which areas receive lake effect snow

- Heavy snow may be falling in one location while the sun is shining just a mile or two away in either direction



Lake Effect/Upslope Snow

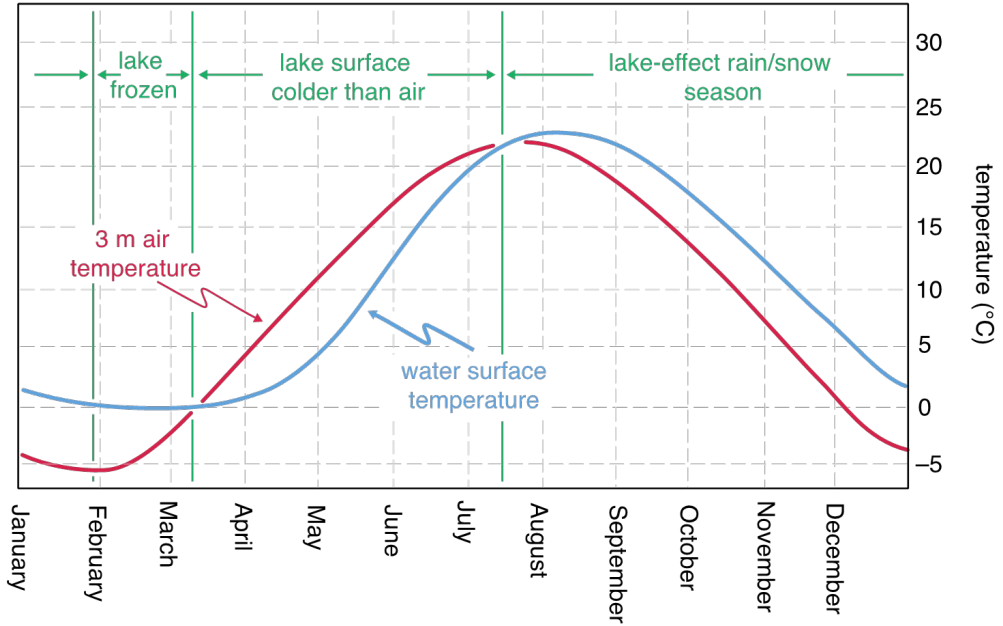
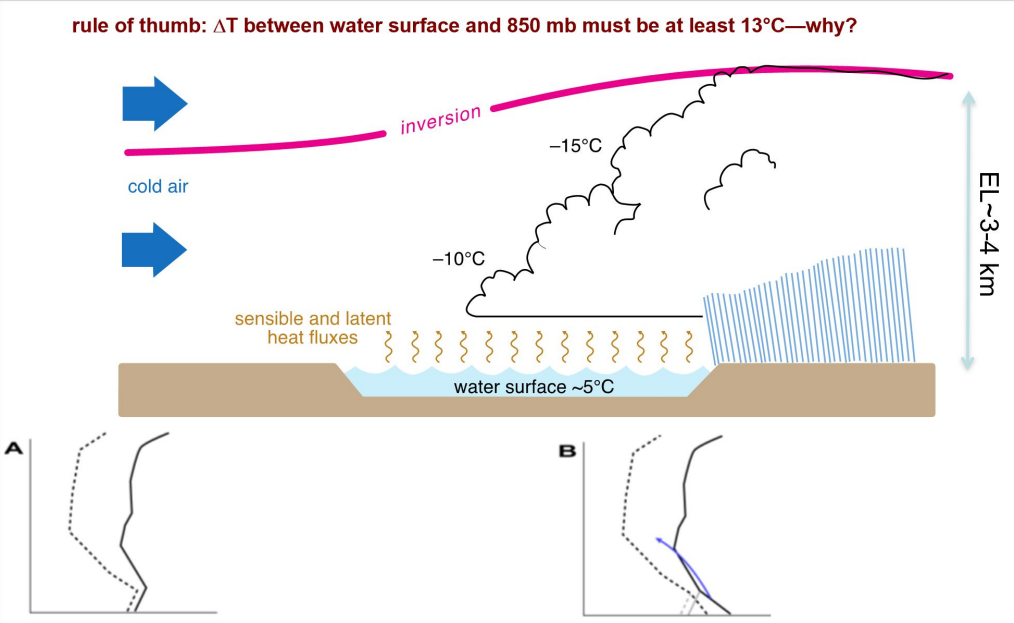


Image Credit: Meteo 414 Lecture

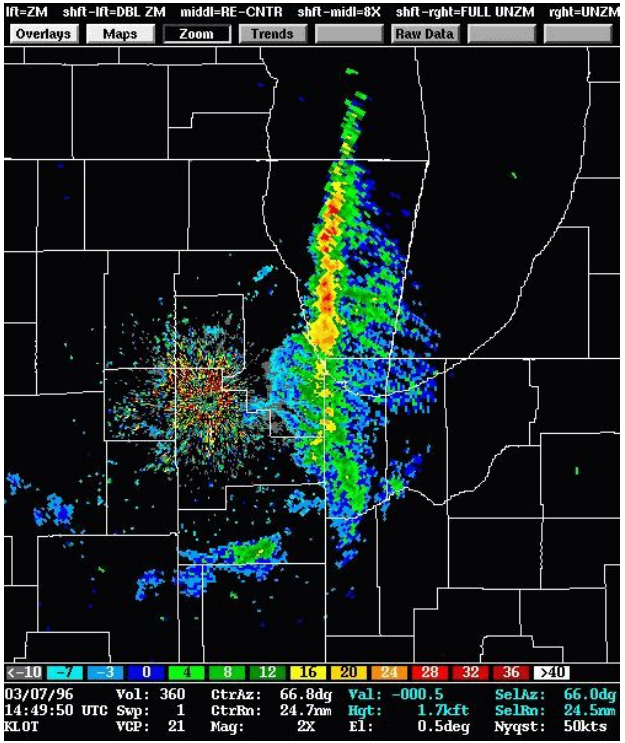
- Lake Effect Snow (LES) typically occurs during the late fall and winter moths across the Great Lakes region
- Variability of LES is particularly dangerous to motorists

