

2009 SKYWARN Spotter Course

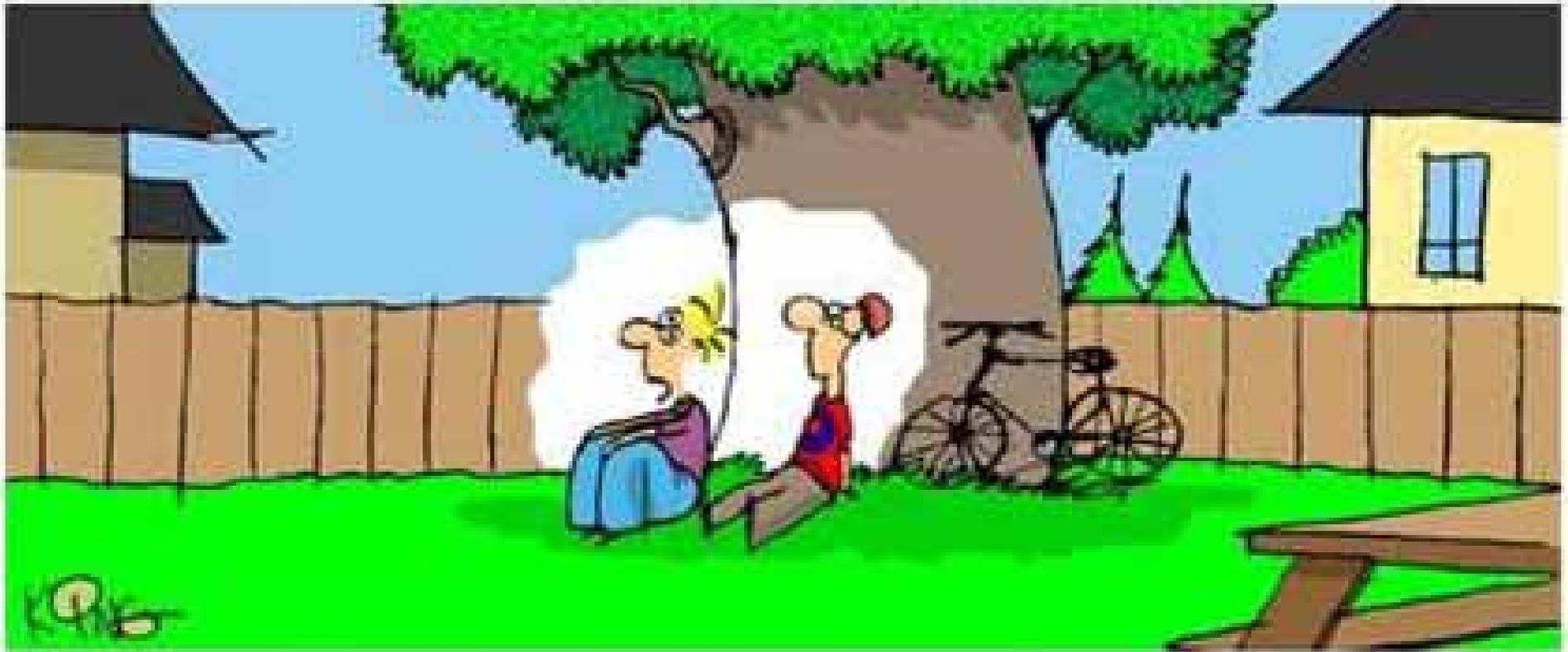
Reporting, Detection, and Survival !



24 hr spotter line 1-800-667-1218

weather.gov/fqf

Be careful what you tell your kids!



"My mom said my room looked like a tornado hit it. I've been out here all day, and I haven't seen a single tornado. How is that possible?"



SKYWARN Spotter Training Program

Introduction and Hazard Awareness

- Role of NWS and spotters
- What basic Information to Report
- Review of past Severe Weather Events
- What is a Severe Thunderstorm
- Tornado vs Funnel Cloud
- A 10 min Break -- Please fill out Spotter Information Forms

What to look for

- Thunderstorm Life cycle
- Thunderstorm Types
- Storm Structure - what to look for

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.**



The Threats

This is why we Need NWS Warnings ...and Spotters!!

Floods

Car in flooded stream - AZ

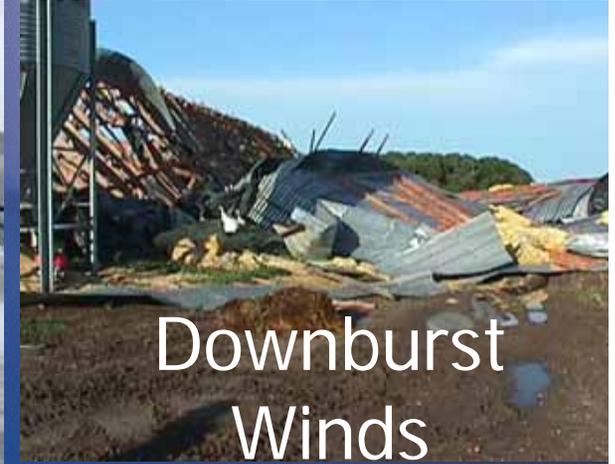


©Warren Faldley/Weatherstock®

Blizzards



Downburst
Winds



Tornadoes



Barnes Co ND 7/18/04

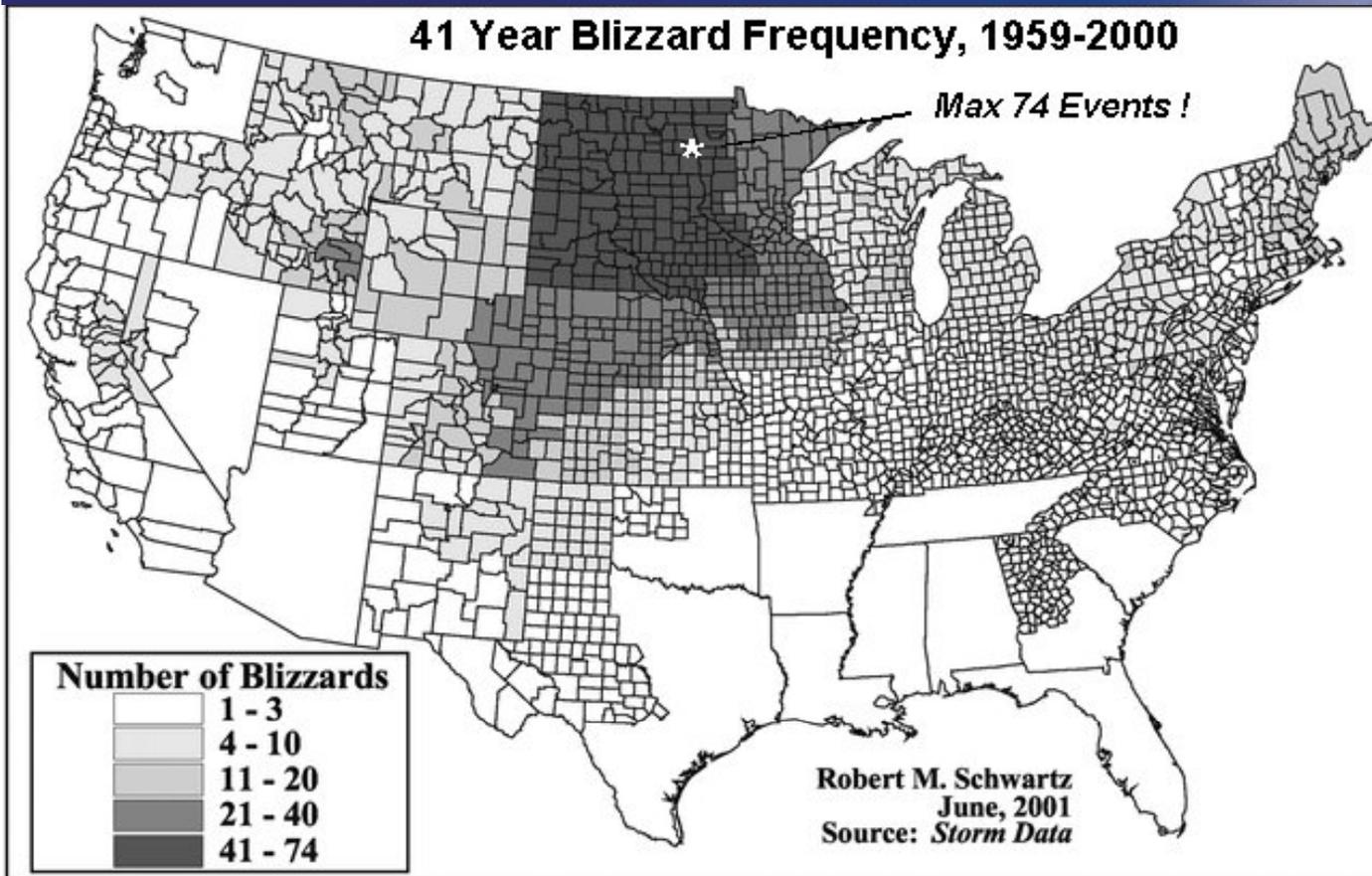
Lightning



Hail



We Are the Blizzard Capital



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!!!

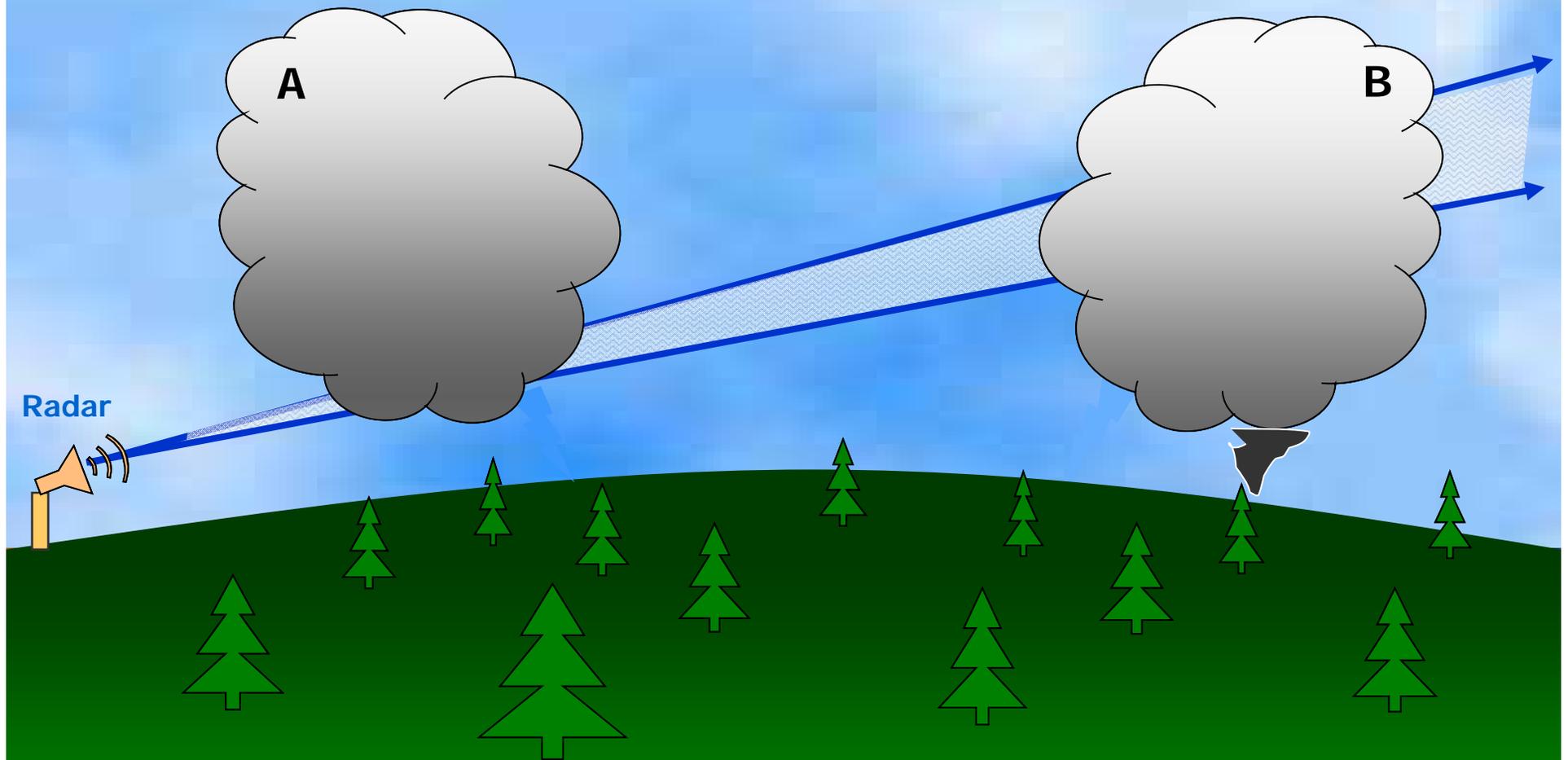
- * Never assume NWS knows everything
- * You may be the reason the warning is issued
- * You may save the lives of those in harms way
- * Ground truth information is what gets everyone's attention
- * Even if a warning is issued, we still need reports!



Operations Area

Why we Need Spotter Reports

RADAR HORIZON



Radar beam cannot see lower portion of storm "B"

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



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

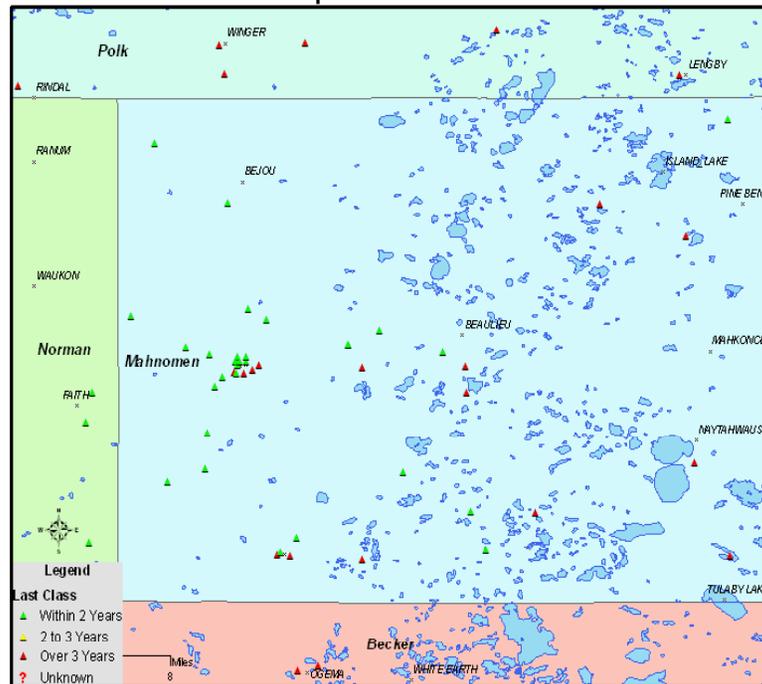
DO YOU WANT TO BE AN ACTIVE SPOTTER? YES NO

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

Storm Spotter Data in GIS



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.

National Weather Service
eSpotter
Online Weather Reporting System

Home News Organization Search

eSpotter Online Weather Reporting System

New to eSpotter? [[Register Here](#)]

eSpotter is an experimental project in the central region area to facilitate the submission of spotter reports online. The system is being developed to enhance and increase timely & accurate online spotter reporting and communications between spotters and their local weather forecast offices.

The use of the system is currently available for trained spotters and emergency managers. eSpotter enabled offices are listed at the bottom of this page.

