SKYWARN - 2009

Advanced Concepts of Severe Storm Spotting

National Weather Service Grand Forks
www.weather.gov/grandforks

National Weather Service – Structure & Role

- Federal Government
- Department of Commerce
- National Oceanic & Atmospheric Administration
- National Weather Service

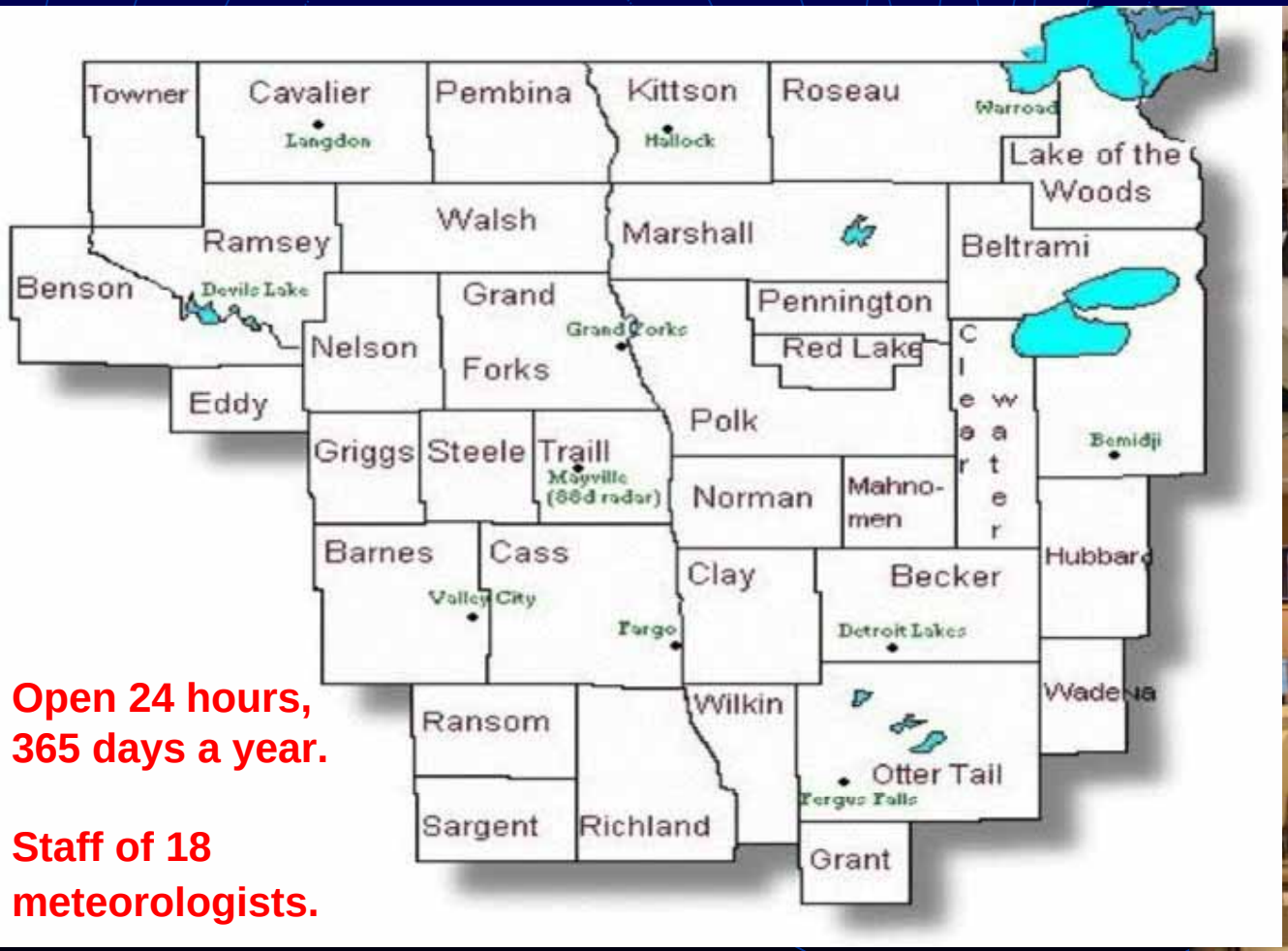
  122 Field Offices, 6 Regional, 13 River Forecast Centers, Headquarters, other specialty centers

Open House September 2008

Our Mission:
Protection of life and property!!!

And, What Does the NWS Do?

Using spotter reports, along with radar and other data, we issue warnings for 35 counties across eastern North Dakota and northwest and west central Minnesota.



Open 24 hours, 365 days a year.

Staff of 18 meteorologists.

When Will the NWS Issue a Warning?

If under the right Atmospheric Conditions...

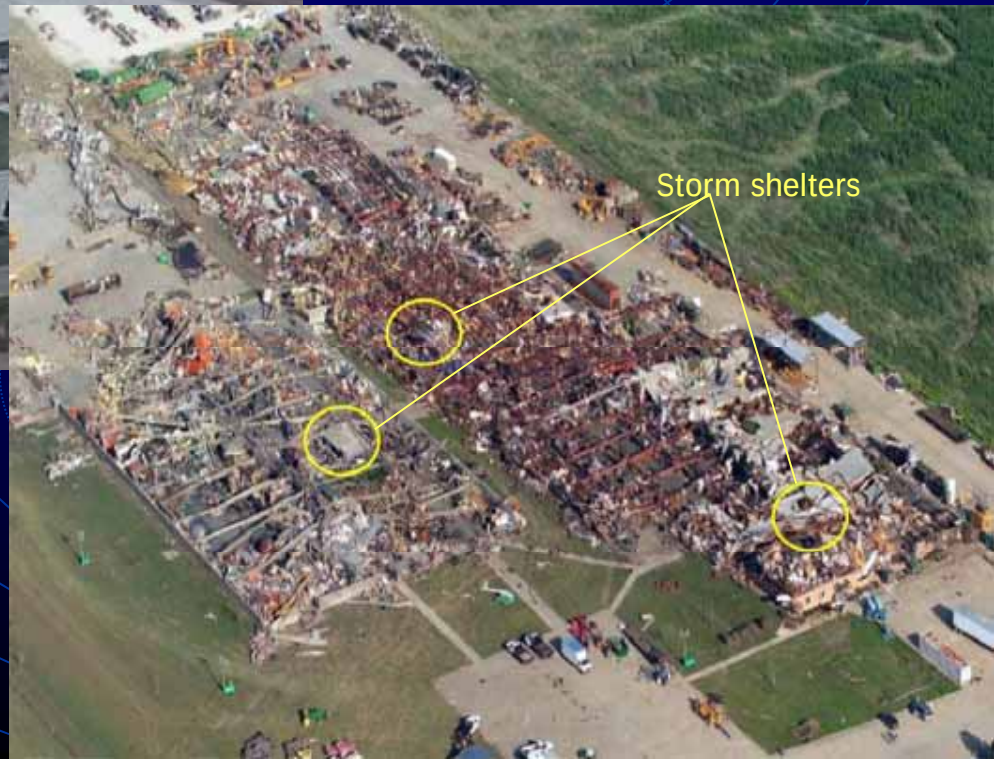
1. Doppler Radar detects severe thunderstorm…

2. Or, a trained spotter observes severe weather and reports it to the NWS.

Why is the NWS Important?

Parsons Manufacturing 120-140 employees

July 13, 2004
Roanoke, IL



F4 Tornado – no injuries or deaths
from advanced warning

SKYWARN Spotters

WHO ARE THEY?

They are You!

A major part of the NWS warning program:

Emergency Response Officials
– (e.g. law enforcement, fire departments, dispatchers)

Amateur (HAM) Radio Operators
– (e.g. ARES, EVAC, Local Clubs ...)

City and County Employees
– (e.g. emergency managers, road crews)

Trained General Public Spotters

Lots of Volunteers!!

What Does a Spotter Do?

YOU ARE OUR "REPORTER" ON THE SCENE

- Pays Attention to the Weather
- Stays Informed **.....from the Outlook**
- Responds to Changes **.....to the Watch**
- Detects the Storms **.....to the Warning**
- Reports any Severe Events!
- You Save Lives !

24 hour Spotter Line 1-800-667-1218

(FOR SPOTTER REPORTS ONLY)

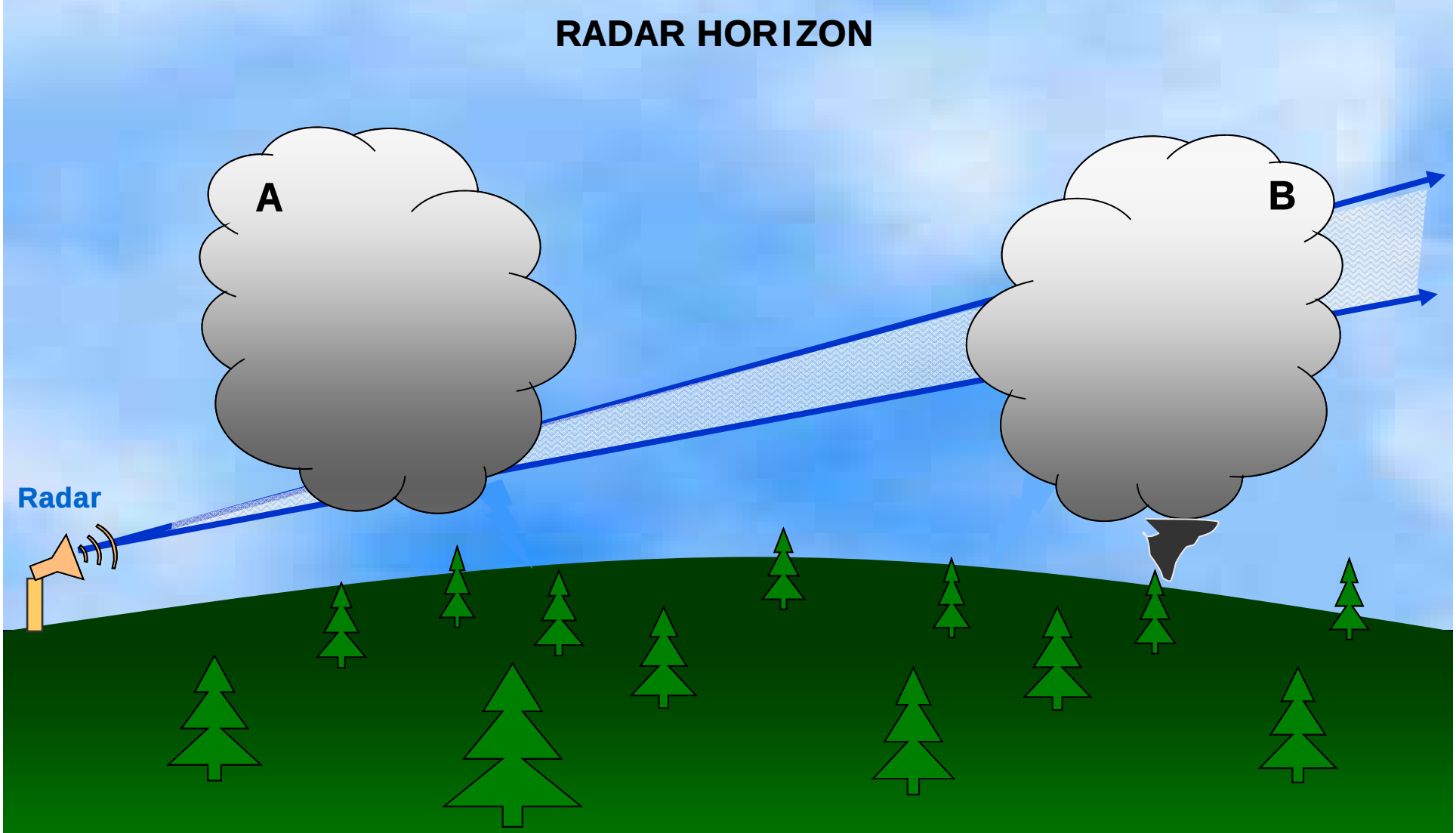
Role of Spotters

Your reports are valuable and helps save lives!!!

- **Never assume NWS knows everything**
- **You may be the reason the warning is issued**
- **You may save the lives of those in harms way**
- **Ground truth information is what gets everyone's attention**
- **Even if a warning is issued, we still need reports!**

Operations Area

Why we Need Spotter Reports



Radar beam cannot see lower portion of storm “B”

June 6, 2008 Park Rapids, MN Tornado

This tornado would have gone un-detected without spotter reports

What Makes a Good Spotter Report?

THE BARE MINIMUM...

- WHAT ?
- WHERE ?
- WHEN ?
- ANY DAMAGE ?

When Should a Spotter Call?

Call 1-800-667-1218 if you observe any of the following:

Tornado, funnel cloud or wall cloud

Hail 1/2" in diameter or larger

Kittson Co. MN July 2005

Flooding or rainfall of 1+" an hour

Winds 40+ MPH: Downed power lines or broken tree limbs bigger than your wrist

Lake of the Woods MN July 2002

Spotter Information Form
Please Return to Instructor!

SKYWARN Spotter Information Form
National Weather Service – Grand Forks, ND

SKYWARN

INSTRUCTIONS: PLEASE PRINT! Fill out the this form as completely as possible. If you have any questions, please ask the instructor. Please return this form to the instructor before leaving. Thank You!

DATE: _____ LOCATION OF TRAINING: _____

NAME: _____

PHYSICAL STREET ADDRESS, TOWNSHIP AND COUNTY:

_____

_____

Very Important

CITY: _____ COUNTY: _____

STATE: _____ ZIP: _____

HOME PHONE: _____ WORK: _____ Cell _____

E-MAIL: _____

AMATEUR RADIO CALL SIGN _____

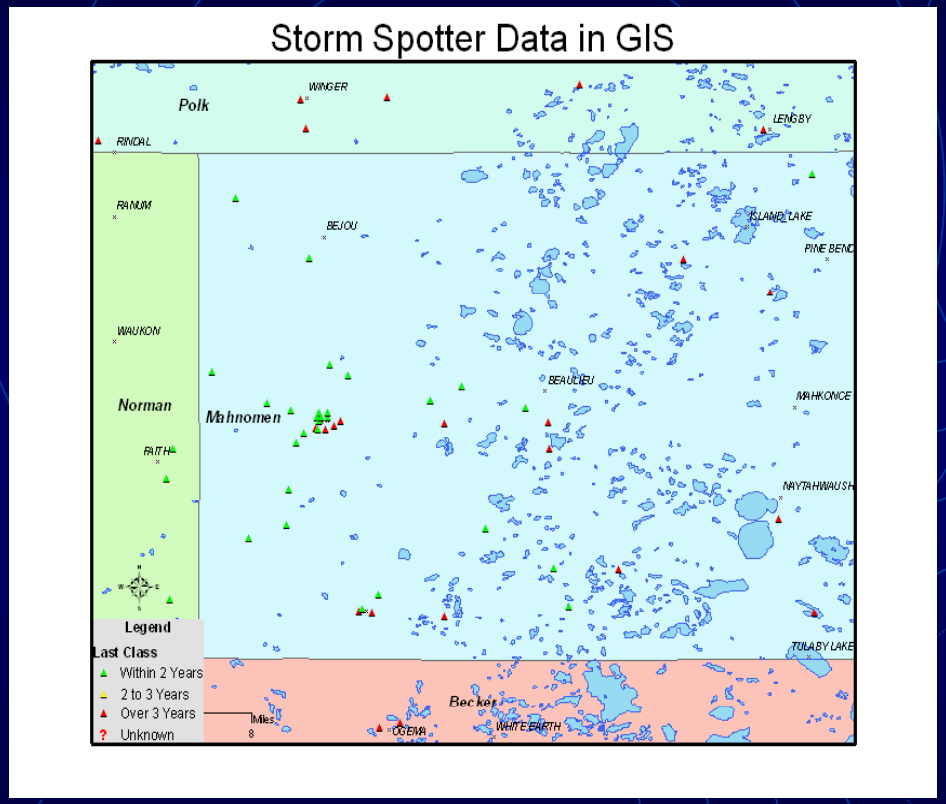
IS THIS YOUR FIRST CLASS (OR IN THE LAST TWO YEARS)? YES NO

DO YOU WANT TO BE AN ACTIVE SPOTTER? YES NO

CAN WE CALL ANYTIME? YES NO

Your Address helps us keep an up to date spotter database

How we use Your Information in our Spotter Database



Data is entered/plotted into the Geographic Information System (GIS) database.

