

2019 SKYWARN Spotter Training

In Search of Truth

- In the Sky
- In-between
- On the ground



During your lives you may encounter...

How will you respond?



Understanding only German, Fritz was unaware that the clouds were becoming threatening.



Provide you with the tools to help make the right decision. Life or Death?





Why are
we
here?



NWS Mission:

- **Protection of Life and Property**



SKYWARN Agenda

- Signup Sheets: Weather Stations (Davis) notes /Physical Addresses if P.O. Box
- NWS Overview
- Weather Safety
- Thunderstorm basics
- Spotting storms

Break Time!

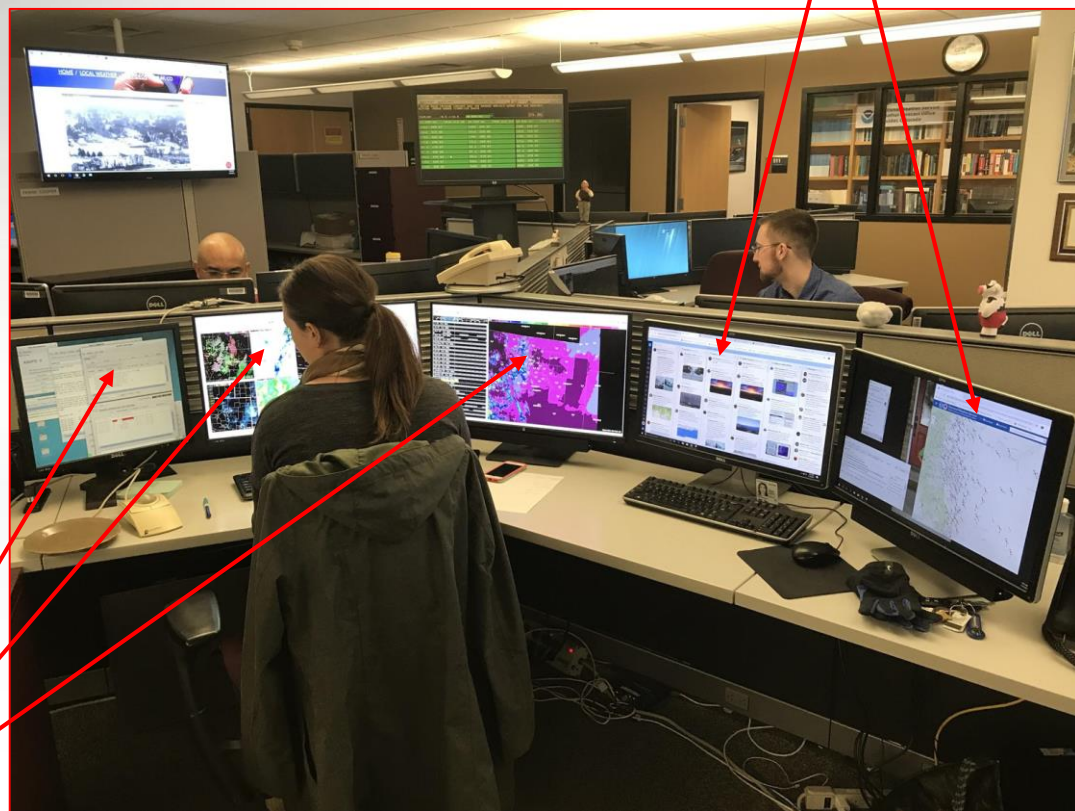
- Reporting/Procedures
- Radar/Case studies

Inside our shop: 24x7x365

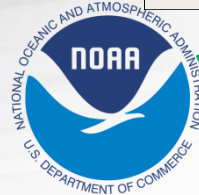
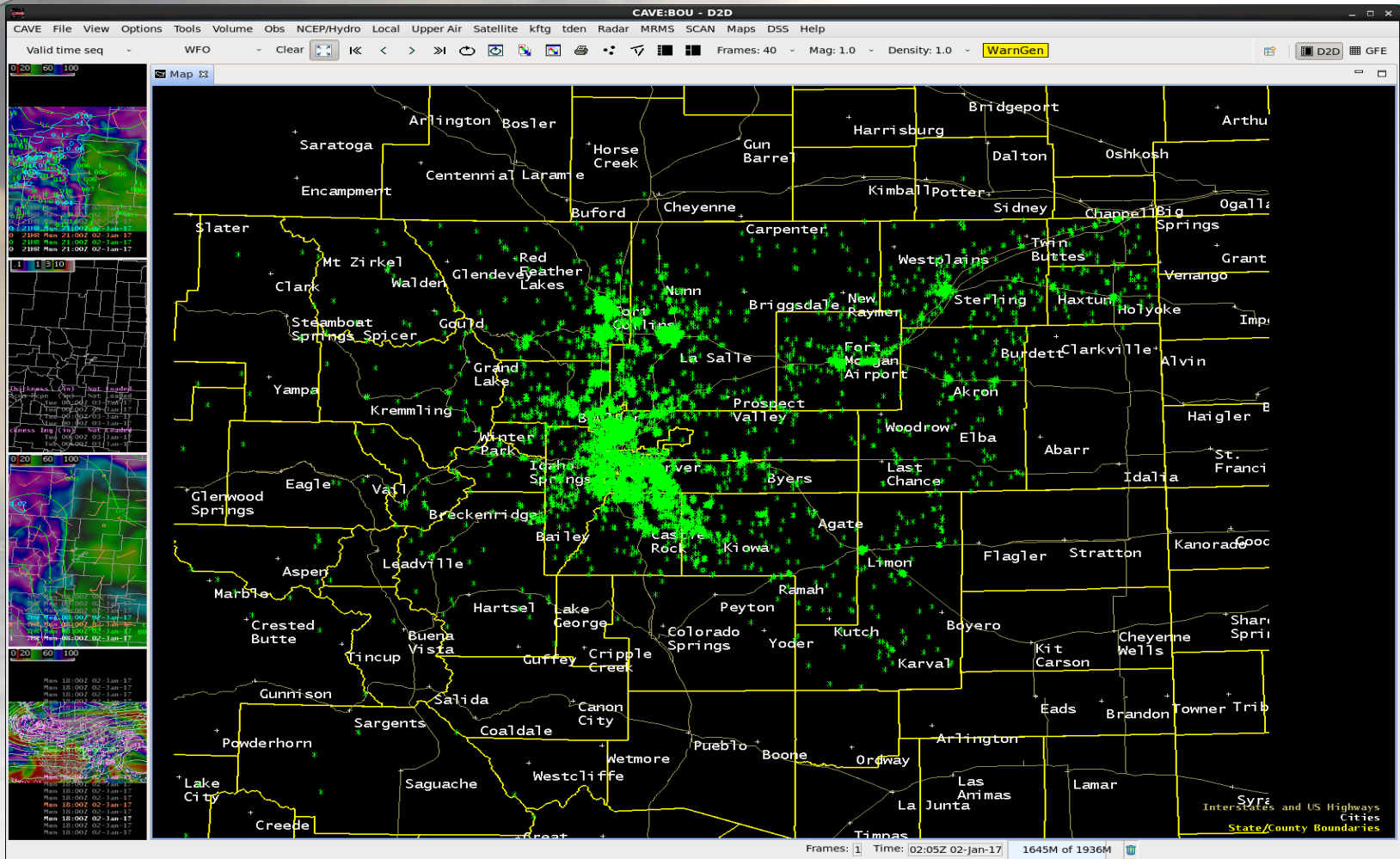
- 2 forecasters updating the forecast
 - Short term (0-36 hr) and Long Term (36 hr - Day 7)
- 1-3 others from 6 AM - 11 PM (more if needed)
- Dedicated Severe Forecaster in summer

AWIPS

Windows
PC



SKYWARN Team Locations

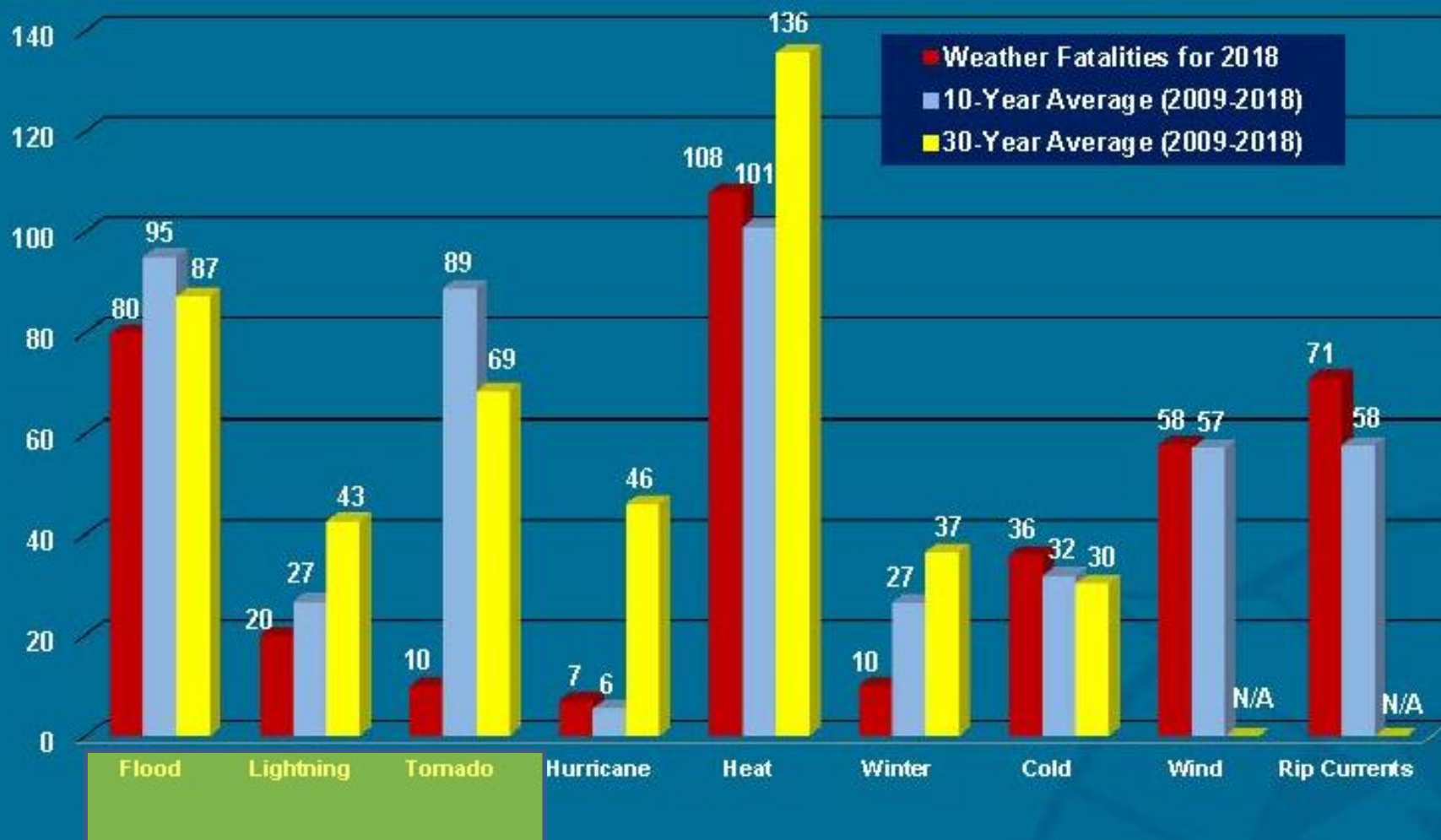


You too can have your own little green dot!





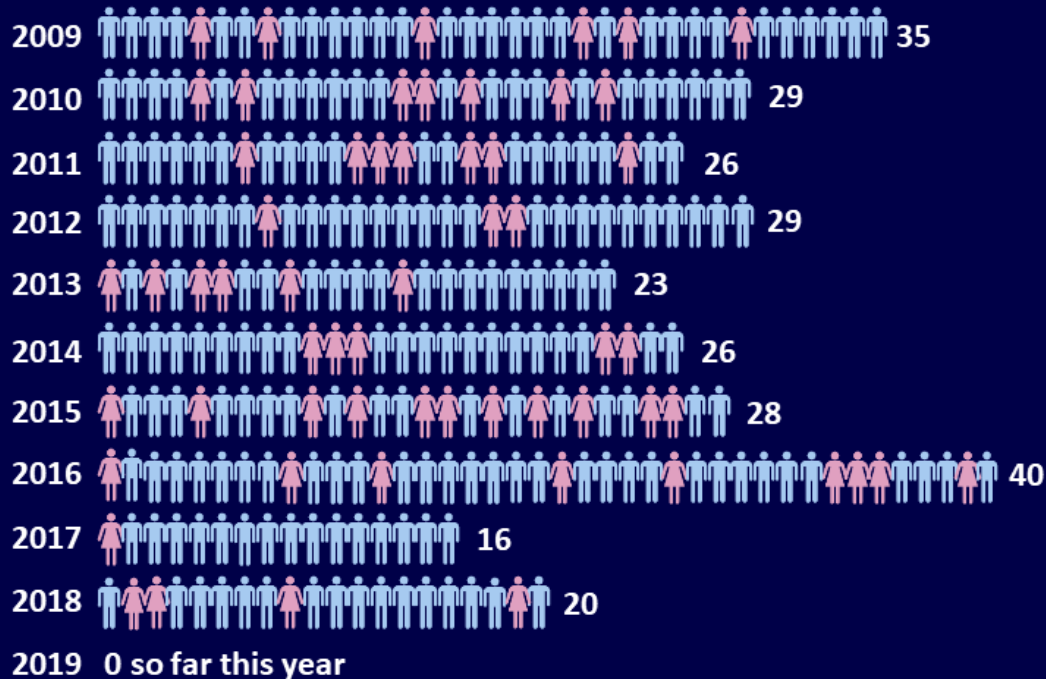
Weather Fatalities 2018



Lightning Fatalities 2018

0 Fatalities in Colorado!

U.S. Lightning Fatalities 2009-2019



-213 -59

For more information:

<https://www.weather.gov/safety/lightning-victims>



Out of the 20 Nat'l Lightning deaths...

- 8 -standing under or near tree
- 5-in/near water
- 7-Other

Nearly 2/3 deaths

- trees
- water



Source: CBS, May 3, 2018 in
SW Denver

Warning Signs

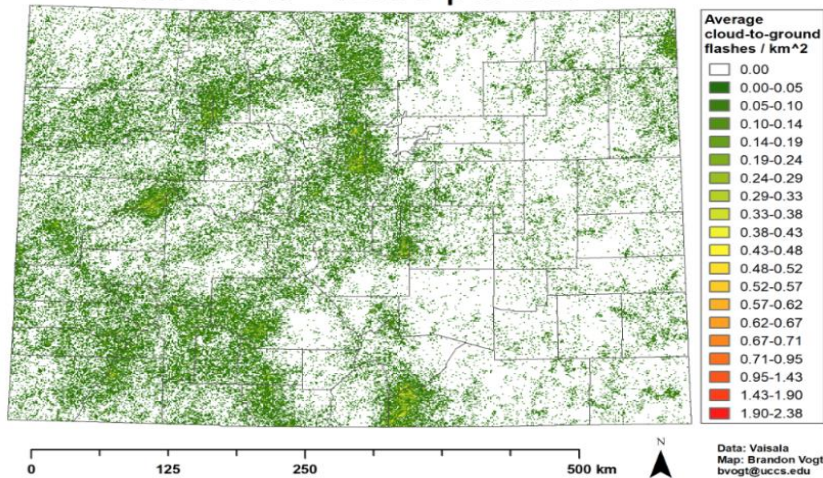
- Thunder!
 - First strike arrives before any thunder
- Static charge



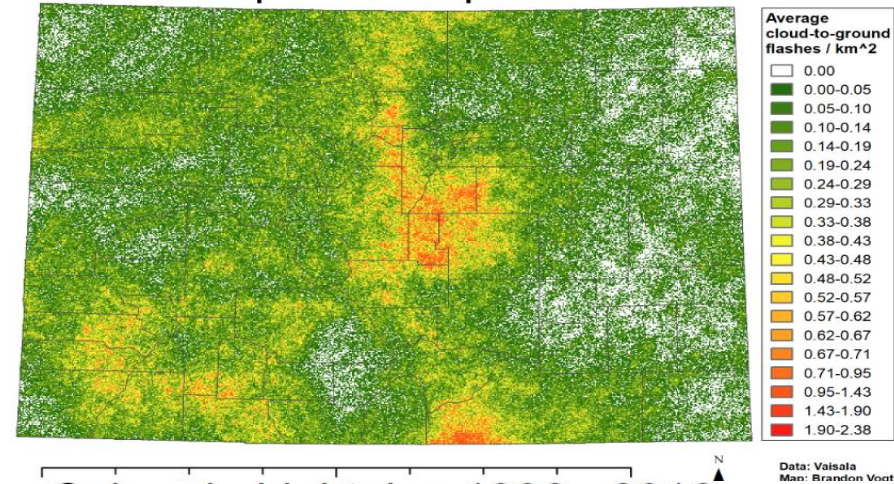
Lightning Density- Time of Day

Source: Vaisala (data), Brandon Vogt (maps)

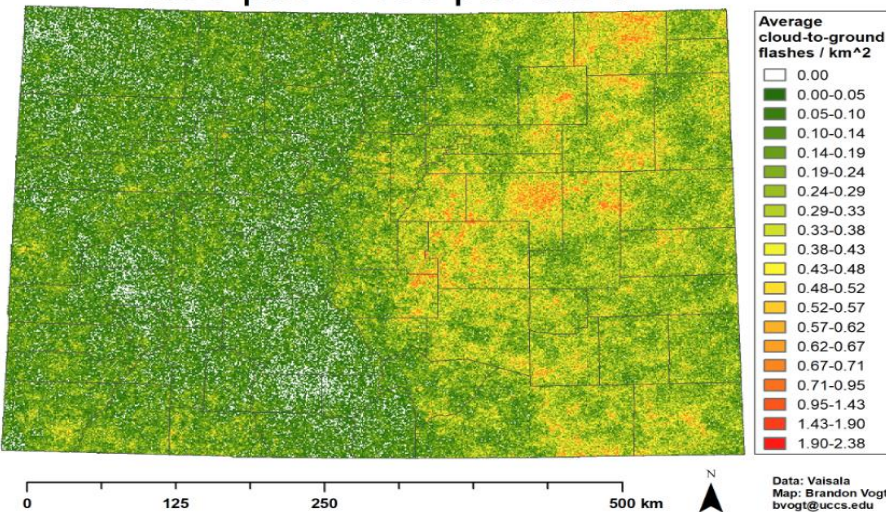
Colorado Lightning 1996 - 2016
11:00 am - 12:00 pm MDT



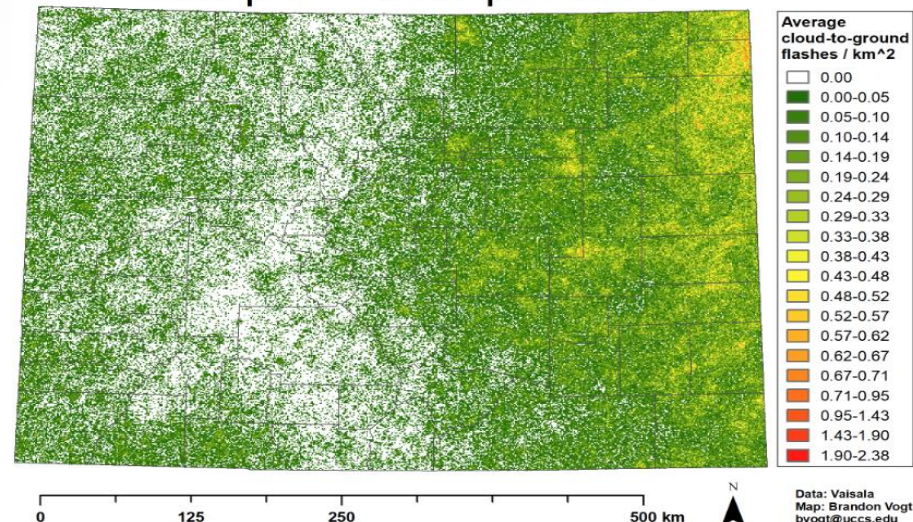
Colorado Lightning 1996 - 2016
2:00 pm - 3:00 pm MDT



Colorado Lightning 1996 - 2016
6:00 pm - 7:00 pm MDT



Colorado Lightning 1996 - 2016
9:00 pm - 10:00 pm MDT



TODD JONES



Just when you thought it was safe

15% of all strikes occur outside the rain area



Lets Play...