Registered Users: Log In

Email Address:

Password:

Forgot your password?
[Click here.](#)

Connections made to this system are monitored. Your email address is used to verify that you are authorized to access this system, and to provide a means for contacting you to

<http://espotter.weather.gov>

(Central Region Area Only)

eSpotter
Main
Request Access

Online Training
Introduction

Access
Logon Screen

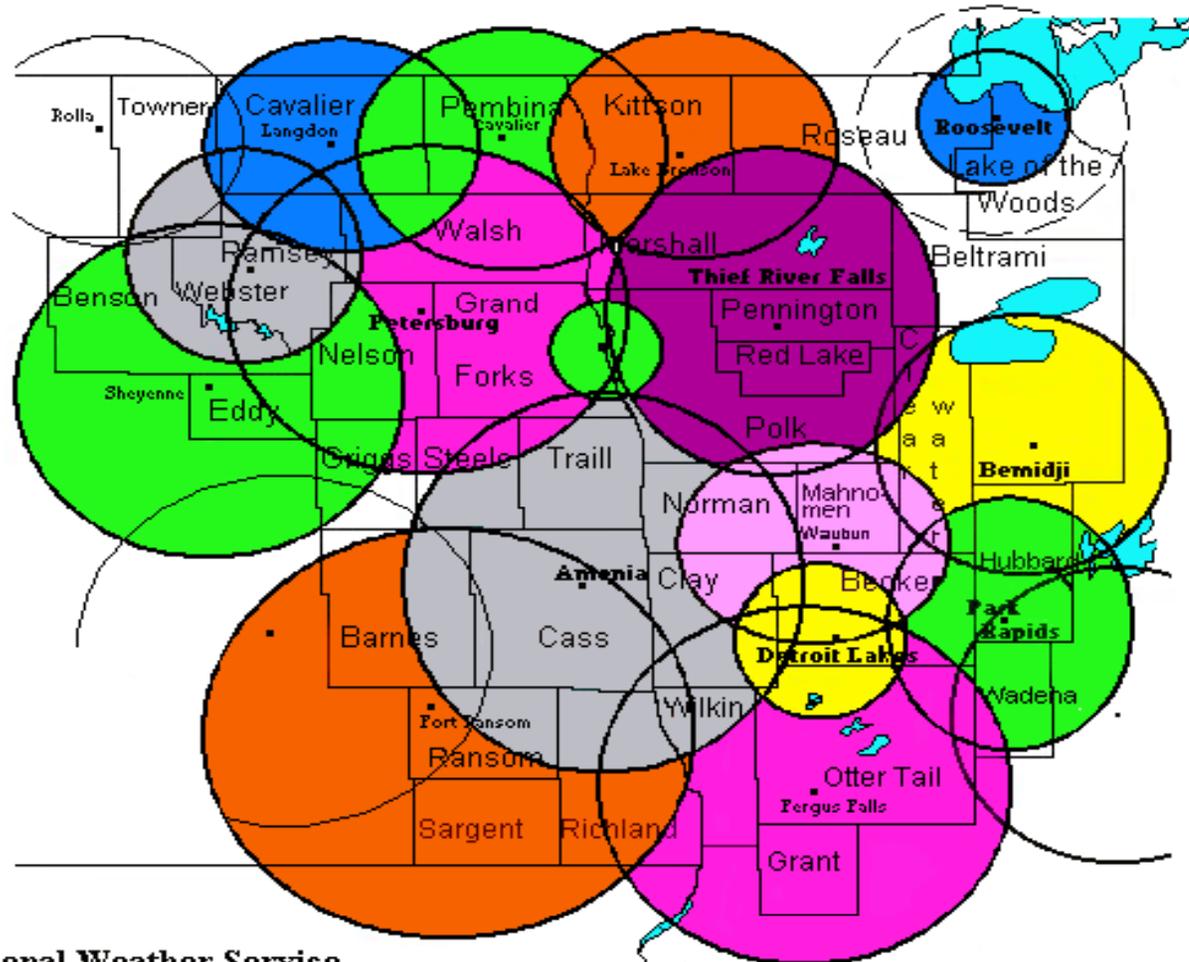
Main Menu
Left
Top
Center

Main Menu (top)
Location
Create Report
Messages

Contact Us
cr.espotter@noaa.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 HWN-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 HWN-43
(SLAVE TO WEBSTER)
162.500 MHZ
- PARK RAPIDS WVG-98
(SLAVE TO DTL)
162.475 MHZ
- PETERSBURG WXM-38
162.400 MHZ
- ROOSEVELT WWF-45
(SLAVE TO TRF)
162.450 MHZ
- SHEYENNE HWN-46
162.525 MHZ
- THIEF RIVER FALLS WXH-43
162.550 MHZ
- WAUBUN WNG-610
(SLAVE TO DTL)
162.450 MHZ
- WEBSTER WVG-25
162.425 MHZ

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

NWS Grand Forks on the Internet

NOAA's National Weather Service Weather Forecast Office
Grand Forks, ND

Home Site Map News Organization Search for: NWS All NOAA Go

Local forecast by "City, St" or Zip Code
City, St Go

Current Hazards
Watches / Warnings
Outlooks
U.S. Hazards
Hurricane Info
Submit Storm Report
EM Briefing

Current Conditions
Observations
Satellite Images
Rivers & Lakes AHPS
Precip Estimate
Snow Cover
Weather Cameras

Radar Imagery
Local Radar
Nationwide

Forecasts
Activity Planner
Local Area
Aviation
Fire Weather
Graphical
Interactive
Computer Model

Rivers / Hydrology
AHPS / River Info

Climate
Local
National
More...

Weather Safety
StormReady
Preparedness
Weather Radio
EMWIN
Skywarn

Local Information
Our Office
Coop Observer
County Warning Area
Science

Top News of the Day
Skywarn Talks for 2009
Archived News Stories

Watches & Warnings Observations Forecast Graphics Rivers & Lakes Climate Fire Weather

Click on the map below for the latest forecast.

Flood Info.

Point and Click Forecast

Read watches, warnings & advisories
Zoom Out
Hazardous Weather Outlook

Latest Conditions in Grand Forks, ND
Feb 3 1:53 pm A Few Clouds -1°F (-18°C)
Choose Your Front Page City
Select A City:

Weather Story Radar Satellite Weather Map

Weather Story

Current Weather Observations...

Location	Time (cst)	Weather	Vsby. (SM)	Temp. (°F)	Dewpt. (°F)	Hum. (%)	Wind (mph)	Wind Chill (°F)	Pres. (in)
Bemidji, MN	14:13	Fair	10+	2	-6	68	N 5	-8	30.44
Crookston, MN	14:15	Fair	10+	-2	-8	77	Calm	NA	30.54
Devils Lake, ND	14:15	Fair	10+	-2	-15	54	SW 7	-16	30.42
Fargo, ND	14:15	Fair	10+	-2	-15	54	SW 7	-16	30.42

<http://weather.gov/grandforks>

NWS AHPS Flood Information



National Weather Service Advanced Hydrologic Prediction Service

Home News Organization Search for: NWS All NOAA

Weather Forecast Office Eastern North Dakota/Grand Forks, ND

River Observations River Forecasts Within 48 Hours Precipitation Download Other Information

Local weather forecast by "City, ST"

City, ST

Adjacent Areas:



National Conditions
Rivers
Satellite
Climate
Observed Precip

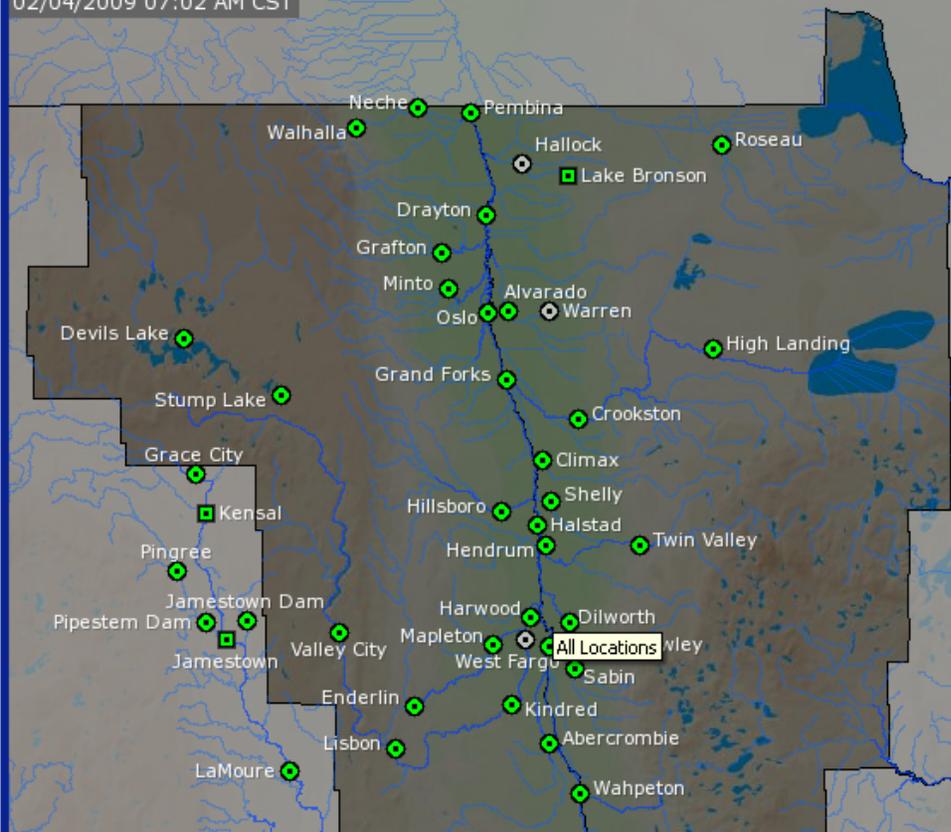
Local Conditions
Warnings
Weather Forecast
Radar

AHPS Documentation
User Guide

What is AHPS?
Facts
Our Partners

Feedback/Questions
Provide Feedback
Ask Questions

02/04/2009 07:02 AM CST



Print / Save Map

Map Legend

Hydrograph Available

Probability and Hydrograph Available

Major Flooding

Moderate Flooding

Minor Flooding

Near Flood Stage

No Flooding

Observation More Than 24 Hours Old

Out of Service

<http://www.crh.noaa.gov/ahps2/index.php?wfo=fgf>

2008 Severe Weather Review

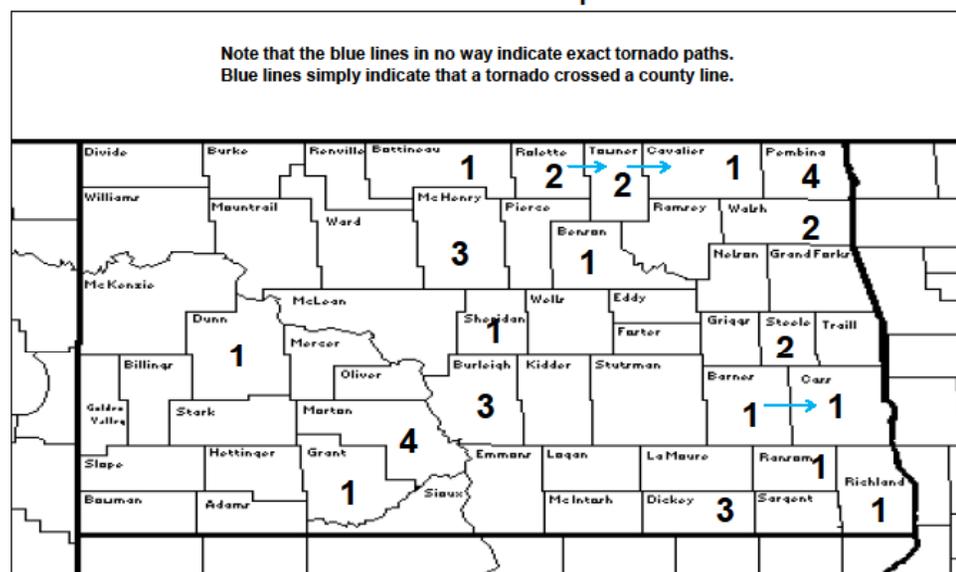
- A relatively slow severe weather season
- 13 Reported tornadoes in eastern North Dakota, 21 in northwest Minnesota
- We had a total of 34 tornadoes in our forecast area

2008 ND Tornadoes (32)

19 BIS + 13 FGF

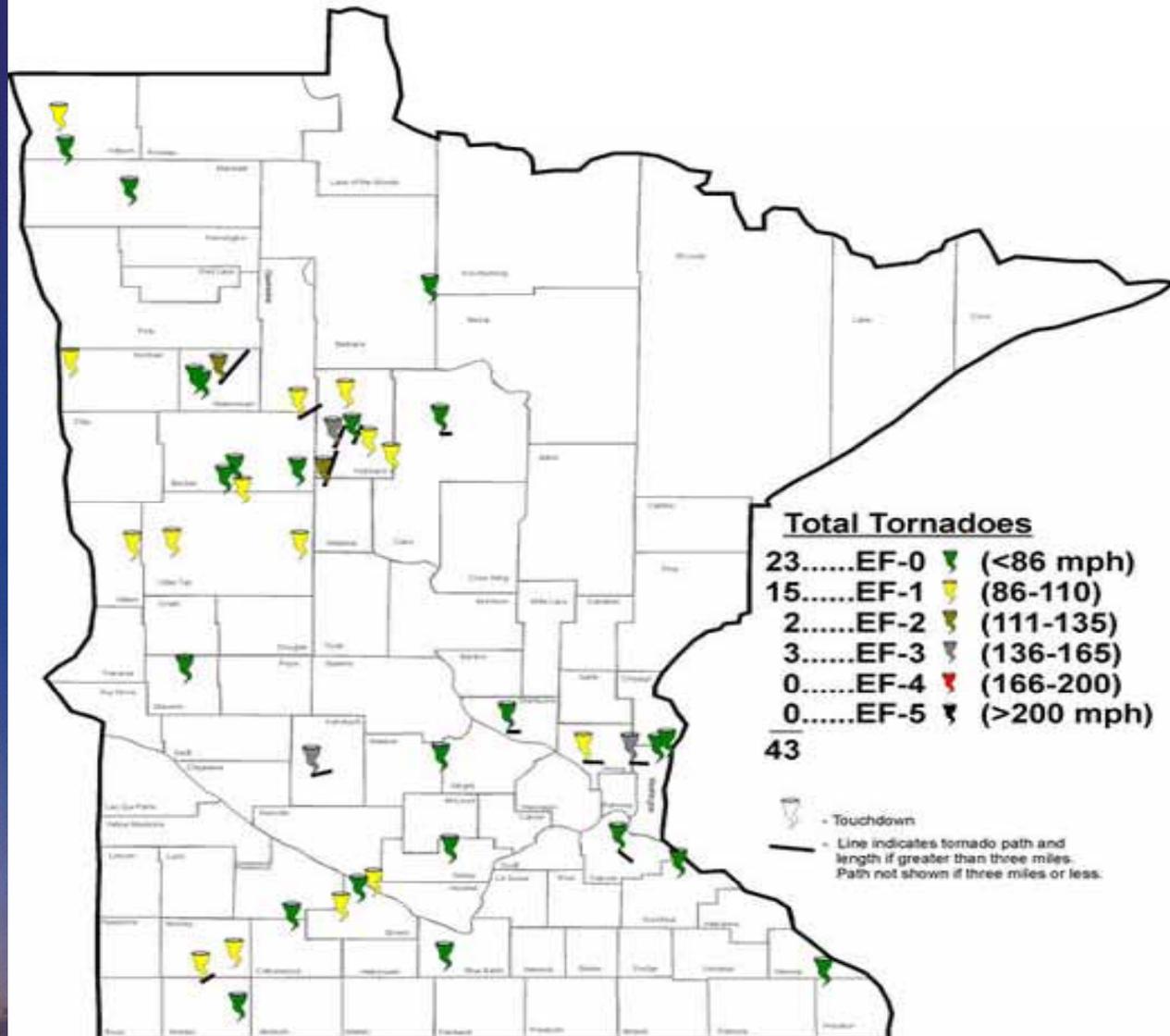
35 entries, 32 distinct tornadoes (3 crossed county lines)