Lake Effect/Upslope Snow

- LE convection is driven by the presence and release of CAPE (~ 10 - 500 J/Kg)
- CAPE is generated by the modification of cP or cA air by a relatively warm and moist surface (unfrozen body of water)
- LE convection subsides when the inversion lowers and intensifies



Lake Effect/Upslope Snow



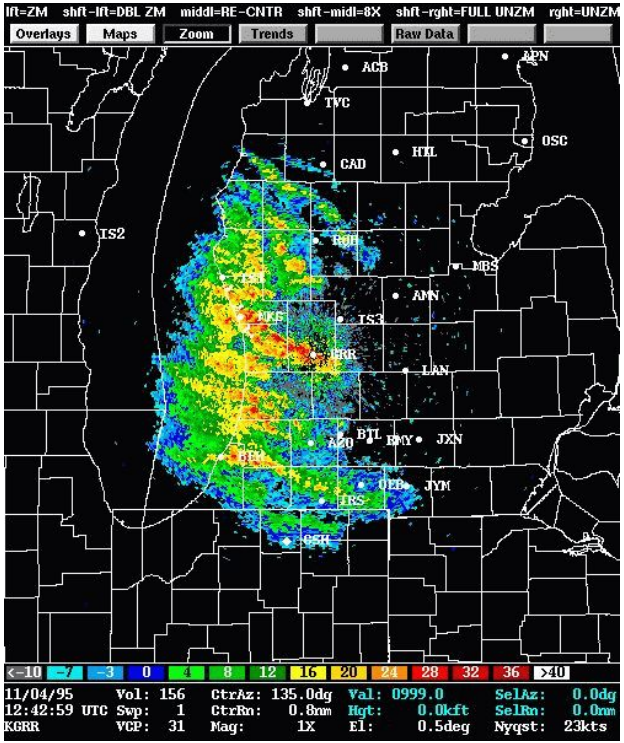


Image Credit: Meteo 411 Lecture

Lake Effect/Upslope Snow

Why are Fetch and Wind Direction Important?

- **Fetch** is the distance the wind travels over the open water surface
- The longer the fetch, the greater the amount of heat and moisture acquired from the lake. This can result in greater precipitation amounts

- A NW wind travels almost 130 miles (210 km) across Lake Superior, 150 miles (242 km) acoss Lake Huron, and only 30 miles (48 km) across Lake Erie
- A WSW wind travels 30 miles (48 km) across Lake Michigan, 60 miles (97 km) across Lake Huron, and nearly 130 miles (210 km) across Lake Erie

Image Credit: WeatherStem Lessons

Image Credit: WeatherStem Lessons

Lake Effect/Upslope Snow

- Topography can also play a significant role when lake effect snow is occurring
- Air that blows off the lakes and towards the mountains is forced to ascend
- Rising air leads to more moisture and precipitation

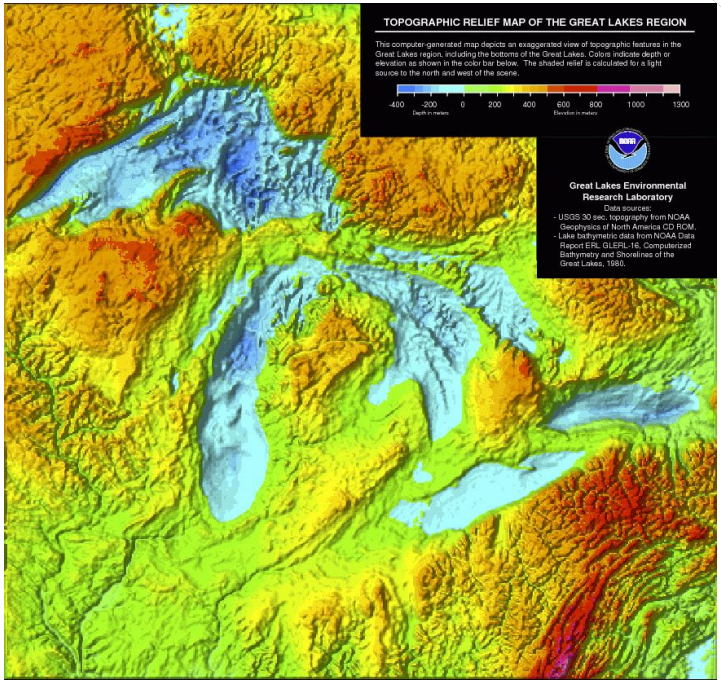


Image Credit: WeatherStem Lessons

Lake Effect/Upslope Snow

*Upslope precipitation is the result of orographic lifting

* In order for precipitation to occur you must have some form of upward vertical motion

* The amount of precipitation can be enhanced when the flow of winds has origins around the Great Lakes.