Safe or Not safe



If you're hit

- Victims are not electrically charged & can be attended to
- Basic CPR:
 - check for heart/breathing problems
 - Call for help
 - Begin CPR





Advice from
LIGHTNING™

Stay current
Follow the flash of inspiration
Spark new ideas
Strike out on your own
Light up the night
Know when to bolt
Charge ahead!

⚡ *Your True Nature* ⚡

ROCKY MOUNTAIN NATIONAL PARK

©Ilan Shamir, Advice from Lightning™ 67163



Tornado Safety On the Road

- Keep your distance from storm
- Always leave an avenue of escape
- Be prepared for storms to change direction
- Never outrun a tornado
 - Get to a sturdy shelter
 - Stay away from overpasses/bridges
- Last Resort: 2 options. No Guarantees!
 - Abandon vehicle if area lower than level of the roadway.
 - Stay in car: buckle up, cover head, stay low



What happens to cars in Tornadoes

South of Byers, 7/27, 2018



Elbert County F2 tornado May 10, 2004



Tornado Safety

In a home:

- Move to the basement
 - Protect yourself from flying/falling debris
- If no basement, seek small interior room
 - As many walls between you and outside as possible



In a mobile home:

- Go to a designated shelter
- Go to a home with a basement



Windsor Tornado Damage



Flash Flooding

Do You Really Know How Deep the Water is?

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



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

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



Flash Flooding-Sep 2013



Big Thompson Canyon Flash Flood 1976

- 90% of victims of the flood tried to escape using a vehicle, instead of climbing to safety
- **144 were killed**
- Rapidly rising water may engulf the vehicle and its occupants and sweep them away.



Rivers and Streams

weather.gov/bou/rivers

NWS Forecast Office Boulder, CO Denver/Boulder, CO
Weather Forecast Office

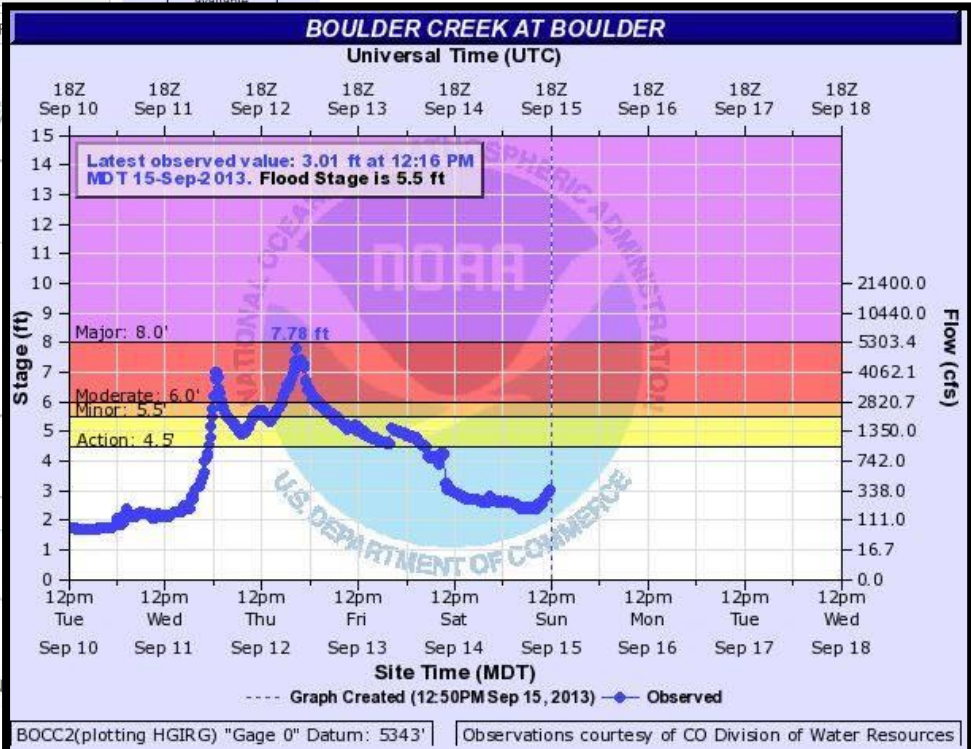
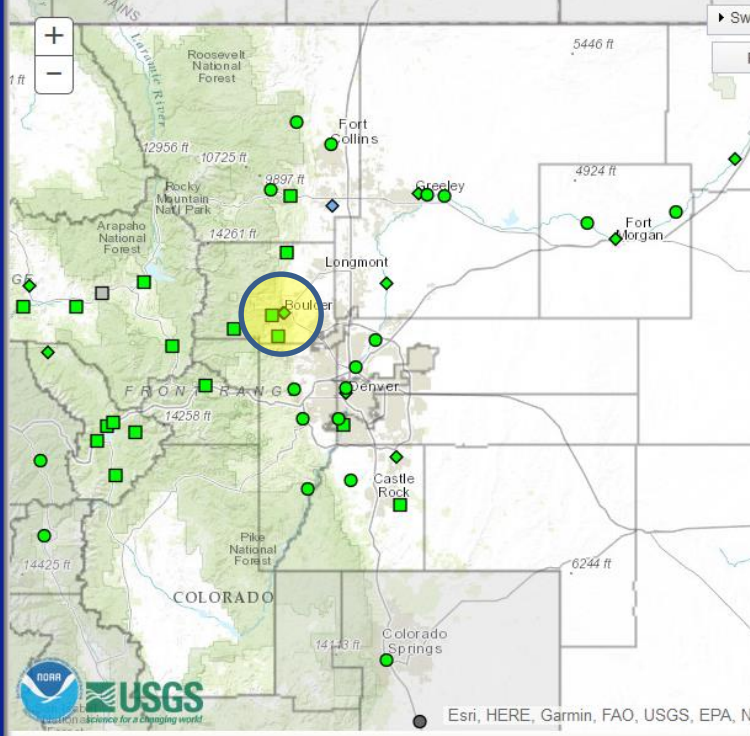
[Weather.gov](#) > Denver/Boulder, CO

[Current Hazards](#)
[Current Conditions](#)
[Radar](#)
[Forecasts](#)
[Rivers and Lakes](#)
[Climate and Past Weather](#)
[Local Programs](#)

[River Observations](#)
[River Forecasts](#)
[Experimental Long-Range Flood Risk](#)
[Precipitation](#)
[Download](#)

Auto Refresh: OFF 🔄
Print this map
Permalink
BOOKMARK
📧

144 total gauges
 1 gauge in flood



[Local weather forecast by "City, ST"](#)
 City, ST

Adjacent Areas:
 ⬆️ ⬆️ ⬆️
 ⬅️ Zoom Out ➡️
 ⬆️ ⬆️ ⬆️

[National Conditions](#)
 Rivers
 Satellite
 Climate
 Observed Precip

[Local Conditions](#)
 Warnings
 Weather
 Forecast
 Radar

[AHPs Documentation](#)
 User Guide
 User Brochure

What is AHPs?
 Facts
 Our Partners

Feedback/Questions
 Provide Feedback
 Ask Questions

Flash Flooding Alerts-Redstone Canyon



SKYWARN Agenda

- NWS Overview
- Weather Safety
- Thunderstorm Basics



How to cook up a Thunderstorm

Ingredients Necessary!

- **Moisture**: *especially near the ground*
 - Humidity, dew point, fuel for storms
- **Instability**:
 - *tendency for air to rise on its own*
- **Lift**:
 - *mechanism to make air start to rise*



Moisture sources



Instability

- “Parcel” of air
- Hot Air Balloon
 - Rises because warmer than surrounding air
 - Unstable
- Parcel of air becomes a thunderstorm

Cool

Warm



Atmospheric stability

Unstable

Stable



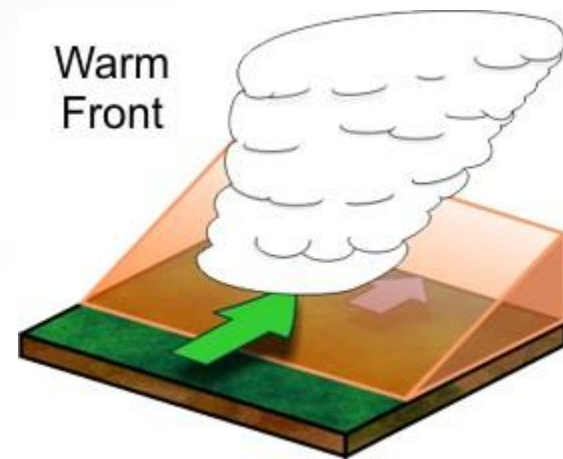
Lift

- Need to get an unstable parcel moving
- Lifting mechanisms
 - Cold Front



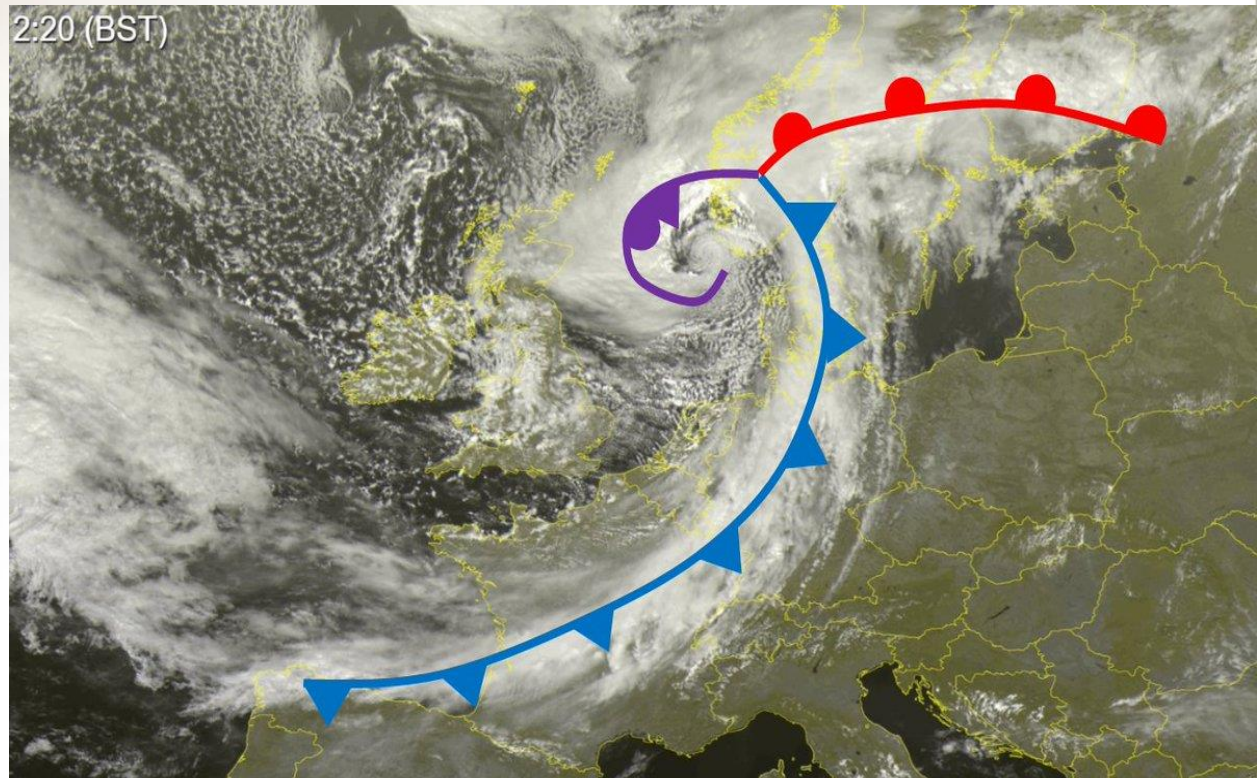
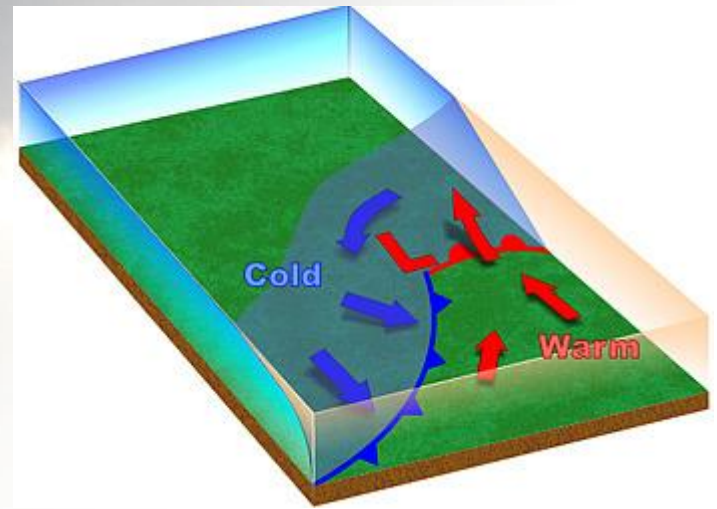
Lift

- Need to get an unstable parcel moving
- Lifting mechanisms
 - Cold Front
 - Warm Front



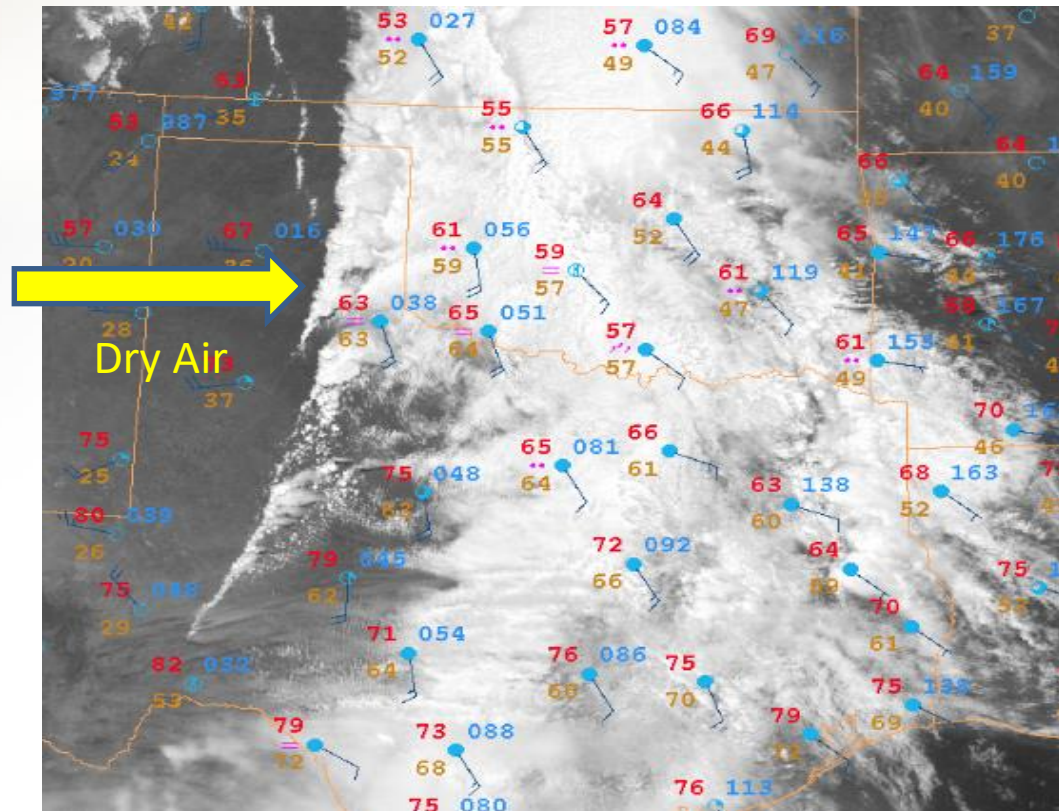
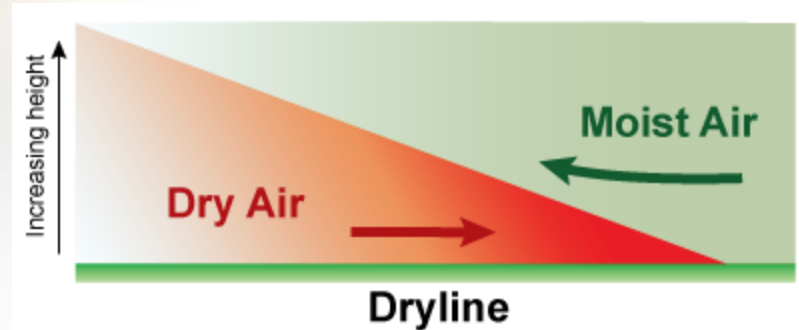
Lift

- Need to get an unstable parcel moving
- Lifting mechanisms
 - Cold Front
 - Warm Front
 - Low Pressure



Lift

- Need to get an unstable parcel moving
- Lifting mechanisms
 - Cold Front
 - Warm Front
 - Low Pressure
 - Dryline



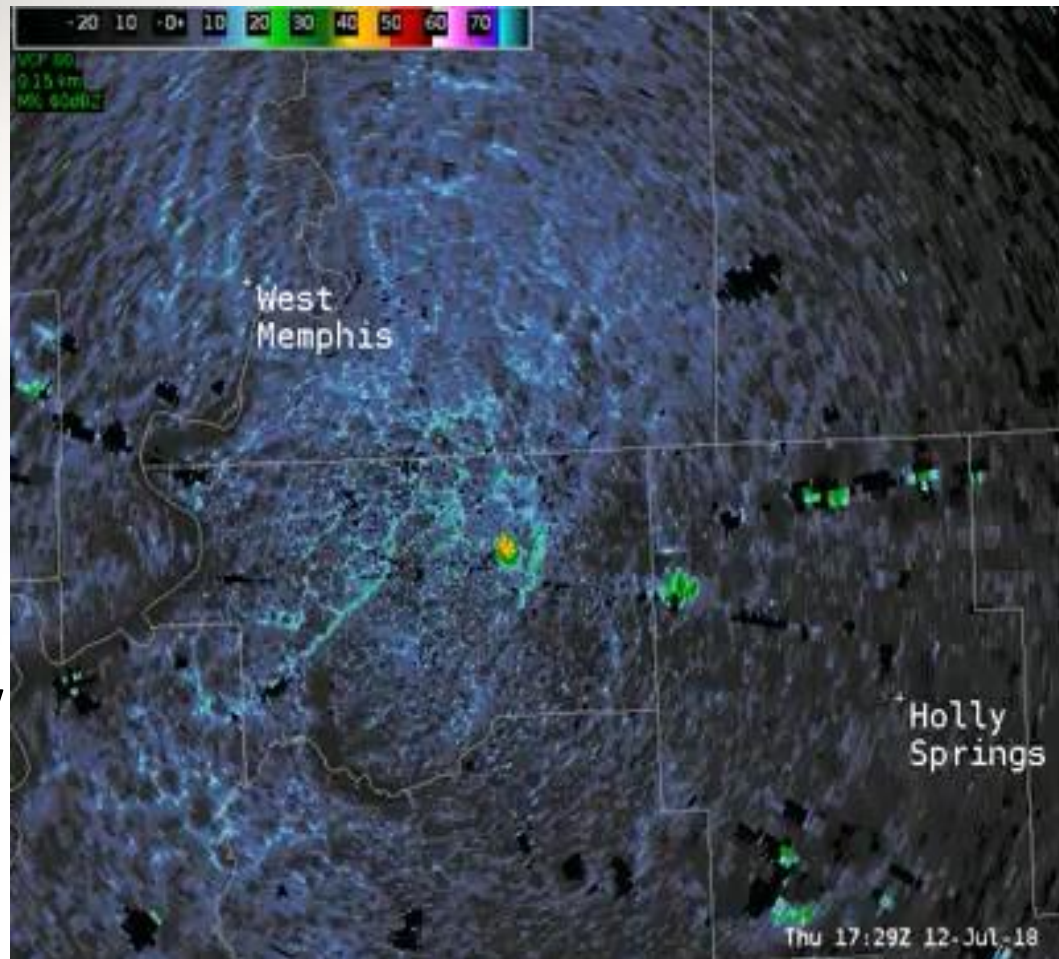
Lift

- Need to get an unstable parcel moving
- Lifting mechanisms
 - Cold Front
 - Warm Front
 - Low Pressure
 - Dryline
 - Upper Trough
 - Jet Stream