1 crossed the weather office separation line



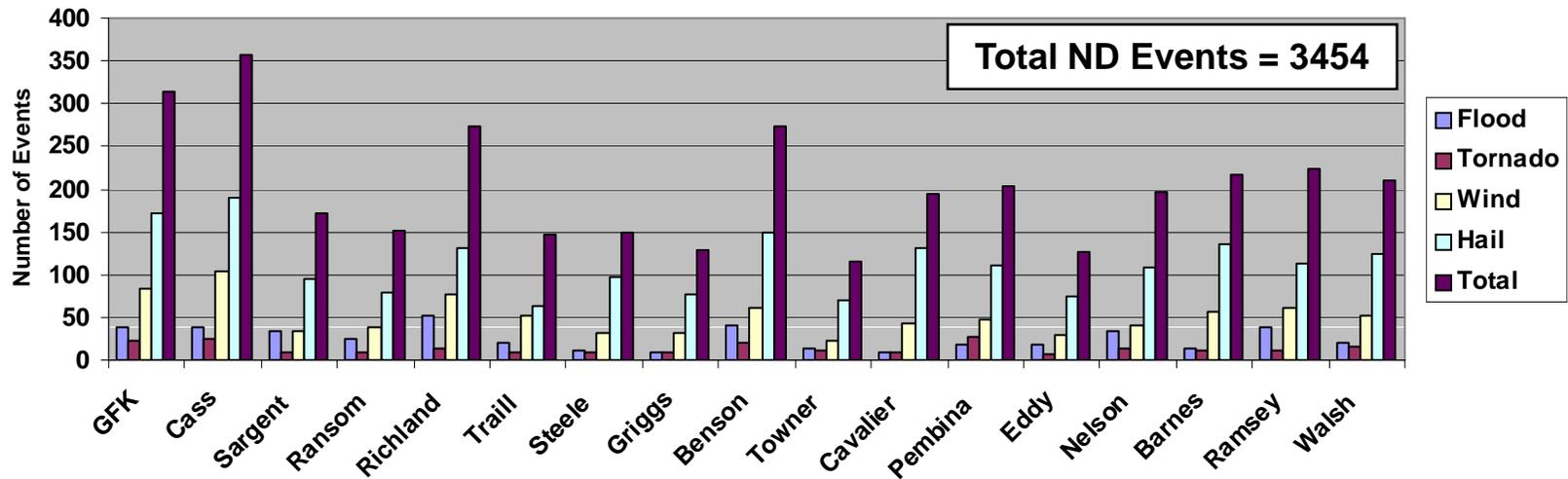
2008 Severe Weather Review

2008 Minnesota Tornadoes

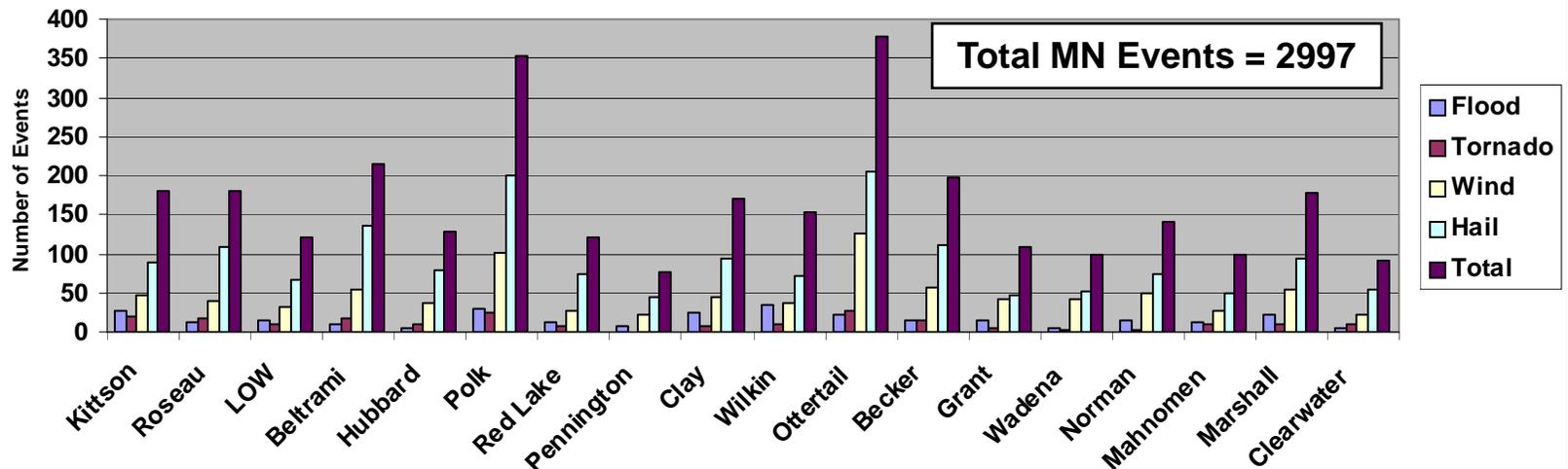


1998-2008 Severe Weather Statistics

North Dakota Convective Weather Events 1998-2008



Minnesota Convective Weather Events 1998-2008



May 25, 2008 Pembina County

4.2 miles
WNW of
Hamilton



EF3 Tornado near Park Rapids June 6, 2008

- Radar did not detect a tornado, unlike the Northwood EF4 tornado
- This tornado was not expected
- It is rare to have an EF3 tornado occur with little evidence on radar and during the morning when tornadoes usually don't occur
- Without spotter reports, this tornado would have gone un-detected using radar only
- We need your reports!!!

Tornado and Damage near Park Rapids



Funnel Clouds near Grand Forks June 9, 2008



Fargo June 14, 2008



15 SE Rocklake, ND (Towner county) July 7, 2008



Langdon, ND July 16, 2008



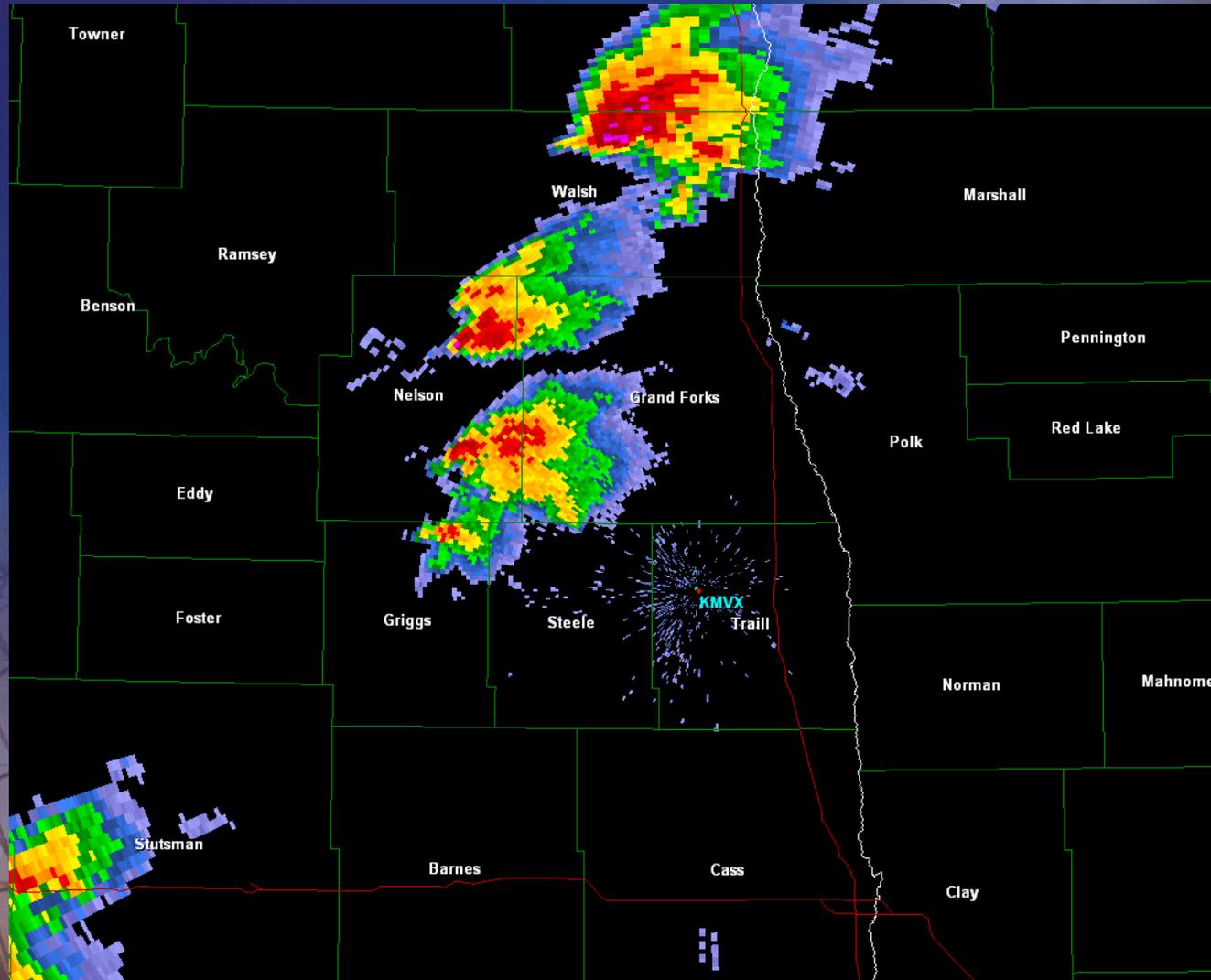
Incredible structure, we'll learn more about that later

Mahnomen July 24, 2008

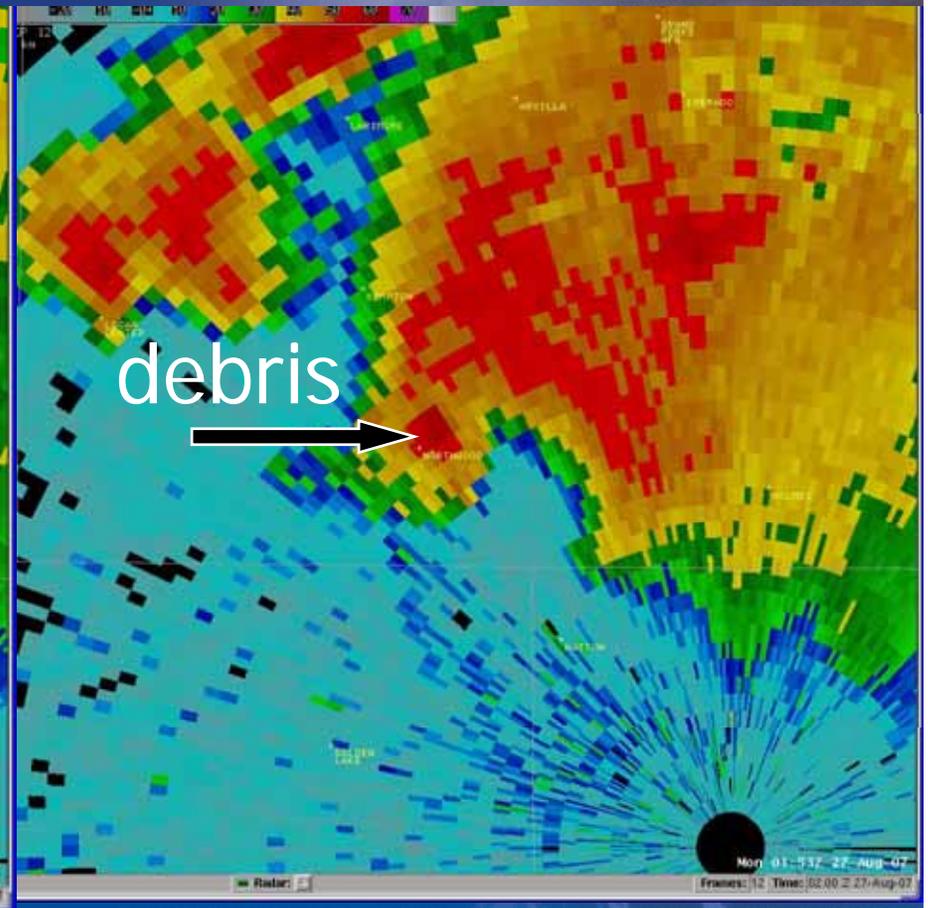
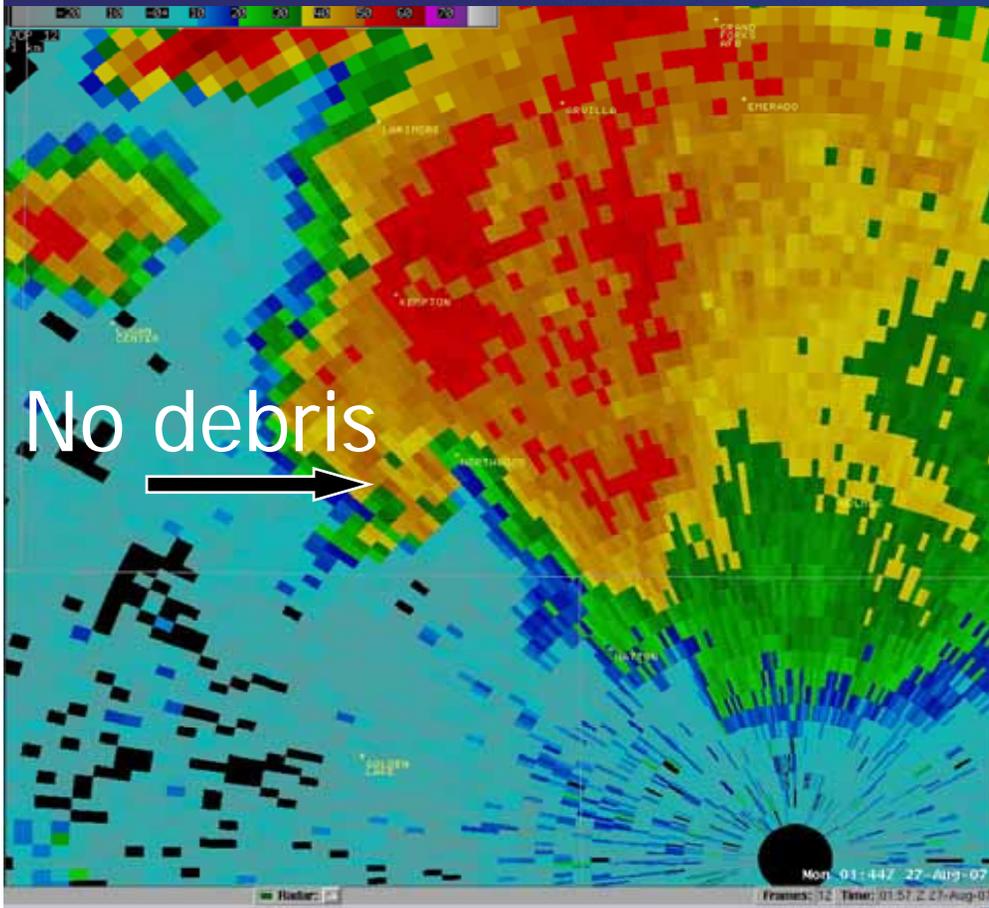


Northwood, ND EF4 Tornado

August 26, 2007



Northwood Radar Imagery Showing "Debris Ball"



844 pm CDT

853 CDT

Higher reflectivity showed the debris within the tornado

Northwood Damage Pictures



What is a Severe Thunderstorm?

4.75 inch hail Nashua MN
July 2, 2003



Hail 1" in diameter or larger
- size of a quarter or **larger!!**

This has changed from $\frac{3}{4}$ " inch or
dime size hail

(4.75 inch size hail fell in far southern Wilkin county)
Almost a state record!



Winds of 58 mph or **greater**

- Round your reports to the
nearest 10 mph (i.e. 40 mph,
60 mph, 90 mph, etc...)

**Damage from a severe thunderstorm can range
from minimal to catastrophic**

Large Hail is Destructive

1 inch size hail driven by high winds caused damage to this home near Straubville ND (Sargent Co.) On July 2, 2003



2.50 inch hail caused damage to windows in Bisbee ND (Towner Co.) on May 19, 2004



4 inch hail near Warroad on August 5th, 2006



Hail and your car windshield

Tips on Reporting Hail Size

Report the biggest hail stone you see

Don't use "marble" size!



We don't know how big your marbles are!

Tips on Reporting Hail Size

Penny	0.75 inches
Nickel	0.88 inches
Quarter	1.00 inches
Half Dollar	1.25 inches
Walnut	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

Winds from a Severe Thunderstorm can Cause Tornado-Like Damage

**Perham MN area (Otter Tail Co.)
90 mph winds destroyed this potato
barn on June 20, 2005**



**Fairdale ND (Walsh Co.)
Grain bins destroyed by winds
estimated at 100 mph July 2, 2003**



**Langdon ND area (Cavalier Co.)
Barn destroyed by high winds
on June 19, 2005**



Tips on Reporting Wind Speed

Wind Speed Estimation	Description
less than 1 mph	Calm; smoke rises vertically
1 - 3 mph	Direction of wind shown by smoke drift, but not by wind vanes
4 - 7 mph	Wind felt on face; leaves rustle; ordinary vane moved by wind
8 - 12 mph	Leaves and small twigs in constant motion; wind extends light flag
13 - 18 mph	Raises dust and loose paper; small branches are moved
19 -24 mph	Small trees in leaf begin to sway; crested wavelets form on inland waters
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 - 46 mph	Breaks twigs off trees; wind generally impedes progress
47 - 54 mph	Slight structural damage occurs
55 - 63 mph	Damage to chimneys and TV antennas; pushes over shallow rooted trees
67 - 74 mph	Rarely experienced; structural damage becomes possible
above 75 mph	Very rarely experience; see Fujita scale descriptions

Wind speed estimation taken from the Beaufort Scale.

Significant Tornadoes Can Occur Every Year



Southwest Barnes County July 18, 2004

The Power of a Tornado

Leighton, Alabama - 5/9/08



Courtesy S&M Equipment Leighton, AL & WHAT-TV Huntsville, AL

Tornado vs Funnel Cloud



Barnes Co. F4 July 18, 2004



Tornado:

A violently rotating column of air *in contact* with the ground.

- **Do not** need the visible funnel on the ground, just the rotating column of air.

Funnel Cloud:

A rotating, funnel-shaped cloud not in contact with the ground. Look for dust or debris at the ground.

Tornado vs Funnel Cloud

Is this a tornado or a funnel cloud?