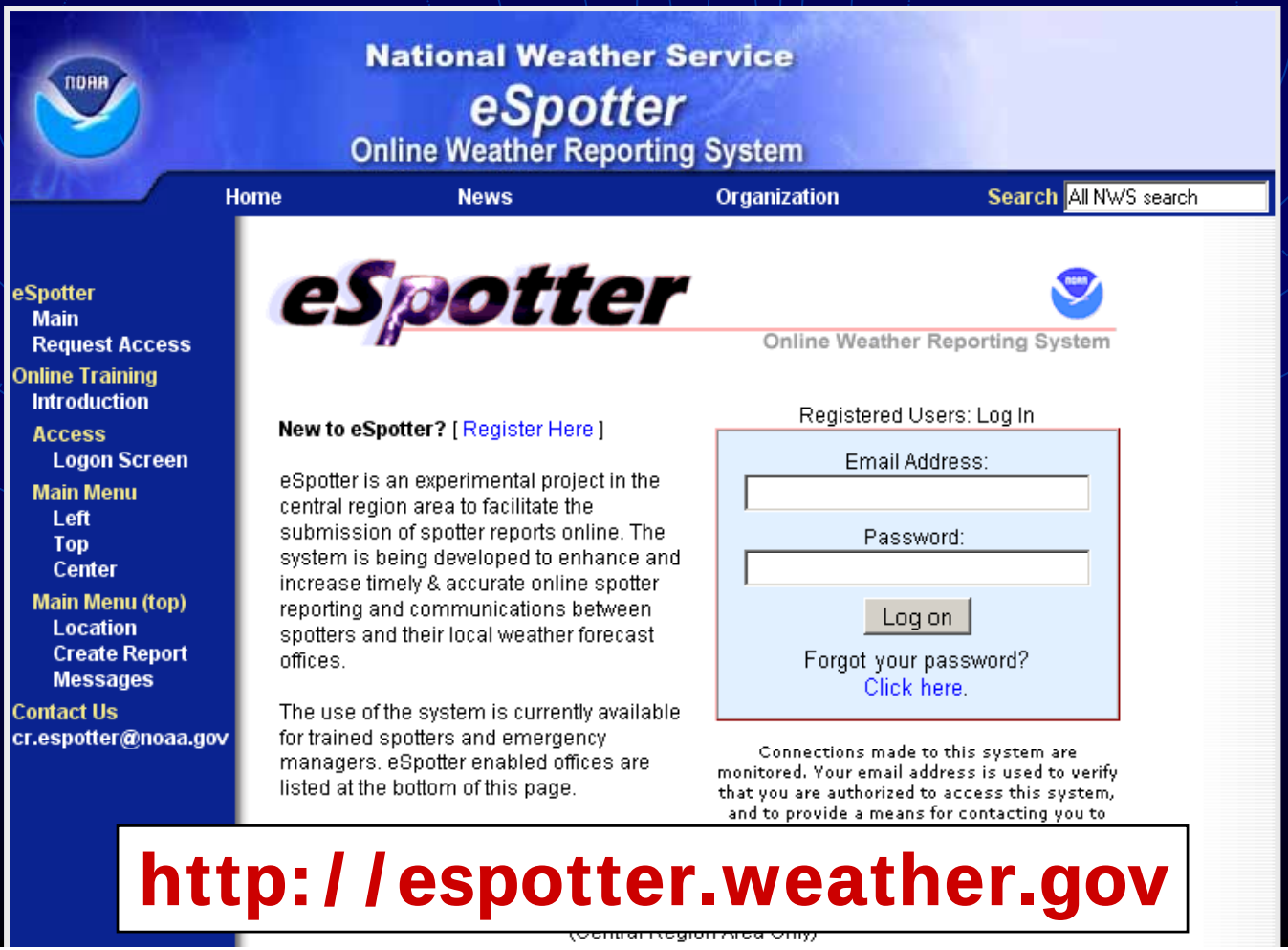
Radar imagery is combined with the GIS spotter data in Google Earth, allowing forecasters to find the nearest spotter for a particular storm.

Please Report as Soon as Possible

- By Phone… 1-800-667-1218.
- By HAM Radio… or via Dispatcher.
- By E-Spotter… Internet.

e-Spotter Online

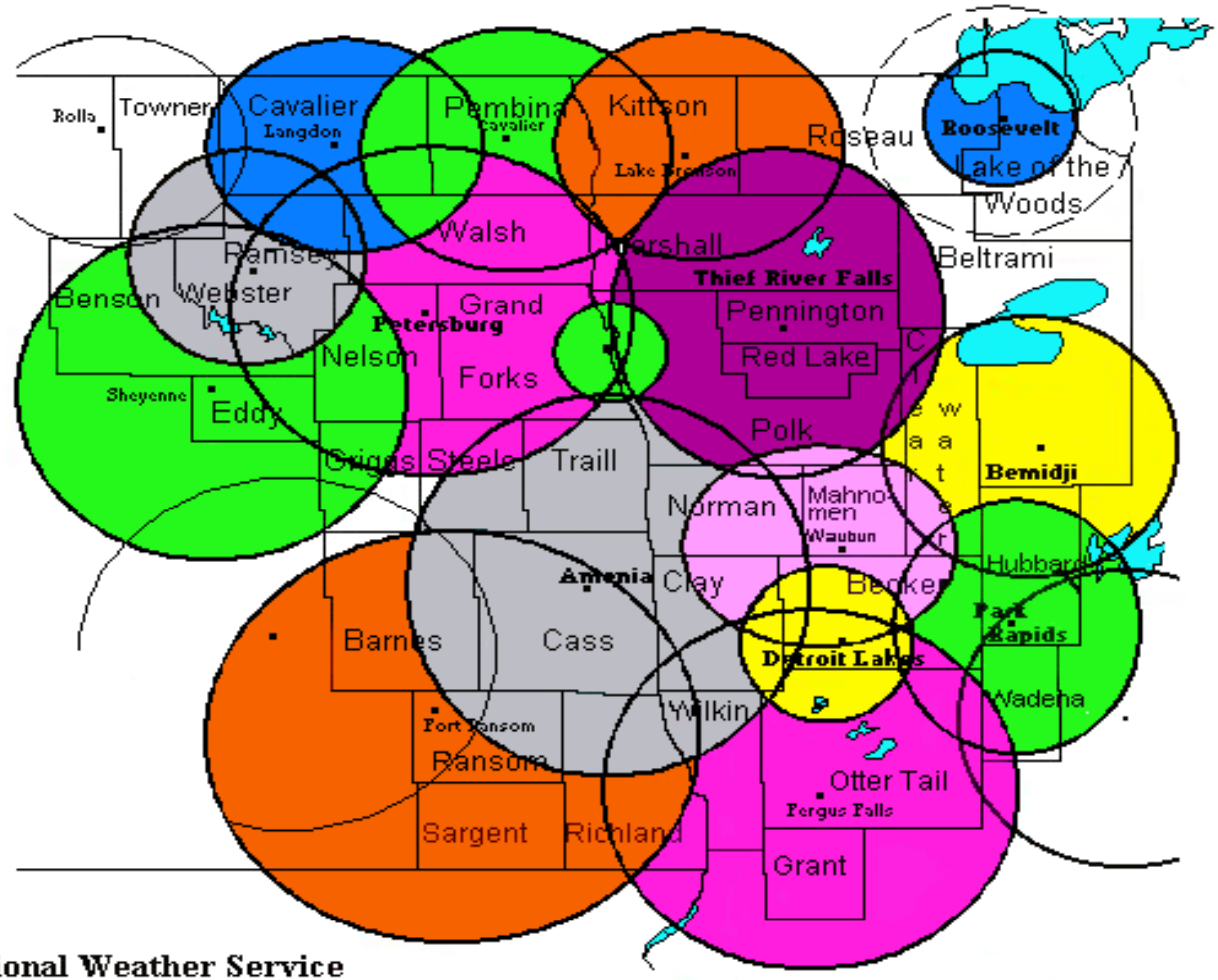
Sign-up for E-Spotter…severe weather reports via the Internet. Please call us though, if possible.