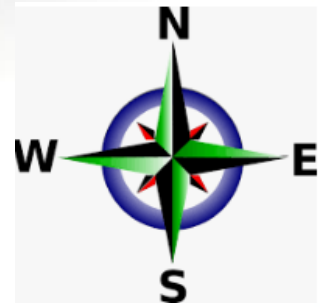


Lift

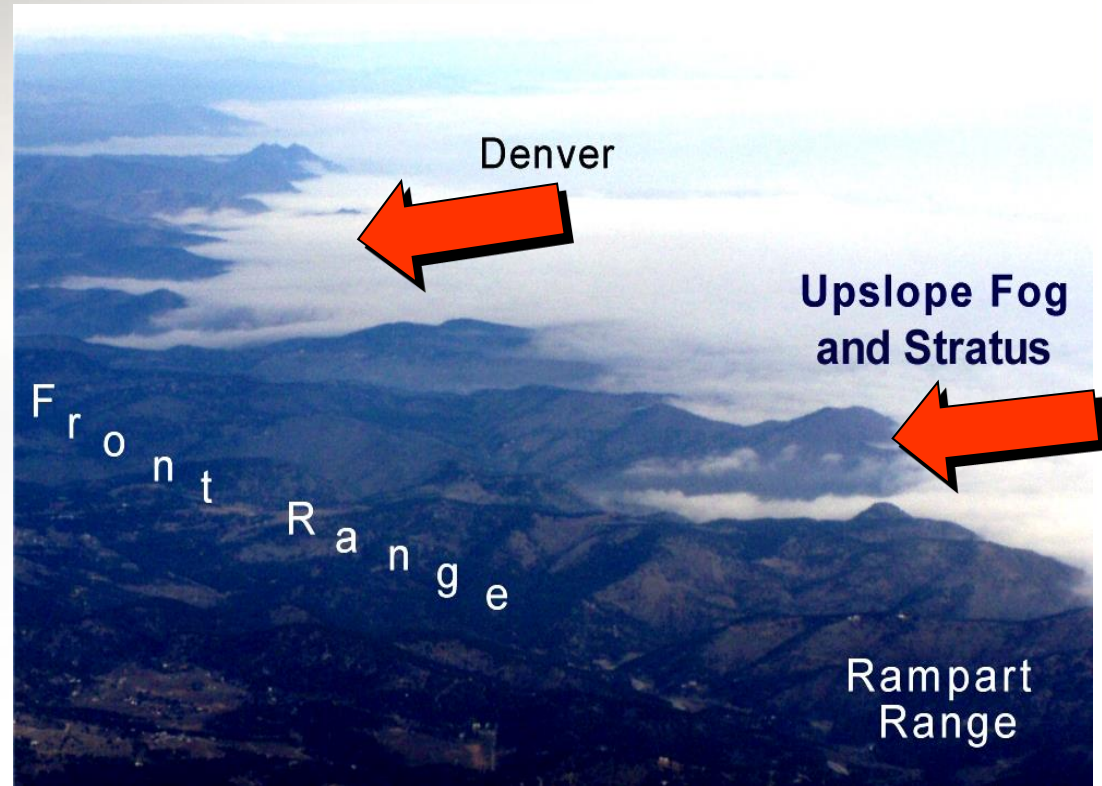
- Need to get an unstable parcel moving
- Lifting mechanisms
 - Cold Front
 - Warm Front
 - Low Pressure
 - Dryline
 - Upper Trough
 - Jet Stream
 - Thunderstorm outflow

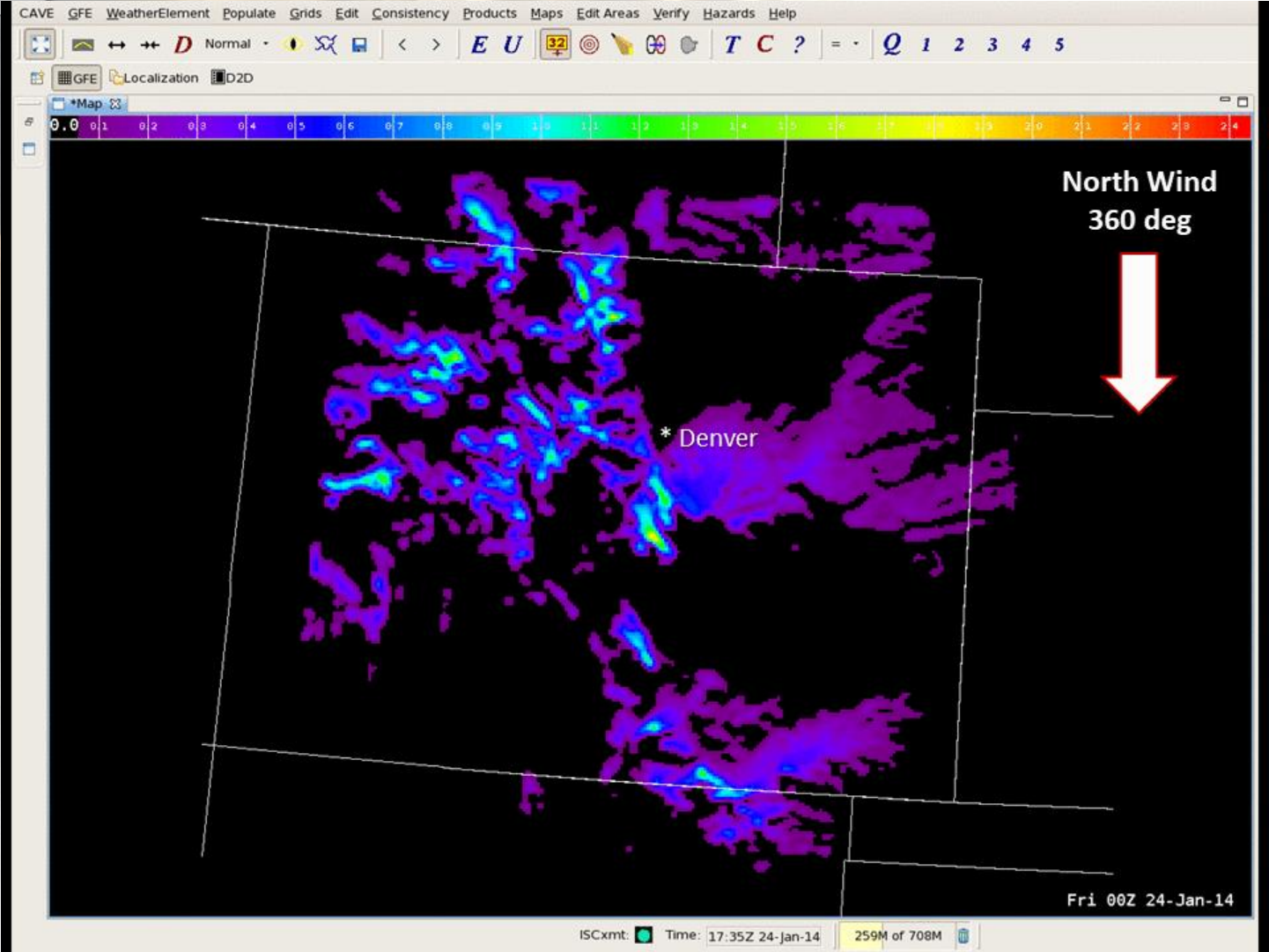


Lift



- Need to get an unstable parcel moving
- Lifting mechanisms
 - Cold Front
 - Warm Front
 - Low Pressure
 - Dryline
 - Upper Trough
 - Jet Stream
 - Thunderstorm outflow
 - Upslope





Thunderstorm Types

- Single Cell (Pulse)
- Multicell
- Multicell in line (squall line, bow echo)
- Supercell



Single Cell Storm Life Cycle



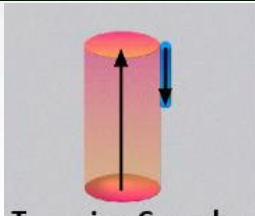
Towering Cumulus Stage



Mature Stage



Dissipating Stage



Towering Cumulus



Mature

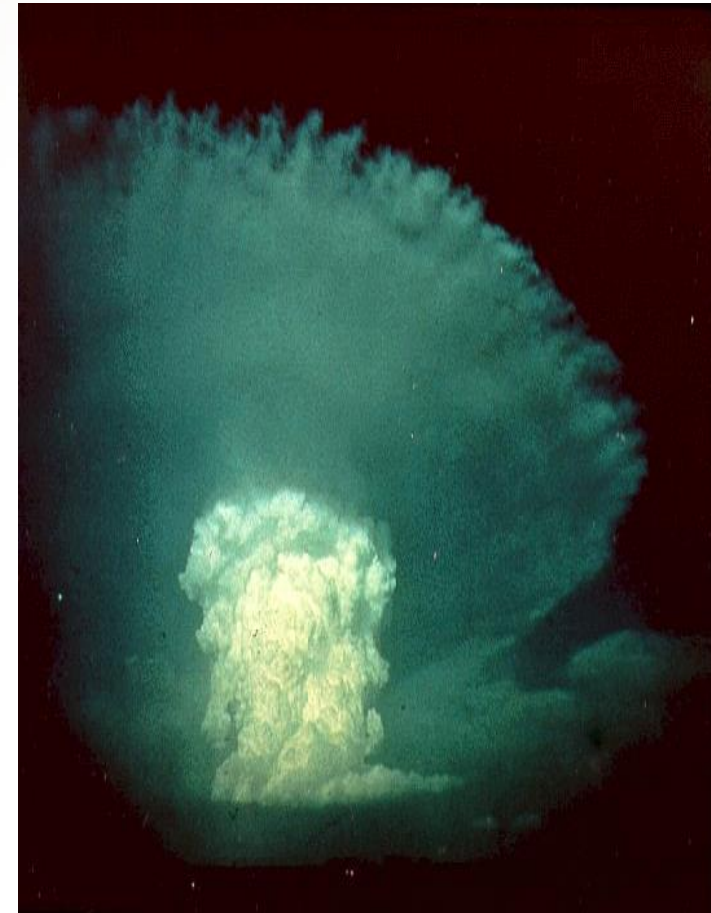


Dissipating



Single Cell Storms

- Weak winds aloft
- Typically during or just after peak afternoon heating
- Intense updrafts
- Collapsing downdraft:
 - Strong/damaging winds
 - Short duration rain/hail~5-10 min



Towering Cumulus

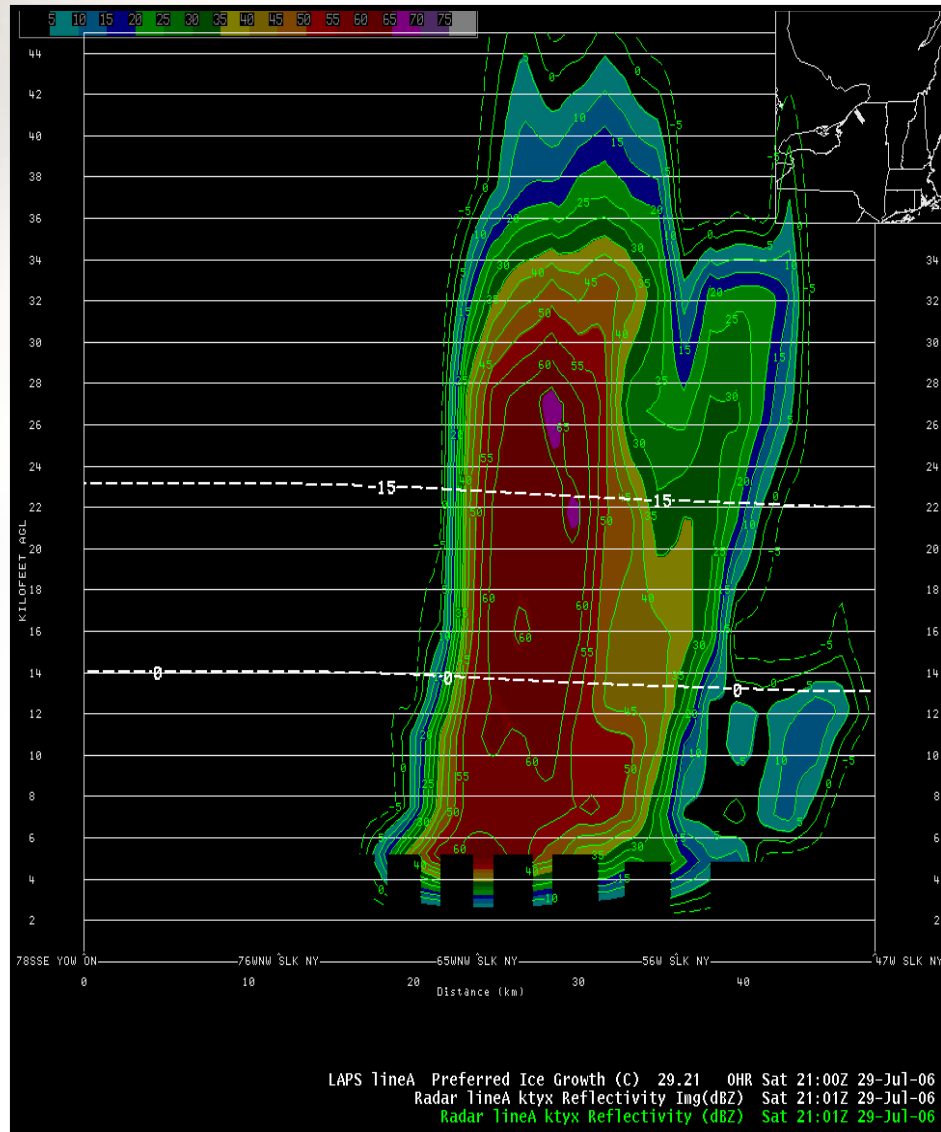
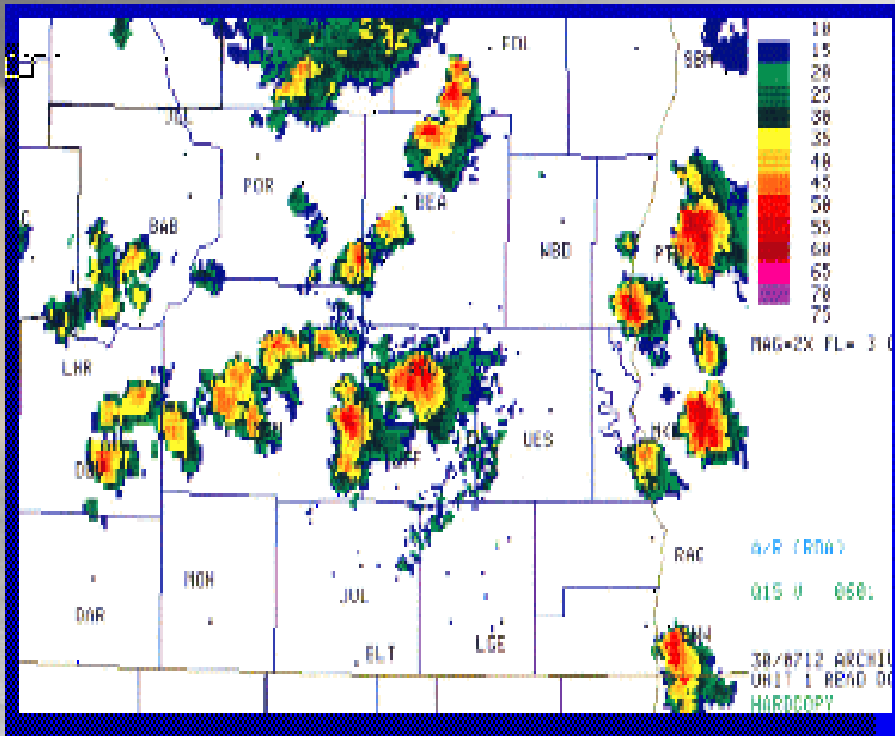


Mature



Dissipating

Single Cell Storm on Radar

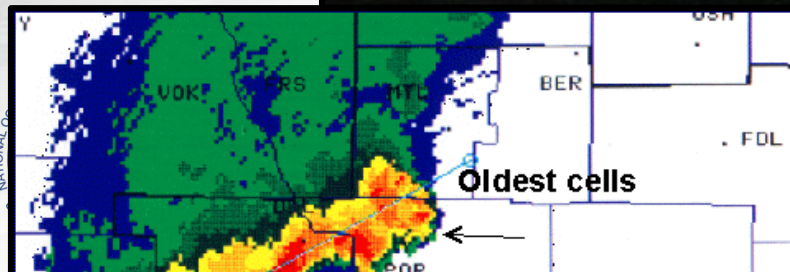


Multi-Cell Thunderstorm

- Most common thunderstorm
 - Multiple cells
 - Updrafts and downdrafts in different stages of development
- Each cell may last only 30 minutes
- Life cycle of the cluster may last several hours
- Severe weather usually isolated and short duration.