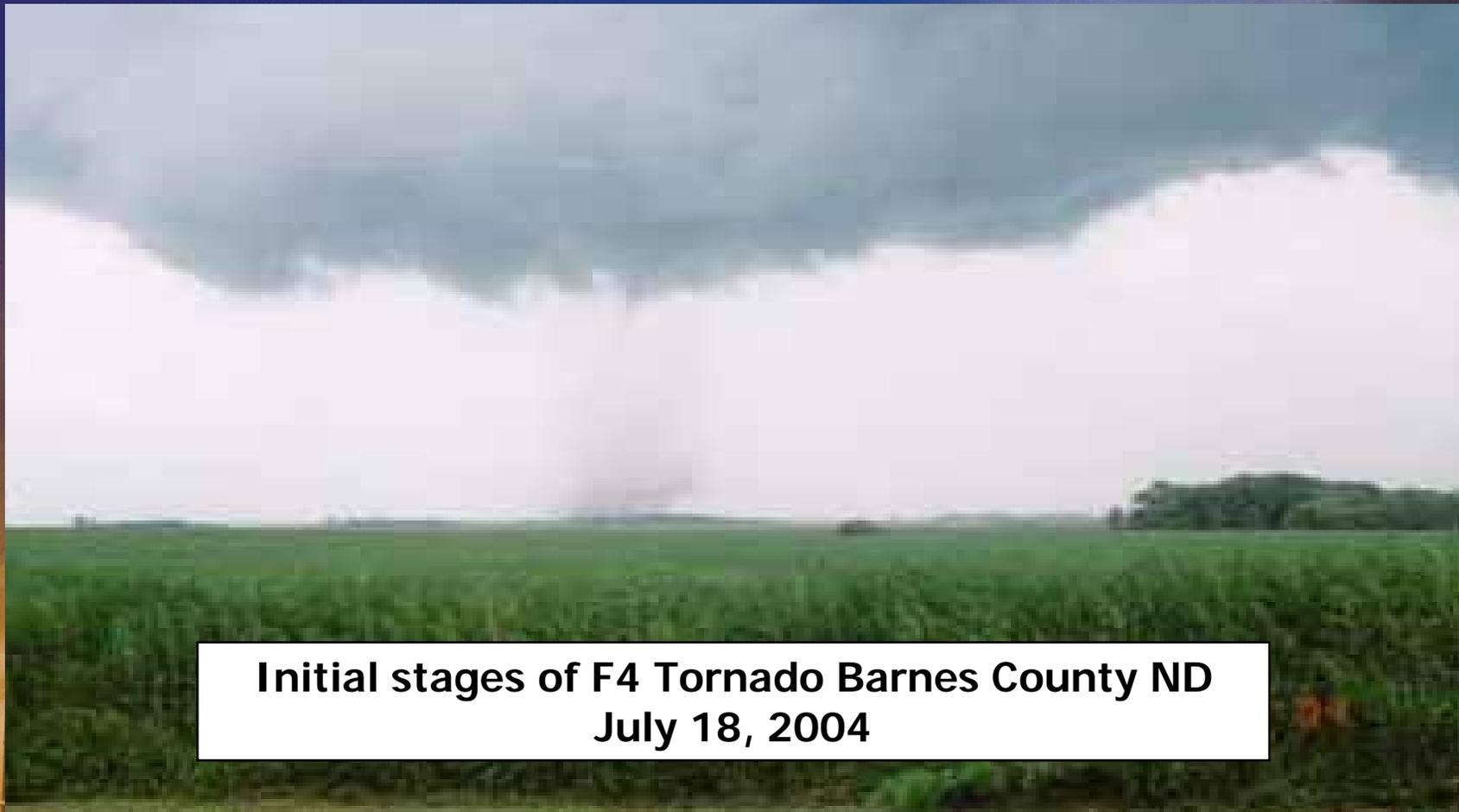


It's a Tornado!



Tornado vs Funnel Cloud

Notice the swirl of dust on the ground.
It is the beginning stages of a tornado.



**Initial stages of F4 Tornado Barnes County ND
July 18, 2004**

Safety First!



Flood Safety



It may just be a whole lot deeper than what you think!

Remember, boats float, cars don't.



Weather Related Hazards

Flash Flooding



Weather Related Hazards

Lightning Safety Tips

- Lightning tends to strike the tallest object in an area...make sure it is not you
- Remain in your vehicle whenever possible
- If you must go outside, crouch down to make yourself a poor lightning target



Weather Hazards

Do not seek shelter under an overpass

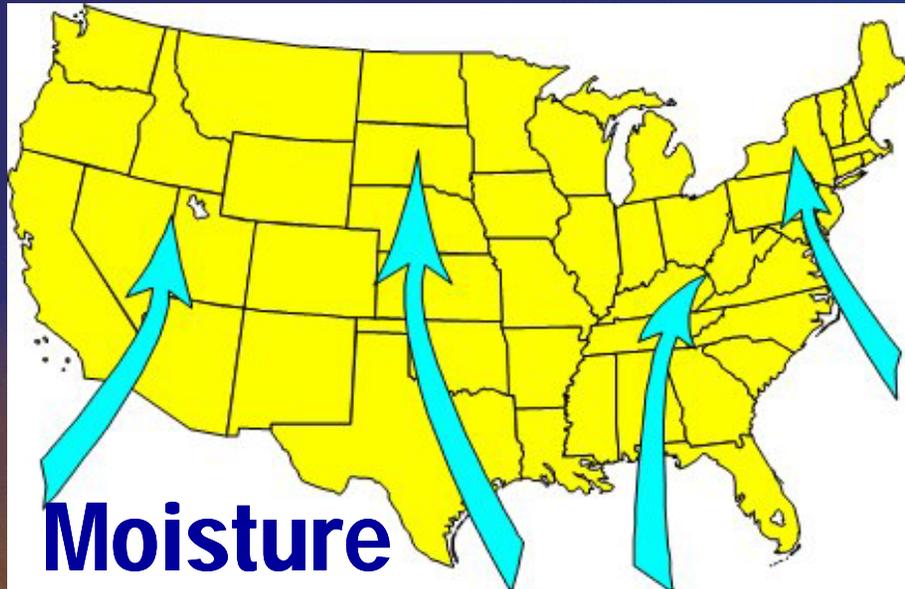


Winds actually accelerate under an overpass by as much as 25 percent

Let's Take a 10 min Break

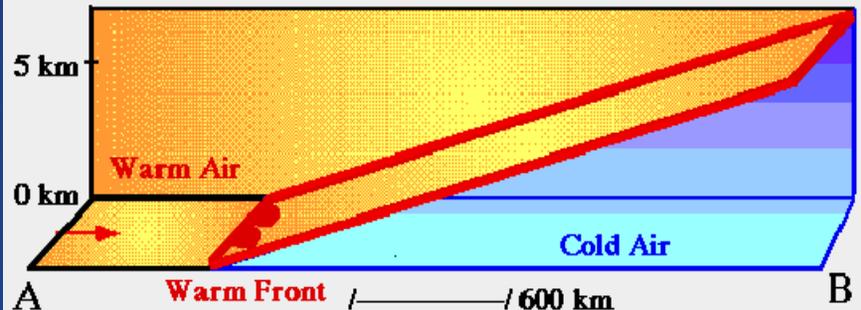
- Please fill out Spotter information sheet and hand in to your instructor.
- Again, the physical address and phone number is very important and will help us when verifying severe storms.
- We only use this information for our program that is used to call when we verify storms.
- When we issue any warning, we must then verify that storm actually had severe weather.
- If you call us, this makes our job much easier!
Thanks!!!!!!

Thunderstorm Ingredients

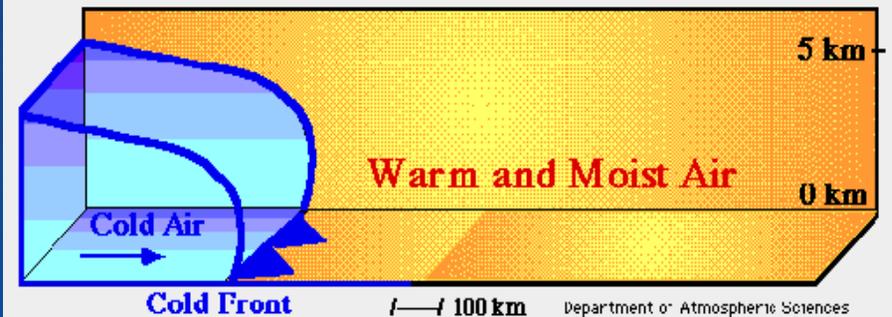


Lift

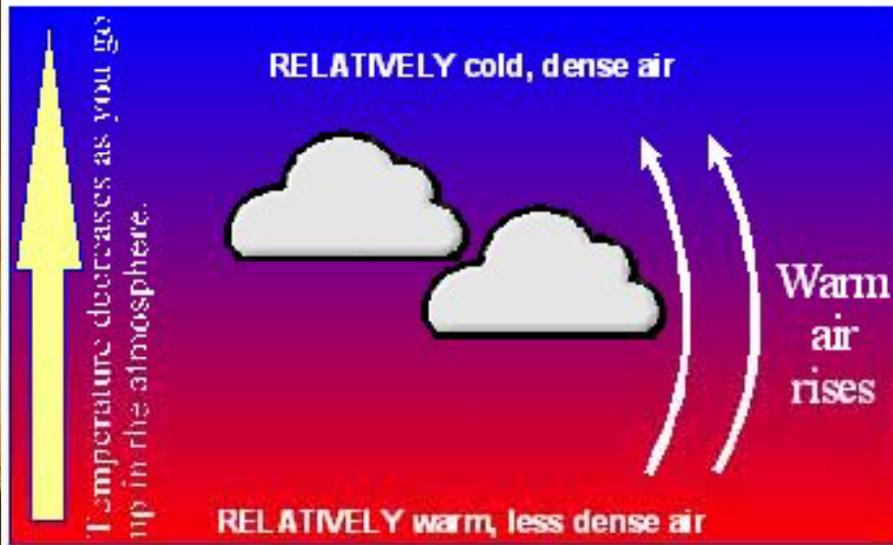
Moisture



Department of Atmospheric Sciences
University of Illinois at Urbana-Champaign

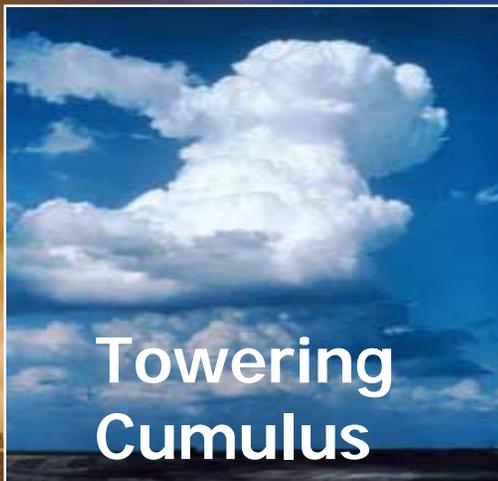
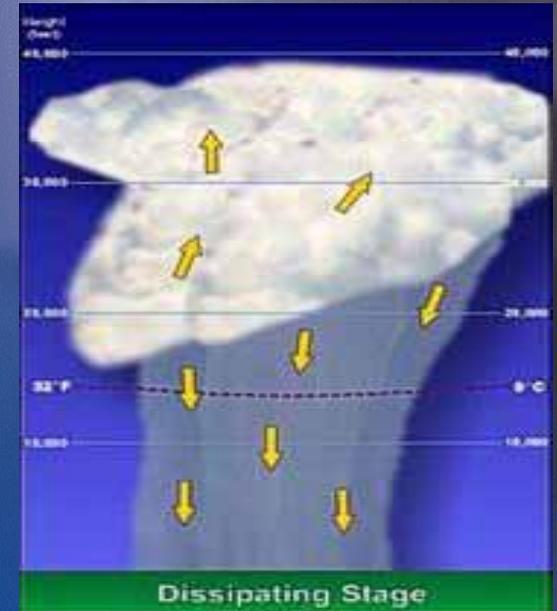
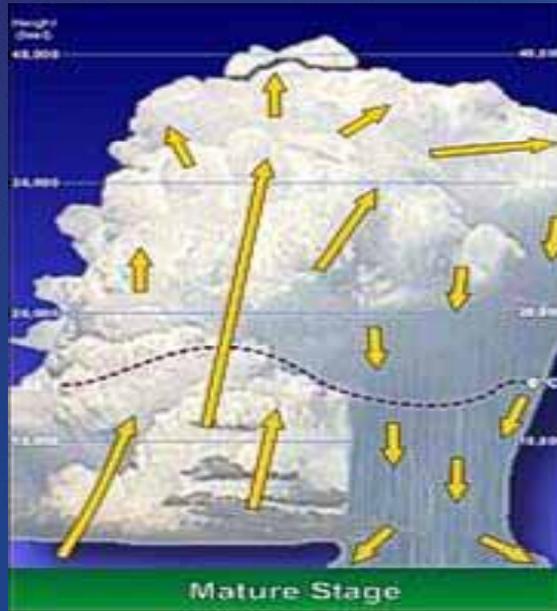
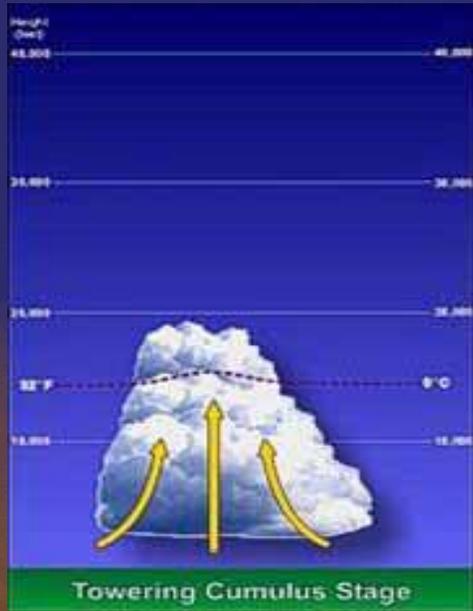


Department of Atmospheric Sciences
University of Illinois at Urbana-Champaign



Instability

Thunderstorm Life Cycle



Typical Thunderstorm Life Cycle

Developing Stage

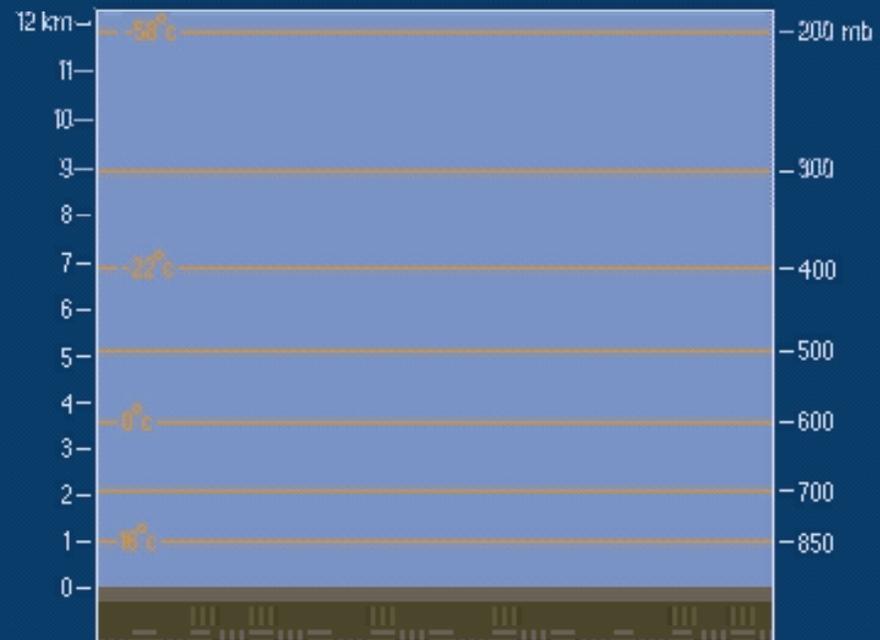
- Towering Cumulus (rising air)
- Usually little if any rain
- Lasts about 10 minutes
- Occasional lightning

Mature Stage

- Most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes
- Lasts 10 to 20 minutes, or much longer

Dissipating Stage

- Rainfall decreases in intensity
- Downburst potential
- Lightning remains a danger



Typical
Thunderstorm Life
Cycle Animation

Thunderstorm Types

Single
Cell

Multicell
cluster or line

Supercell

Short-Lived
Pulse Severe



Severe
Rotating Updraft



- Brief Updraft
- Brief severe weather events



- Sustained by new growth



- Sustained for hours
- Severe weather likely

Non-Tornadic Wind Events - Downbursts

Downburst - strong downdraft or outflow of wind
#1 cause of wind damage in eastern North Dakota

Categories of downbursts:

Macroburst

- Swath of damage is more than 2.5 miles wide
- Long lived events with long damage paths
- Radar echo often shows **"bow shaped"** appearance
- Sometimes called **derechos** if extremely long lived and damaging