* Northwest-facing mountain areas experience a much snowier climate when compared to areas just downwind (precip shadow)

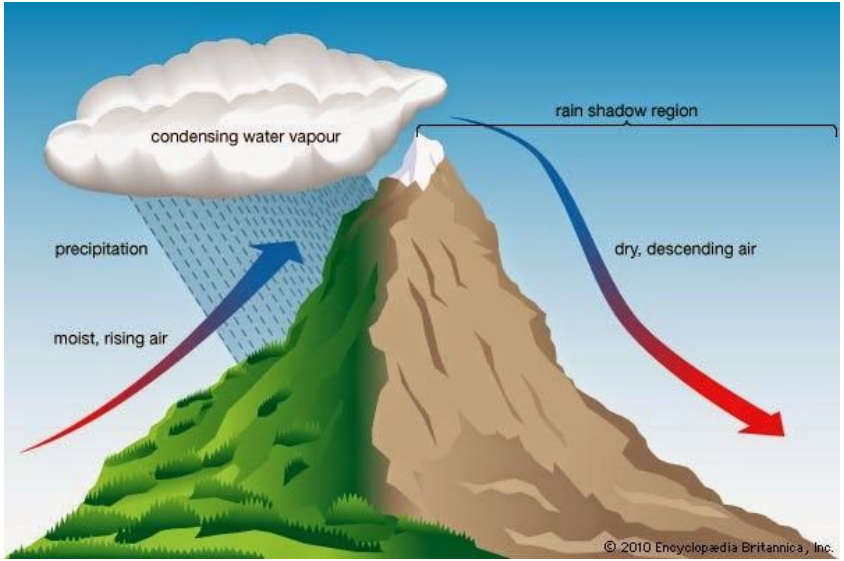
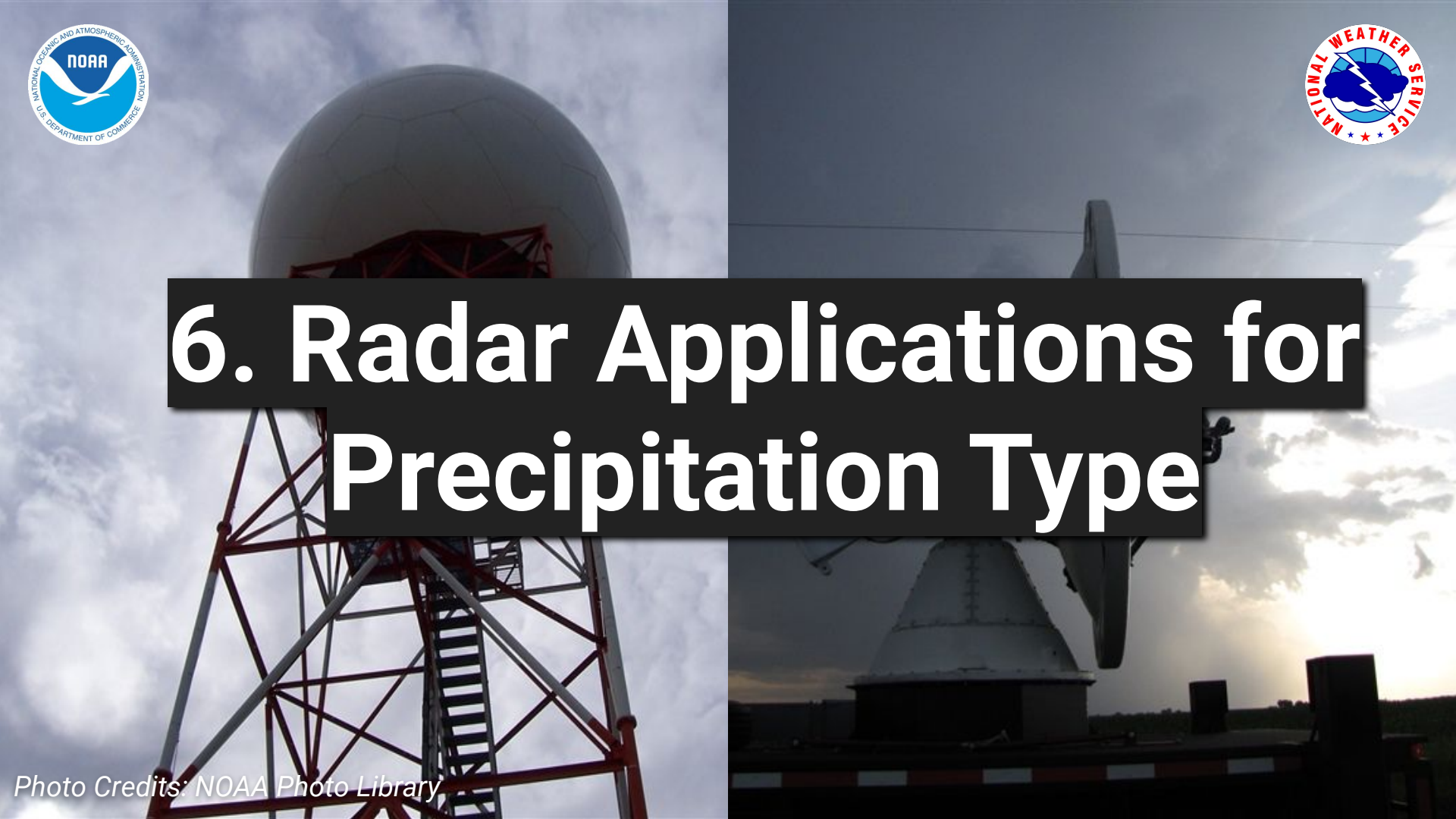


Image Credit:
Spectrum News1



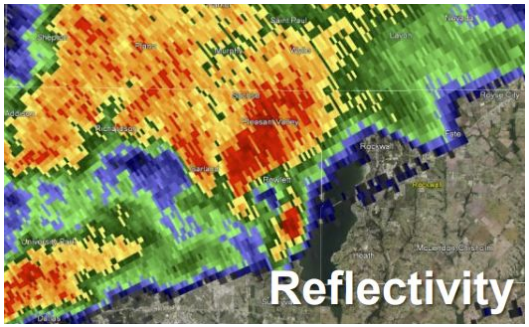
6. Radar Applications for Precipitation Type