http://espotter.weather.gov

Hear us on NOAA Weather Radio

NOAA Weather Radio Transmitters in FGF CWA



NOAA WEATHER RADIO TRANSMITTERS

AMENIA WXH-42
162.475 MHZ

BEMIDJI WXM-99
162.425 MHZ

CAVALIER KWN-44
(SLAVE TO PETERSBURG)
162.450 MHZ

DETROIT LAKES WXM-64
162.400 MHZ

FERGUS FALLS WNG-680
162.500 MHZ

FORT RANSOM WNG-656
162.525 MHZ

NWS GRAND FORKS WWF-83
162.475 MHZ

LAKE BRONSON WNG-583
(SLAVE TO TRF)
162.525 MHZ

LANGDON KWN-43
(SLAVE TO WEBSTER)
162.500 MHZ

PARK RAPIDS WWG-98
(SLAVE TO DTL)
162.475 MHZ

PETERSBURG WXM-38
162.400 MHZ

ROOSEVELT WWF-45
(SLAVE TO TRF)
162.450 MHZ

SHEYENNE KWN-46
162.525 MHZ

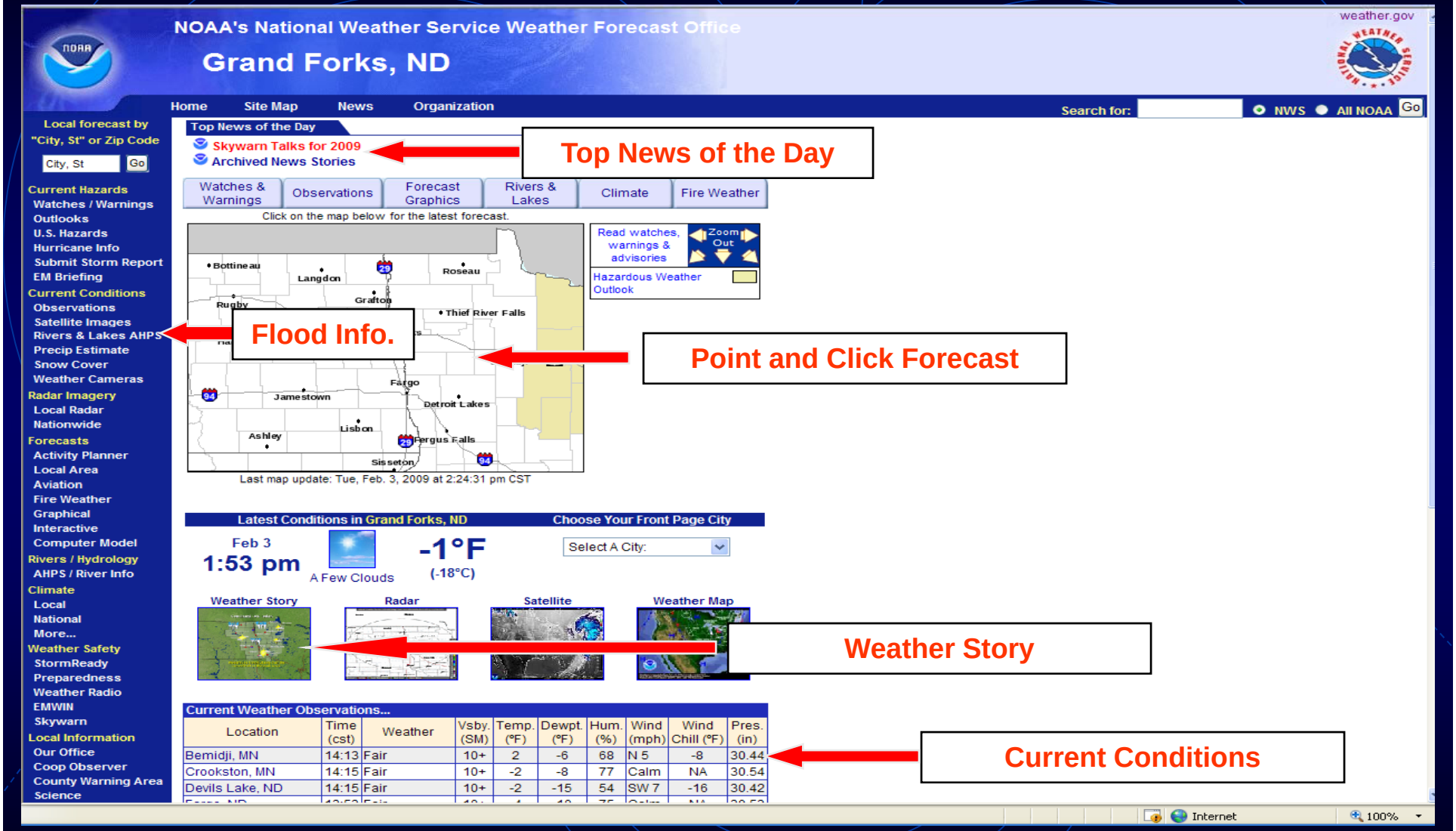
THIEF RIVER FALLS WXH-43
162.550 MHZ

WAUBUN WNG-610
(SLAVE TO DTL)
162.450 MHZ

WEBSTER WWG-25
162.425 MHZ

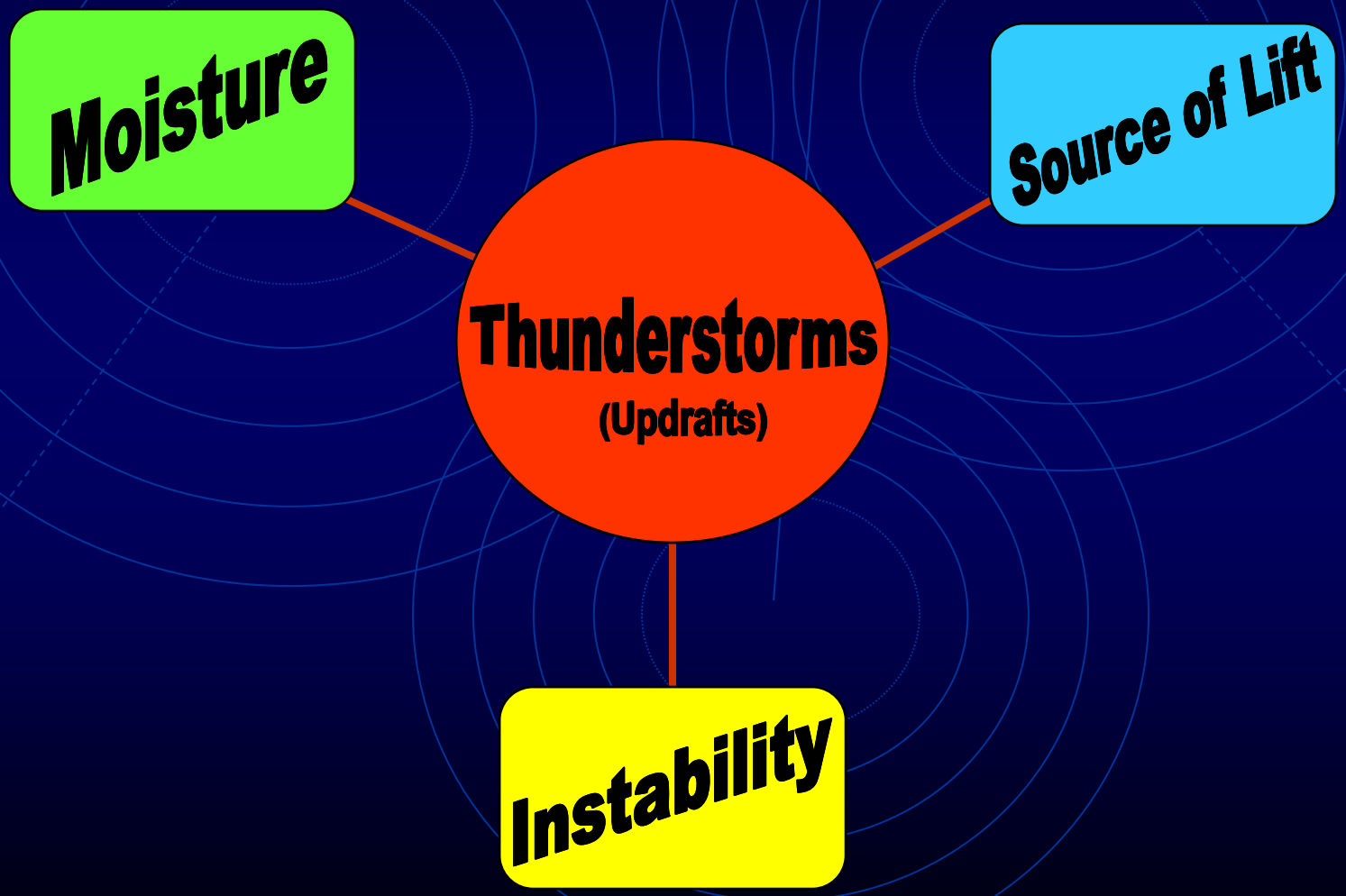
National Weather Service
Eastern North Dakota (FGF)
Grand Forks ND

NWS Grand Forks on the Internet



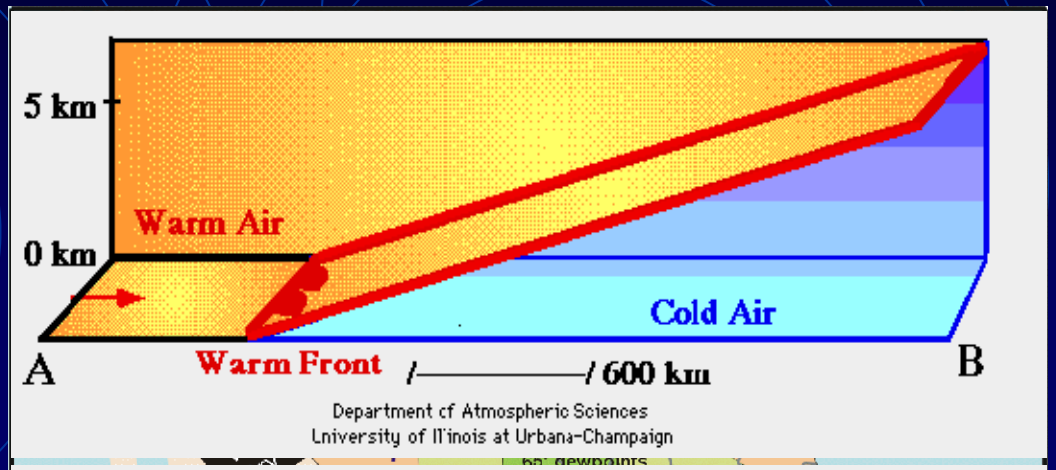
http://weather.gov/grandforks

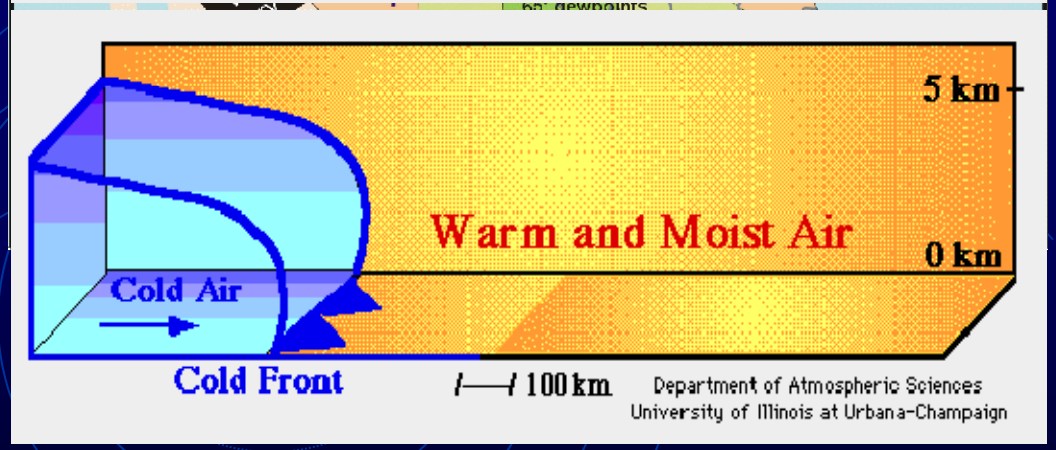
Necessary Ingredients for Thunderstorms



Moisture and Lift

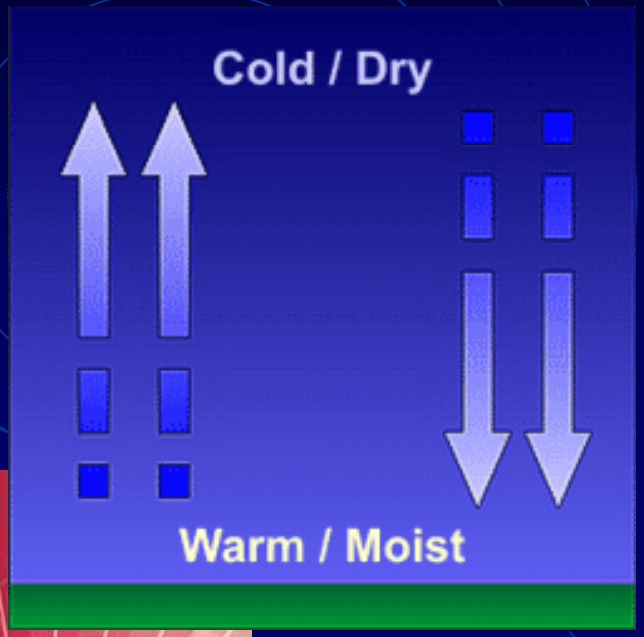
- **Moisture**
  - Typically from Gulf of Mexico
  - Dew points
- **Sources of Lift**
  - Fronts
  - Low Pressure
  - Uneven Heating
  - Jet Streaks
  - Colliding Storm Outflows
  - Lake/Land Breezes



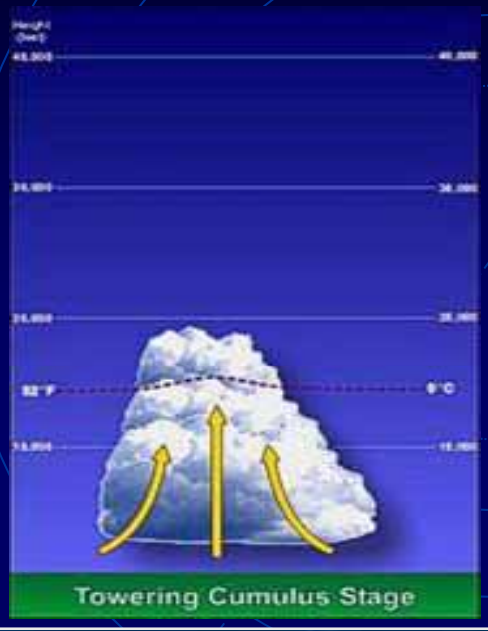


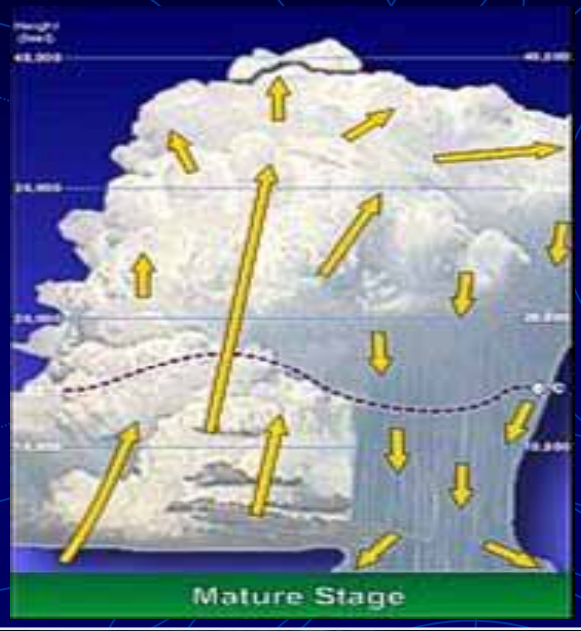
Instability

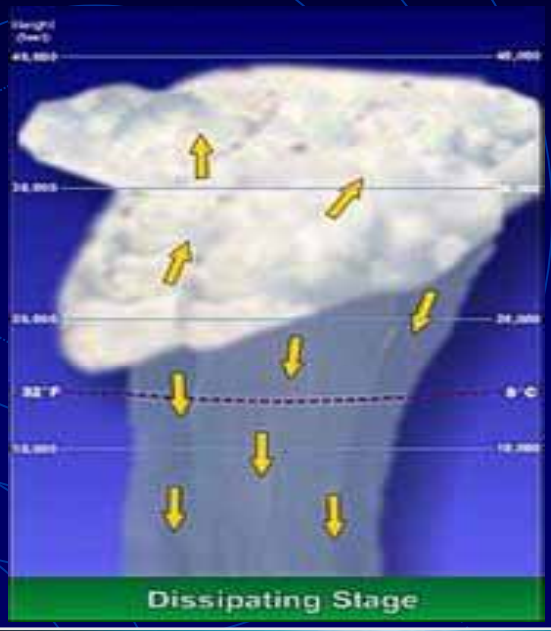
- Warm, moist air rises
- Cool, dry air sinks
- When a warm air parcel continues to rise or cool air parcel continues to sink, the atmosphere is unstable.

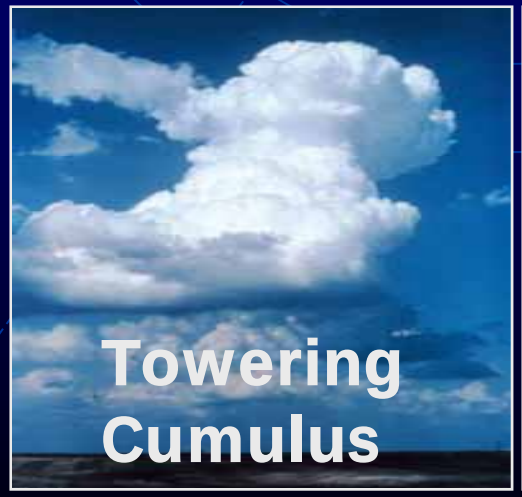


Thunderstorm Life Cycle

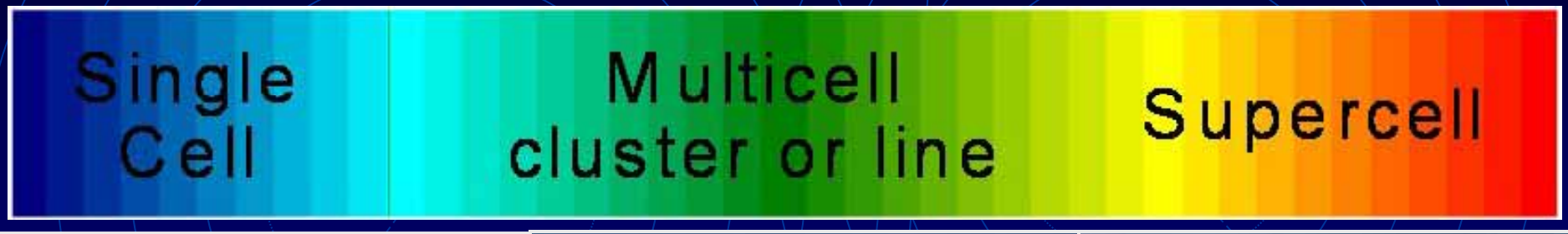








Thunderstorm Spectrum and Risk of Severe Weather



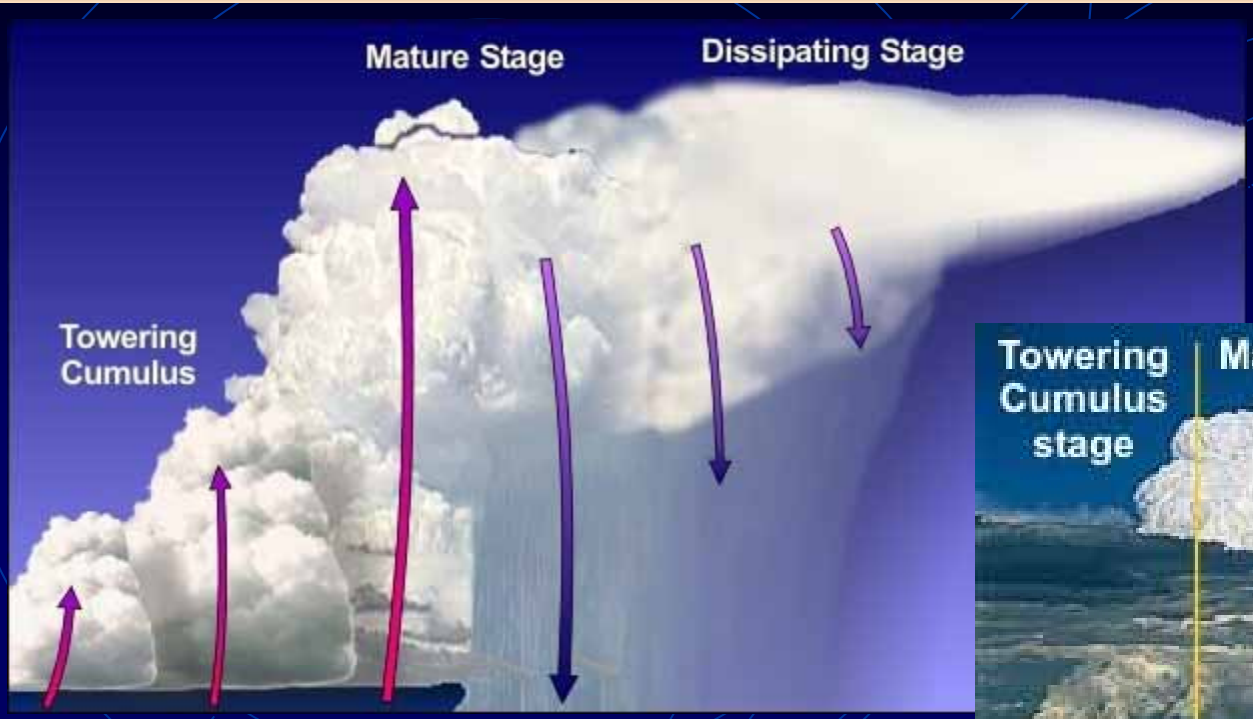
- Brief Updraft
- Brief severe weather events