Microburst

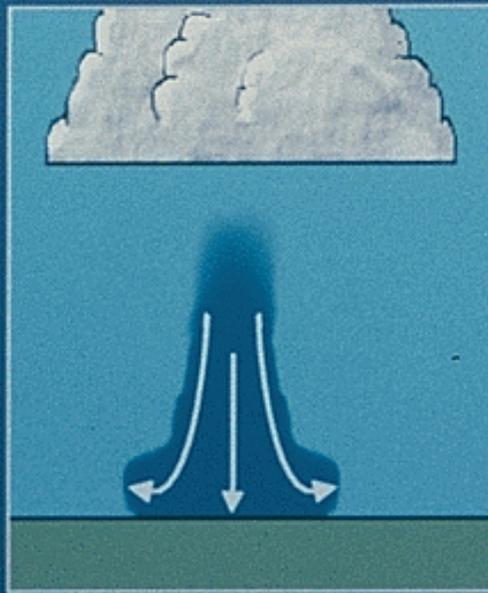
- Swath of damage is less than 2.5 miles wide
- *Extremely difficult to forecast and warn for!*

Microburst Life Cycle

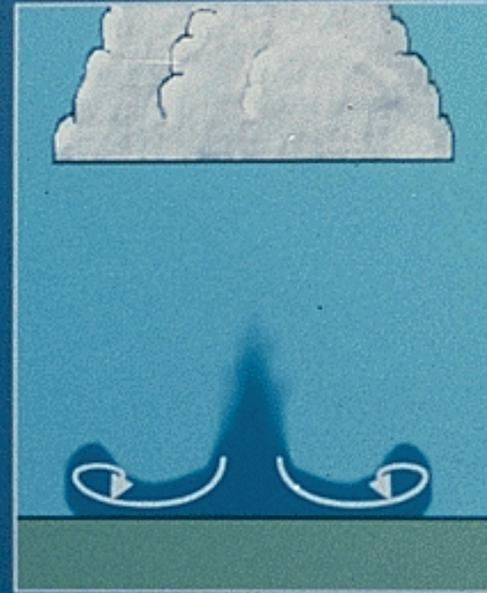
Downburst Life Cycle



FORMATION -
Evaporation and
precip. drag
forms downdraft

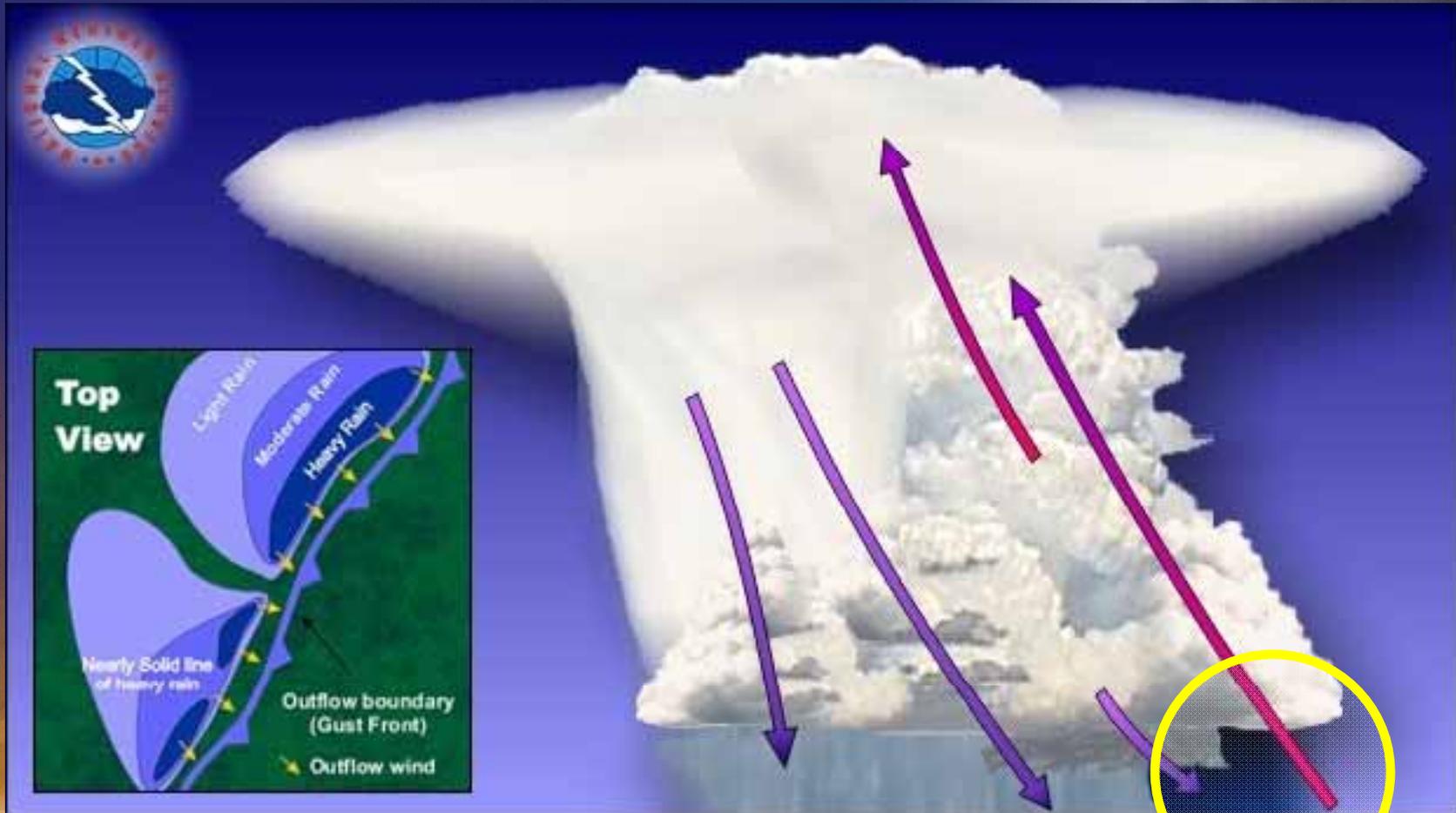


IMPACT -
Downdraft quickly
accelerates and
strikes ground



DISSIPATION -
Downburst moves
away from point
of impact

The Squall Line



**Key to squall line identification
and positioning is the shelf cloud**

Squall Lines and the Shelf Cloud

- How can you tell if you are looking at a Squall Line? ***Look for the Shelf Cloud.***
- Squall line winds can reach speeds equal to that of an F1 or weak F2 tornado.
- Another main threat is Flash Flooding!

Movement is Towards You



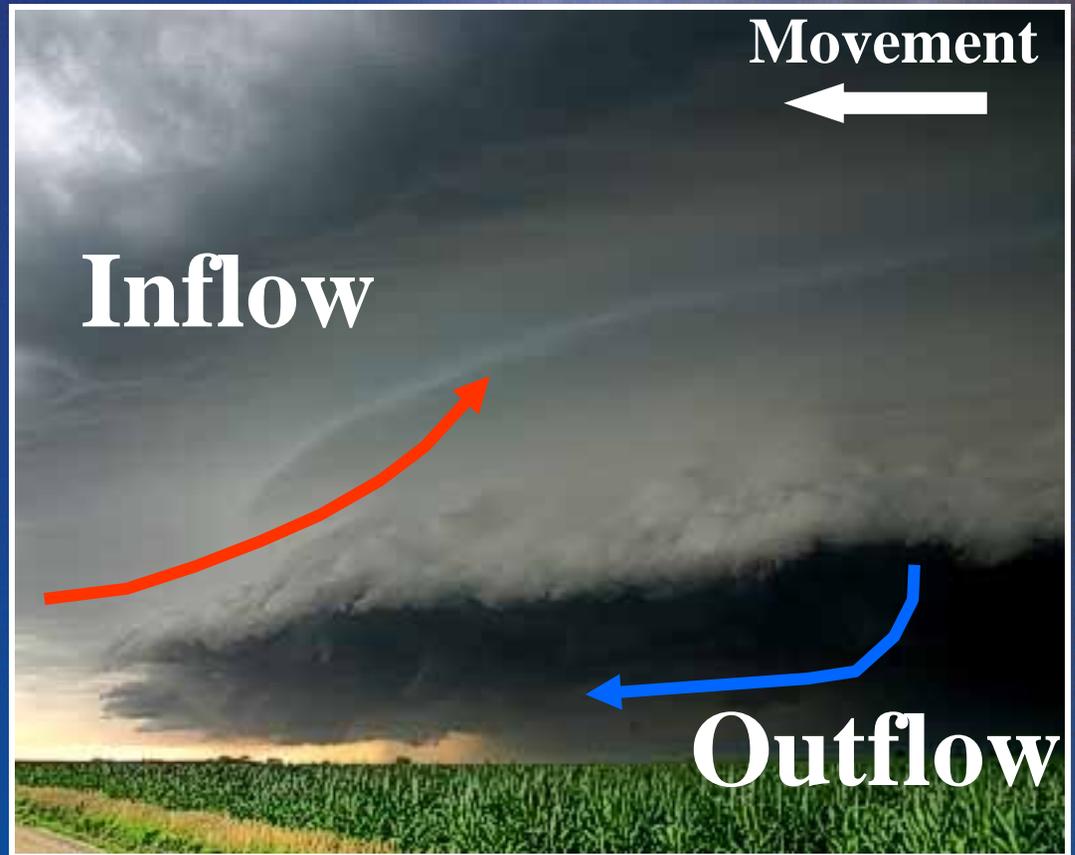
Shelf Clouds

- Slope down away from precipitation area
- Worst is first - then comes the rain.
- Often associated with a squall line – can be associated with gustnadoes



Shelf Cloud Air Flow

- Marks the leading edge of the gust front
- Usually produced by rain cooled air
- What to expect:
Strong and possibly damaging wind, heavy rain, and hail.



Shelf cloud points down and away from precip area

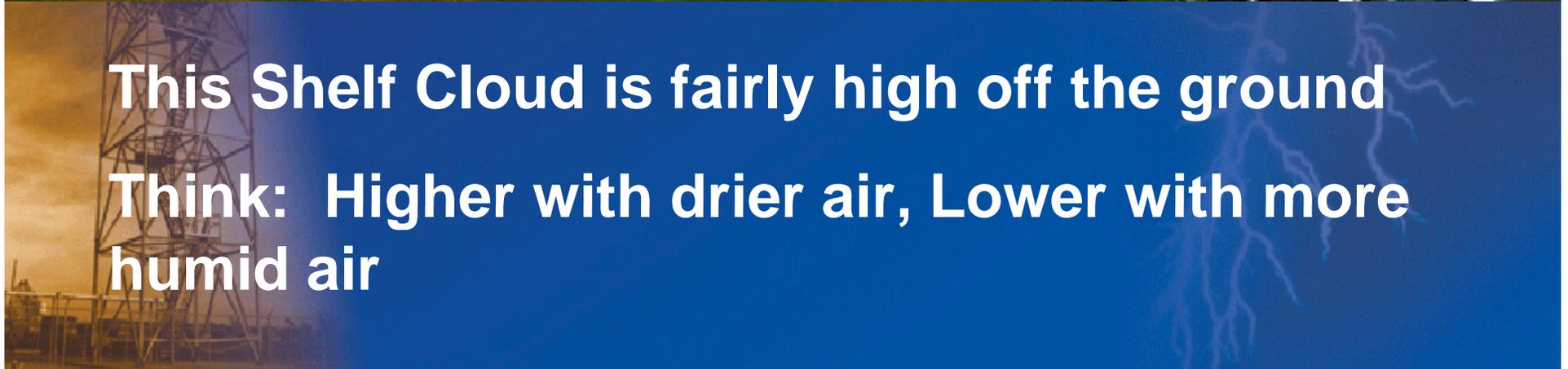
Bow Echo near Rapid City, SD

Strongest Winds



This Shelf Cloud is fairly high off the ground

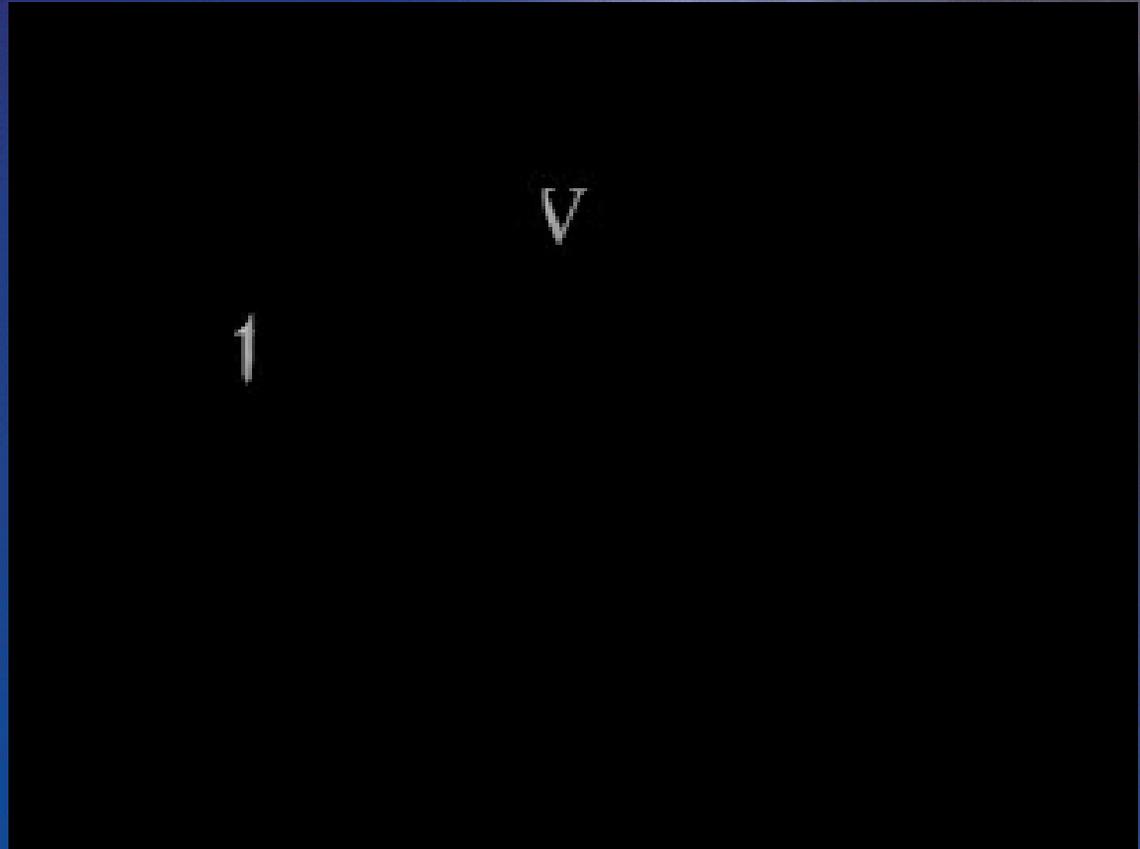
Think: Higher with drier air, Lower with more humid air



Squall Lines and the Shelf Cloud

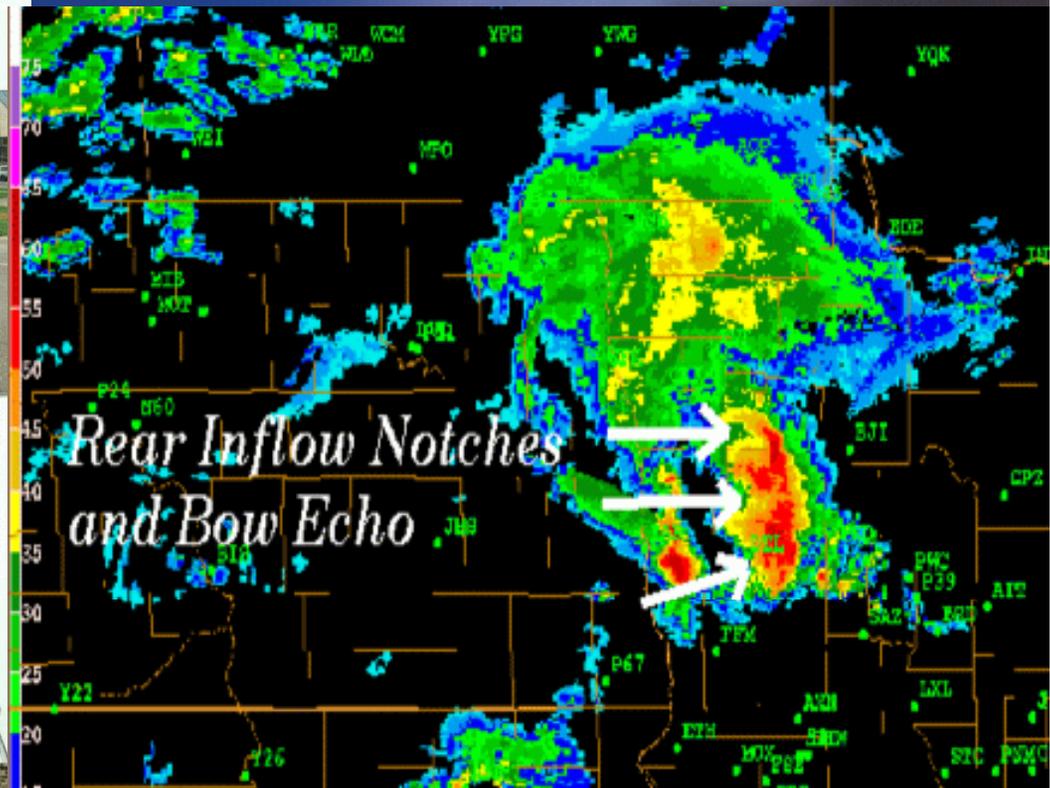
Damage from Squall lines can be greater than most tornadoes in the Northern Plains.