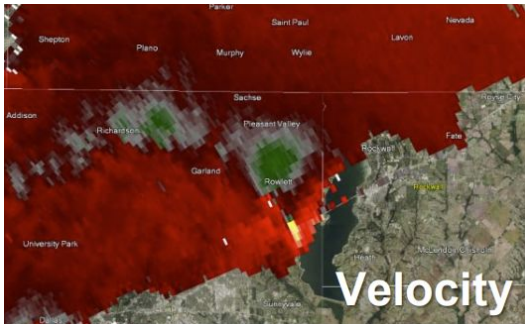
Photo Credits: NOAA Photo Library

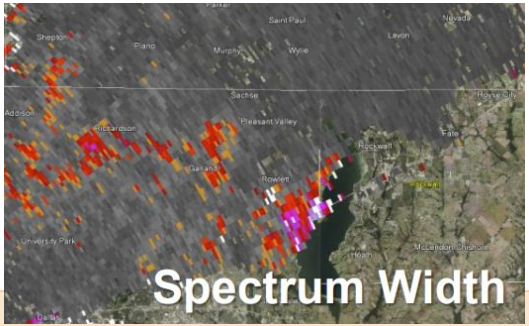
Radar Applications

Legacy Radar Products:

1. Reflectivity
2. Radial Velocity
3. Spectrum Width







Radar Applications

Winter Precipitation

- Strong electromagnetic differences between ice and liquid water mean **particle phase transitions** can be clearly visible in dual-pol data

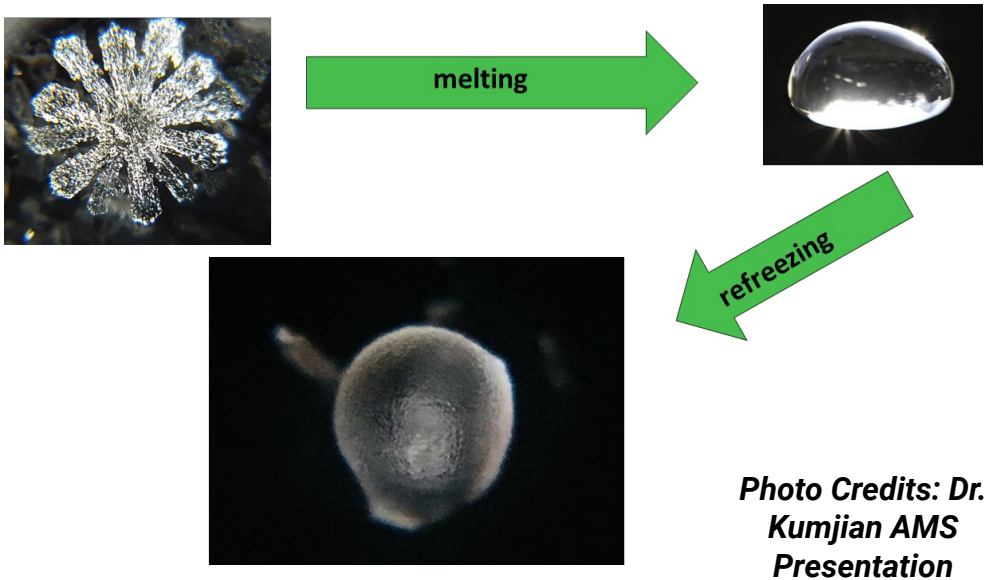


Photo Credits: Dr. Kumjian AMS Presentation

Radar Applications

Dielectric Constant

- The ratio of the permittivity of a material to the permittivity of a free space

* The dielectric constant of liquid water is around 80 meaning it has good reflectivity and can be “picked up” on radar

* The dielectric constant of snow/ice is slightly lower meaning the reflectivity is not as high

Radar Applications

Dual-Polarization Radar

- Many radars transmit and received radio waves with a single horizontal polarization

- Polarimetric radars transmit and received both horizontal and vertical polarizations