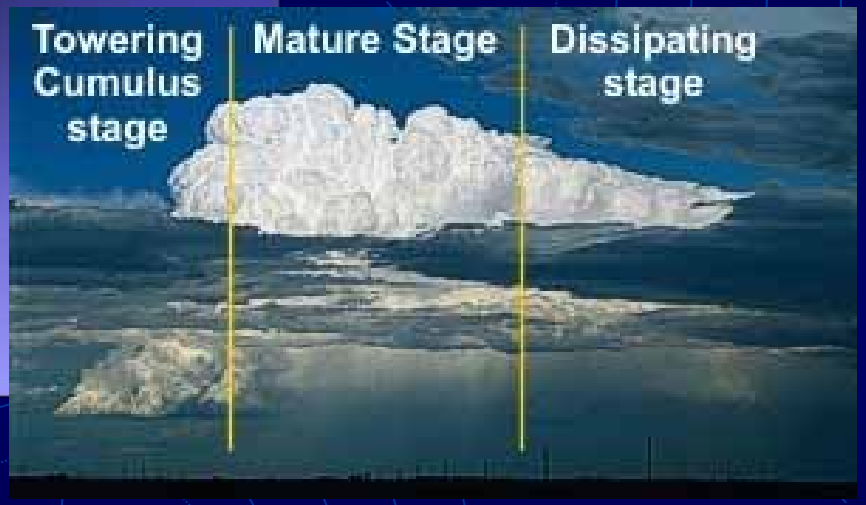
- Sustained by new growth

- Sustained for hours
- Severe weather likely

Storms frequently transition from one type of storm to another – they are a process, not a static entity!

Multicell Thunderstorms

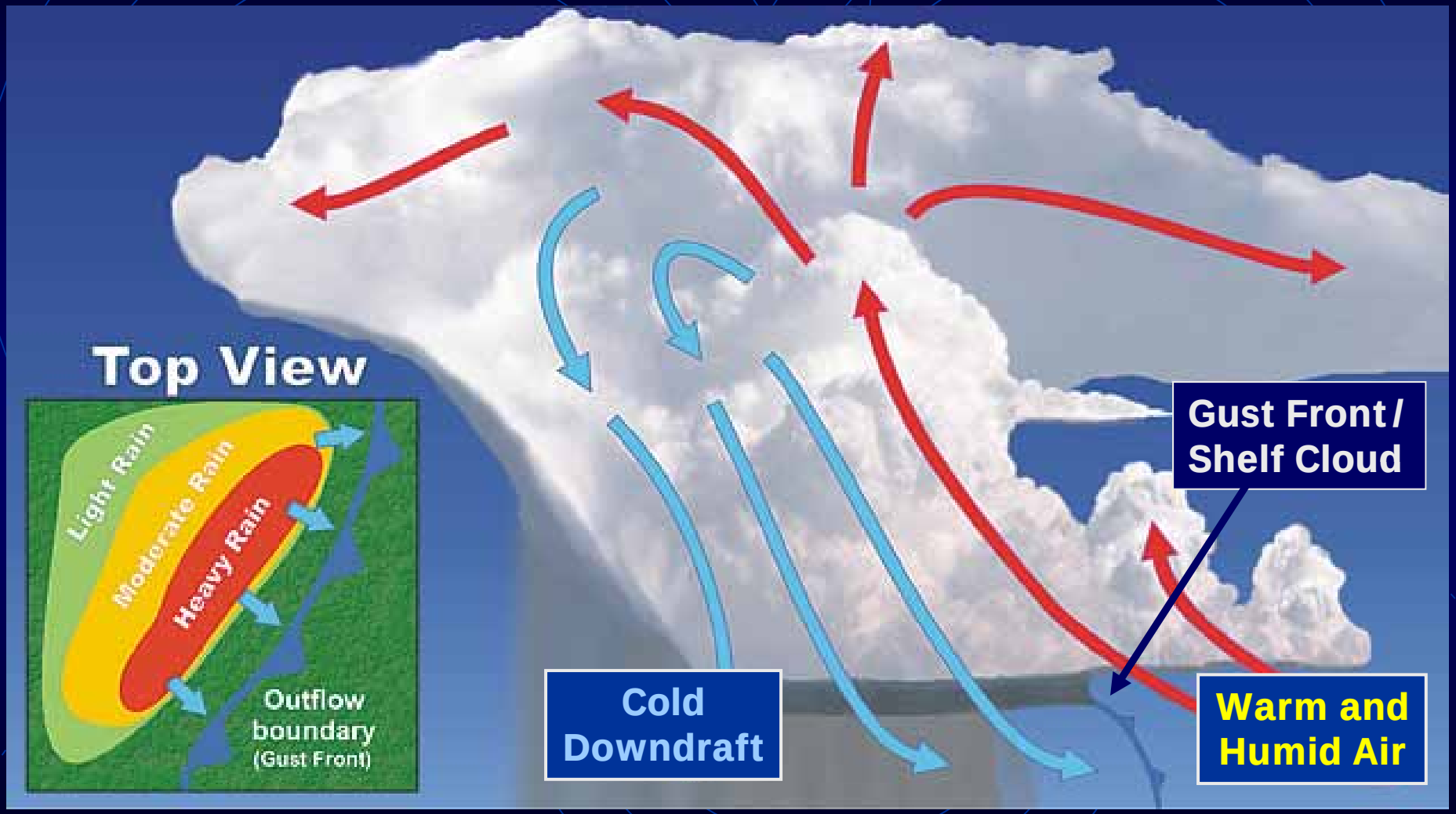




- Most common
- May last for several hours
- Primary threats are downbursts, moderate hail, flash floods and on occasion weak tornadoes
- Severe weather occurs more frequently near the updraft/downdraft interface, under the most intense cell

Multicell Thunderstorms

Multicell Thunderstorms – Squall Line



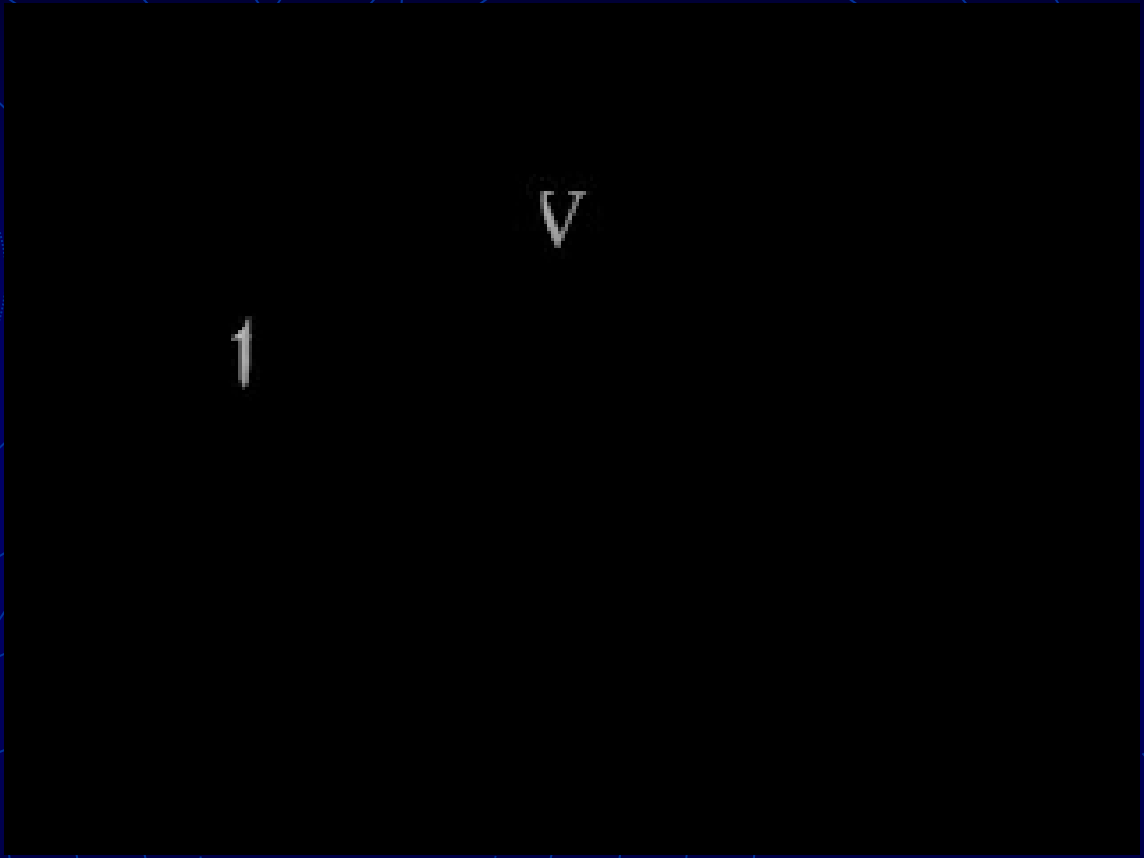
Looking North

Fargo June 14, 2008 – Pronounced Shelf Cloud

Squall Lines and the Shelf Cloud

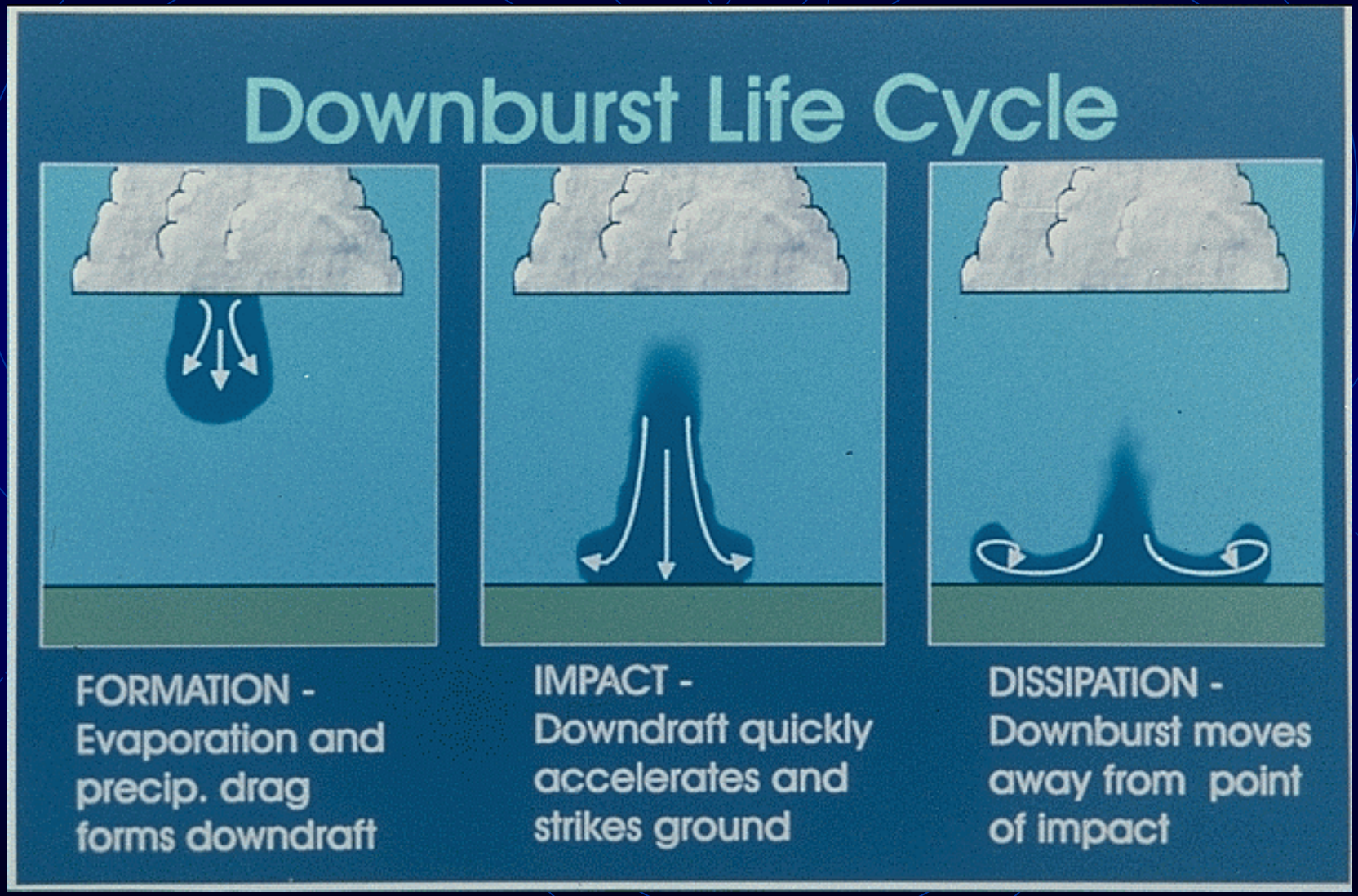
Damage from Squall lines can be greater than most tornadoes in the Northern Plains.

Winds can easily exceed 60 mph and reach up to 140 mph.

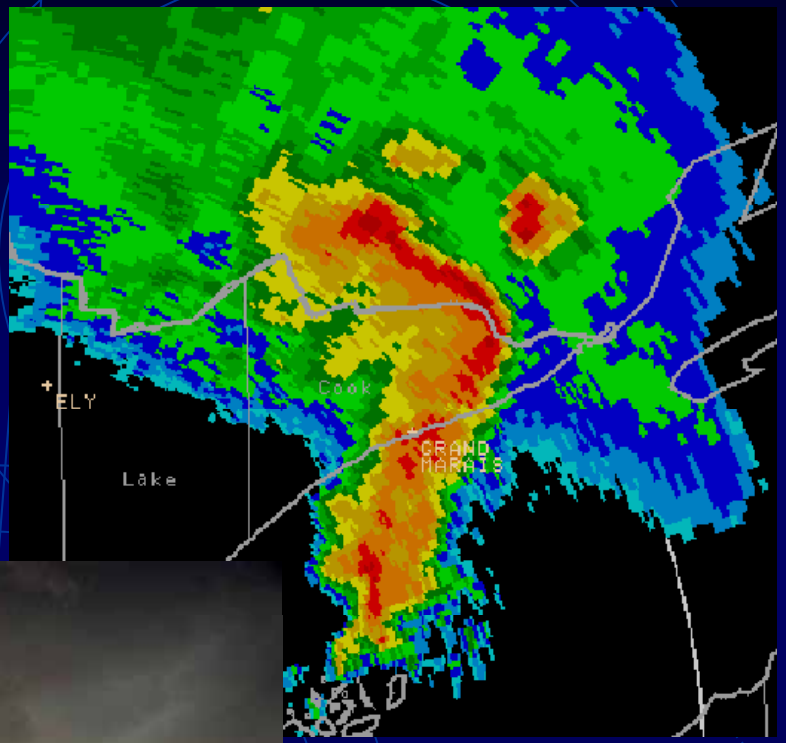


Face your vehicle directly into or away from the wind, or shelf cloud.