Winds can easily exceed 60 mph and reach over 100 mph.



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

Fargo Wind Event July 4, 1999



Wind Event August 8, 2001

Straight line wind damage – not a Tornado !!
Measured wind gust over 100 mph in Hillsboro and Grand Forks
and 80 mph in Red Lake Falls



Over 2,400 trees blown down in Hillsboro



Red Lake Falls MN – 77 mph gust



Oklee MN

The Bin Buster Summer of 2003

On June 24th, July 2nd, July 3rd, July 20th... Extreme Wind Events raked parts of eastern North Dakota and northwest Minnesota



Devils Lake Downburst Winds

August 12, 2000 – 111 mph at 1:05 AM



Downbursts can cause tornado-like damage!

A man was driving the car on the left when the roof of the building across the street dropped on him (he was seriously hurt but survived).

Supercell Thunderstorm

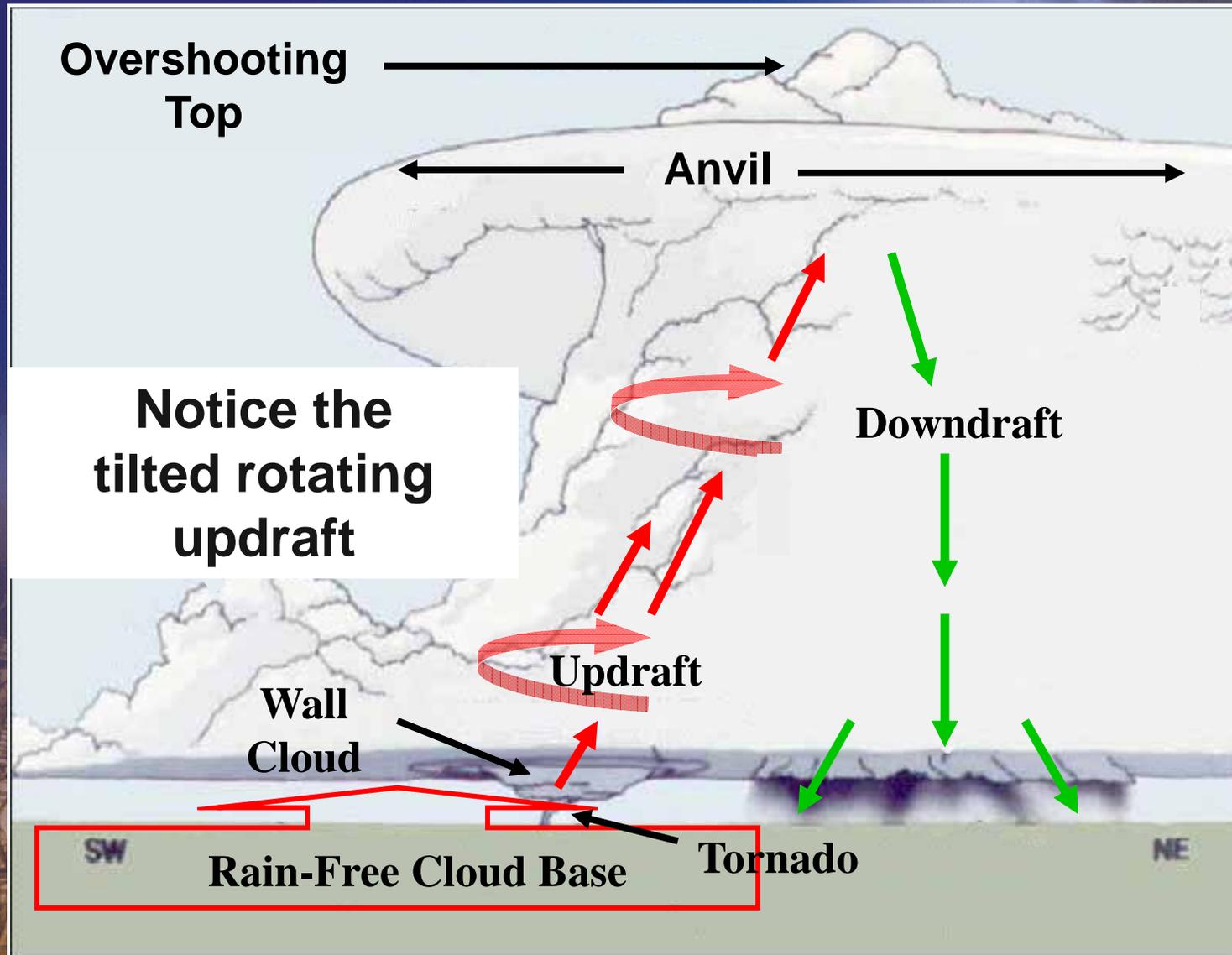
What you Need to Know



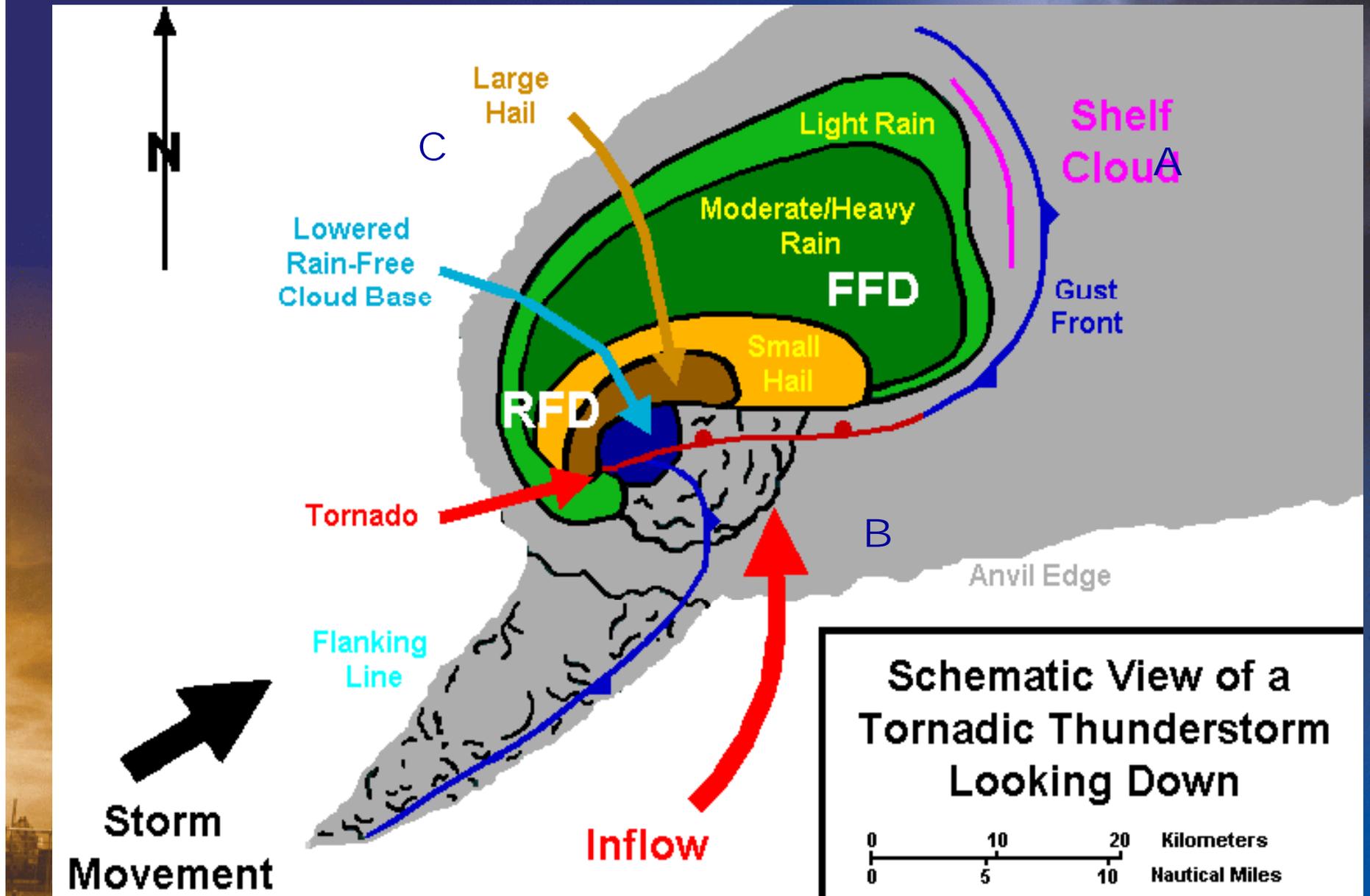
- Highly organized
- Less than 5% of all t-storms
- Long lasting (> 3 hours)
- Almost always associated with Severe Weather
- Can produce large, violent tornadoes
- Can produce softball size hail, flash floods and damaging downburst winds



Supercell Thunderstorm Structure



Classic Supercell – Birds-eye View



Western North Dakota Supercell July 17, 2001

Most supercells develop a mesocyclone. Mesocyclones are seen in storms as a large rotating cloud on the updraft side of the supercell. Doppler radar will detect this rotation and depict it on radar. This rotation is a first clue that a tornado may develop.



Rotating Supercells

In real time, this entire mesocyclone would be rotating.
Not all mesocyclones produce tornadoes though!



Lancaster MN Rotating
Supercell
July 31, 2004



Most Supercells have Wall Clouds

Four Characteristics of a Tornadic Wall Cloud



Persistence

10 to 20 minutes or more

Rotation

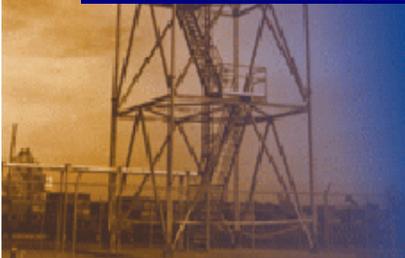
Fast and sometimes violent

Strong surface inflow

20-30+ mph winds blowing into the wall cloud

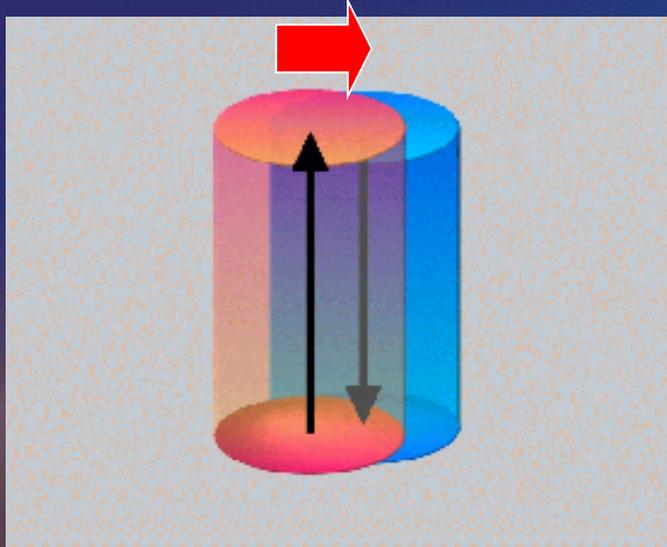
Rapid vertical motion

Up or down near the wall cloud



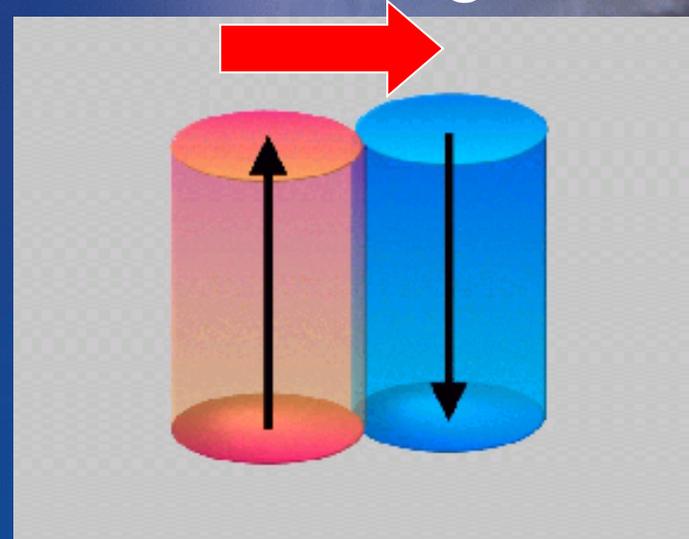
Wind Shear

Weak



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

Strong

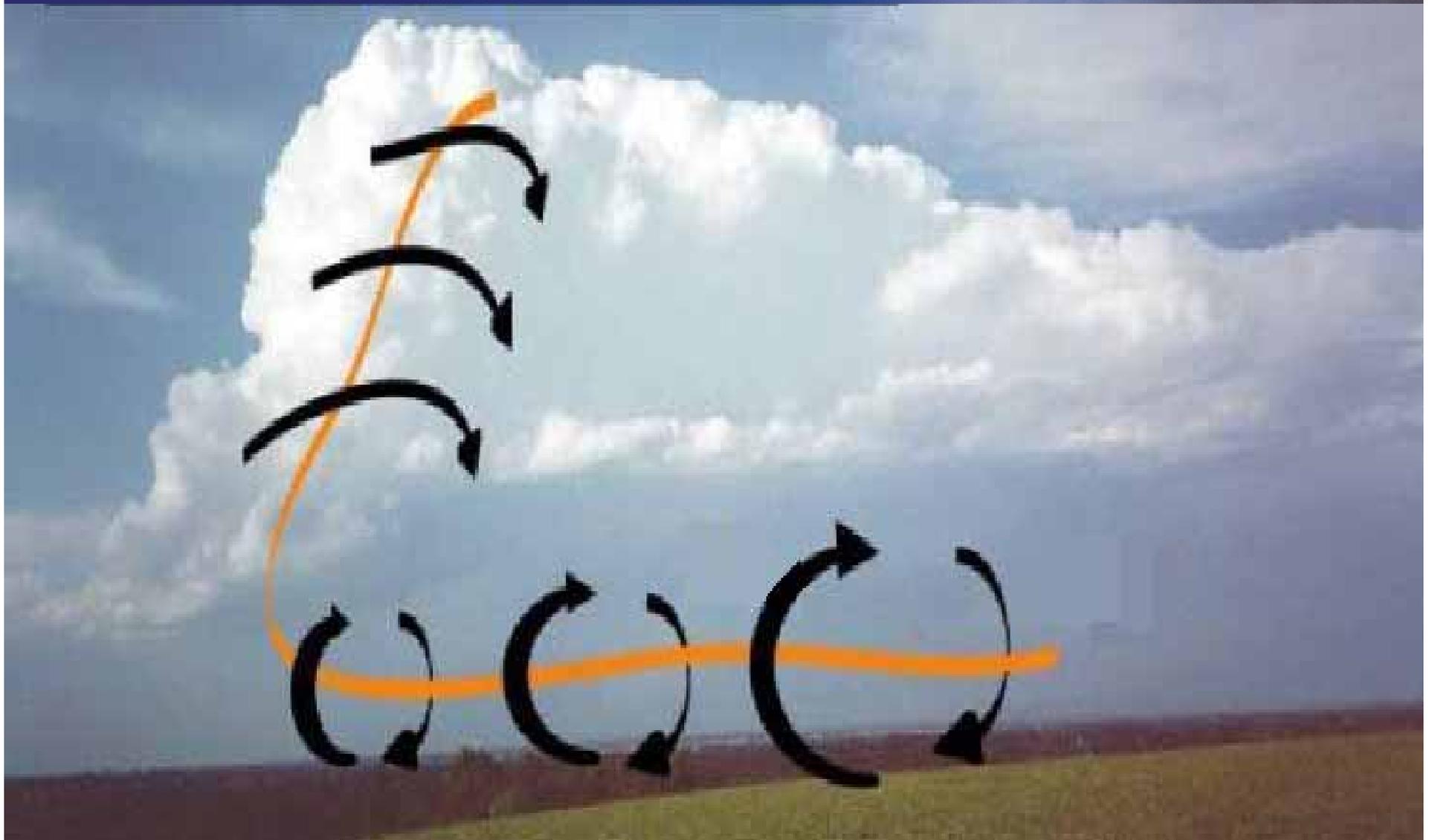


Updraft & downdraft are separated, so they co-exist. The updraft is also tilted, therefore, the storm lives longer.