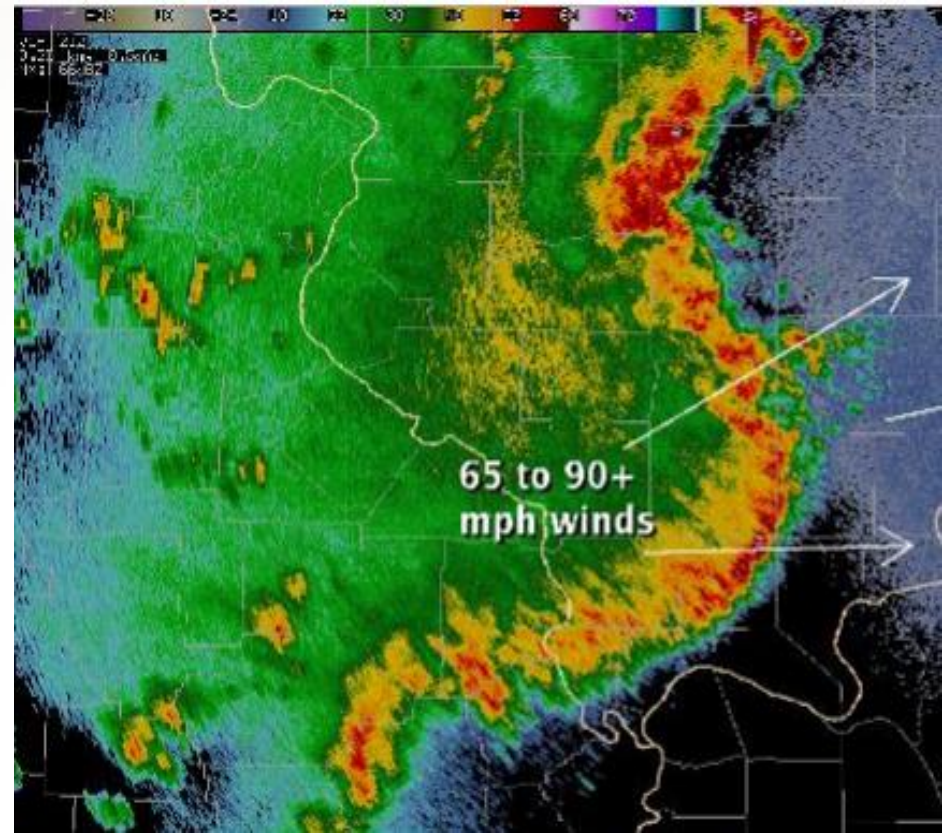


Multi-Cell Thunderstorm



Multi-Cell Line Storm (Squall Line)

- A long line of storms with a continuous, well developed gust front along the leading edge
- May be a solid line, or may be breaks
- Main threat is damaging straight line winds- Up to 100 mph!
- Bow echo – when portion of the leading edge downdraft accelerates ahead of the main line



Supercell Thunderstorm

- Characterized by persistent rotating updraft
- Rotation transports precipitation away from main updraft
- Precipitation induced downdrafts do not fall back down through updraft
- Storm can survive for long periods of time
 - March 18 1925, deadliest tornado event in US history- 12 hour lifespan, 300 miles



Supercell Ingredients

- 3 Ingredients for Thunderstorms:
 - Moisture
 - Instability
 - Lift
- Additional ingredient for Supercell:
 - Shear (2 types)
 1. Directional (wind direction changes with height)
 2. Speed (wind increases with height)



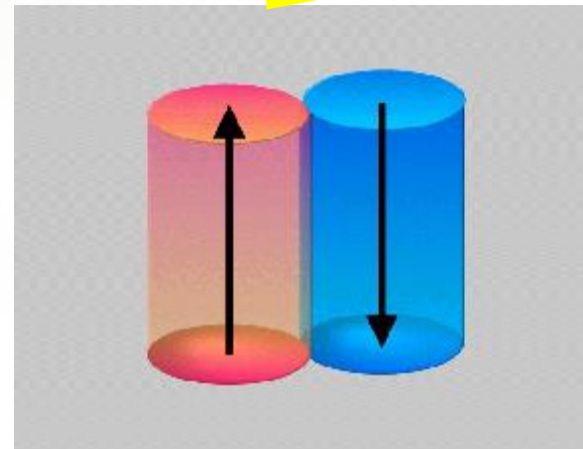
Photo by Mike Charnick

Wind Shear

- Weak Shear



- Strong shear



Updraft in **weak** wind SPEED shear



Courtesy David Floyd (WFO GLD)

Updraft in **STRONG** wind SPEED shear



Courtesy David Floyd: (WFO GLD)

Wind Shear

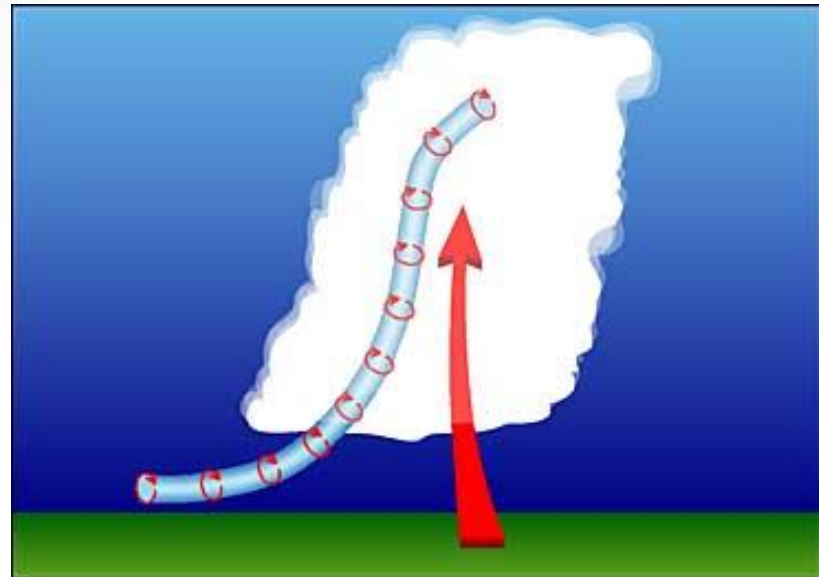
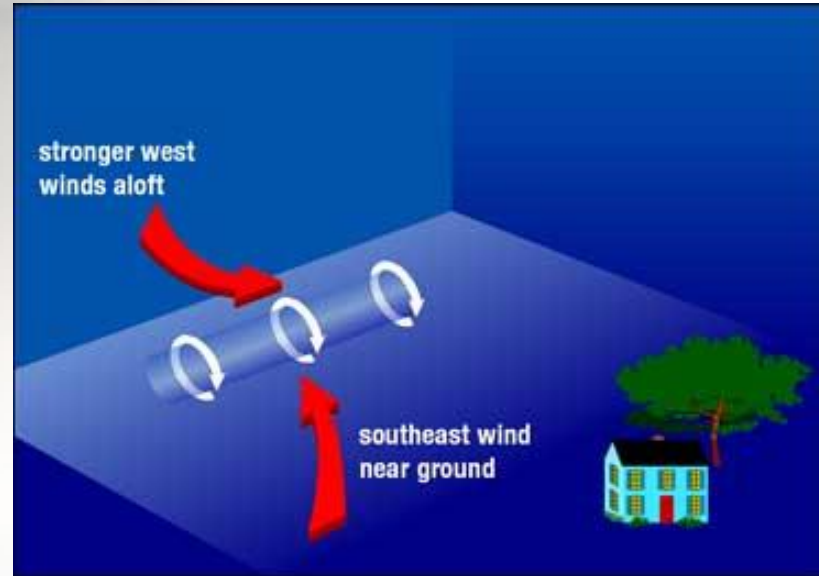
Courtesy of Mike Nelson, KMGH, and Viaero

2017-03-08 18:13:35 Peetz Hill 8 miles SW of Peetz CO



Role of Shear in Supercells

- Wind Shear
 - Speed Shear
 - Directional Shear
- Shear is tilted in updraft,
- Leads to supercell rotation

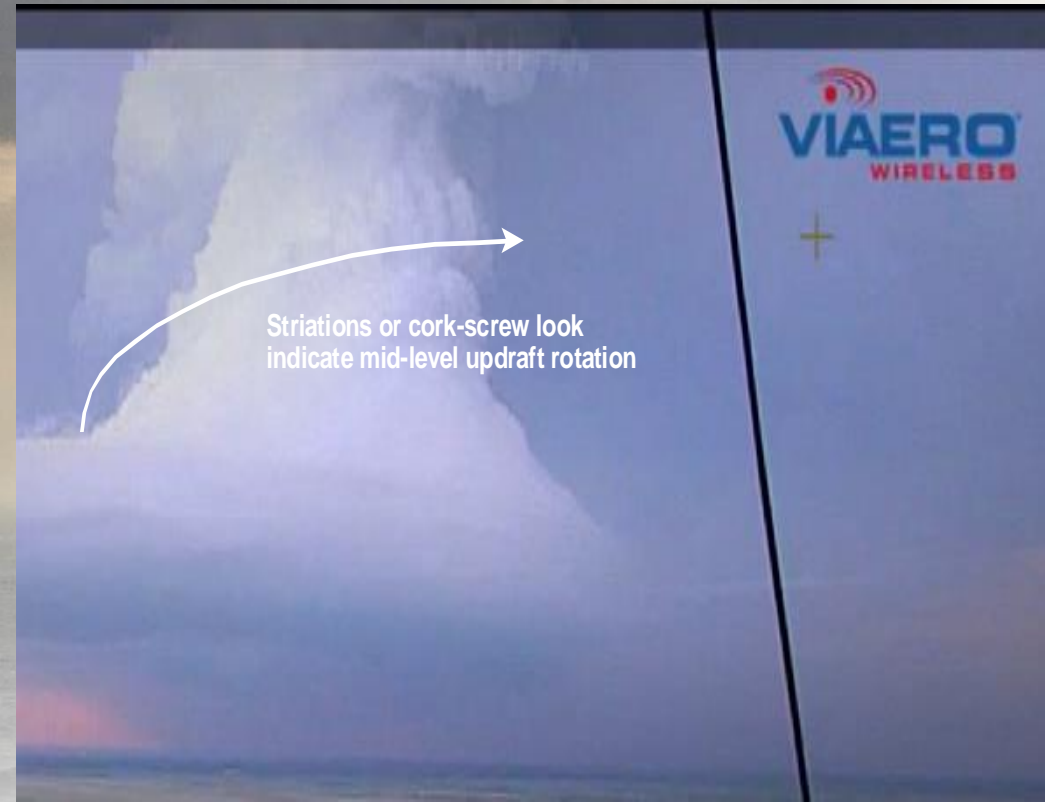


Supercell Cloud Features

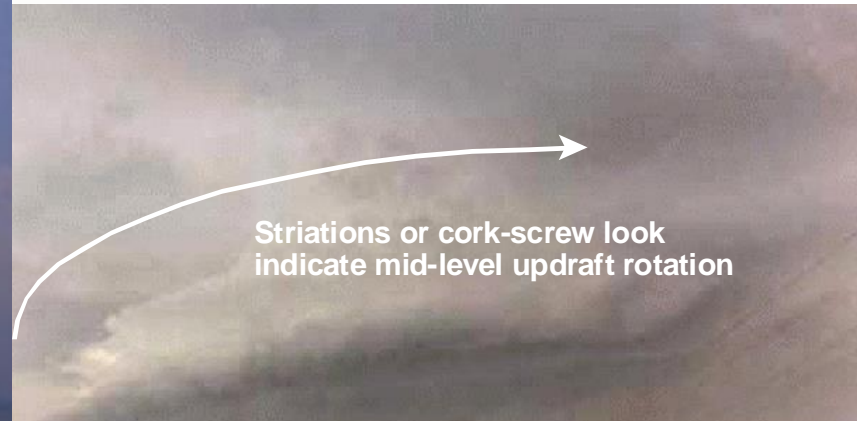
- Mesocyclone
- Wall Cloud
- Rear Flank downdraft (RFD)



Mesocyclone



“Barber Pole”



Montana Mesocyclone



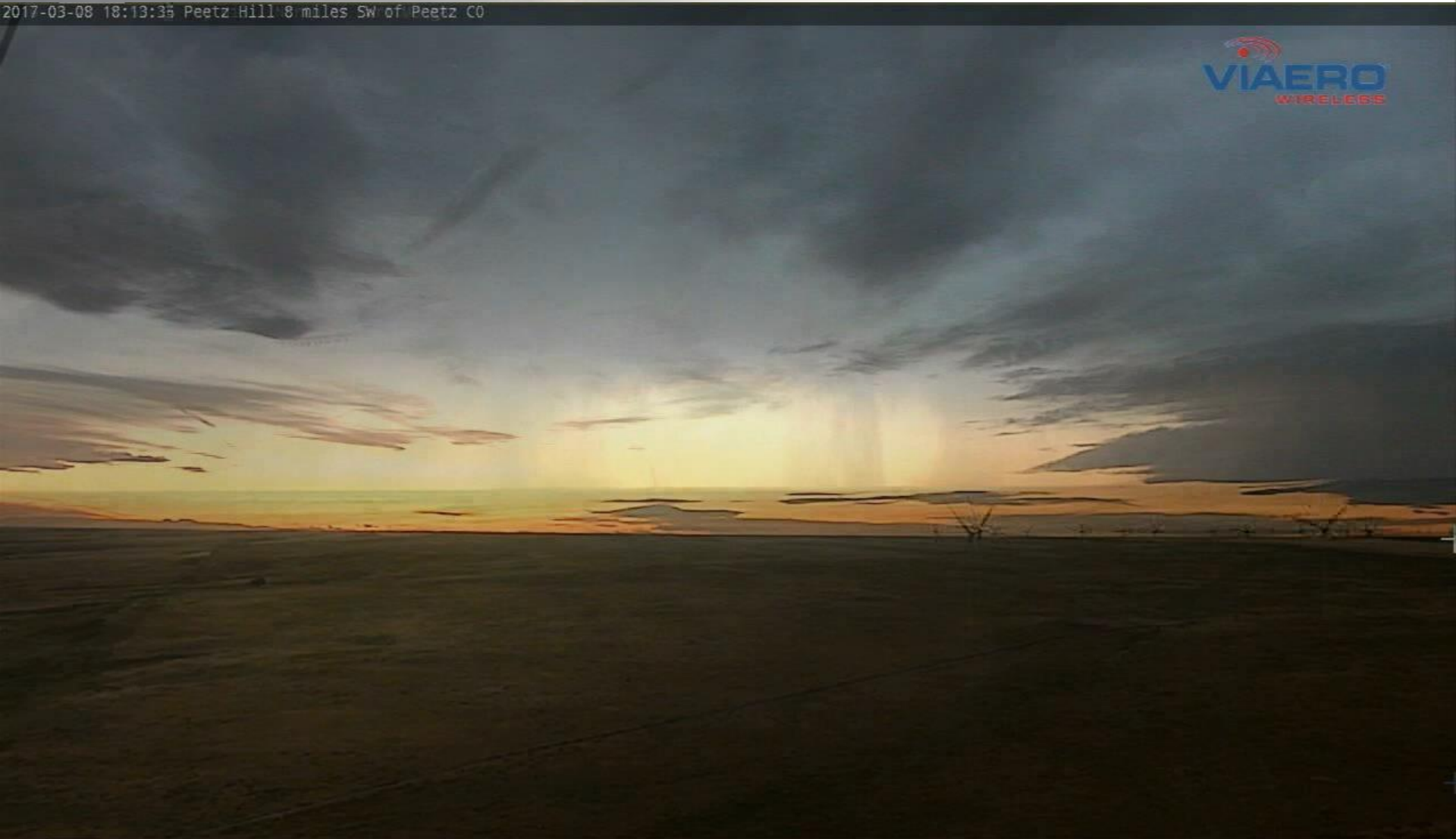
2004 Bruce Sherbon



Mesocyclone ‘barber pole’”

Courtesy of Mike Nelson, KMGH, and Viaero

2017-03-08 18:13:35 Peetz Hill 8 miles SW of Peetz CO

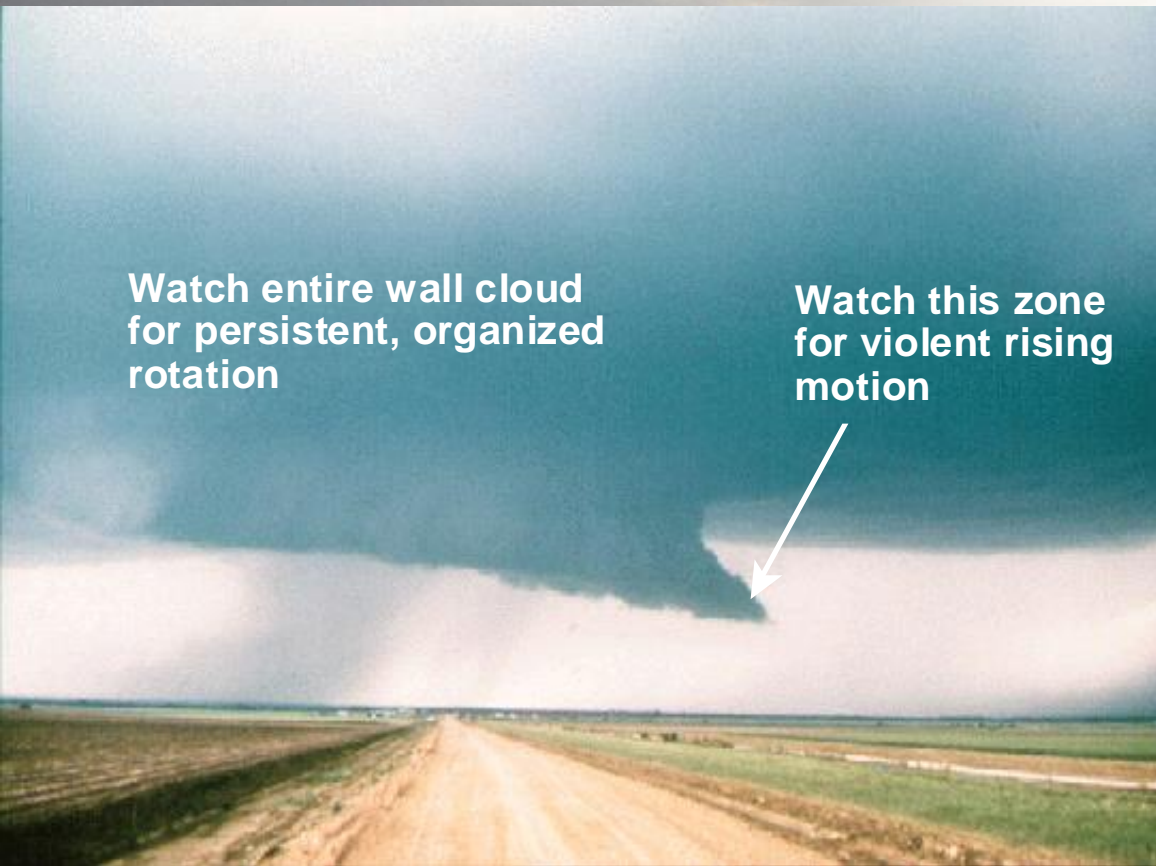


Supercell Cloud Features

- Mesocyclone
- Wall Cloud
- Rear Flank
downdraft (RFD)