Downburst Life Cycle

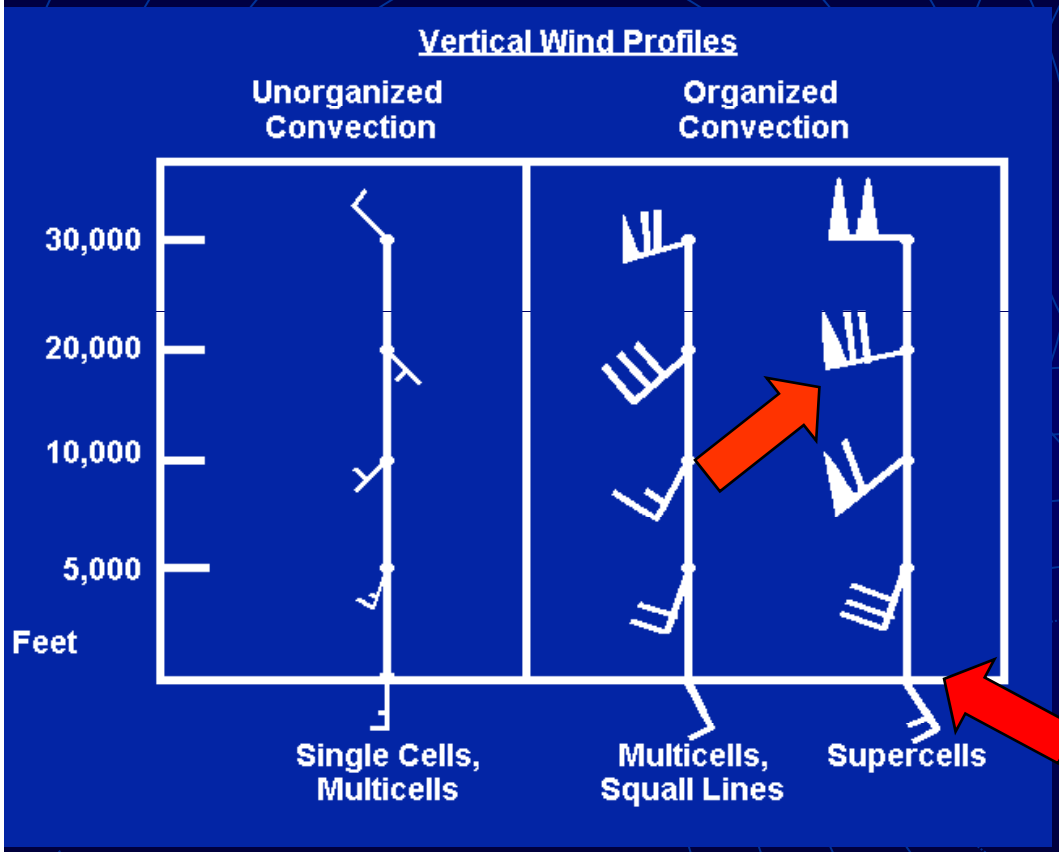


Downbursts



Northeast Minnesota
July 4, 1999

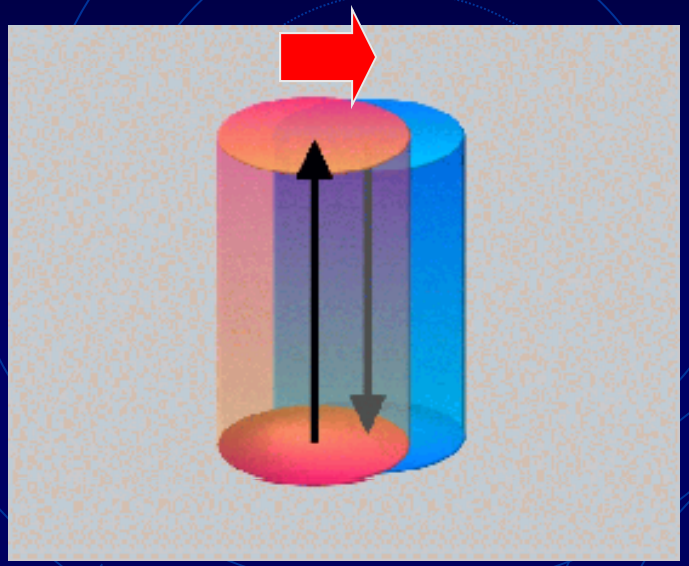
Vertical Wind Shear



- **Vertical wind shear** is a change in wind speed and/or direction with increasing height above the ground.
- **Wind Shear** is crucial to potential thunderstorm organization and severity. The greater the shear, the greater the potential for organized severe weather.

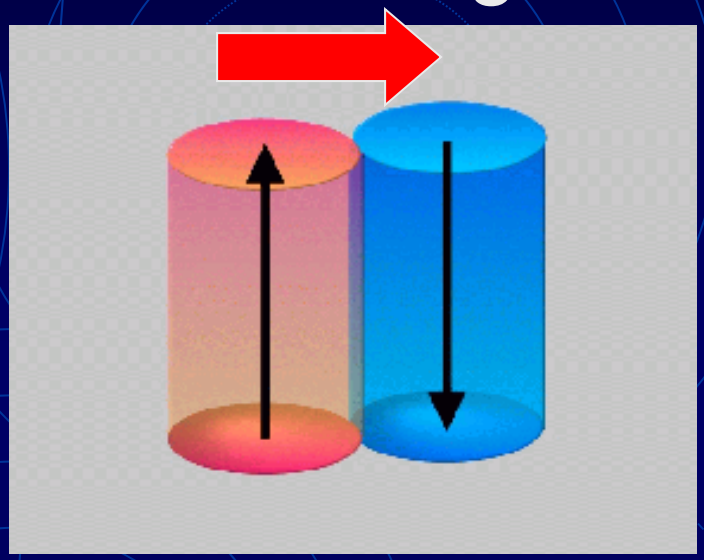
Updrafts and Wind Shear

Weak



Very little separation between updraft and downdraft. Downdraft chokes updraft causing storm be short-lived.

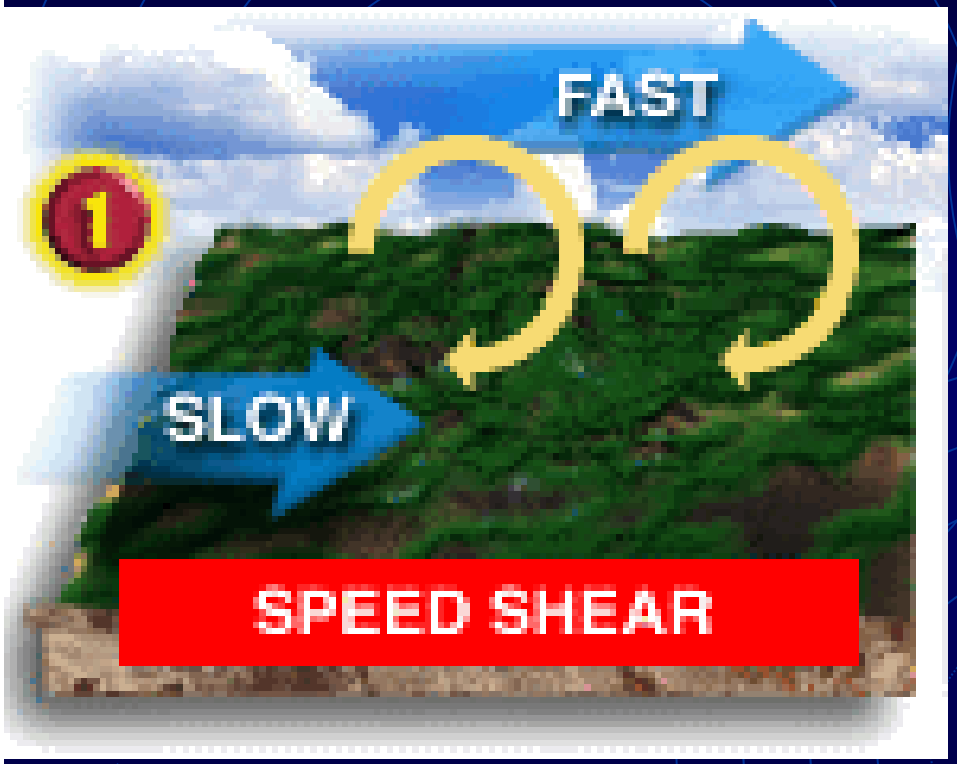
Strong

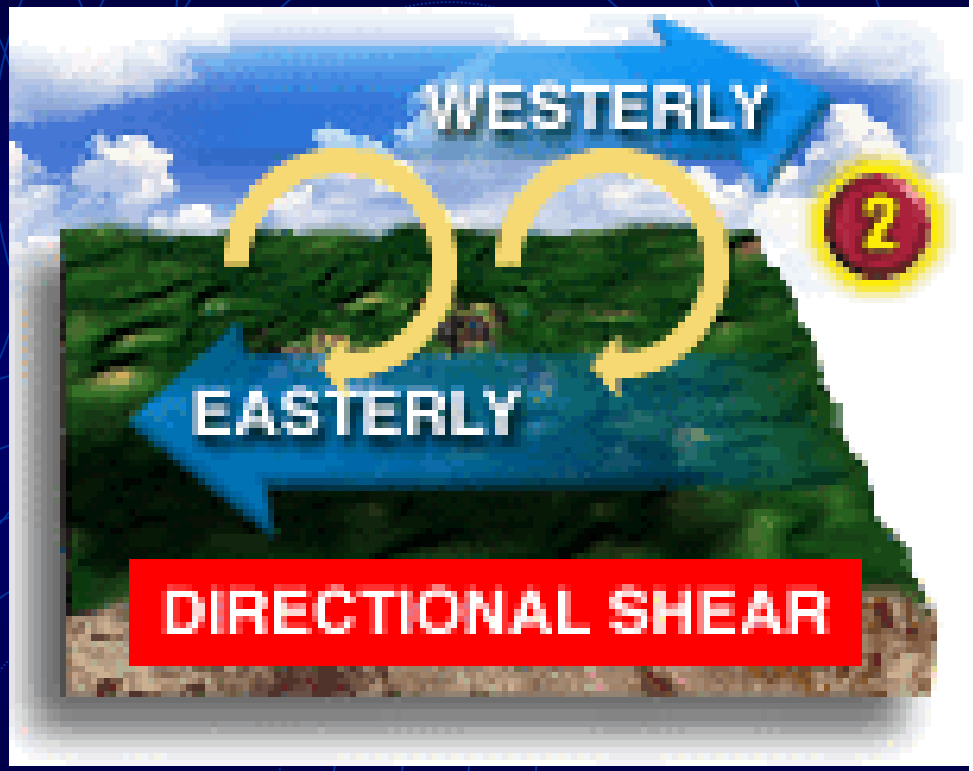


Updraft & downdraft are separated, so they co-exist. The updraft is also tilted, therefore, the storm lives longer.

Supercell Updraft / Downdraft

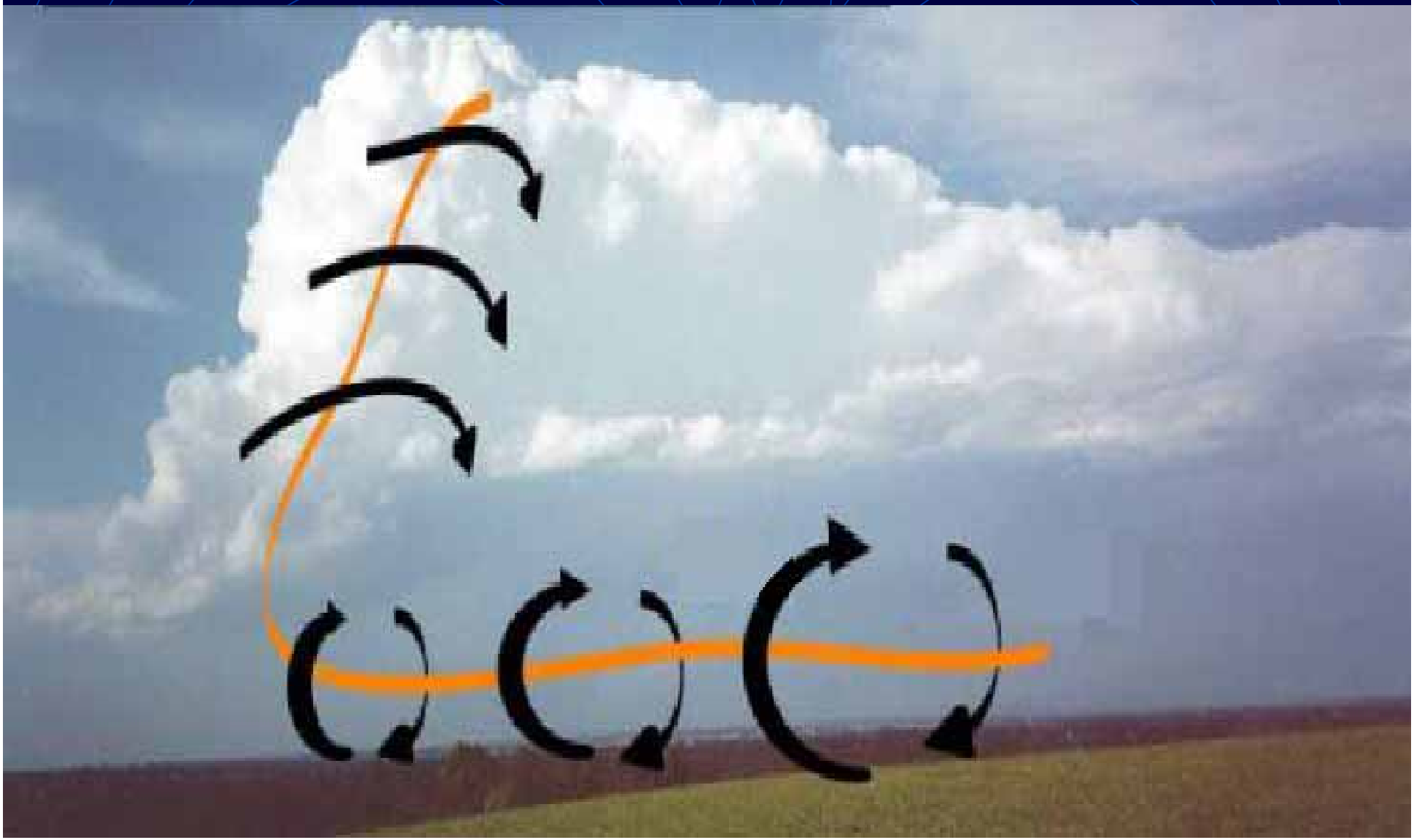
The Role of Wind Shear in creating Supercells





- Greatest impact on storm organization!
- Change of wind speed and/or direction with height.