Can Determine:
1. Size
2. Shape
3. Variety

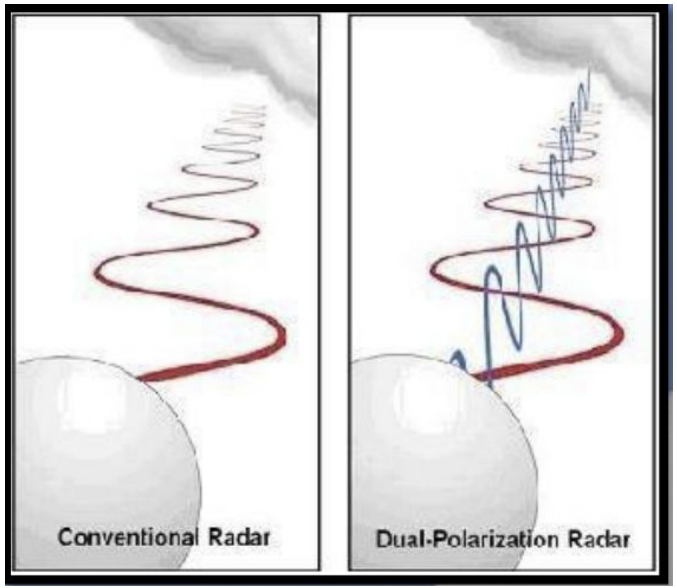
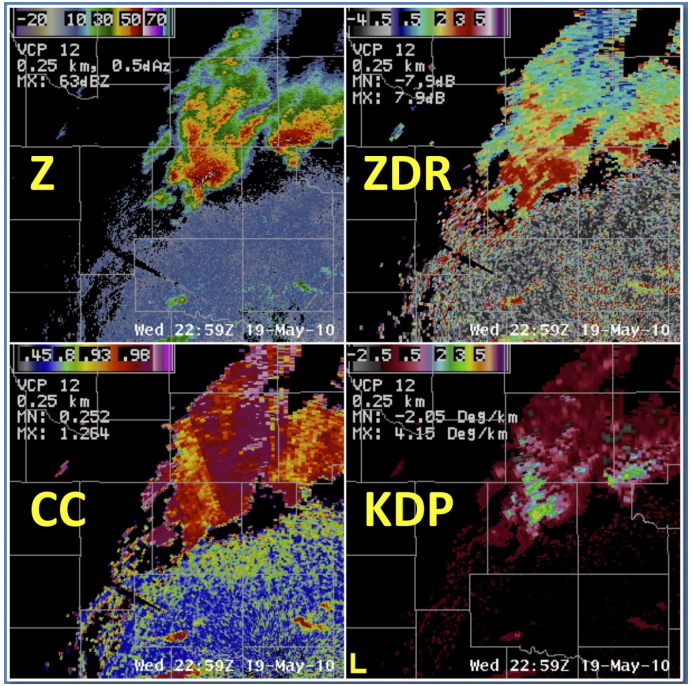


Image Credit: NWS Weather.gov

Radar Applications

Additional Products Available with Dual-Pol:

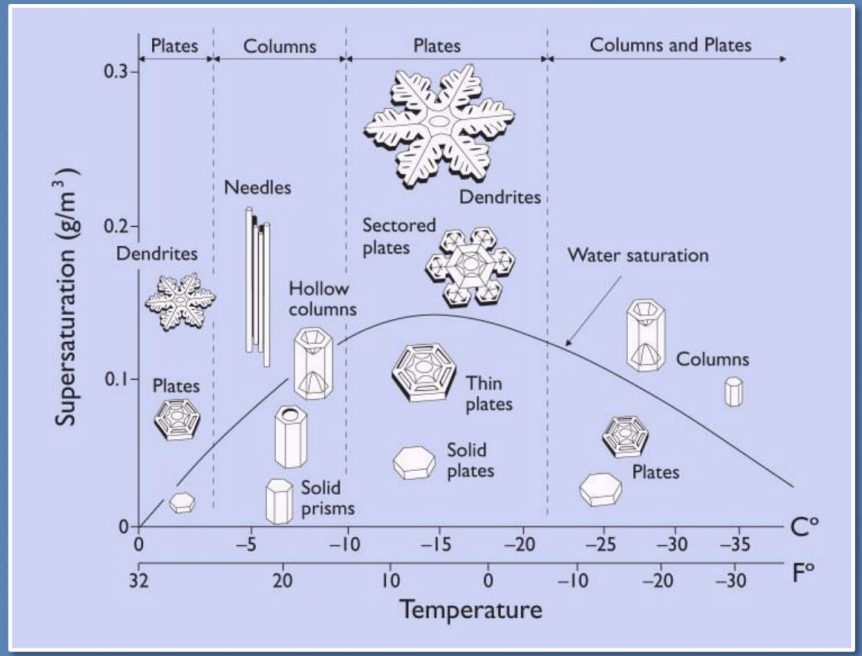
- Differential Reflectivity (ZDR)
- Correlation Coefficient (CC)
- Specific Differential Phase (KDP)



Typical Values (Snow/Ice)