Supercell Updraft/Downdraft

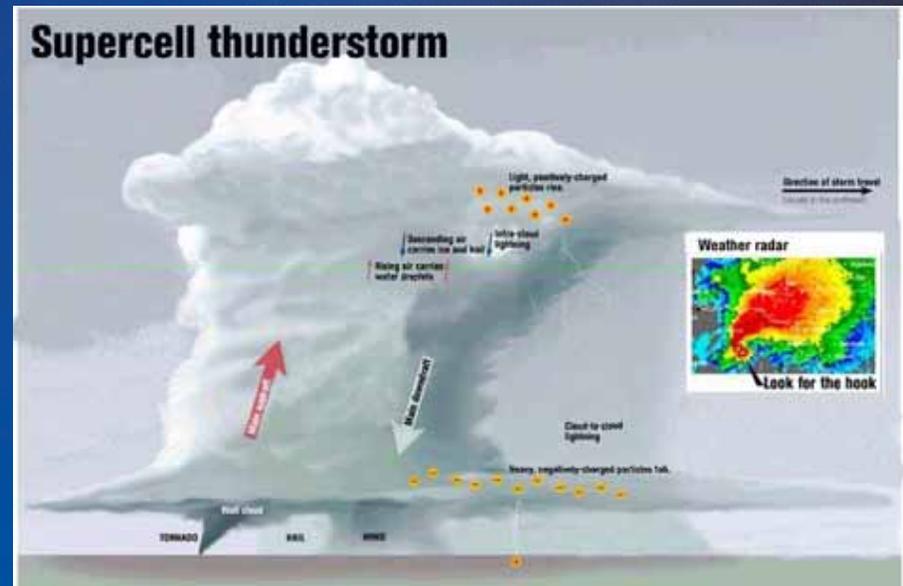


Shear Causes Tilted Updraft and a Longer Lived Storm



How do we Determine which Storm will Produce Severe Weather?

Visual Clues of Updraft Strength and Organization



Upper Level Storm Clues

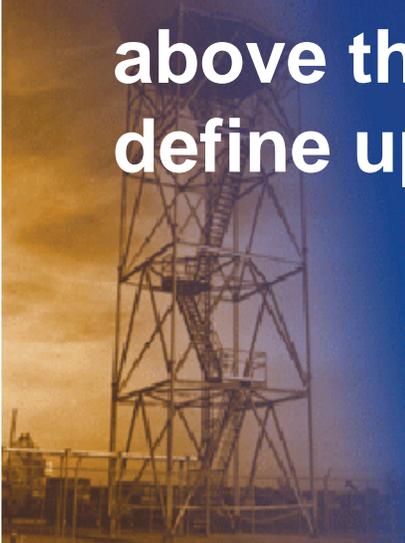
Best observed 30-40 miles from storm

Anvil Characteristics

Thick & bubbly with sharp, well-defined edges

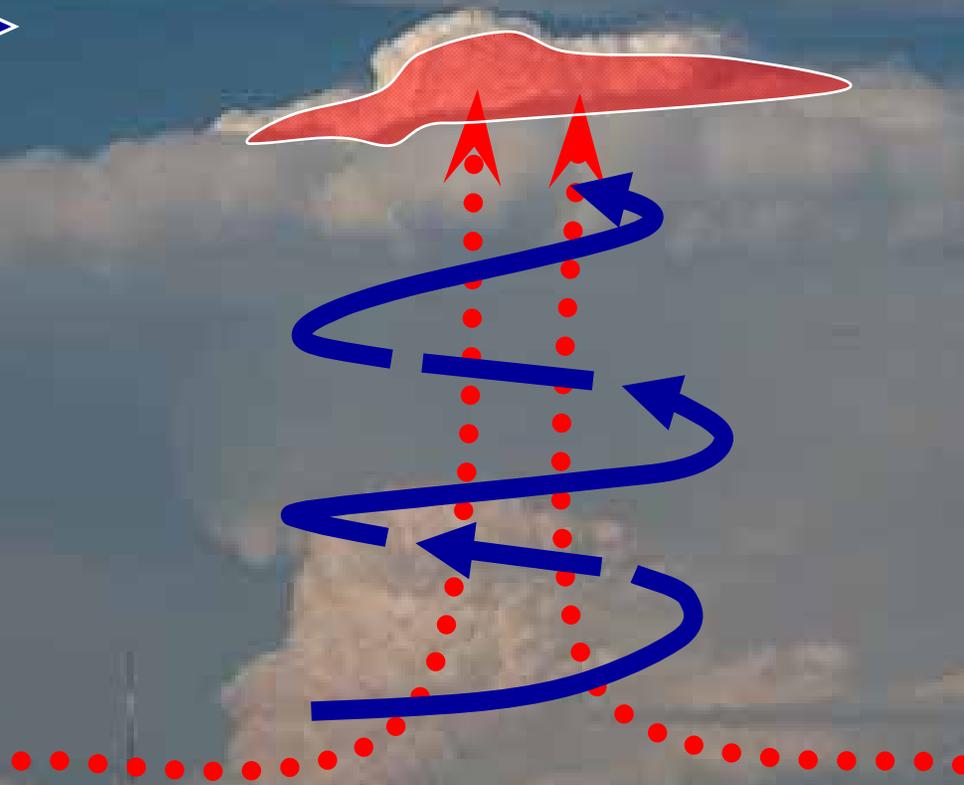
Overshooting Top

Domelike bubble of cloud material extending above the anvil cloud. Visual clue of a well define updraft.



Overshooting Top

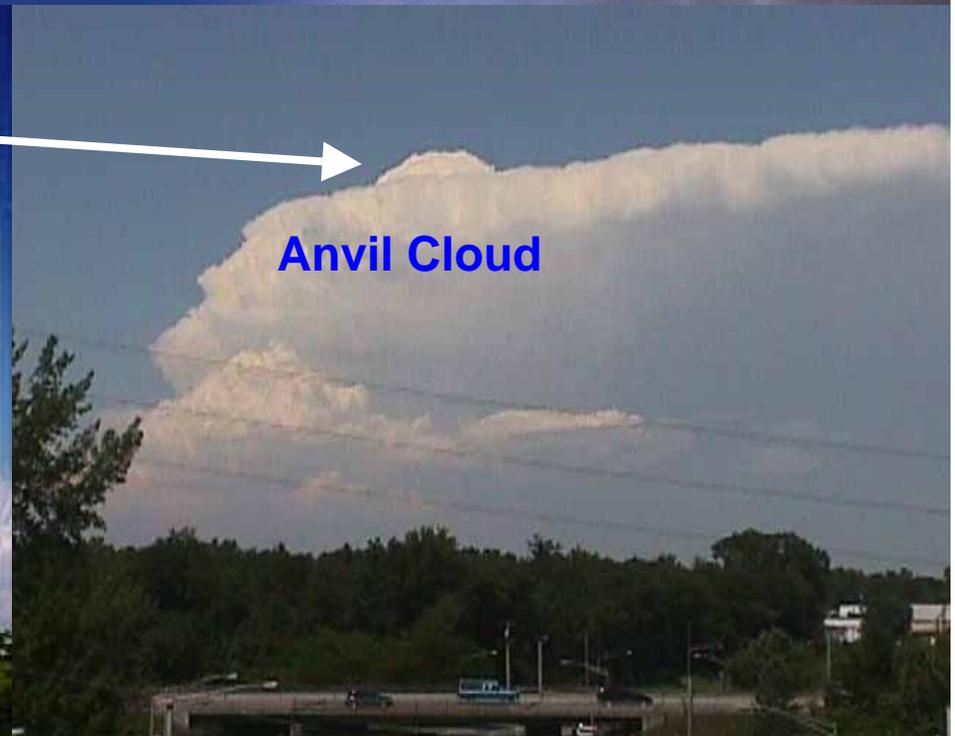
Storm Movement



Thick Anvil and Overshooting Top



Severe Thunderstorms (Supercells) at a Distance



Albany NWS Washington
County, NY, July 9, 2001.

Mid Level Storm Clues

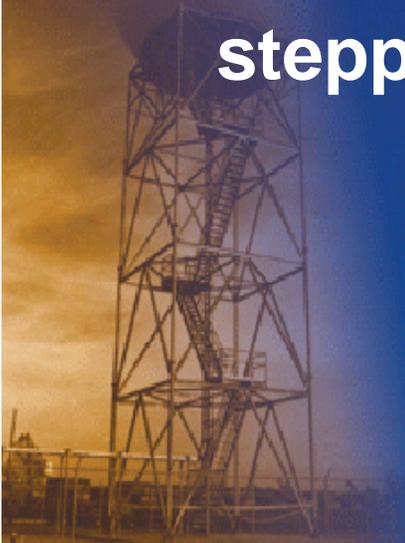
Best observed 10-20 miles from storm

Main Storm Tower

Solid appearance with cauliflower texture

Flanking Line

A row of towering cumulus clouds stair-stepping up to the main storm tower



Strong Updraft Towers

Examples of two storms with a strong updraft, evident by the well defined and solid cauliflower appearance.



These storms will become severe quickly, and should be watched carefully.

Strong Updraft Towers and Explosive Development

This is a storm with very strong updraft towers



It is important to convey the appearance of very strong updrafts to the NWS, as it indicates severe potential.

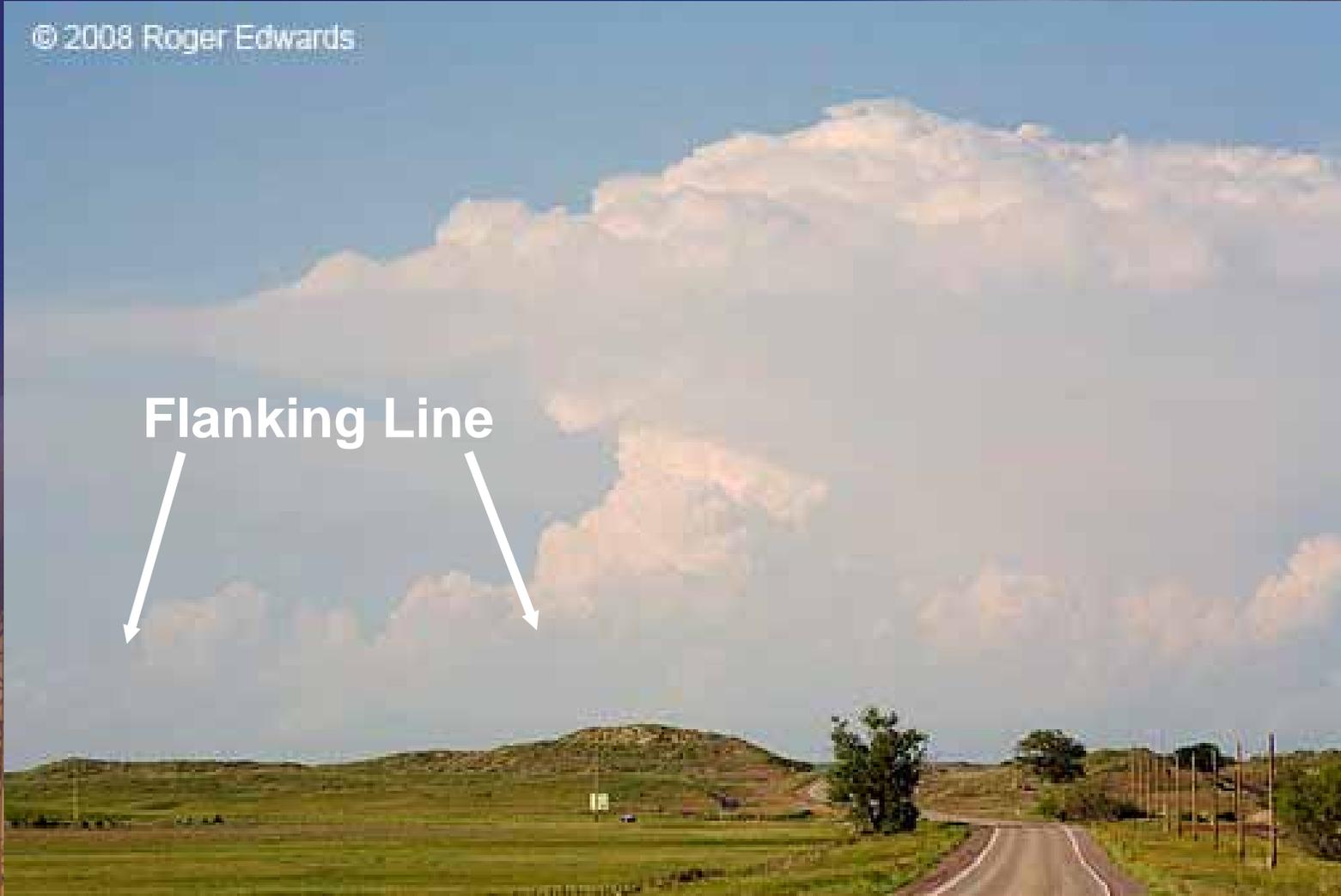
Explosive Updraft Development



Flanking Line

© 2008 Roger Edwards

Flanking Line



Low Level Storm Clues

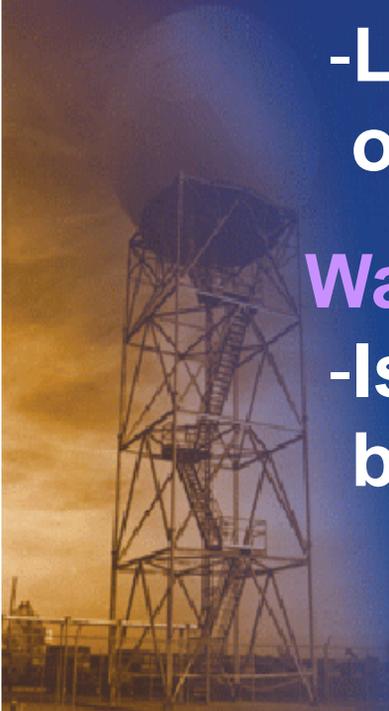
Best observed 3-8 miles from storm

Rain-free Base

- Low, flat cloud base with updraft towers above.
- Little or no precipitation falling out of cloud.

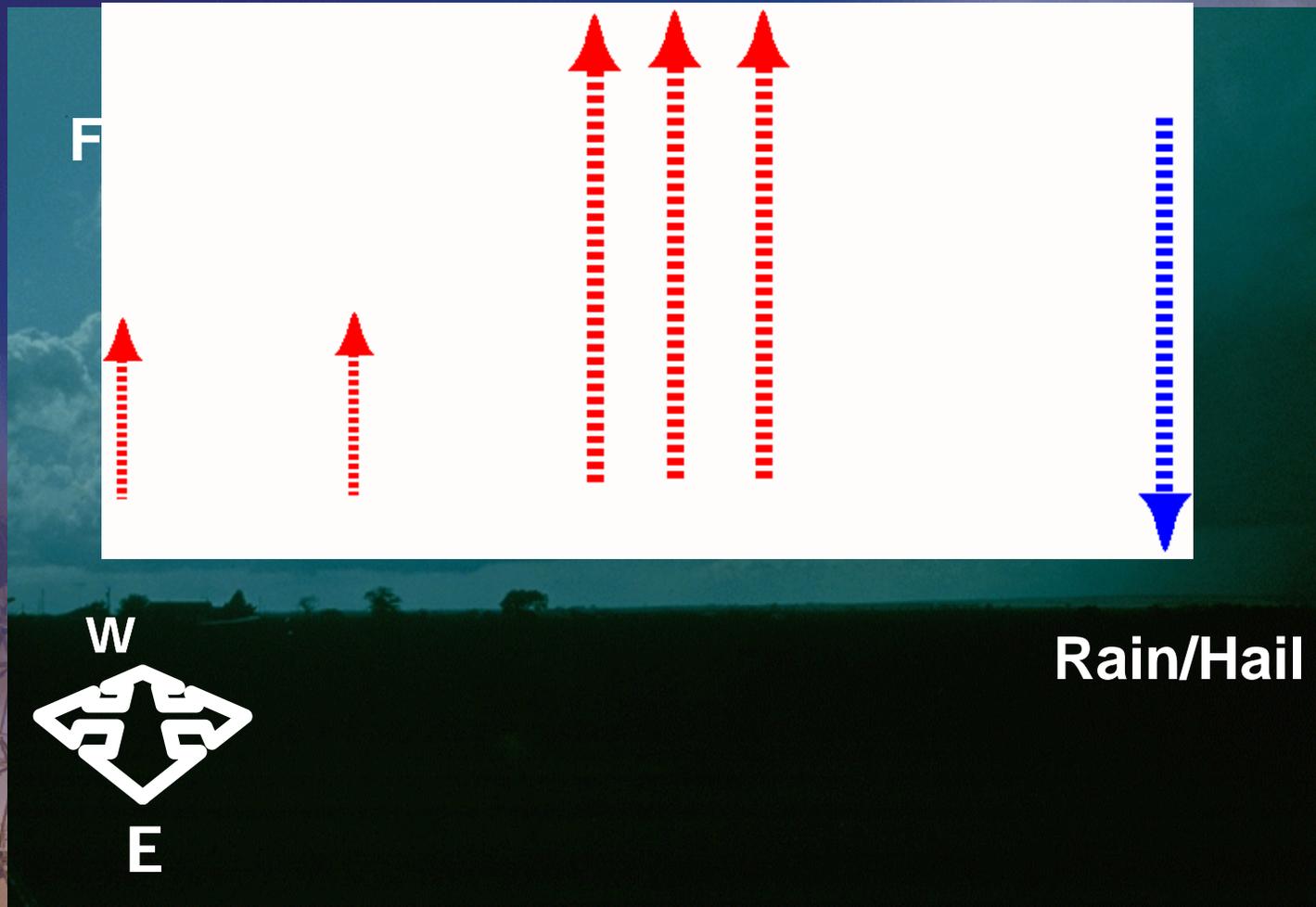
Wall Cloud

- Isolated lowering of the rain-free base.