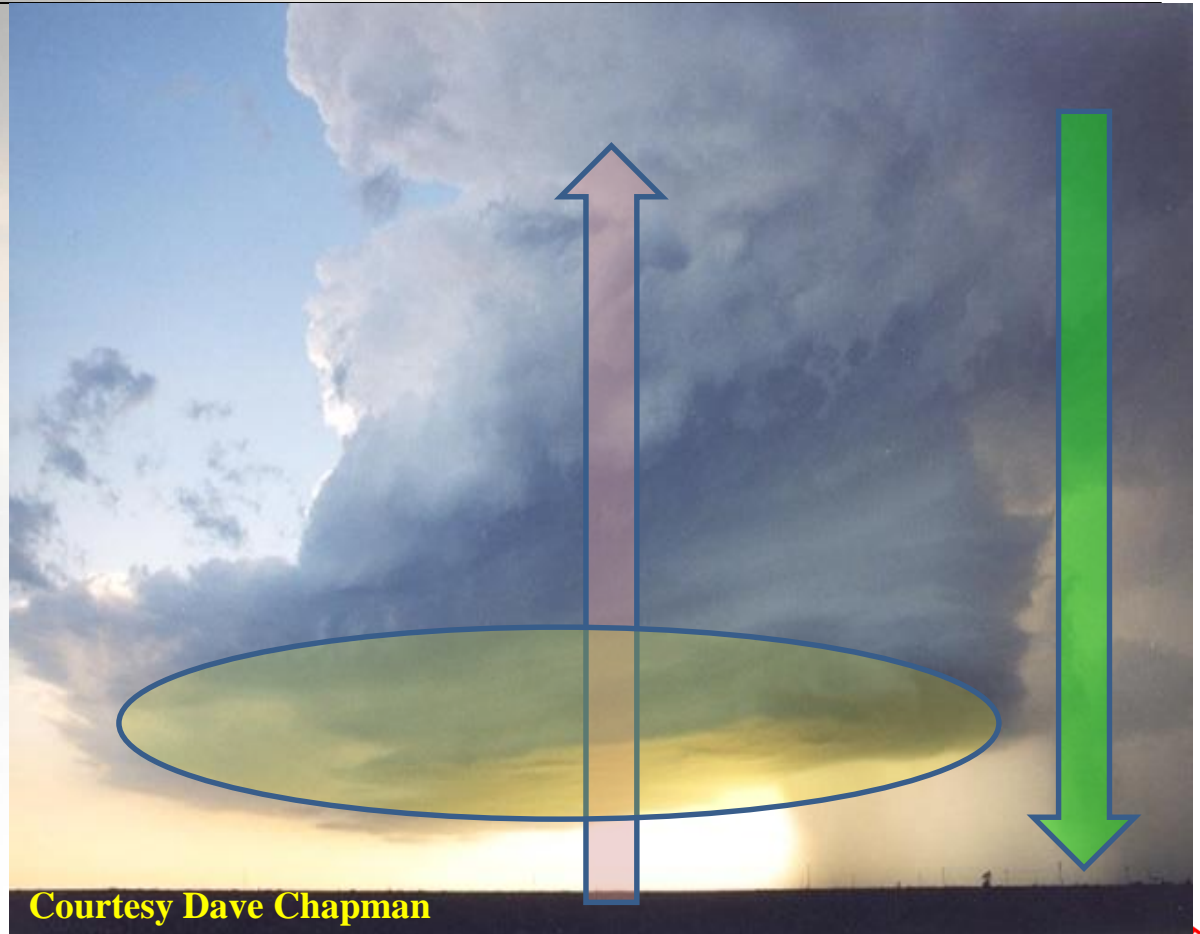
Wall Cloud Features



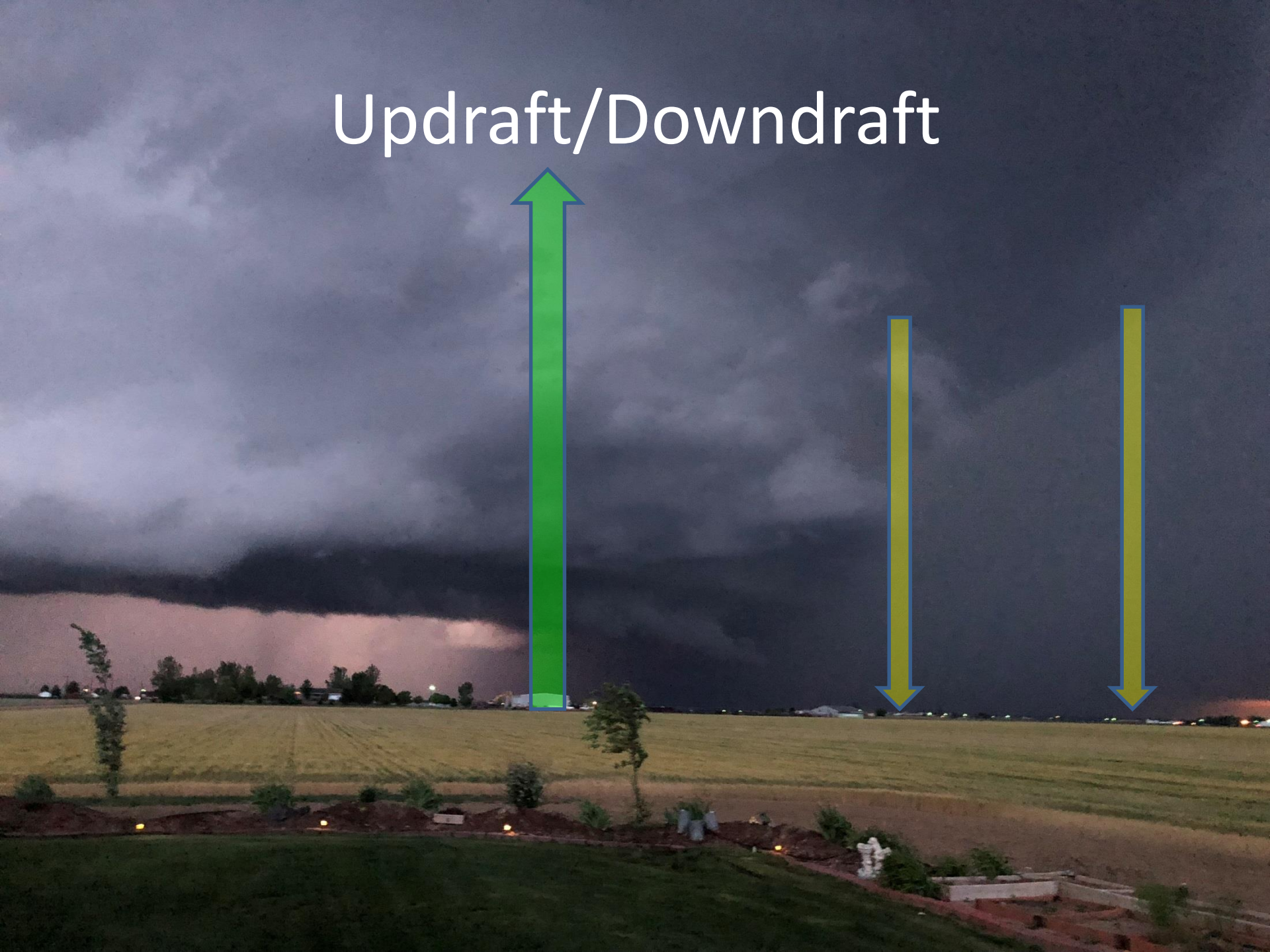
- Presence of a wall cloud indicates a strong updraft.
- Wall clouds usually slope down toward rain core.
- Look for rotation.
- Persistent, rotating wall clouds are important. Report these at once!

Updraft/Downdraft

- Inflow side of storm
- Rain free base
- Upward cloud motion
- Wall cloud / tornado area
- Supercells have **rotating** updrafts
- Downward Motion
 - Rain/Hail/Winds



Updraft/Downdraft



Inflow/Updraft



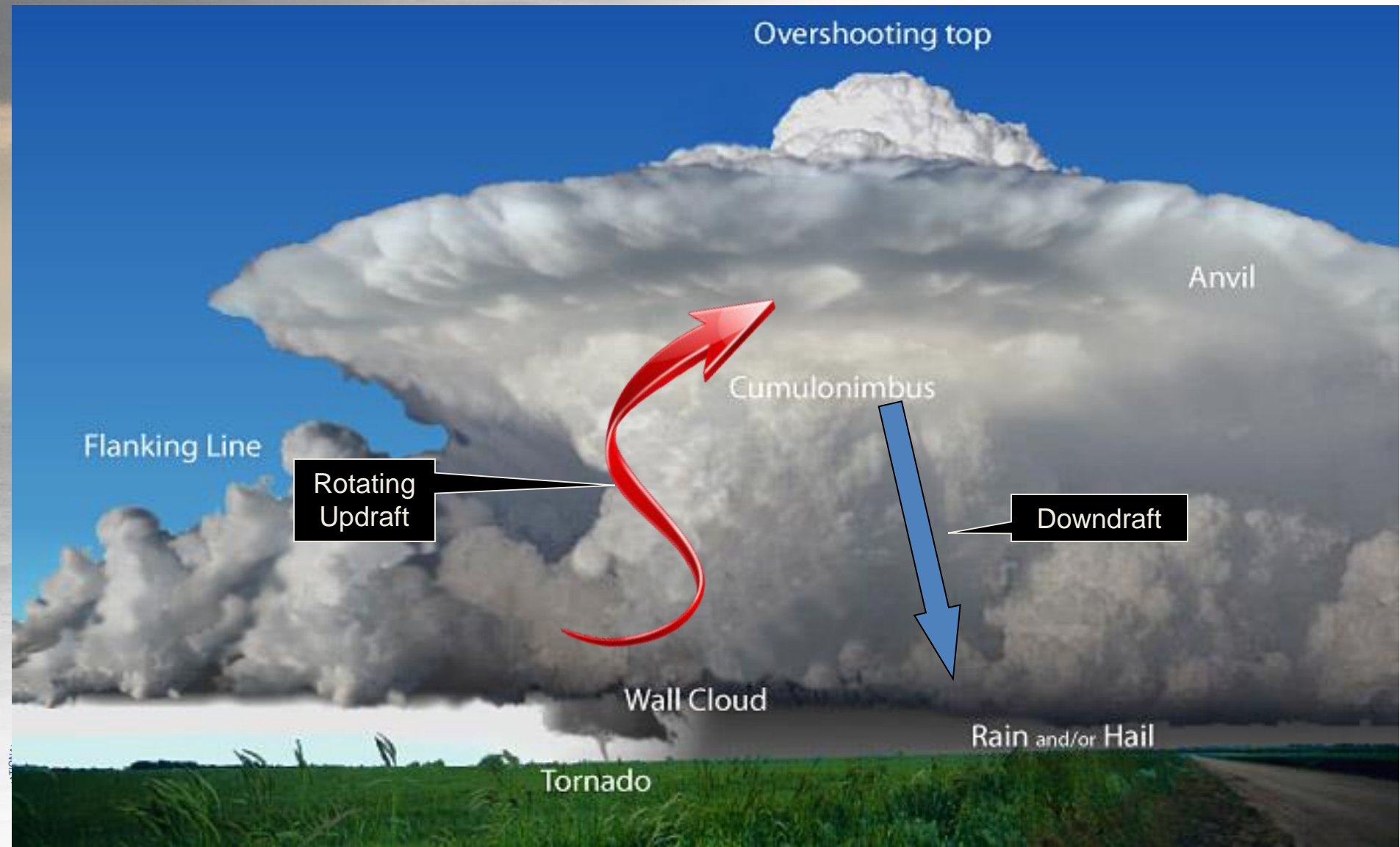
Wall Cloud/Outflow

Courtesy of Mike Nelson, KMGH, and Viaero

2017-03-08 18:13:35 Peetz Hill 8 miles SW of Peetz CO



Supercell Thunderstorms



Supercell Cloud Features

Mesocyclone

- Wall Cloud
- Rear Flank
downdraft (RFD)



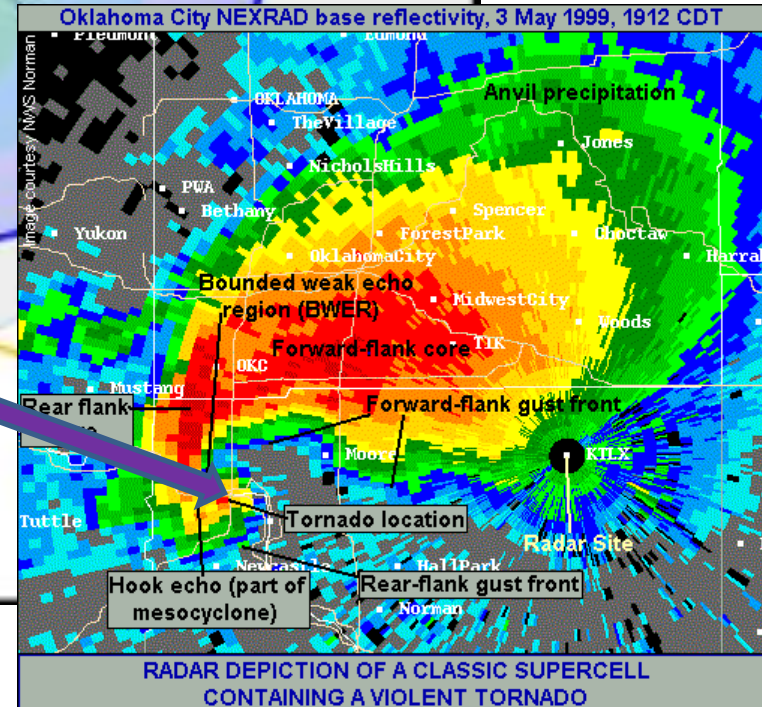
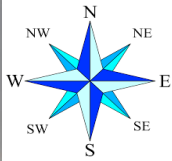
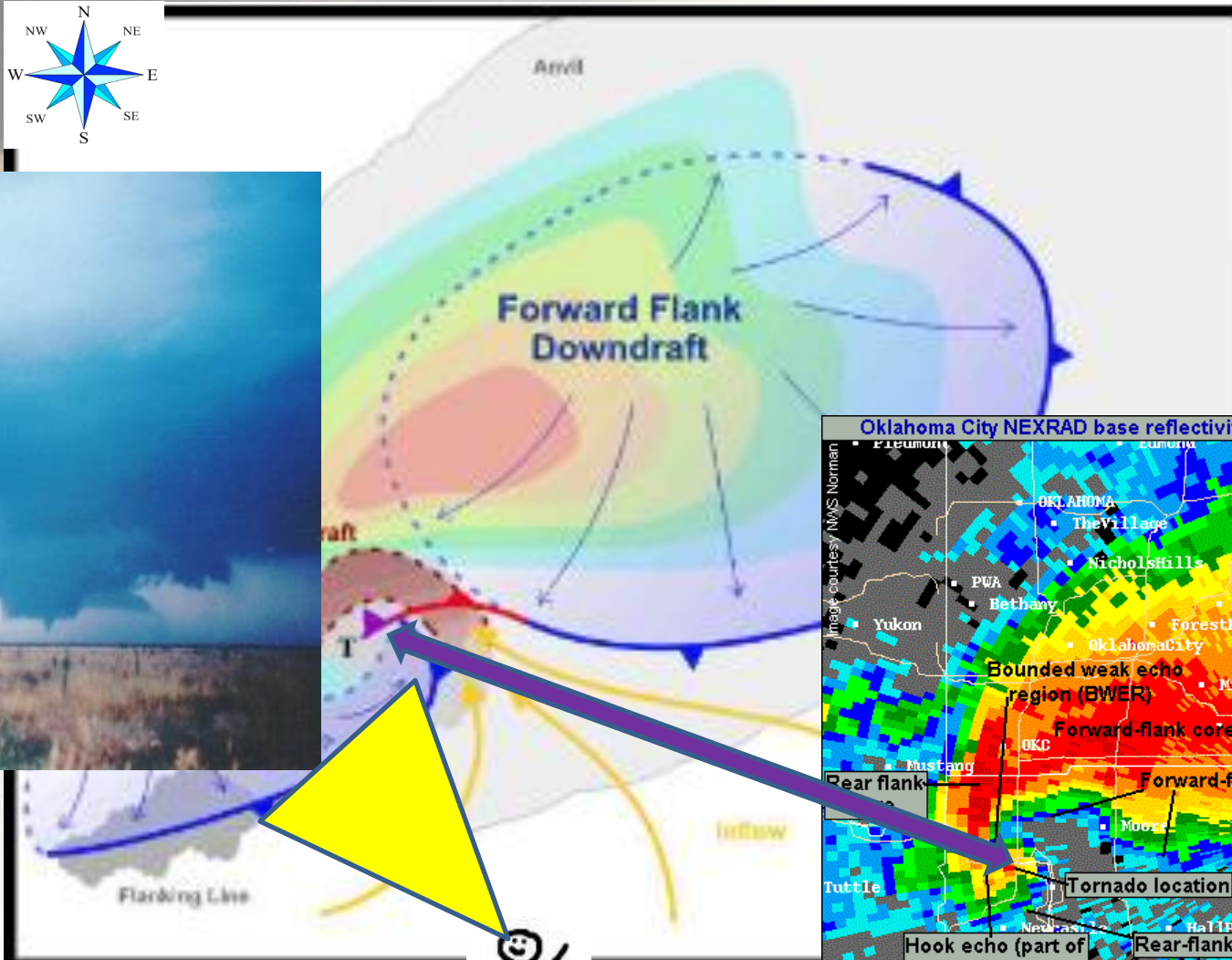
Photo Courtesy: Dalton Beringer



RFD/tornado formation



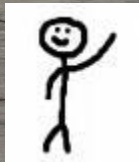
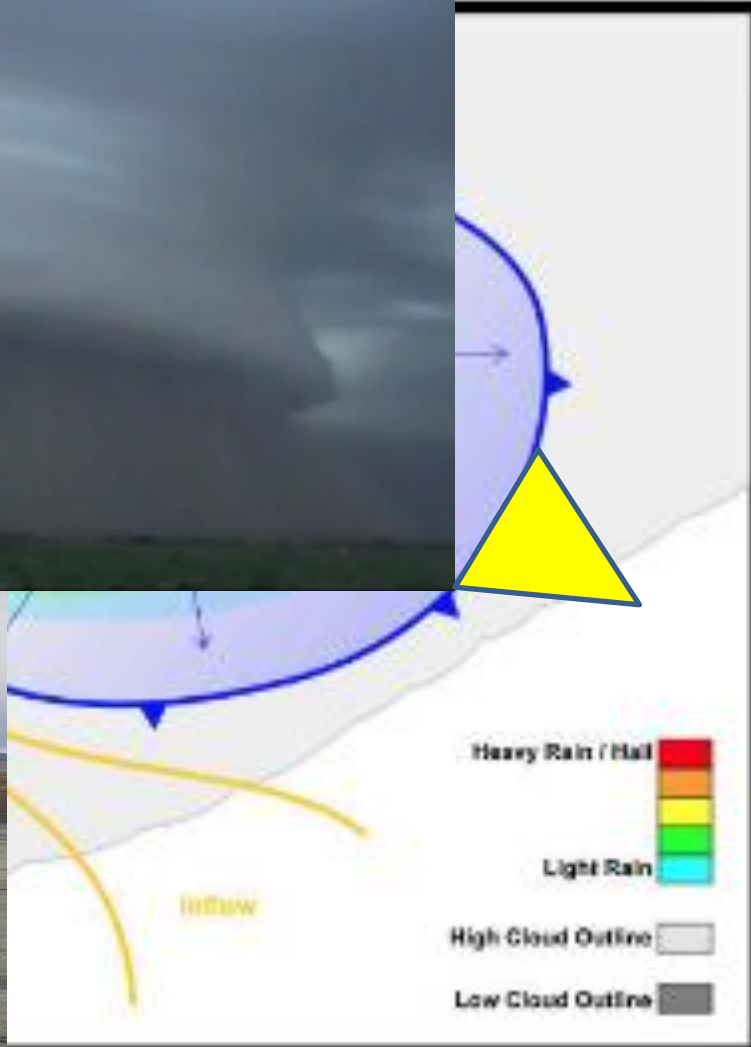
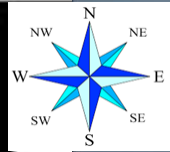
Supercell Storm structure