Z (dBZ)	ZDR (dB)	CC	KDP (deg/km)
< 40	0.2 to 0.5	> 0.97	-1 to +0.5

- Density affects ZDR
- Melting snow will have lower CC

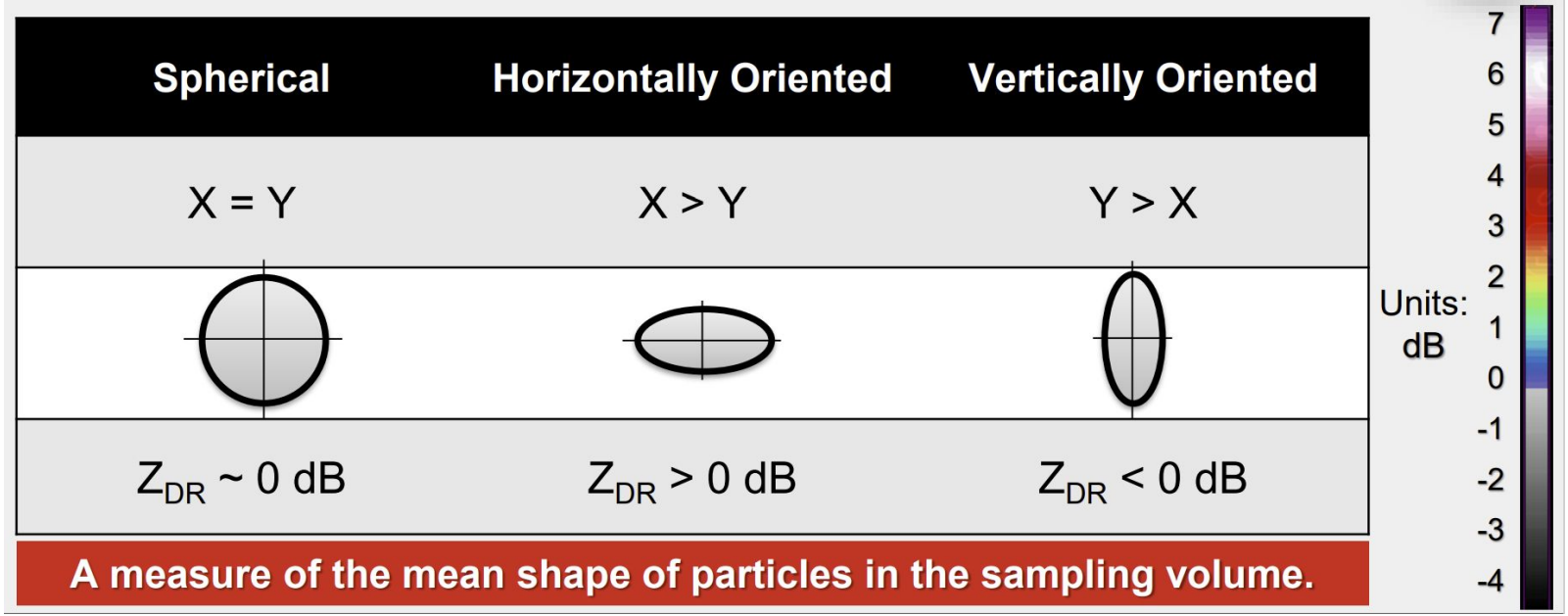


Courtesy: SnowCrystals.com

Image Credit: NWS Weather.gov

Radar Applications

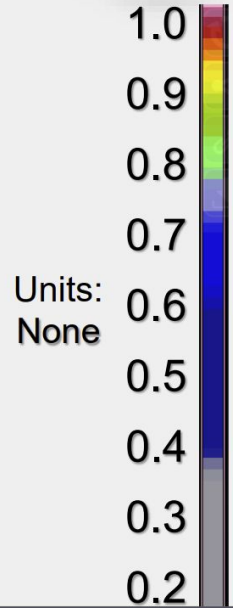
Differential Reflectivity (Z_DR), shape:



Radar Applications

Correlation Coefficient (CC): Diversity

Meteorological (Uniform)	Meteorological (Non-Uniform)	Non-Meteorological
Rain, Snow, etc	Hail, Wet Aggregates (melting snow)	Birds, insects, debris
High CC (>0.97)	Moderate CC (0.80 to 0.97)	Low CC (<0.8)



Melting Layer "Bright Band"

Why a ring?

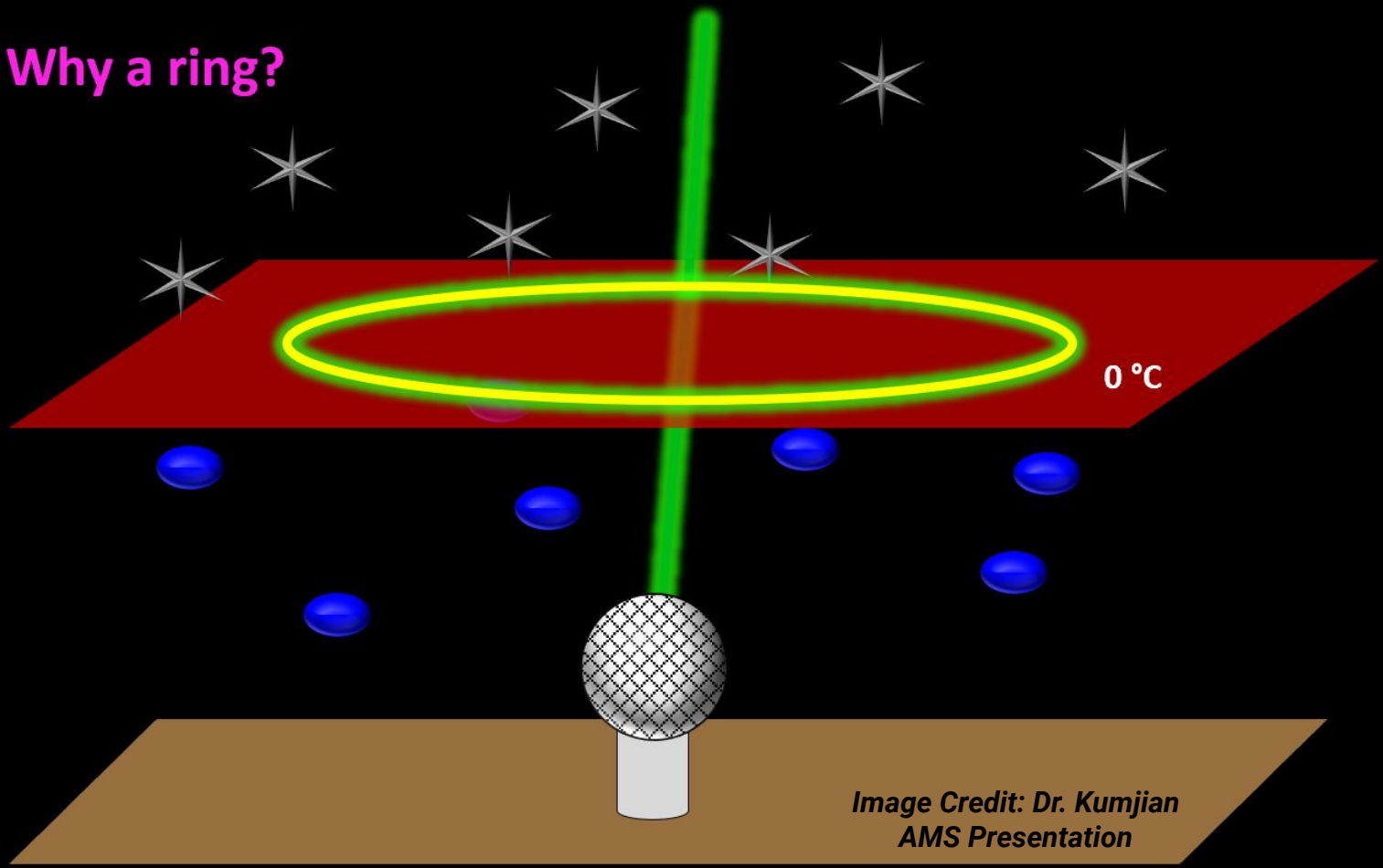
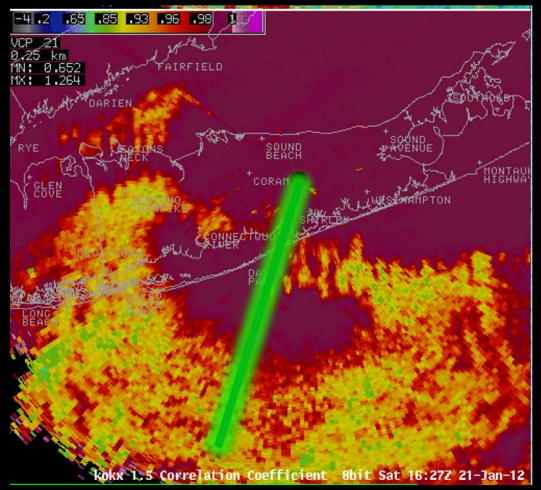