Shear Causes Tilted Updraft and a Longer Lived Storm

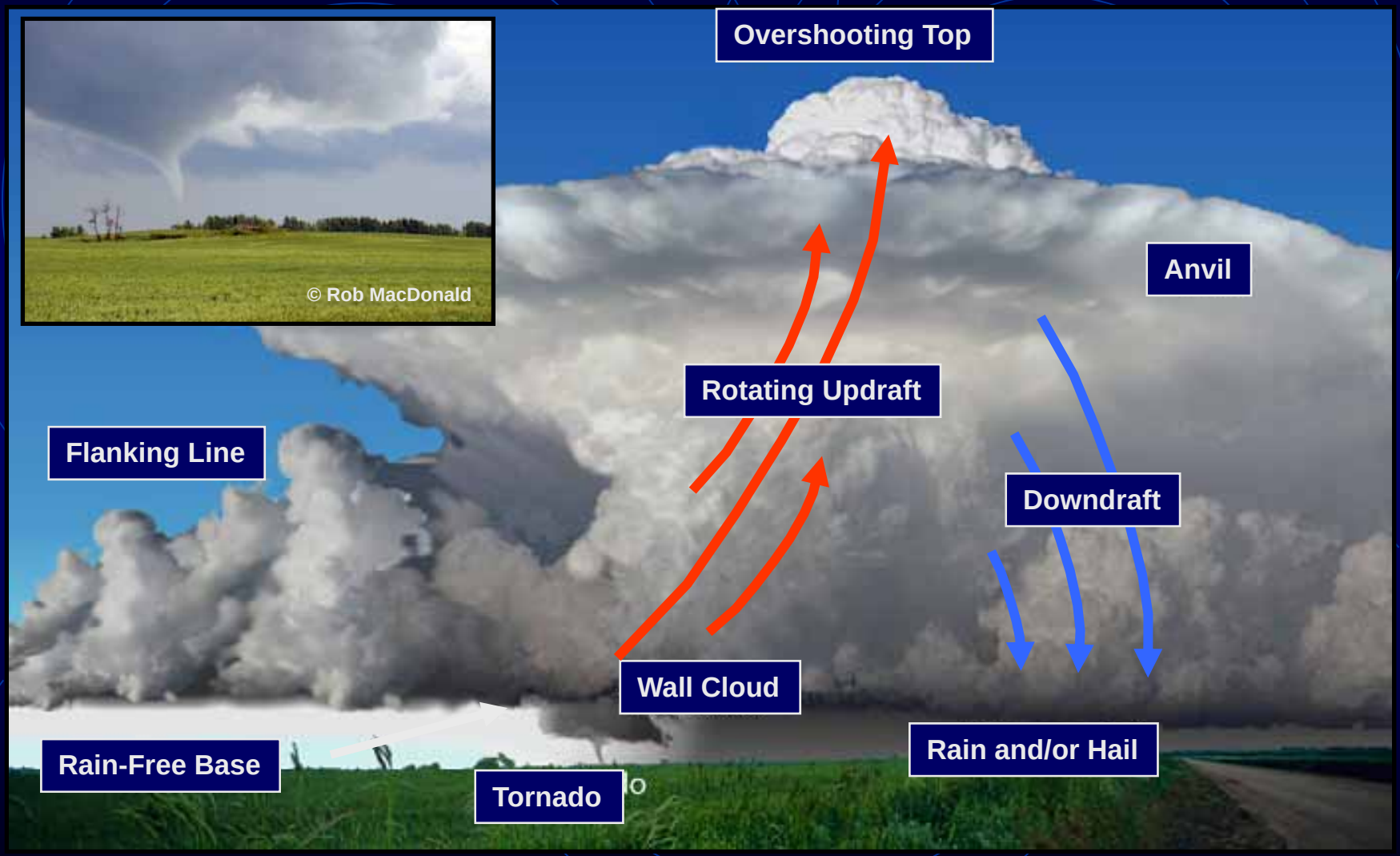


Supercell Thunderstorm

What you Need to Know

- Highly organized
- Less than 5% of all t-storms
- Long lasting (> 3 hours)
- Almost always associated with Severe Weather
- Can produce large, violent tornadoes
- Can produce softball size hail, flash floods and damaging downburst winds

Supercell Visual Clues



Supercell Mesocyclone Recognition

Lancaster MN Rotating Supercell
July 31, 2004

- Laminar or smooth appearance
- Striations – bands of light and dark shading

Characteristics of a Wall Cloud

Four Characteristics of a Tornadic Wall Cloud

Persistence
- 10 to 20 minutes or more

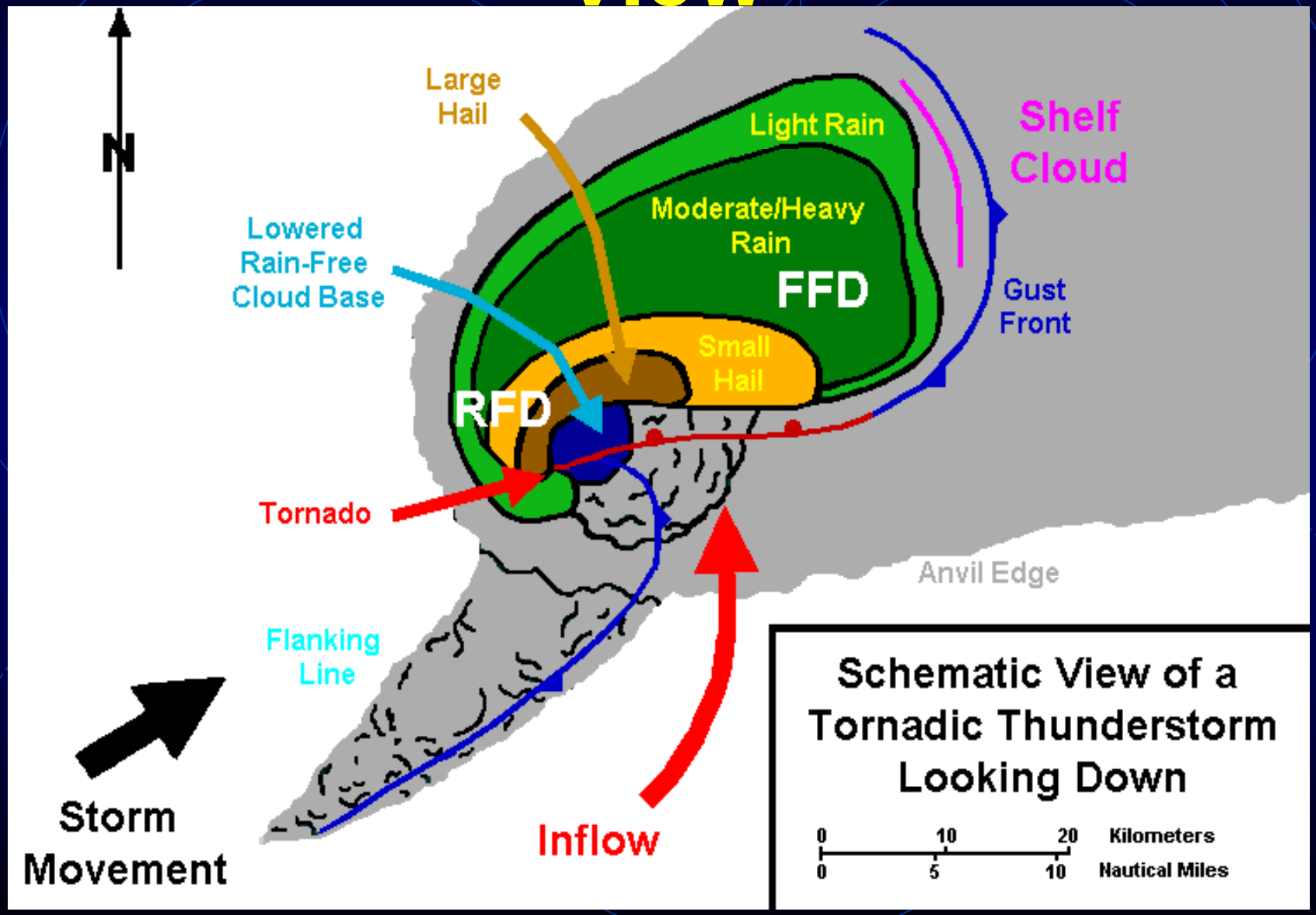
Rotation
- Fast and sometimes violent

Strong surface inflow
- 20-30+ mph winds blowing into the wall cloud

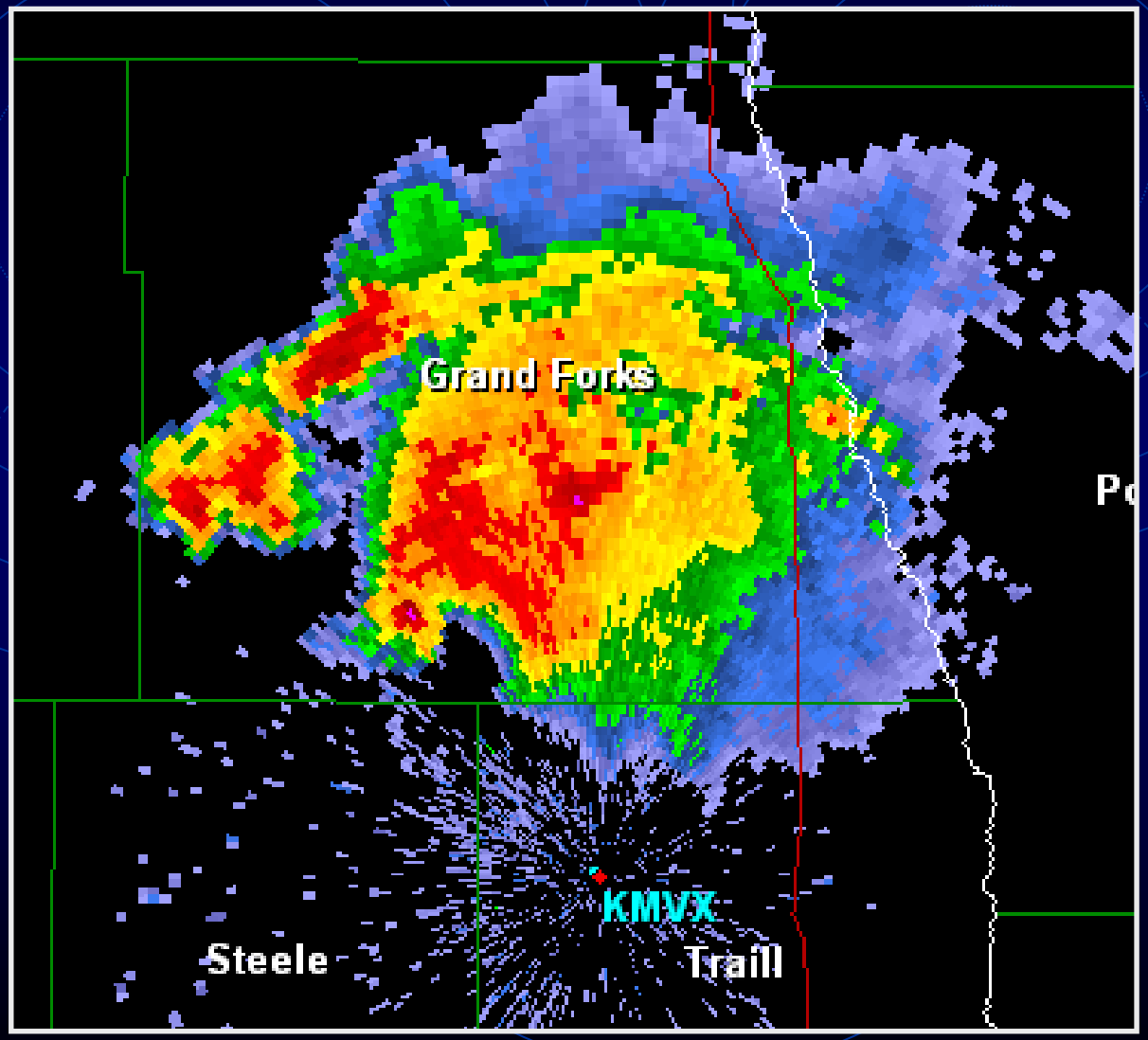
Rapid vertical motion
- Up or down near the wall cloud