Courtesy of NWS, Jeff Haby



Outflow/Shelf Cloud

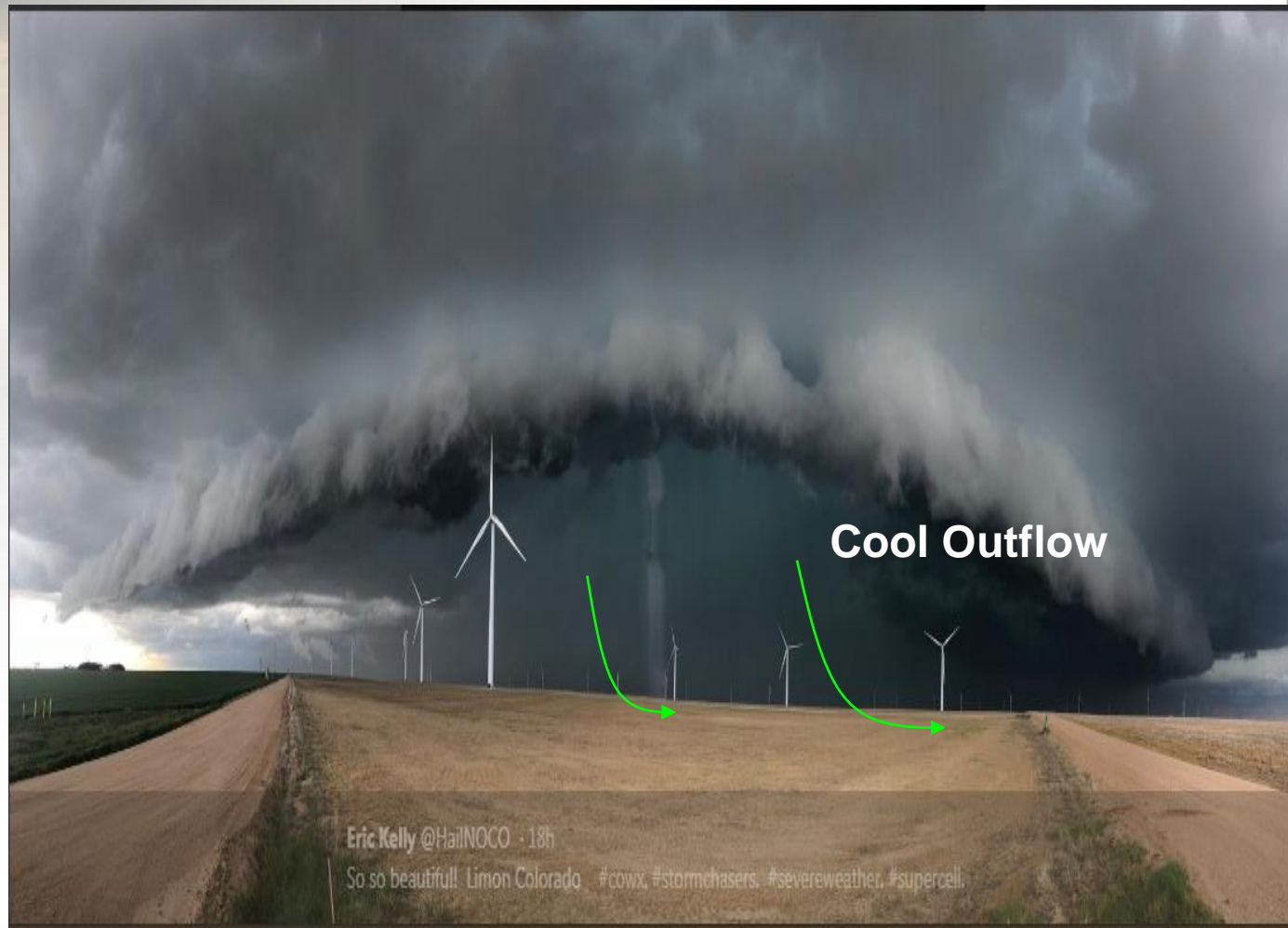


of NWS, Jeff Haby



Downdraft: Shelf Cloud

- * Marks the leading edge of the gust front (ahead of the storm)
- * Produced by the rain-cooled air
- * Cloud slopes down away from the rain
- * Often associated with straight line wind damage (not tornadoes)



Outflow/downdraft/shelf cloud

Courtesy of Mike Nelson, KMGH, and Viaero

2017-03-08 18:13:35 Peetz Hill 8 miles SW of Peetz CO





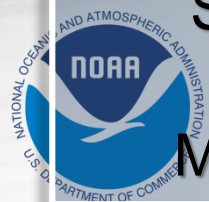
Wall Cloud

Abrupt or “blocky” lowering

Associated with storm inflow
and under rain free base

Slopes toward the rain

Moves along with storm



Shelf Cloud

Linear feature

Associated with storm outflow

Slopes away from the rain

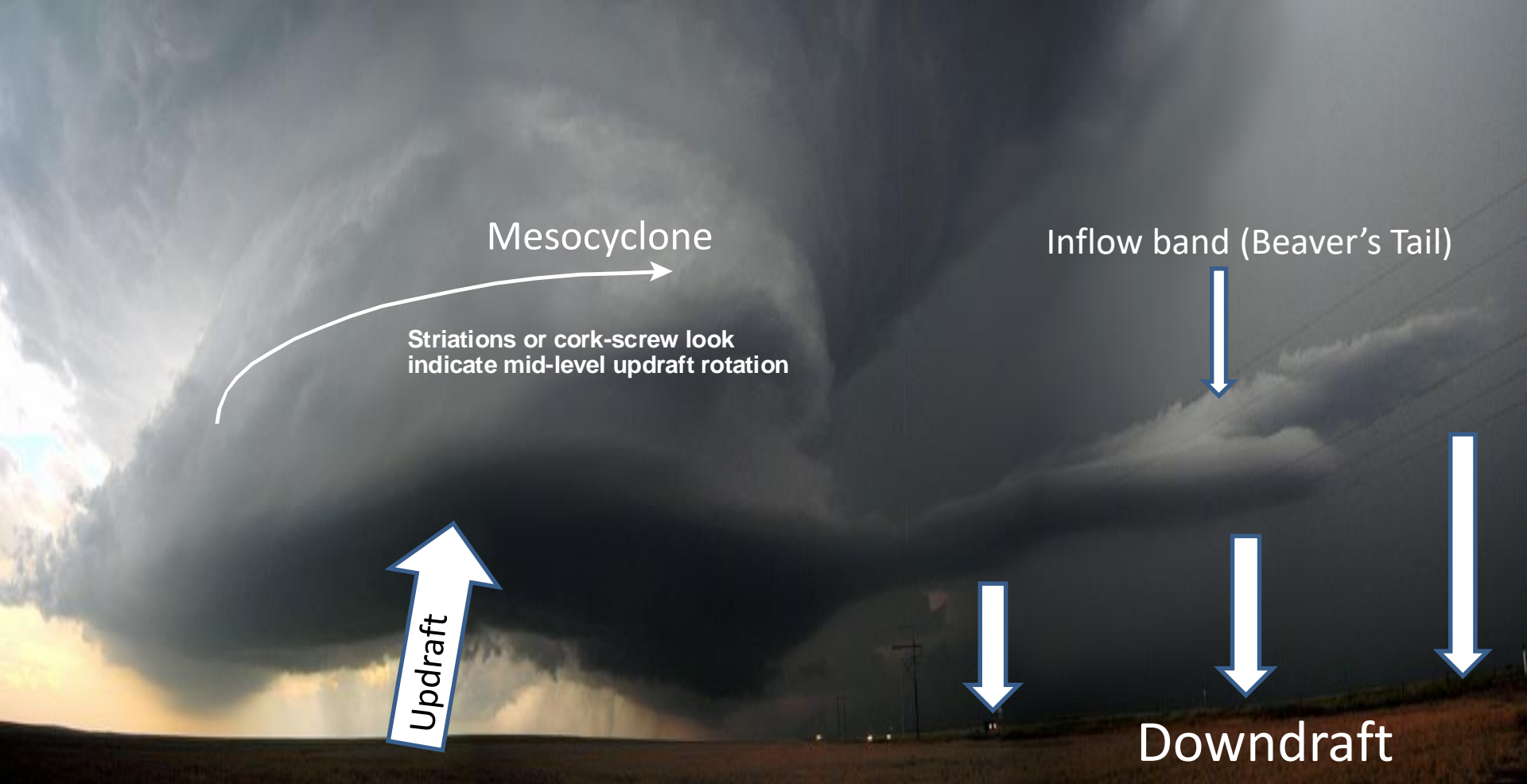
Moves ahead of rain area



Downdraft Features: Roll Cloud



Supercell Features



SKYWARN Agenda

- NWS Overview
- Weather Safety
- Thunderstorm Basics

Break Time!

- Spotting Storms
 - More cloud features, tornadoes
- Advanced Portion



Break Time Enjoyment

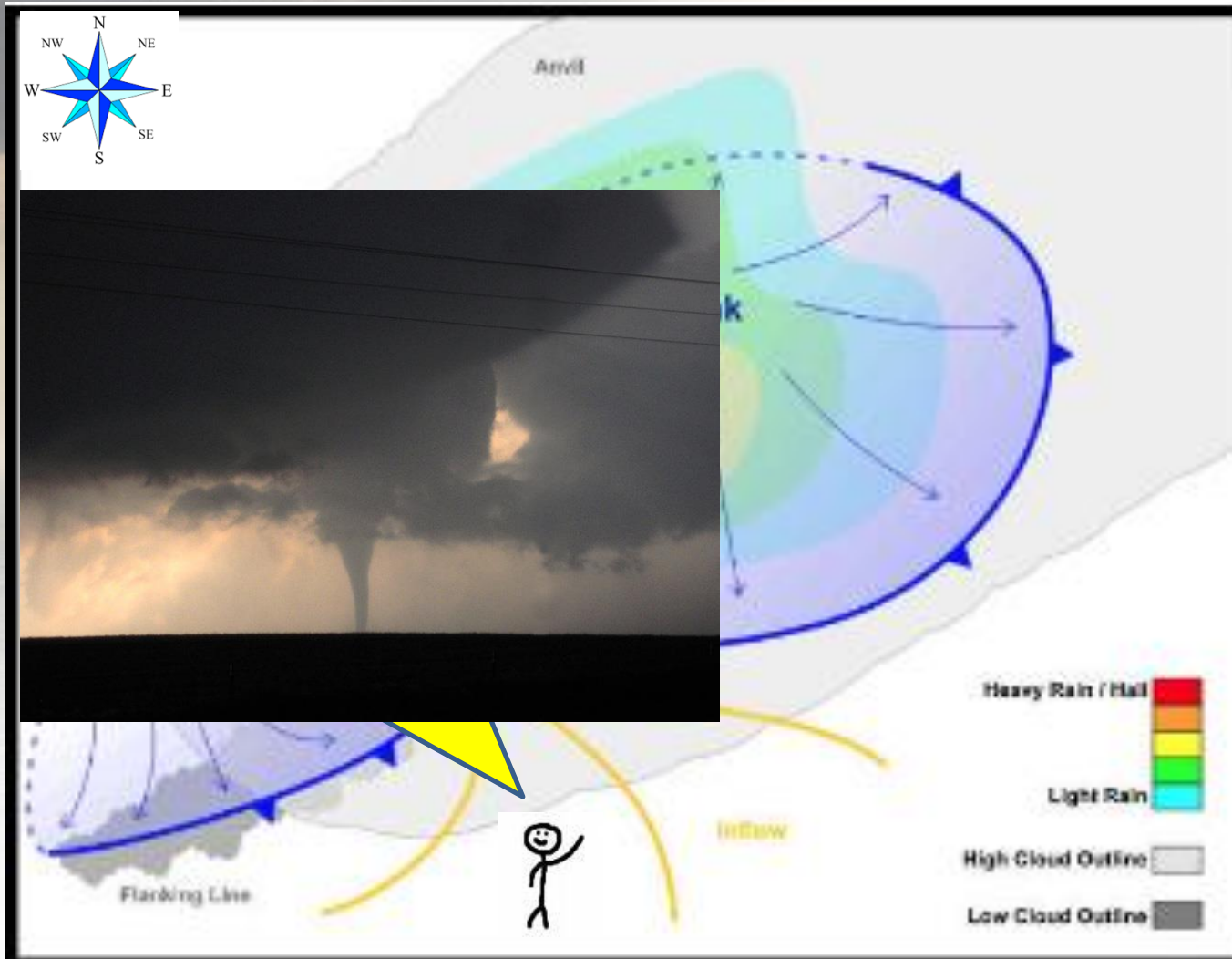


Spotting Storms

- What you see will be dependent on:
 - What side of storm you are on
 - Distance to storm
 - Visibility (humidity, haze, blowing dust)
 - Trees, buildings, other storms
- Your primary goal – SAFELY determine the strength and rotation of the updraft.

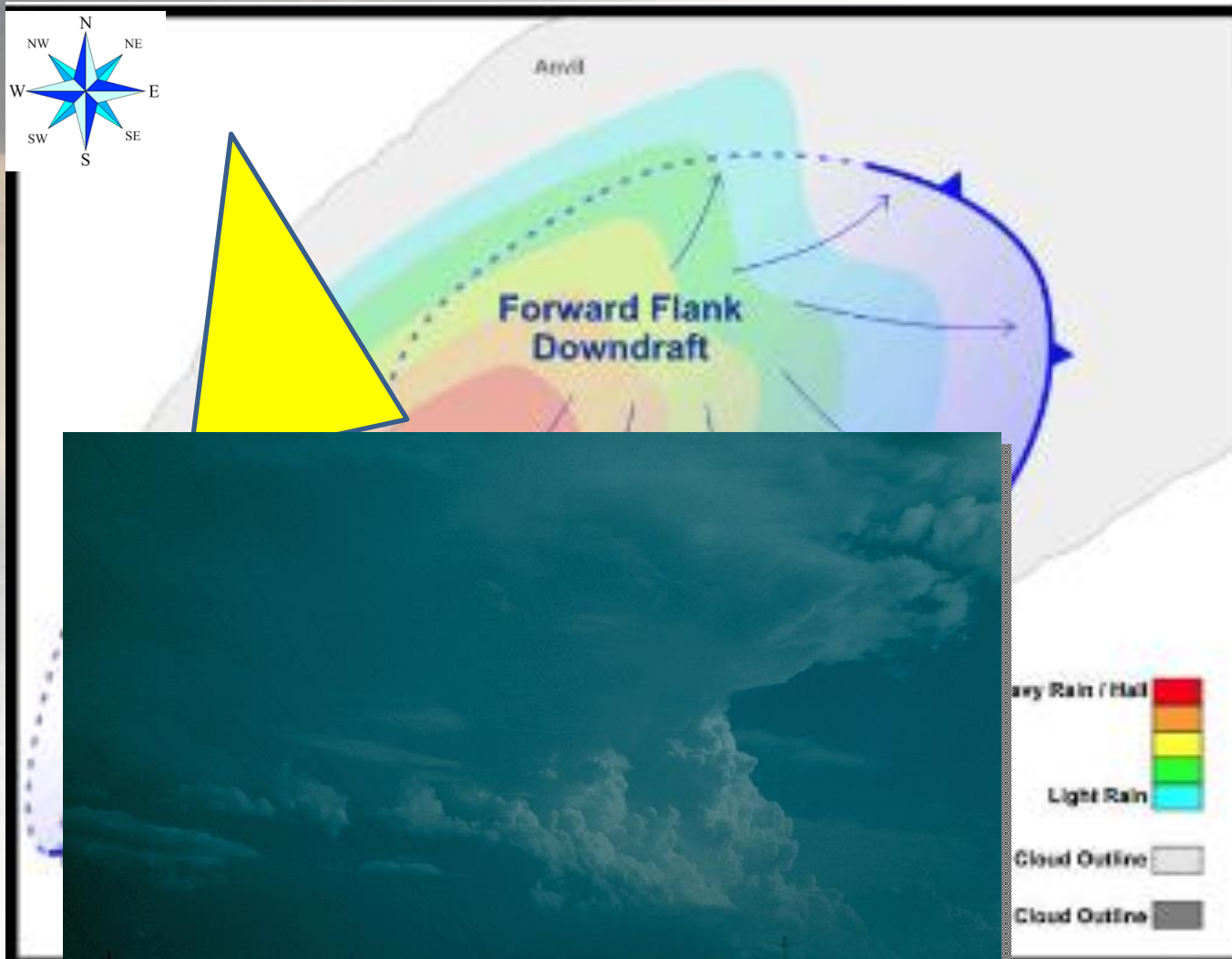


Supercell Storm structure



Courtesy of NWS, Jeff Haby

Supercell Storm structure



S, Jeff Haby

Upper level storm clues

- Best seen 30-40 miles from storm
 - Look for sharp, well defined edges on cirrus anvil
 - Look for overshooting top

Overshooting top

Cirrus anvil



Anvil/Overshooting Tops

Courtesy of Mike Nelson, KMGH, and Viaero

2017-03-08 18:13:35 Peetz Hill 8 miles SW of Peetz CO



Other Cloud Feature with Anvil

Mammatus Clouds

- Associated with Anvil cloud
- Clouds in sinking air
- Can be associated with severe storms
- Does not mean a tornado will form



Photo Courtesy by Candice Bivens

Mid level storm clues

- Main Storm Tower

- Best seen 10-20 miles from the storm
- As buoyancy increases, so does updraft strength



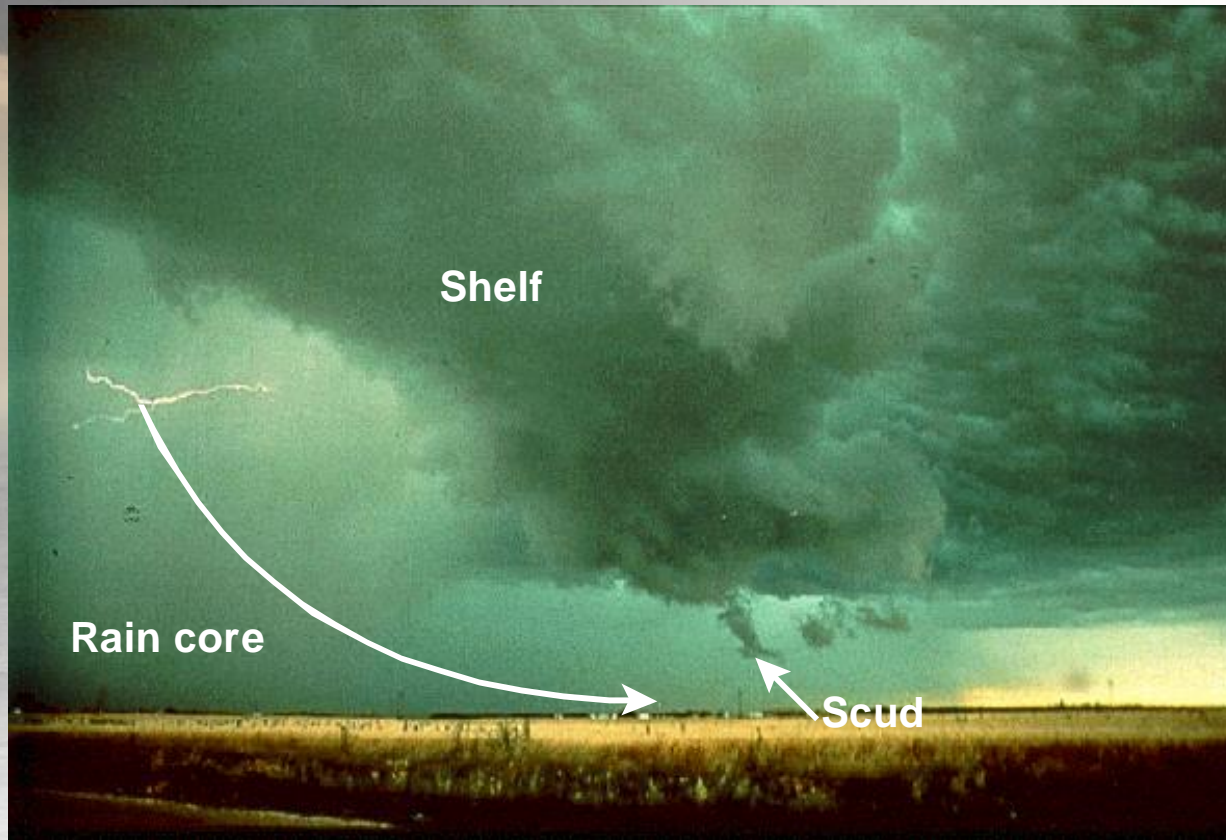
- Flanking Line:

a row of towering cumulus clouds
clouds stair-stepping up to the main

Photo by Tom Warner



“Accessory” Clouds



- Often turbulent with small scale twisting and curling motions in clouds.