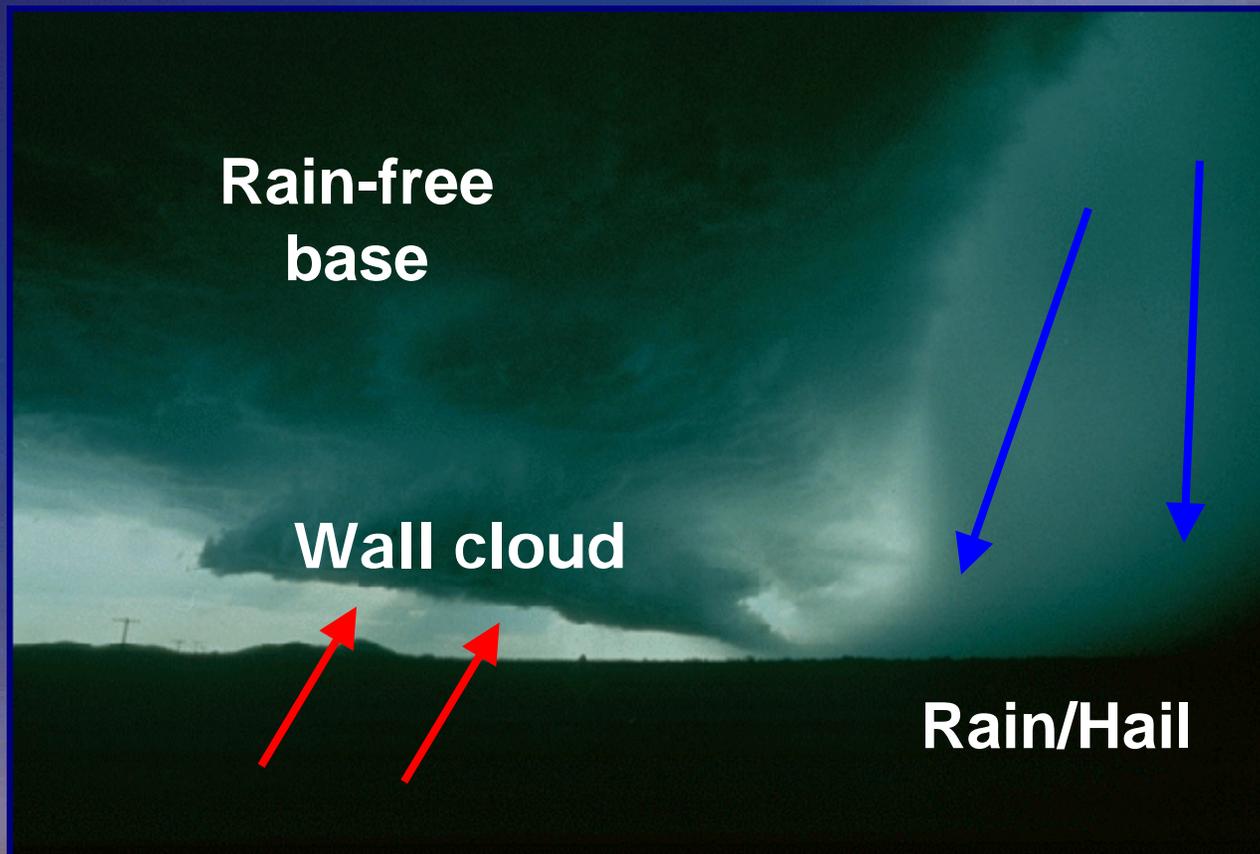
Rain-Free Base

Low, flat cloud base with updraft towers above



The Wall Cloud

A Wall Cloud is the isolated lowering of the rain-free base and acts like a vacuum cleaner, sucking up heat and humidity



Focus on the updraft !!

Classic Rotating Wall Cloud Video



Fargo F5 Tornado: June 20, 1957

Fargo F5 Tornado
www.video2x.com
June 20, 1957



Wall Cloud

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

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

© 2002 Dave Lewison



Most **important** things to look for when you see a suspicious cloud:

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



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

Mon Sep 9 19:19:40 2002



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.

What is this?



Scud Cloud

Wall Cloud

Tornado

Smoke

What is this?

© 2000 David Fogel



Funnel Cloud

Wall Cloud

Tornado

Shelf Cloud

What is this?

© 1998 David Fick



Scud Cloud

Wall Cloud

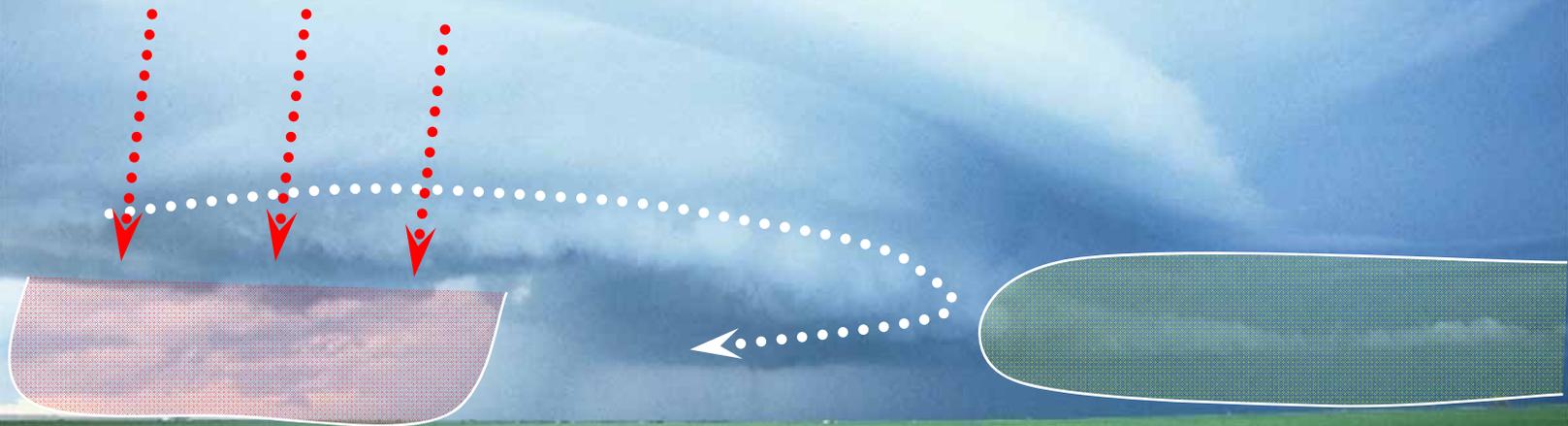
Tornado

Shelf Cloud

Name the Feature and Storm Type

©/All rights reserved Gene D. Rhoden 2003

- 1
- 2
- 3

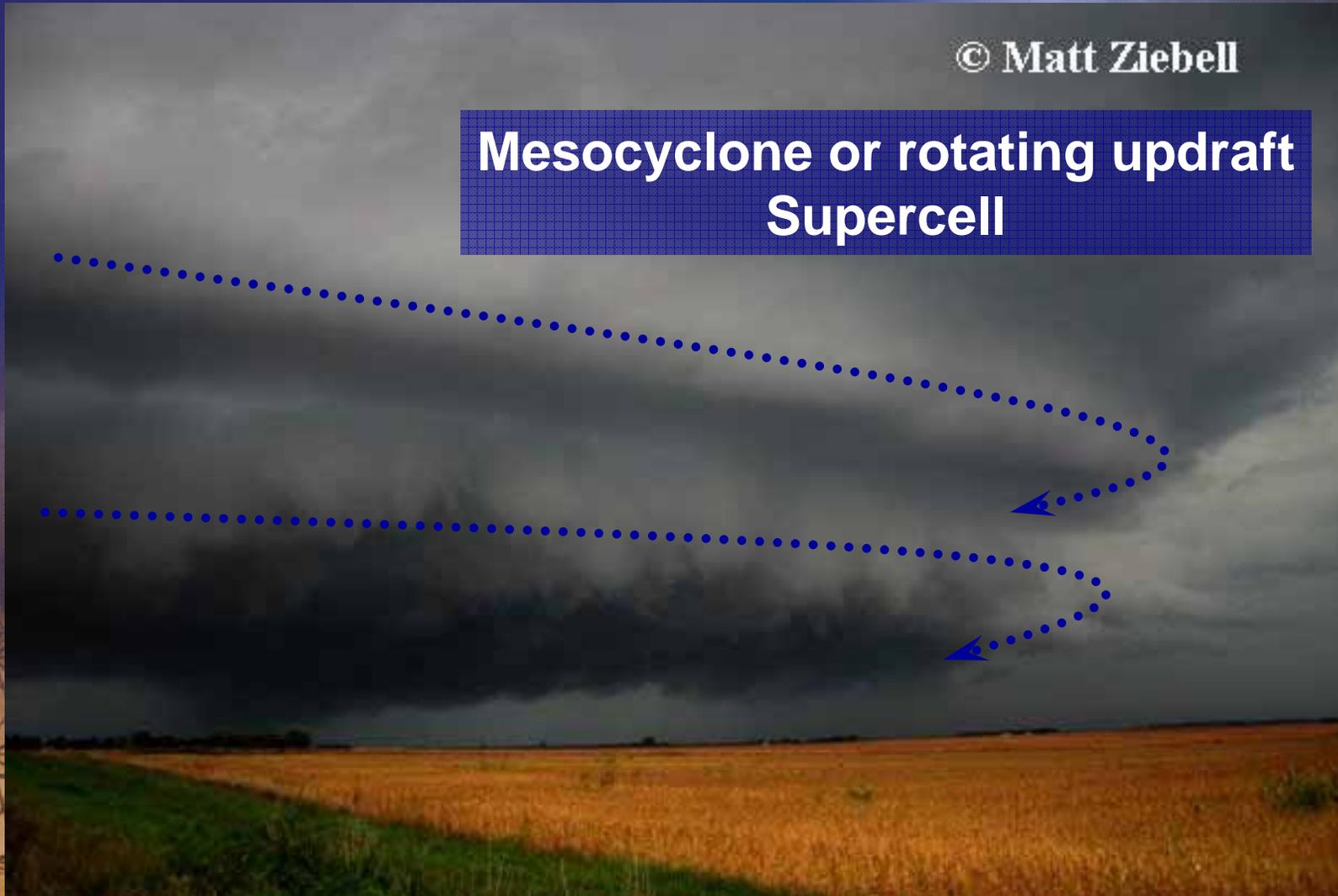


Beaver Tail

Name the Feature and Storm Type

© Matt Ziebell

Mesocyclone or rotating updraft
Supercell



Name the Feature and Storm Type

Storm Movement



Wall Cloud
Supercell

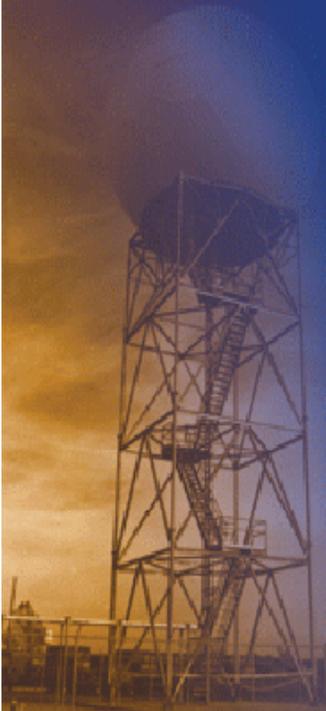
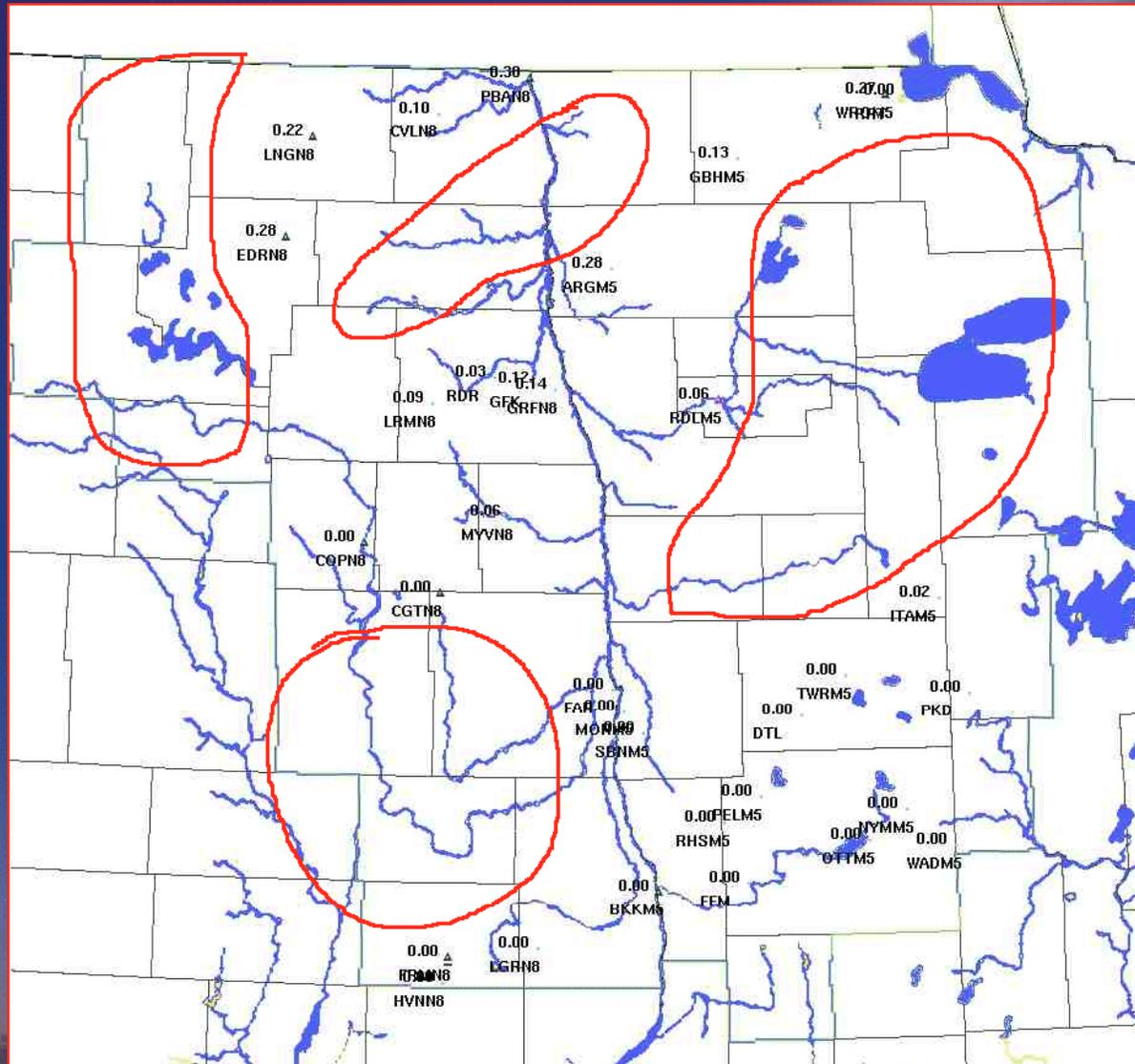


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Cooperative Observers Wanted!

- **Coop Observers take observations daily and relay this information to the National Weather Service**
- **This information is vital for climate statistics, and helps immensely**
- **If interested, contact Mark Ewens
Mark.Ewens@noaa.gov, or let us know today!**

Map of Where we Need Cooperative Observers



Cumulus Crazy Horse - a - mus

Thank you Very much for your time and attention

Any Questions???

1-800-667-1218