Mammatus Clouds – Visual Clue that a Supercell is Nearby

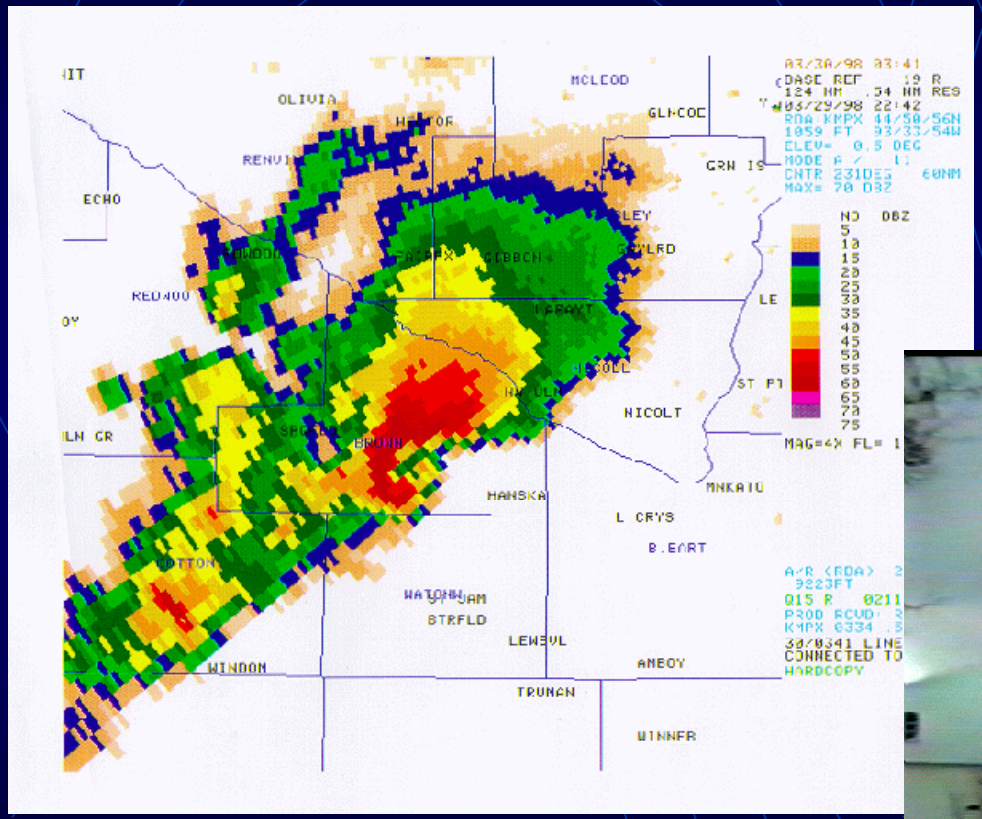
Classic Supercell – Bird-eye View



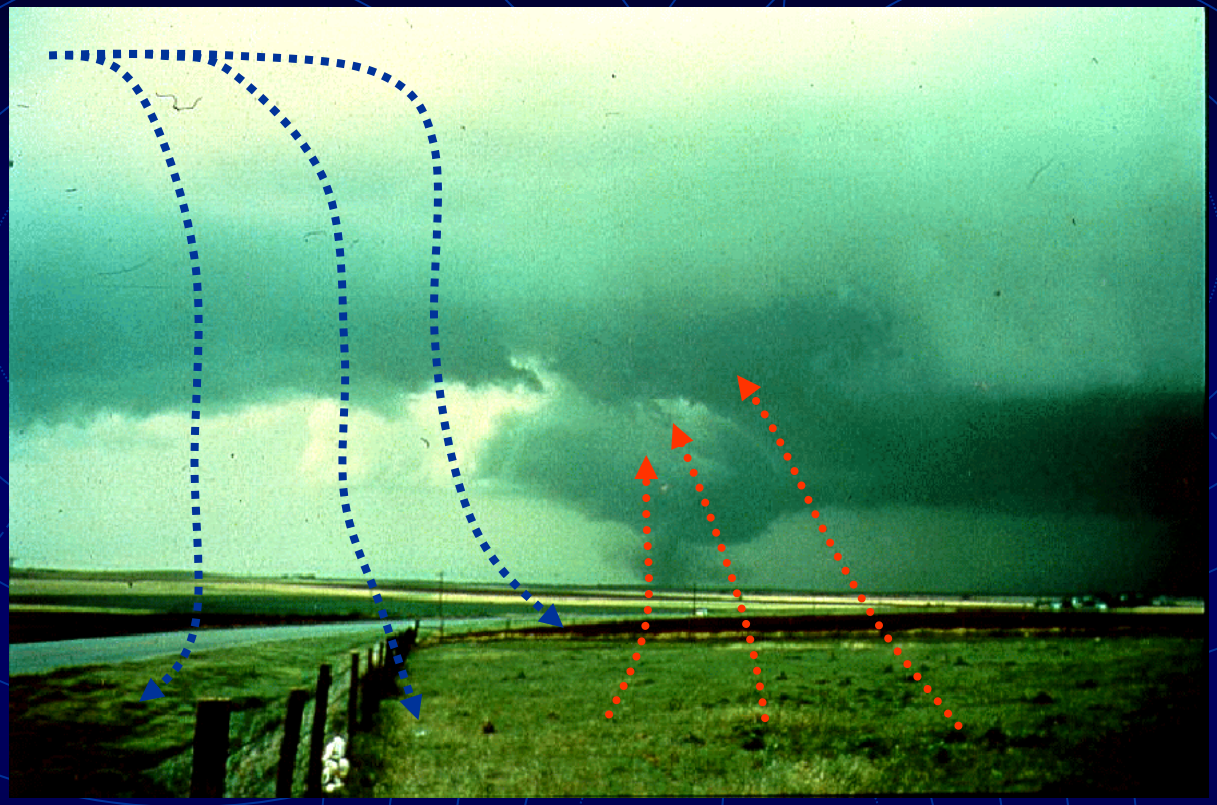
Northwood, ND Supercell as Shown by Radar



Comfrey/St. Peter, MN Tornado March 29,1998

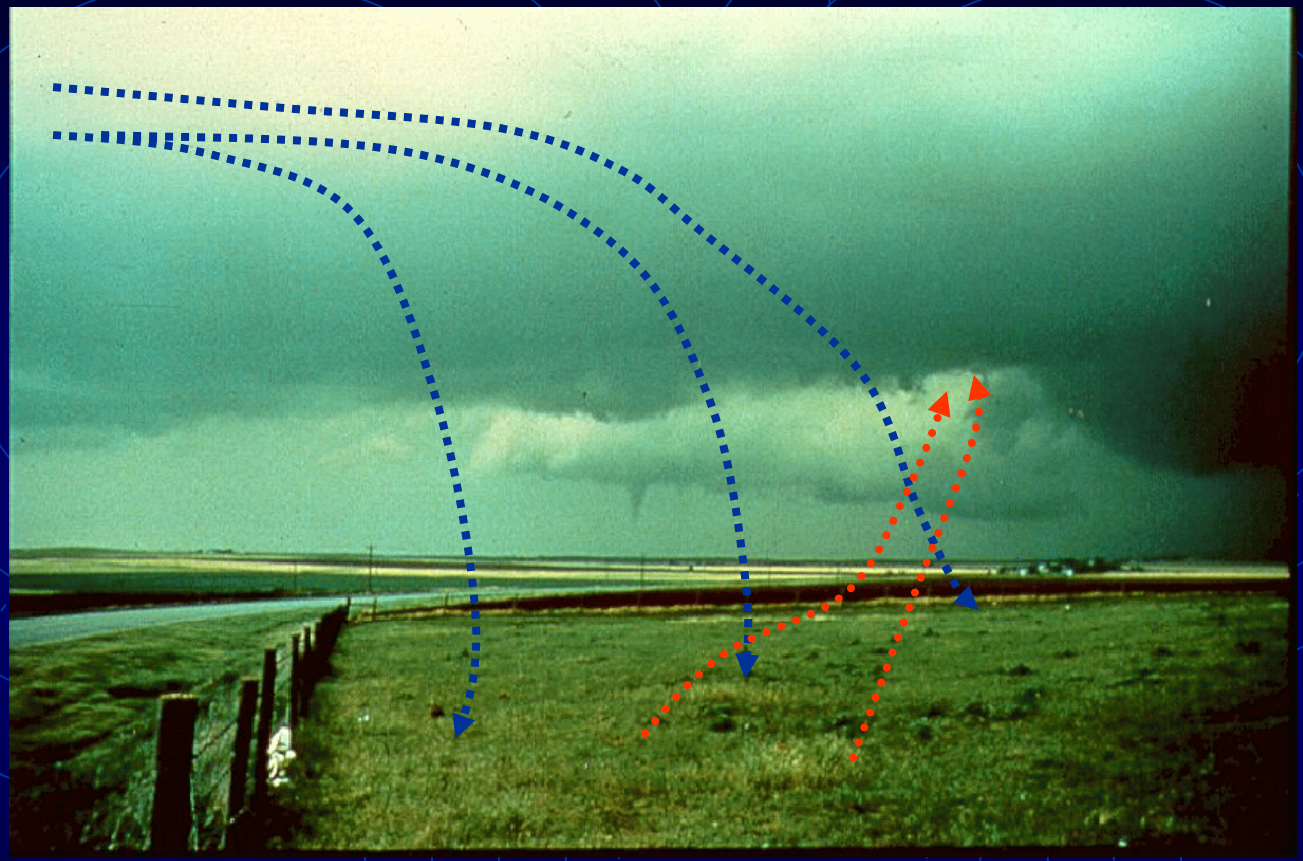


Rear Flank Downdraft



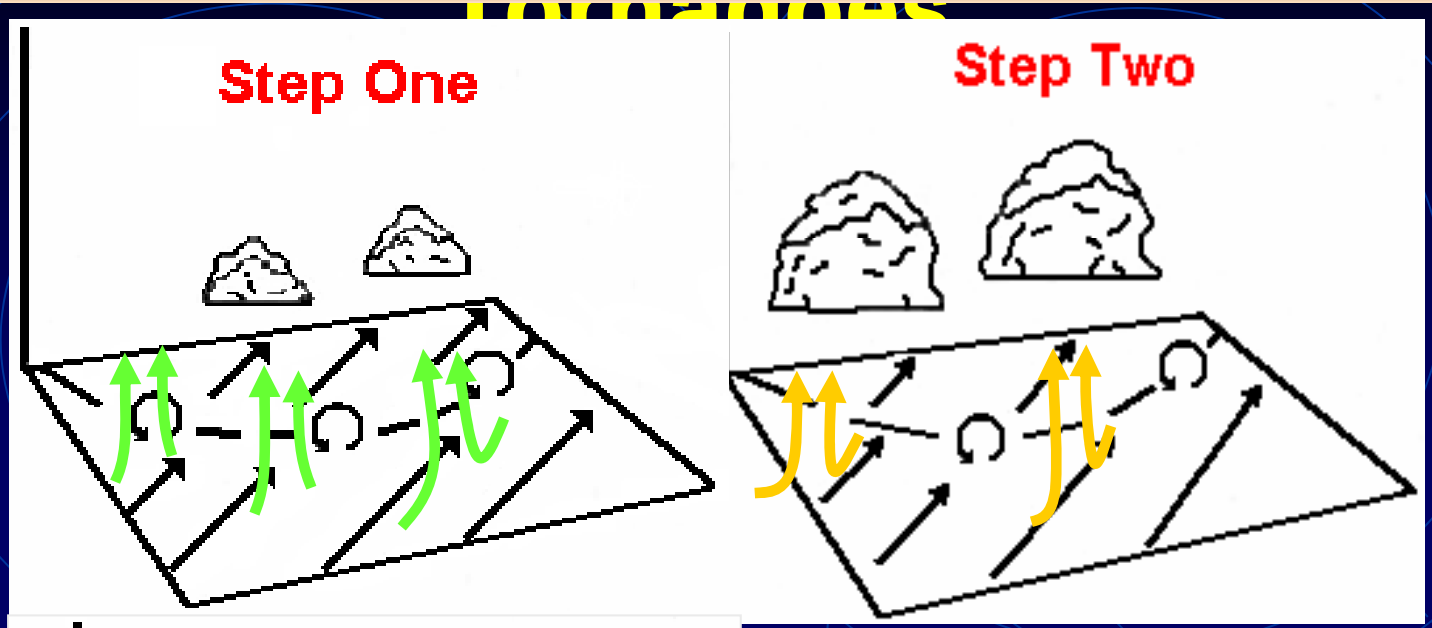
- Develops in the mid levels of the storm on the back side
- Descends to the ground
- May appear as a “clear slot” or “bright slot” just to the rear of the wall cloud.

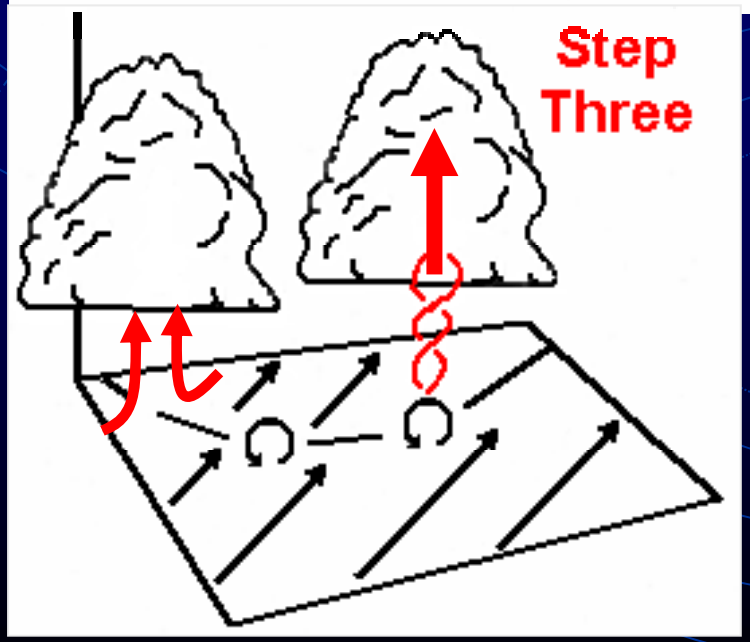
Rear Flank Downdraft



- May enhance atmospheric spin enough to result in tornado
- May cutoff moist inflow reducing tornado threat, or weaken existing tornado