Image Credit: Dr. Kumjian
AMS Presentation

Melting Layer "Bright Band"

Complex shapes



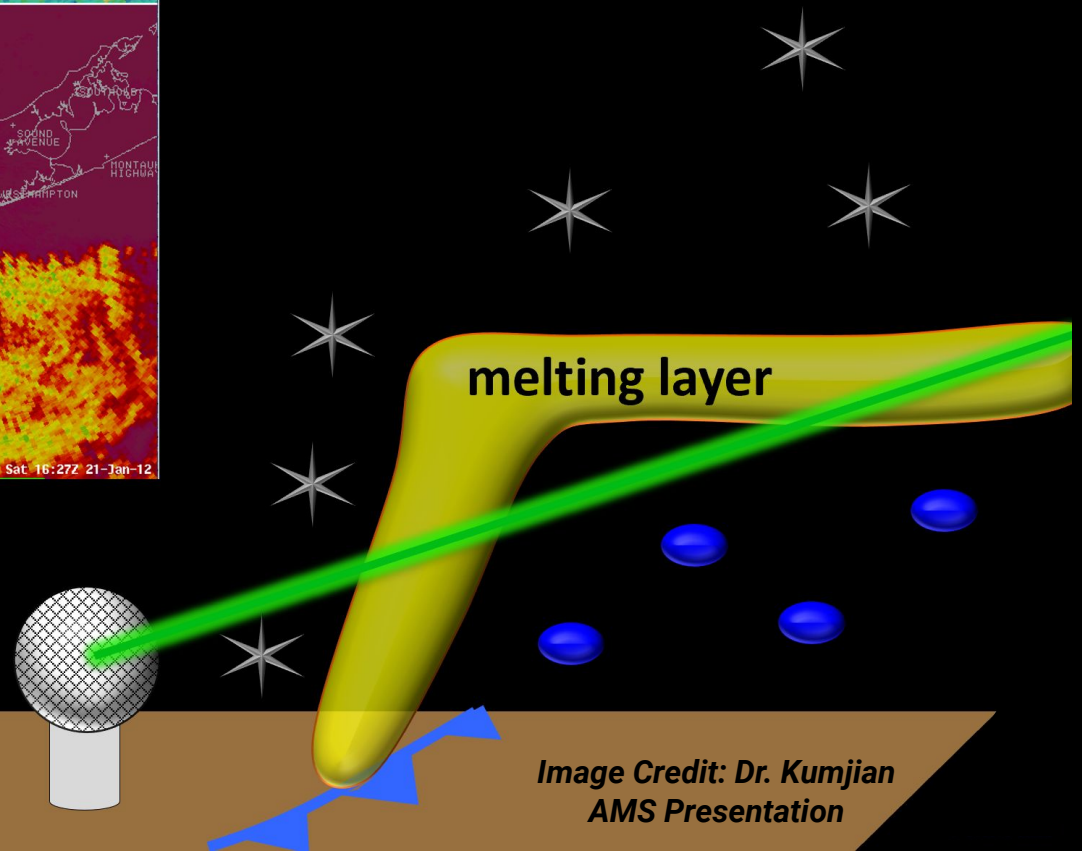


Image Credit: Dr. Kumjian
AMS Presentation

Radar Applications

* During winter weather the height of the **melting layer** has impacts on precipitation type at the surface

* Dual-pol information provides insights into **melting layer microphysics**

* **“Bright Banding”** is a radar reflectivity phenomena in which precipitation appears to be heavier in a localized area when in reality the radar is detecting melting snowflakes

* **Bright Banding** will appear in a ring-like shape encircling the radar. The height of the melting layer can be estimated using the radius of the bright banding ring