- Motion is neither organized nor persistent.

- Scud clouds may form and dissipate rapidly.

Downdraft Indicators-Virga



© C. Doswell



Downdraft/Microburst



Photo Courtesy: Rhonda Spencer, W276. Aug 2, 2017



Downdraft/Microburst



Microburst: affecting an area *less than 2.5 miles* across.

Macroburst: winds extending in *excess of 2.5 miles* across.



Tornado

- A rotating column of air, *in contact with the surface*,
- Pendant from a cumuliform cloud,
- Often visible as a funnel cloud and/or circulating debris/dust at the ground.



© Verne Carlson

Glossary of Meteorology,
American Meteorological Society



Different Types of Tornadoes

- Rope-
- Cone or elephant trunk-
- Wedge-
- Supercell-
- Non-Supercell (landspout)-



These are both tornadoes

Supercell

Stormscale rotation

Mesocyclone

Tornado forms in
mature thunderstorm.

On radar, look for large
rotating storm.

Good warning verification

Can be violent or weak



Non supercell

no storm rotation

no mesocyclone

tornado forms in early
stage of development.

On radar, look for a
boundary.

poor warning verification

tend to be weak



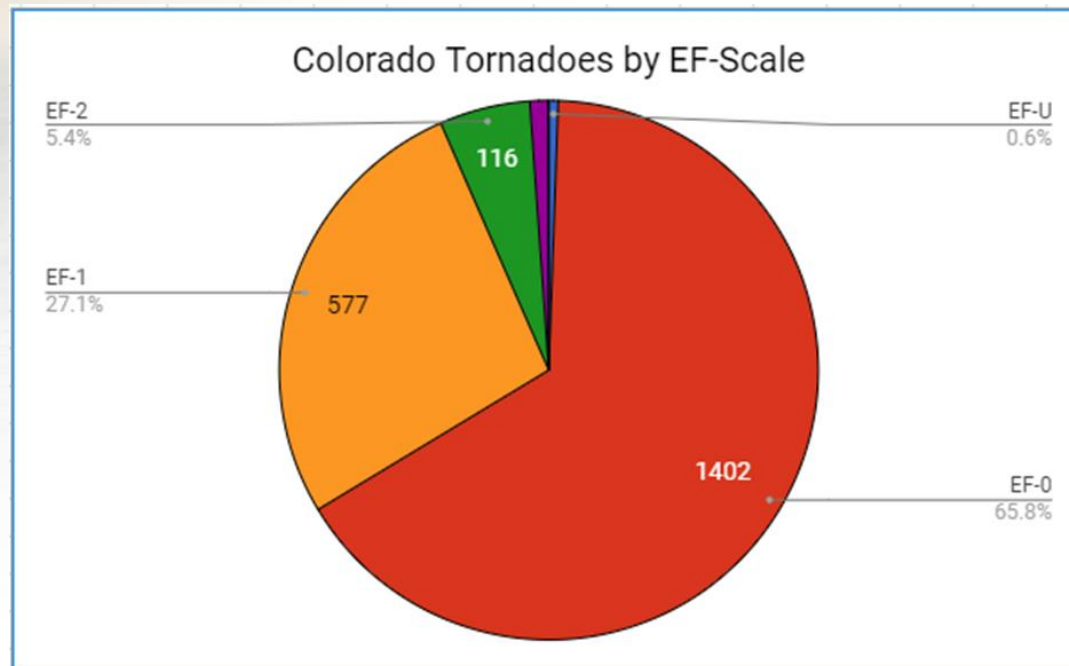
Enhanced Fujita Scale

Wind estimates based on damage

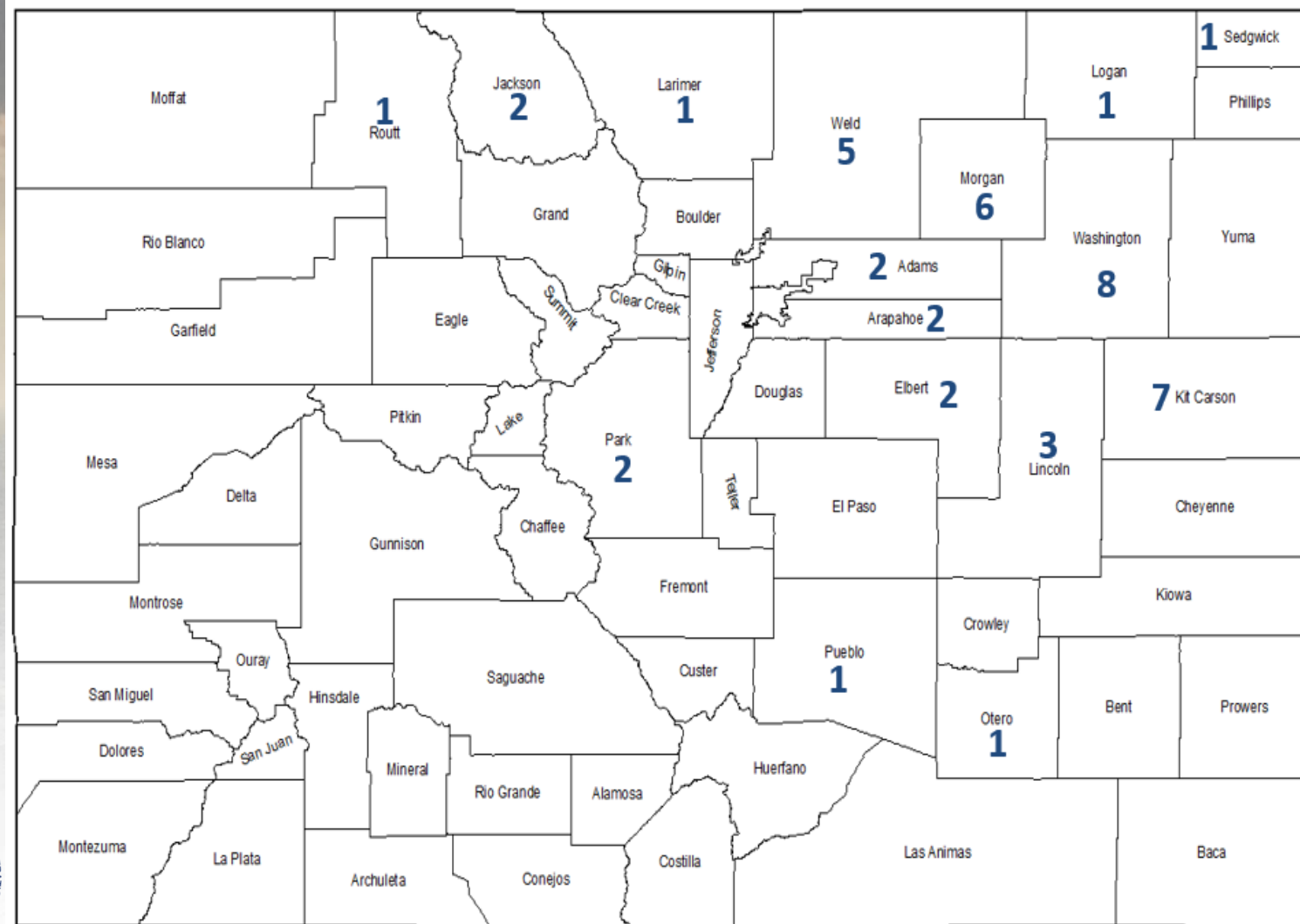
EF0 (Gale)	65-85 mph 3-second gusts
EF1 (Weak)	86-110 mph 3-second gusts
EF2 (Strong)	111-135 mph 3-second gusts
EF3 (Severe)	136-165 mph 3-second gusts
EF4 (Devastating)	166-200 mph 3-second gusts
EF5 (Incredible)	over 200 mph 3-second gusts

Tornadoes in Colorado

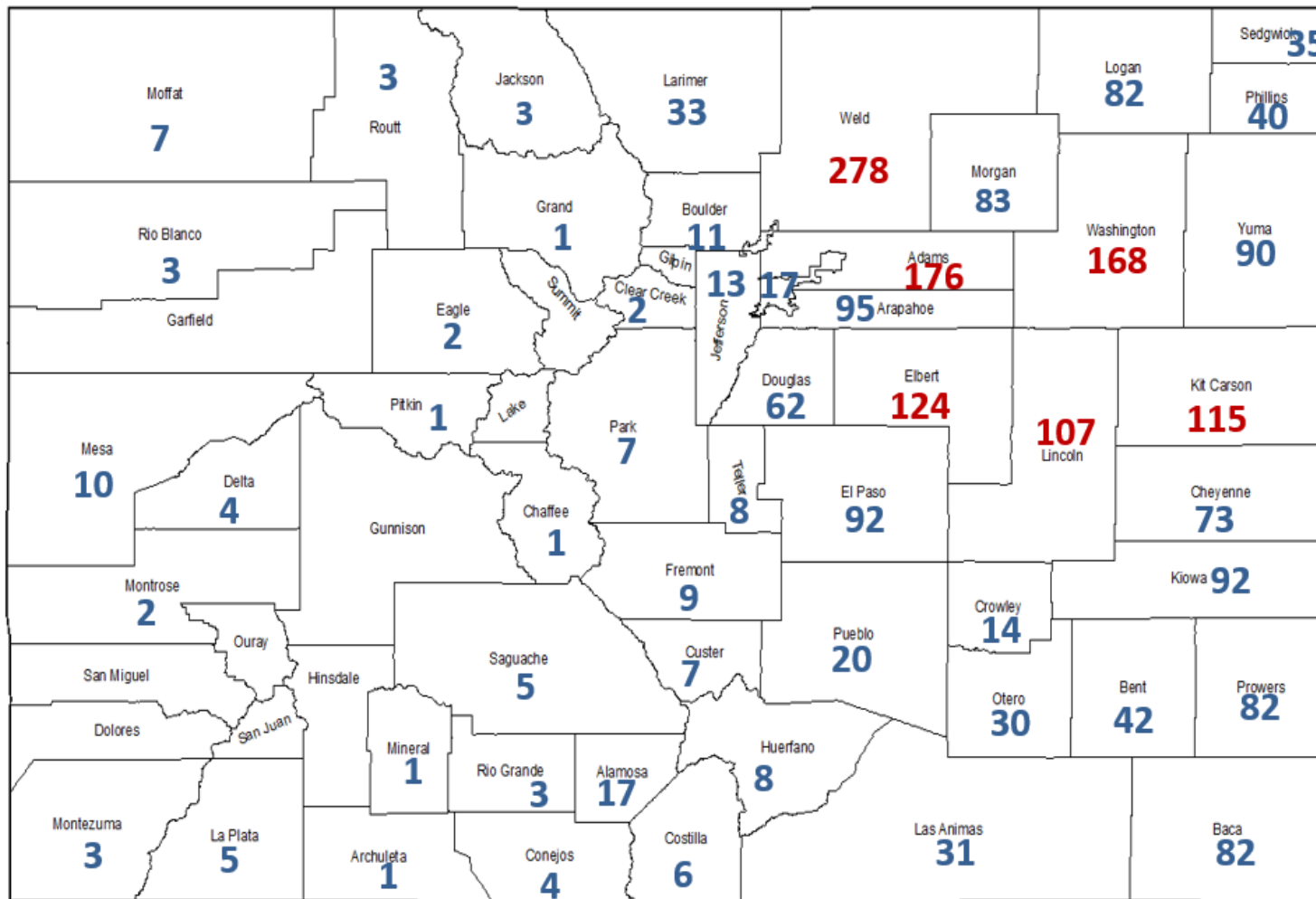
- Colorado averages 41 tornadoes a year
- 94% of tornadoes since 1950 are EF-0 or EF-1
- Downward trend of tornadoes in last 20-25 years



2018 Tornadoes in Colorado: 45 total



Tornadoes in Colorado: 1950-2018



Denver Cyclone Terrain Effects

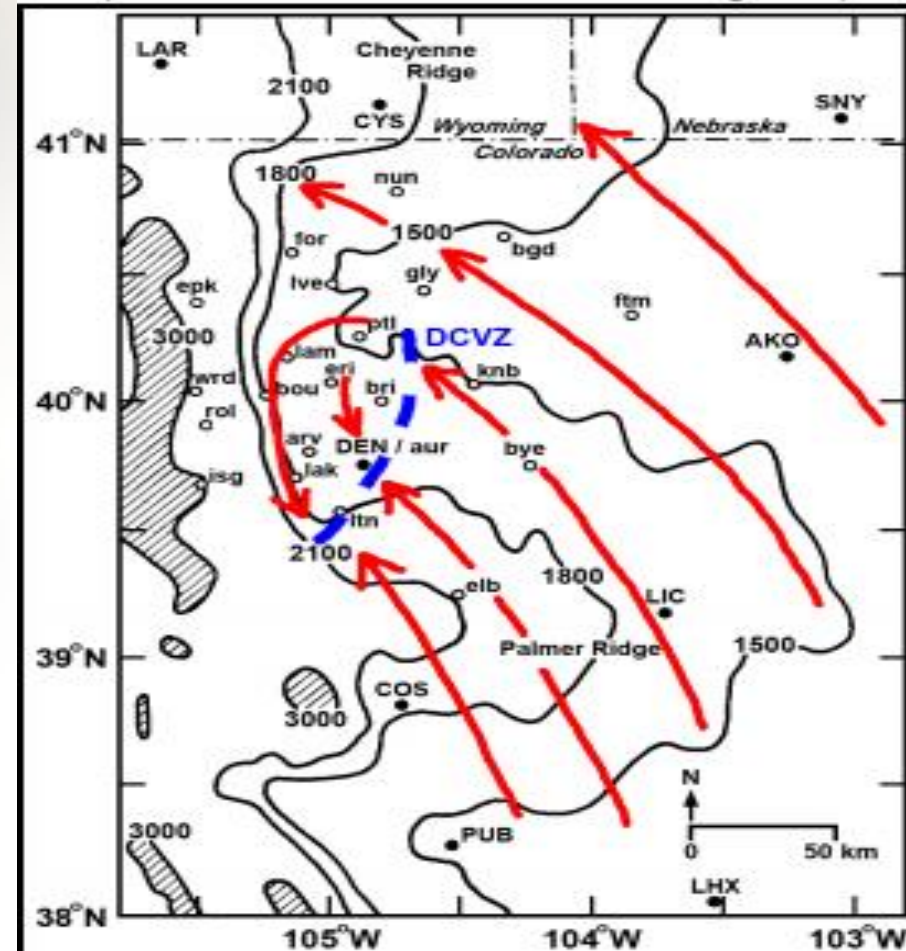
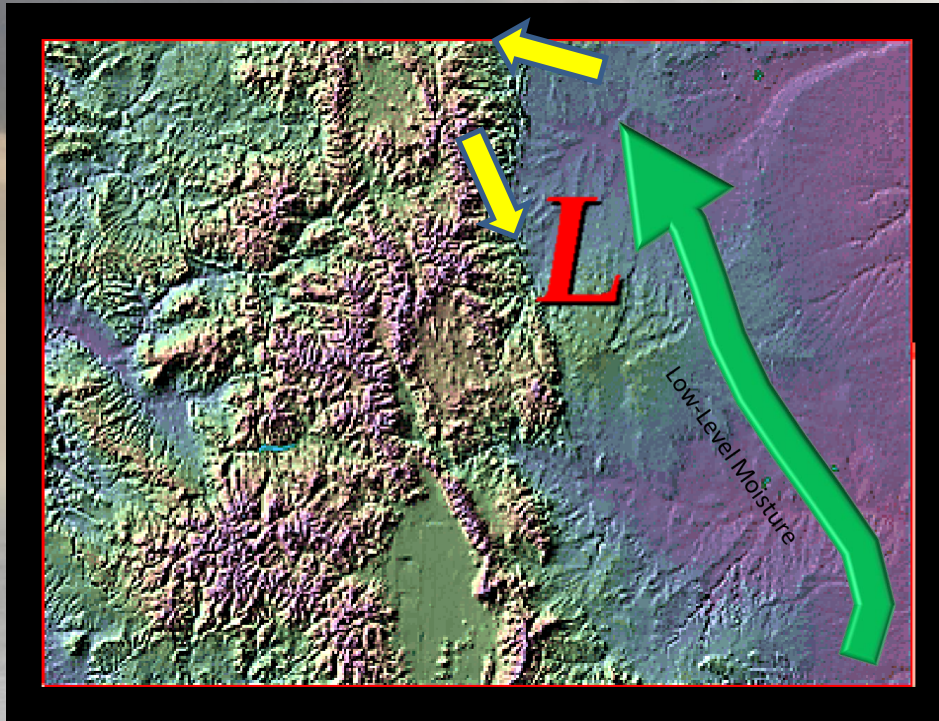
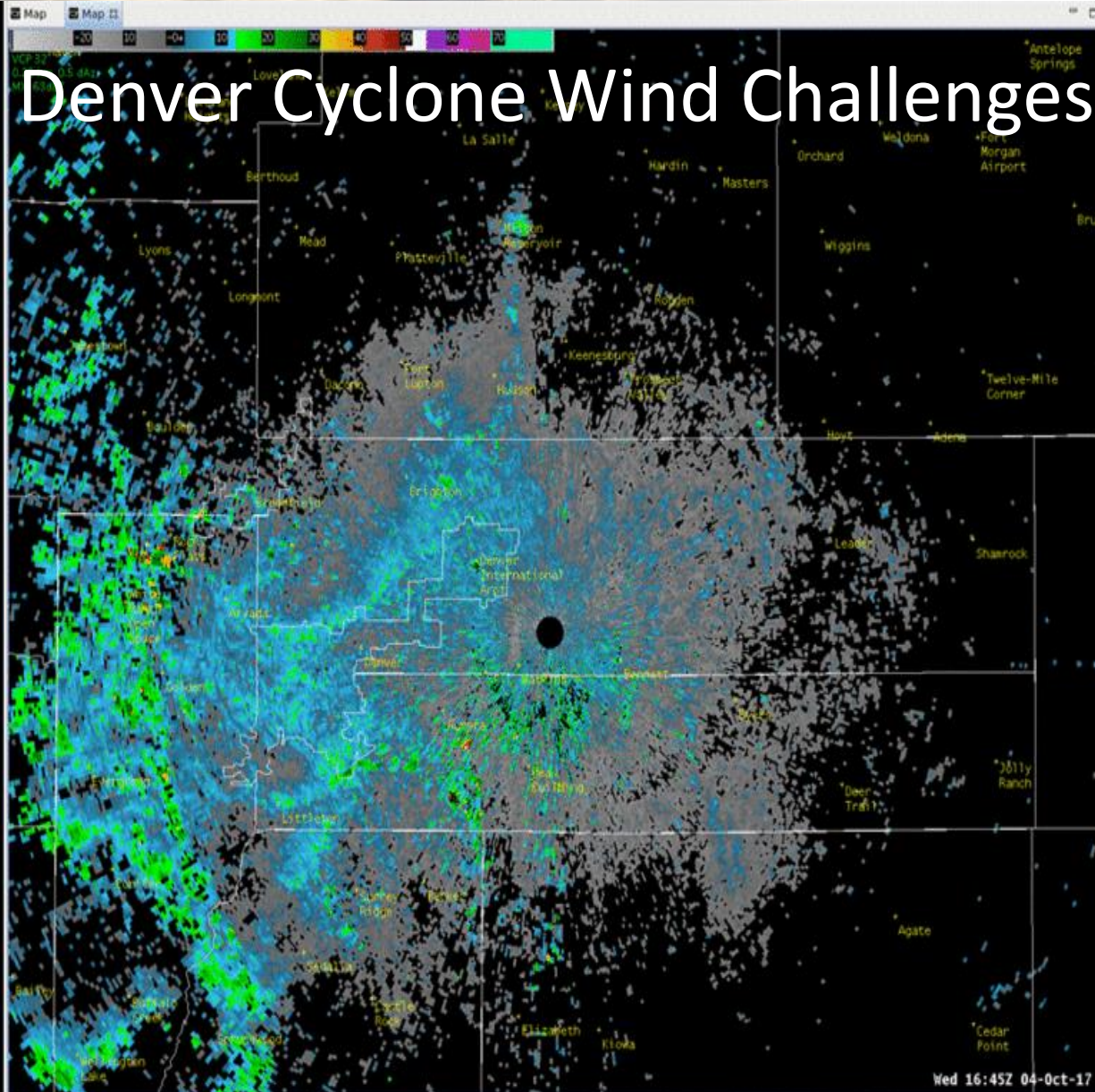


Fig. 1. Schematic of the Denver Cyclone overlaid on a topographic map (m), with the PROFS mesonet stations shown by open circles and the standard NWS stations by darkened circles.