Non-Supercell Landspout Tornadoes

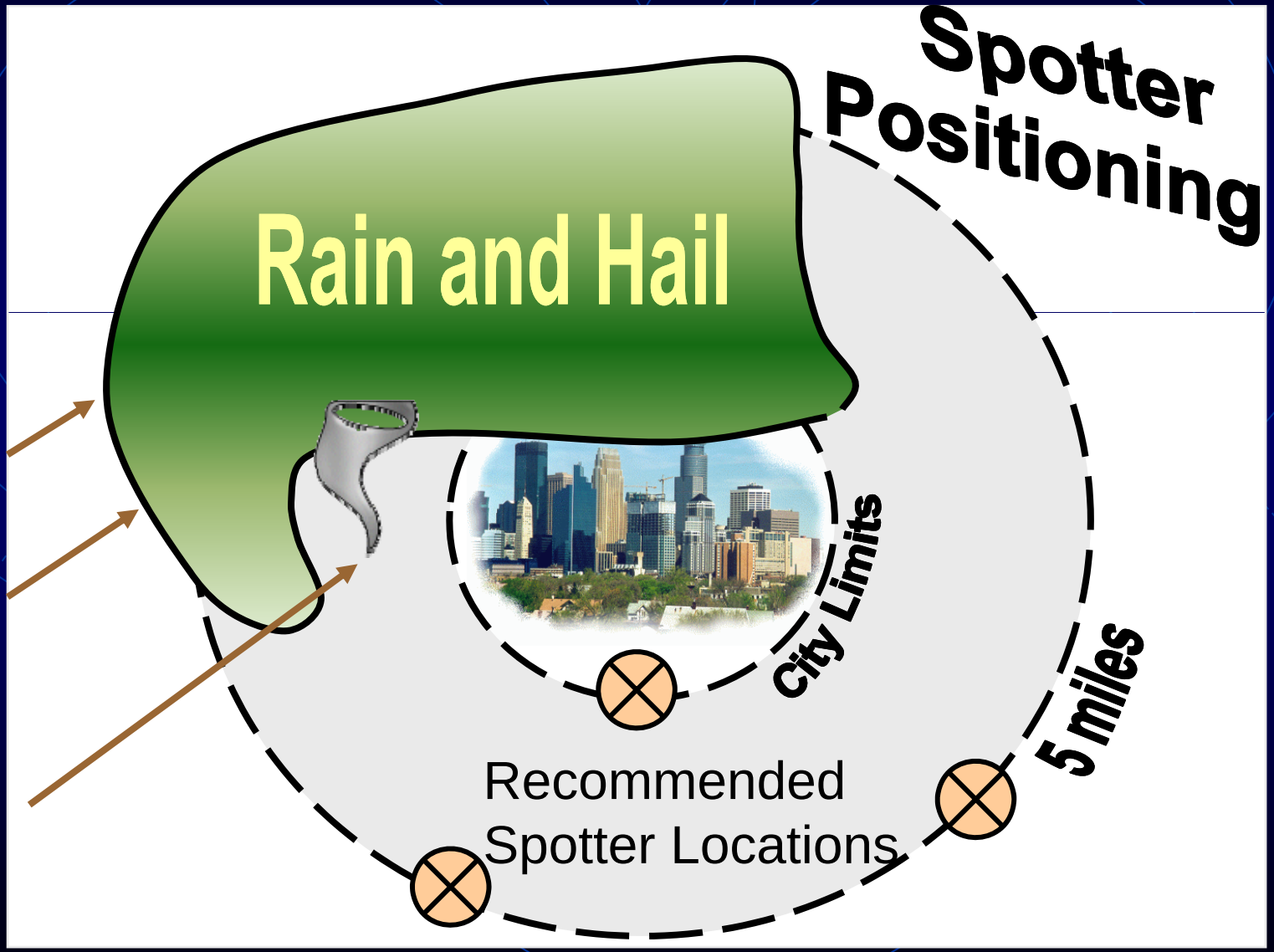




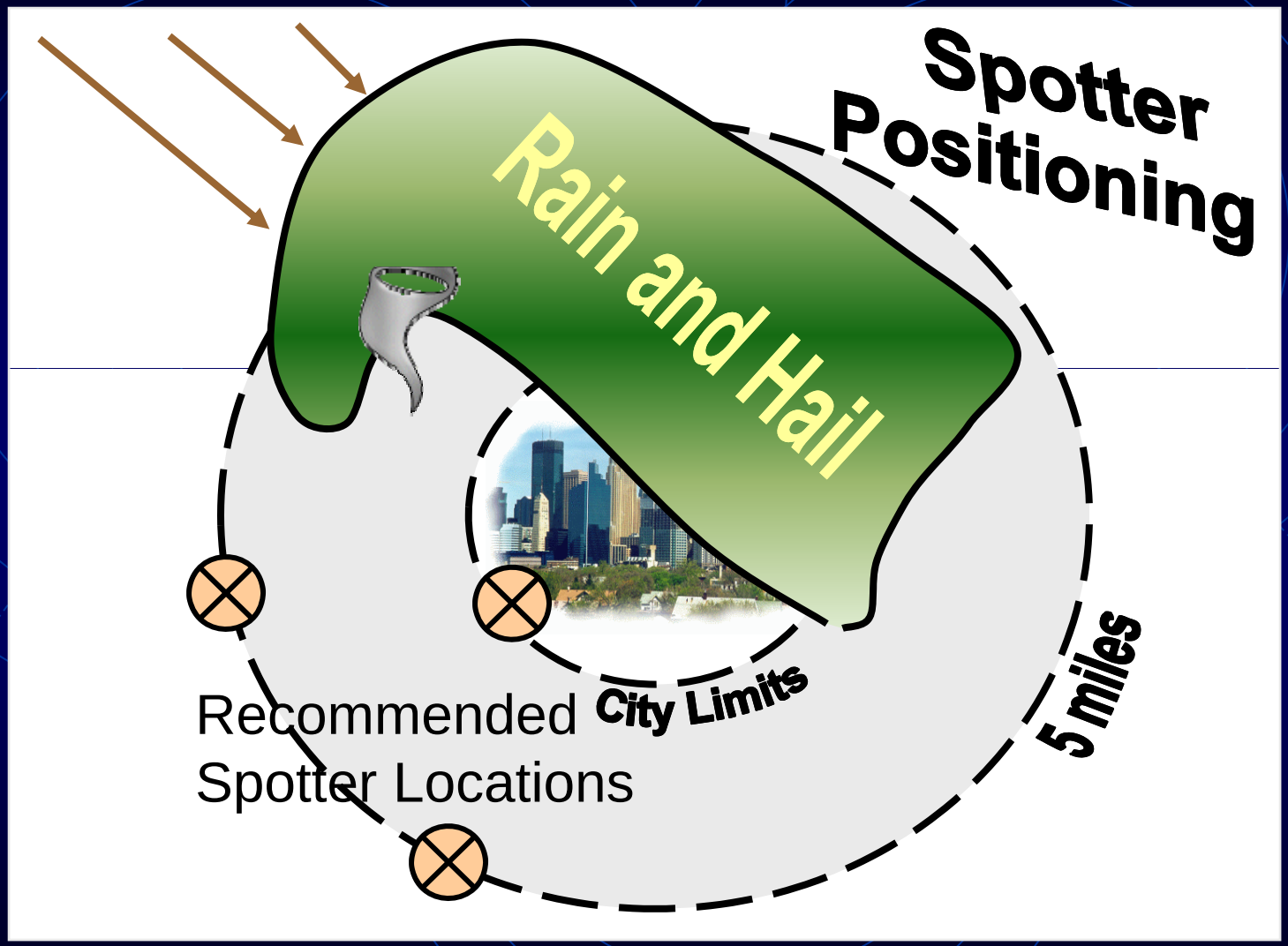
Landspout tornadoes develop from the ground up under a developing updraft.

Landspouts

Spotter Positioning for Tornadoes



Spotter Positioning for Tornadoes



Watch out for rear flank downdraft winds that could exceed 60 mph

Rear Flank Downdraft Winds

Visual Clues of Tornado Development

- Increasing spin at cloud base, wall cloud
- Appearance of debris swirl under wall cloud
- Clear slot develops due to rear-flank downdraft

Visual Clues of Tornado Development

Wall Cloud Development

Where is the wall cloud?

Tornado Development

Tornado/Funnel Cloud Look-Alikes

Rain/Hail Shaft: **Dense formation between strongly rotating, well-developed mesocyclone and wall cloud, and the ground.**

Tornado/Funnel Cloud Look-Alikes

Rain Shafts: When a rain shaft is located behind the center of an obvious rotating supercell, spotters can be fooled into thinking a tornado is present. This is especially true at long distances when signs of rotation are not discernable.

Tornado/Funnel Cloud Look-Alikes

Non-rotating Low Clouds:
Make sure the cloud is rotating and look for debris near the surface.

Tornado/Funnel Cloud Look-Alikes

Important things to look for when you see a suspicious cloud feature:

1. **Rapid cloud rotation**
2. **Concentrated whirling debris or dust cloud under updraft (rain free) base or wall cloud**
3. **Cloud fragments condensing and rising into the developing tornado**

Tornado/Funnel Cloud Look-Alikes

Non-rotating Low Cloud: Large, harmless scud cloud below storm base, in the outflow region behind the narrow shelf cloud visible in the foreground. The hill elevates the visual horizon and gives the illusion that the cloud is on/near the ground.

Tornado/Funnel Cloud Look-Alikes

This is an Optical Illusion. This was an upward-directed shadow, cast on a higher cloud deck by a low cloud eclipsing the setting sun. Shows potential for error when trees or buildings obscure view.

Tornado/Funnel Cloud Look-Alikes

Smoke-nado from video taken by MNDOT camera. Photo of smoke from a tire fire in Anoka that had been burning for 4 hours. The line across the sky was the smoke from the fire caught in an inversion.

Enhanced Fujita Damage Scale

Scale	Wind Estimate (mph)*	Typical Damage
EF0 (weak)	**65 to 85**	**Light Damage** Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over.
EF1 (weak)	**86 to 110**	**Moderate Damage** Roof tiling peeled off; Mobile homes pushed off foundations or overturned.
EF2 (strong)	**111 to 135**	**Considerable Damage** Roofs torn off frame houses; mobile homes destroyed; large trees snapped or uprooted; cars lifted off ground.
EF3 (strong)	**136-165**	**Severe Damage** Roofs and some walls torn off well-constructed houses; most trees in forest uprooted.
EF4 (violent)	**166-200**	**Devastating Damage** Well-constructed houses leveled; cars thrown and large missiles generated.
EF5 (violent)	**200 plus**	**Incredible Damage** Strong frame houses leveled off foundations and swept away; trees debarked.

What is This?

Scud Cloud

Tornado

Wall Cloud

Shelf Cloud

What is This?

Funnel Cloud

Wall Cloud

Tornado

Shelf Cloud

What is This?

Scud Cloud

Wall Cloud

Tornado

Shelf Cloud

What is This?

Heavy Rain

Wall Cloud

Tornado

Shelf Cloud

What is This?

Scud Cloud

Tornado

Wall Cloud

Shelf Cloud

What is This?

Scud Cloud

Wall Cloud

Tornado

Smoke

What is This?

Funnel Cloud

Wall Cloud

Tornado

Shelf Cloud

What is This?

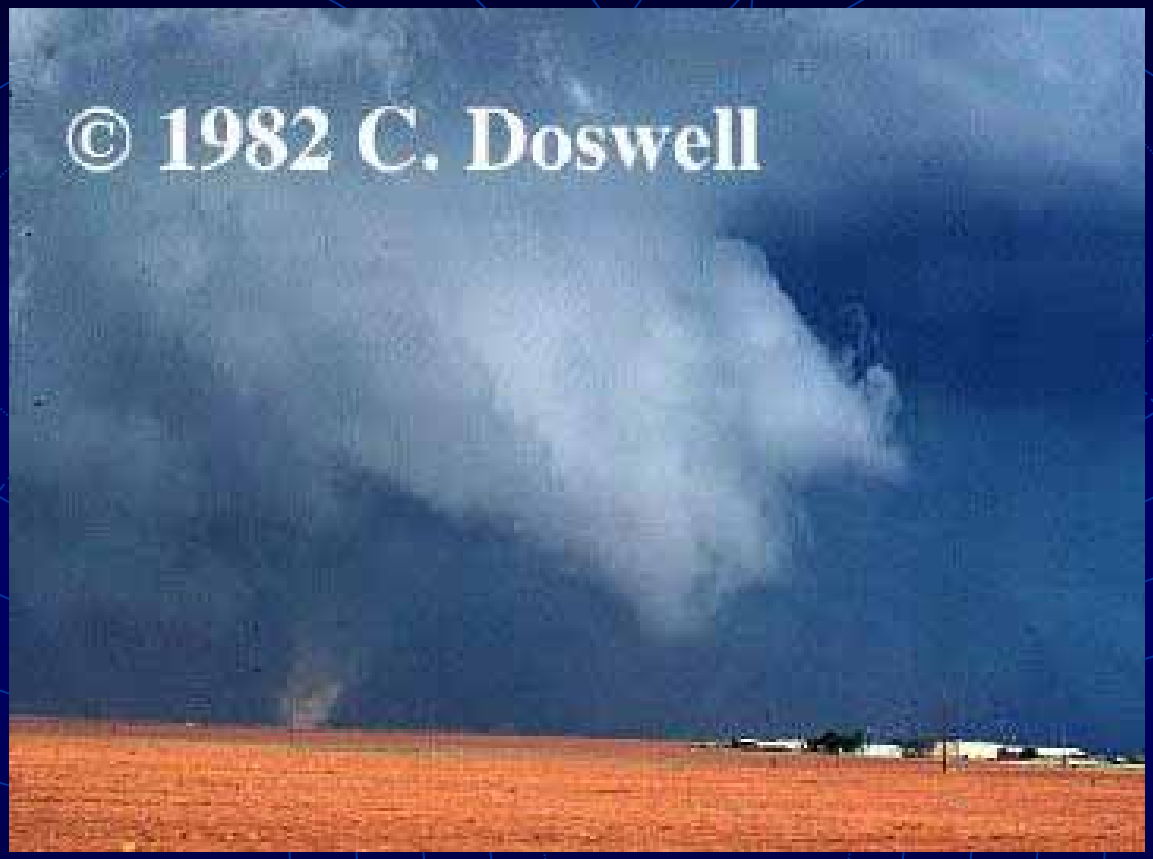
Scud Cloud

Tornado

Wall Cloud

Shelf Cloud

What is This?



Scud Cloud

Wall Cloud

Tornado

Shelf Cloud

What is This?

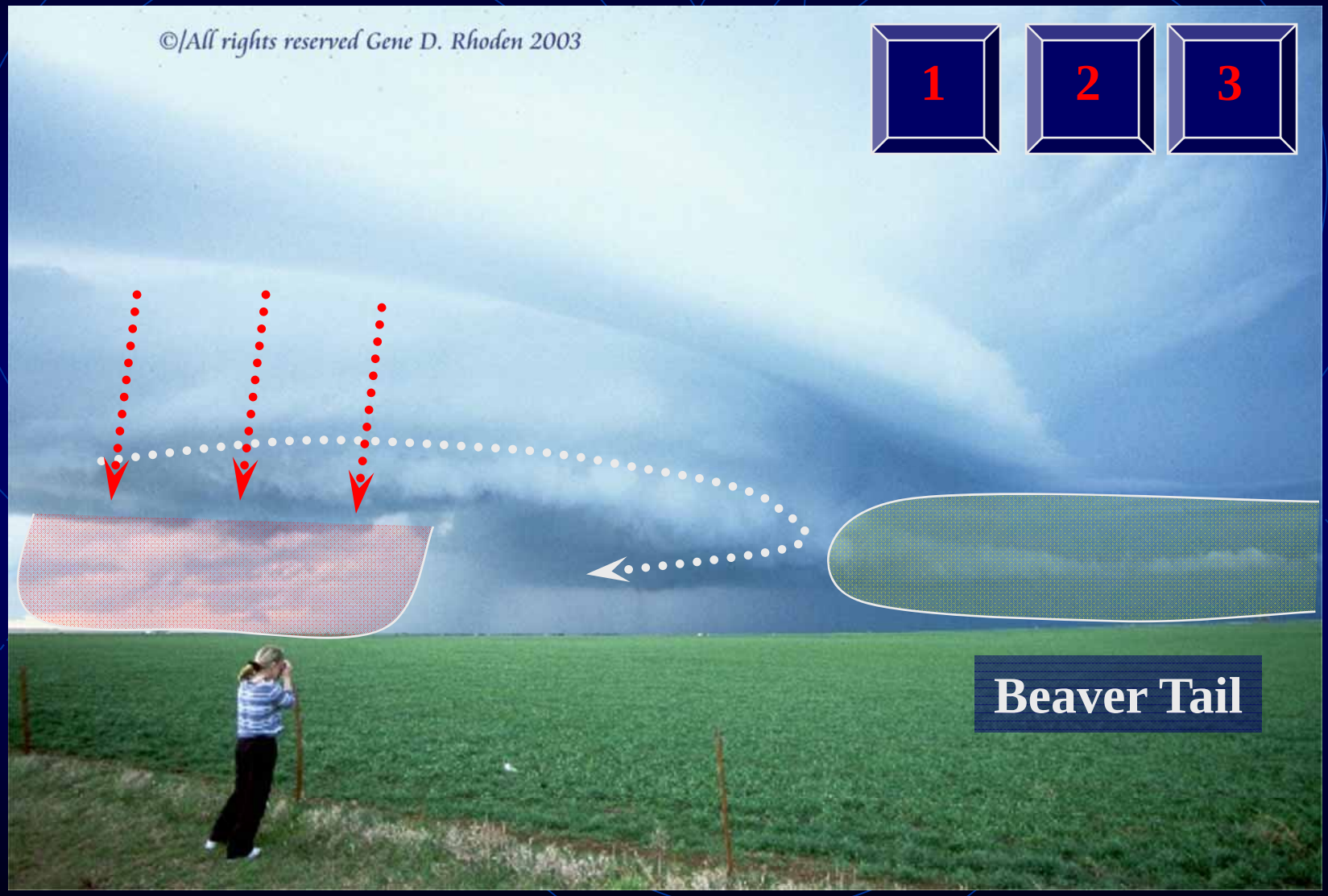
Scud Cloud

Wall Cloud

Tornado

Shelf Cloud

Name the Feature and Storm Type



Parkersburg, IA EF5 – 5/25/08

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Credit Grundy County Sheriff

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Credit Grundy County Sheriff

Shelf Cloud near Goodland, KS

The Power of Moving Water

Road Collapses from Flash Flood

Tornado at Night

Unpredictable Lightning

Lightning Safety

The End!

- Thank you for your time
- Remember to visit our website at
- **http://weather.gov/grandforks**