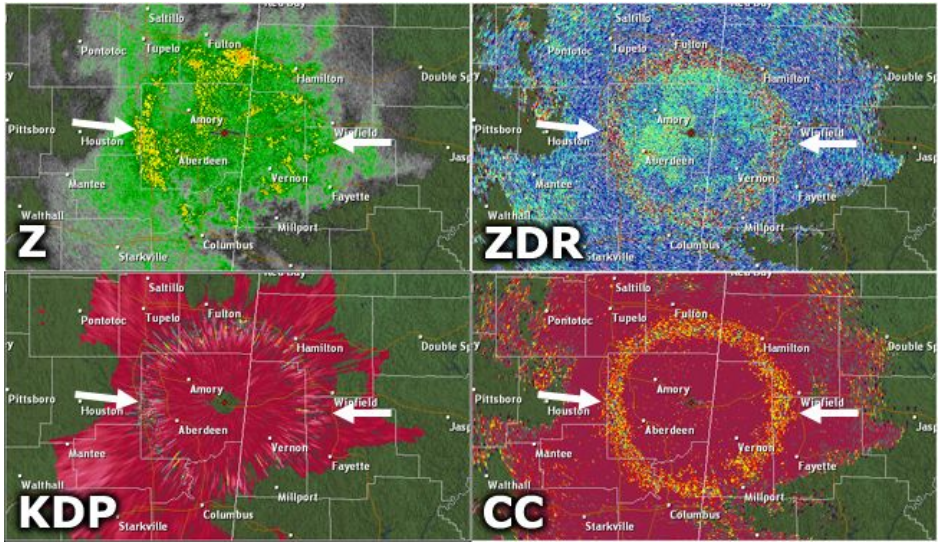
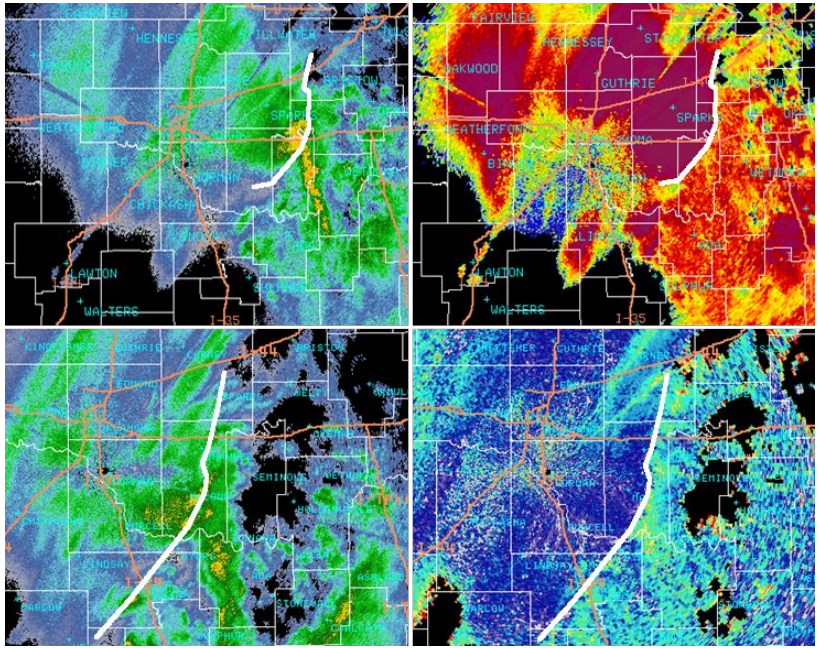


Image Credit: NWS Jackson, MS

Radar Applications

Rain VS. Snow

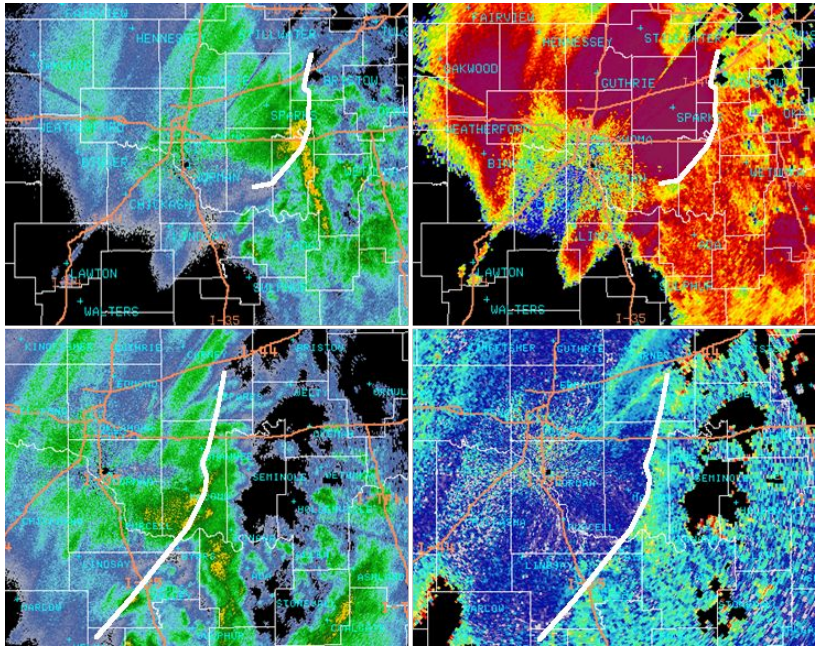
- A winter weather event is shown with a transition from rain to snow along the white line in each panel
- Using just reflectivity data (upper left) it is very difficult to tell where it is raining or snowing, although snow generally looks smoother and rain a bit more cellular (nonuniform)
- In Correlation Coefficient (upper right), higher values represent more uniform precipitation type (essentially all snow west of the white line, where CC values are around 0.98-0.99)



Radar Applications

Rain VS. Snow

- Differential Reflectivity, ZDR (lower right), shows a distinct demarcation between low values less than 0.5 (dark blue) to the left (west) of the white line from higher values (light blue/yellow) to the right (east) of the white line
- Low, uniform ZDR values are associated with similar-shaped non-spherical hydrometeors and in this case snow west of the white line



Thank You

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