Szoke et. al. 2005

Denver Cyclone Wind Challenges

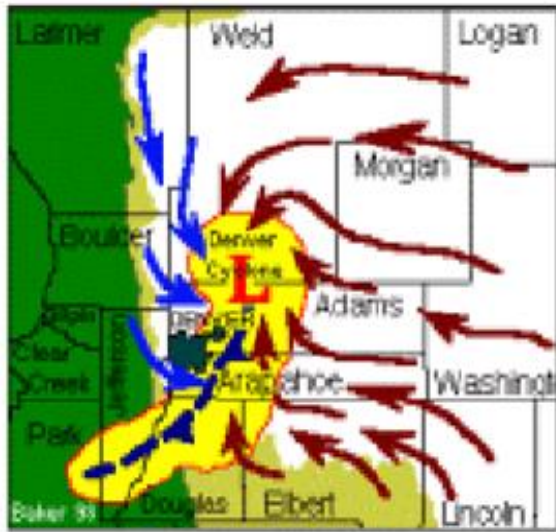


23:04

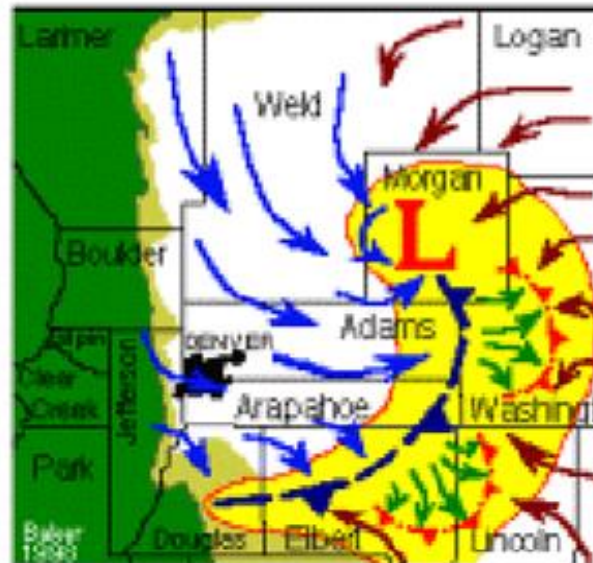
Frames: 80 Time: 23:04Z 04-Oct-17 611M of 856M

Denver Convergence Vorticity Zone (DCVZ)

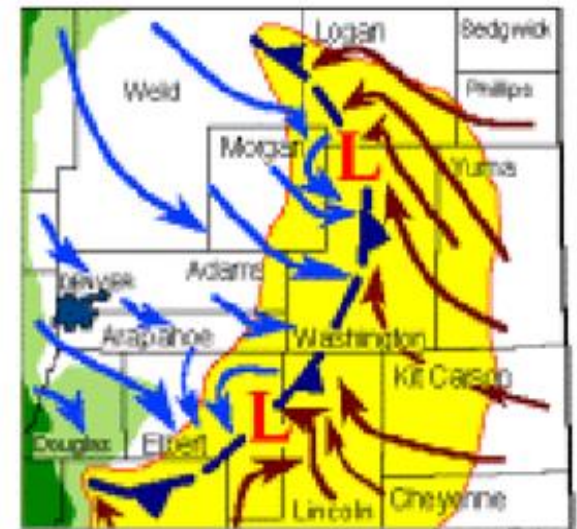
The Eastward Progression of the Denver Cyclone and Its Trailing Wind Convergence Boundary



Late morning or early afternoon



Early to Mid-Afternoon



Late Afternoon or Evening

Funnel Clouds- circulation does not extend to the ground level



N Elizabeth, May 15, 2018



Find the Funnel?



What is a gustnado?

- Small short-lived, low-level rotation along the storm's outflow winds.
- Can cause damage...but technically it is not a tornado because the circulation does **NOT** extend up to the base of the cloud.

Tornado or Not?

May 30, 2018, near Stapleton



Funnel or Tornado?



Rogge, June, 2014
Marcelo Albuquerque

Marcelo Albuquerque
Twitter & Instagram
@COSpotter_MJA



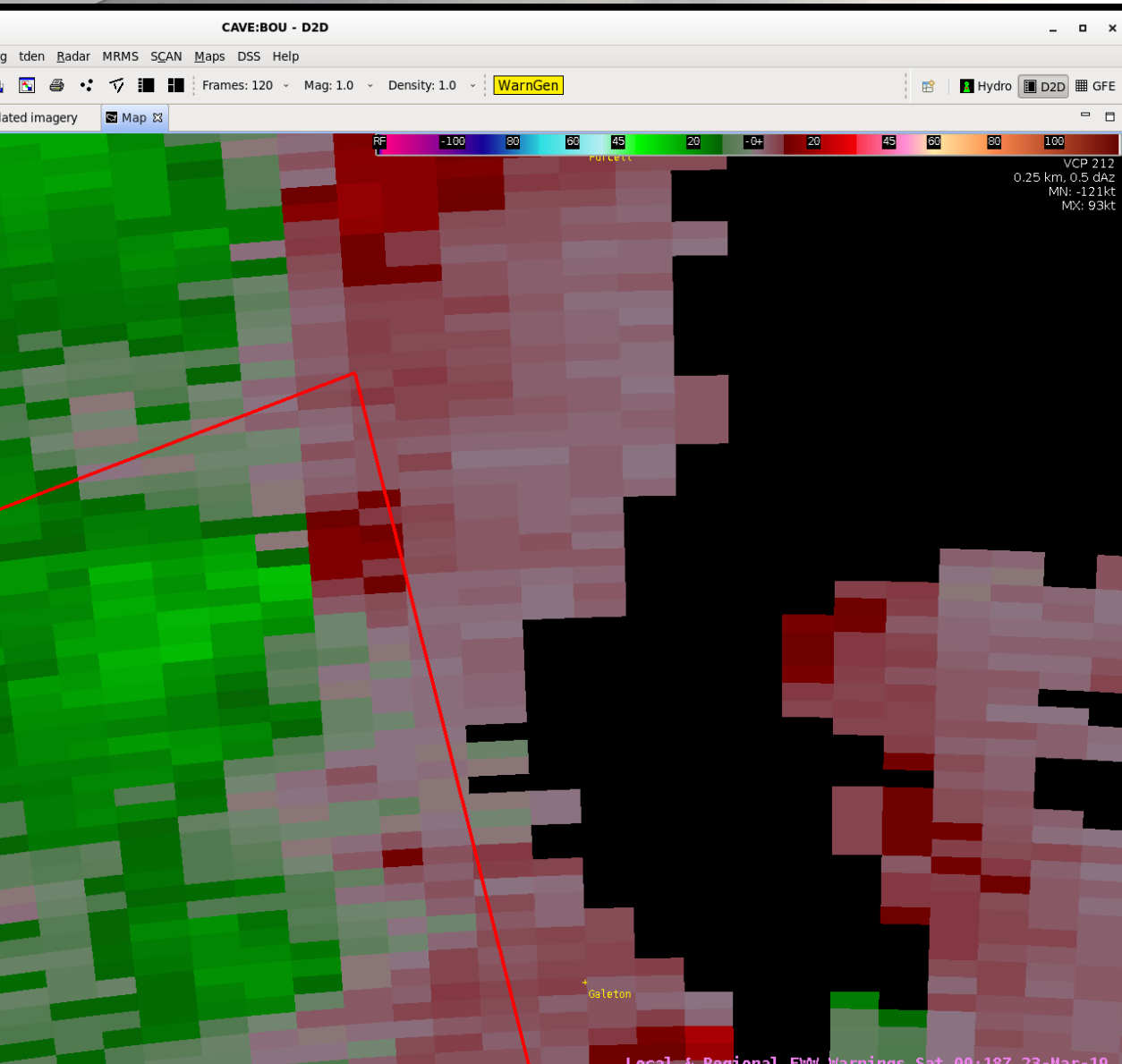
Broomfield, June, 2009

1st Tornado 2019!-March 22nd East of Eaton

Photo Sources: Richard Romkee



Eaton Landspout Tornado



Photo/Video Source: Sue Ann Duran



Bonus Question?



SKYWARN Agenda

- NWS Overview
- Weather Safety
- Thunderstorm Basics
- Spotting Storms
 - Cloud features, tornadoes

Break Time!

- **Reporting Procedures**



Where do you get Warnings?

- Media
- NOAA Weather Radio
- WEA (wireless emergency alerts) to cell phones
- Area sirens
- Private vendors
- Reverse 911 capability from county or city
- Family or neighbors
- Social media (Facebook, Twitter)



Where to Look...Local

- News Headlines
- Weather Story
- Hazard Map
- Point and Click
- Forecast Discussion
 - weather.gov/bou/afd
- Hazardous Weather Outlook
 - weather.gov/bou/hwo
- Radar
- Facebook
- Twitter

The screenshot shows the National Weather Service website for Boulder, CO. The page layout includes a top navigation bar with links for HOME, FORECAST, PASTWEATHER, SAFETY, INFORMATION, EDUCATION, NEWS, SEARCH, and ABOUT. Below this is a search bar for local forecasts. A 'News Headlines' section is circled in red, containing a link to the '2016 Spotter training schedule'. The main content area features a 'Customize Your Weather.gov' sidebar, a 'NWS Forecast Office Boulder, CO' header, and a navigation menu with 'Current Hazards', 'Current Conditions', 'Radar', 'Forecasts', 'Rivers and Lakes', 'Climate and Past Weather', and 'Local Information'. A map of the Boulder area is displayed, with a red arrow pointing to it. A legend for 'Watches, Warnings & Advisories' is circled in red, showing categories like 'Winter Storm Warning', 'Winter Weather Advisory', and 'Hazardous Weather Outlook'. At the bottom, three map thumbnails are circled in red: 'Weather Story', 'Local Radar', and 'Weather Map'. Social media links for Twitter, Facebook, and YouTube are also visible.



Weather on your mobile phone

Mobile.weather.gov

- Android
- Iphone

Other 3rd Party Sites?

Weather-Ready Nation

National Oceanic and Atmospheric Administration



Search

Weather Safety Ambassadors Education News & Events About

Weather.gov on Your Mobile Phone

Take the weather with you on your mobile phone! Wherever you are, you can get the local weather forecast from the National Weather Service with one click on your home screen. Bookmark mobile.weather.gov to make sure that you have the latest weather news and information on the go.

How can you add mobile.weather.gov to your mobile phone's Home Screen?

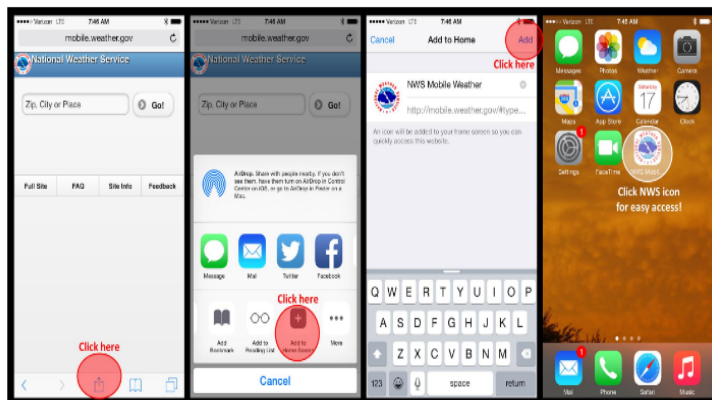
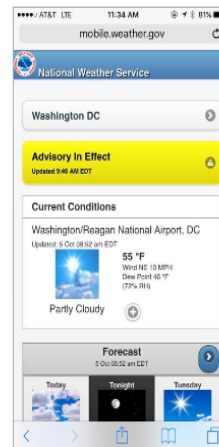
It's easy! Learn how to add the mobile version of weather.gov to your iPhone or Android phone.

Follow these three steps for one-click access to your local forecast.

If you have an iPhone...

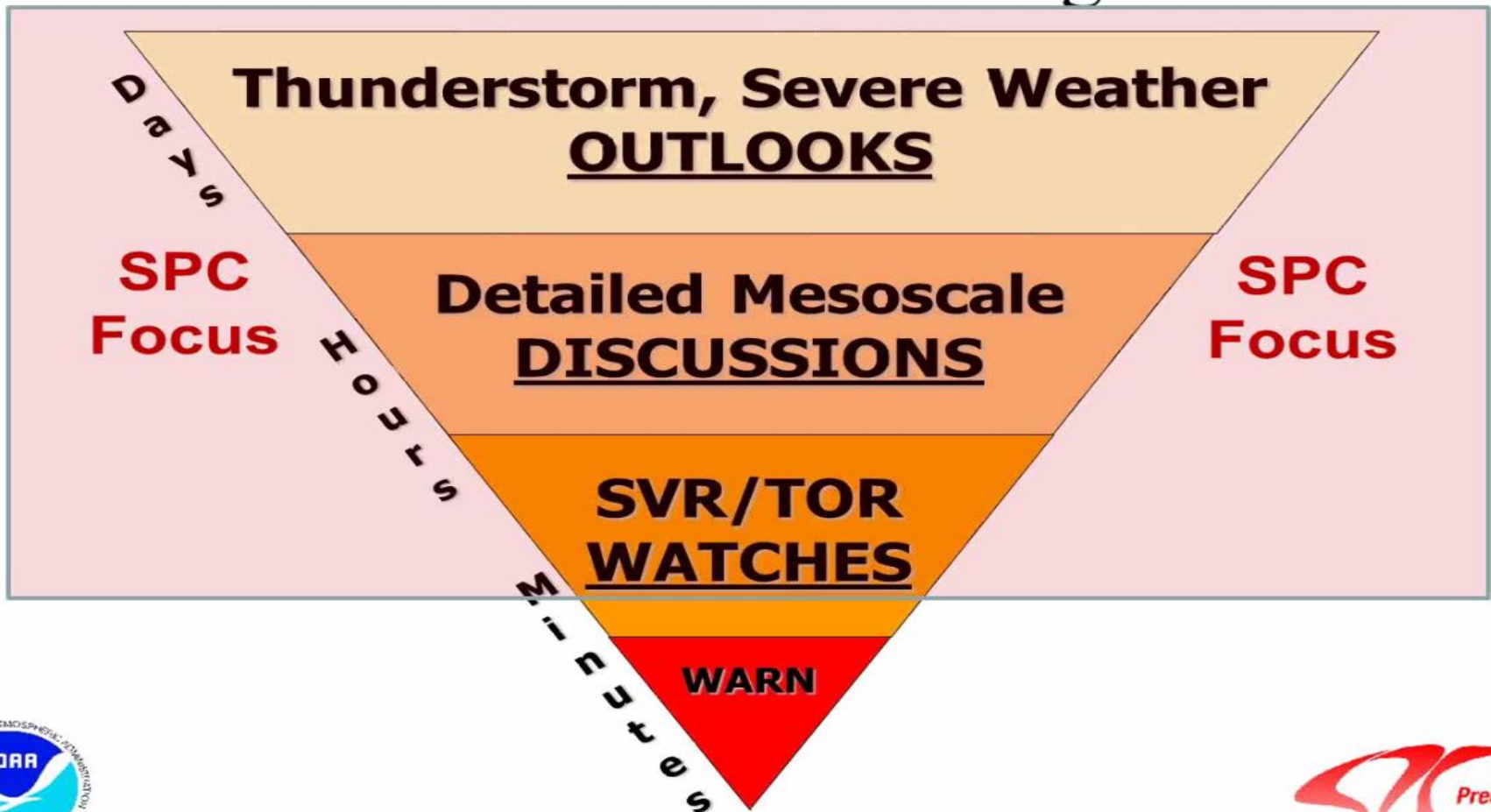
1. Visit mobile.weather.gov using Safari on your iPhone.
2. Click the Send button at the bottom of the screen.
3. Choose "Add to Home Screen" and tap "Add."

Click the screenshot below to enlarge the step-by-step instructions:



Countdown to Convection

Severe Thunderstorm and Tornado Watches and Warnings



SPC.noaa.gov



Storm Prediction Center

N O A A / National Weather Service

HOME | NEWS | SPC PRODUCTS | WEATHER INFO | FORECAST TOOLS | RESEARCH | OUTREACH | NWS/NCEP

Search SPC...

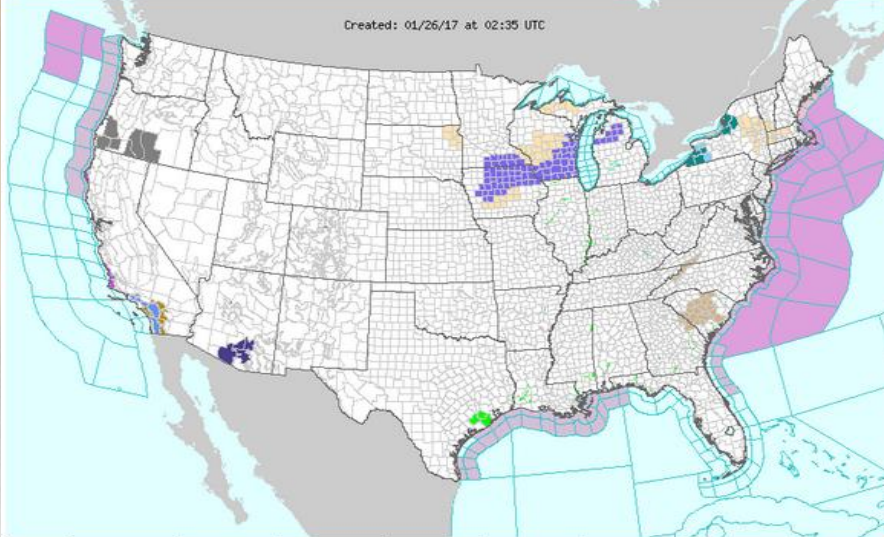


Critical Fire Weather Conditions Today

...CRITICAL FIRE WEATHER AREA FOR PORTIONS OF SOUTHWEST TEXAS...EDWARDS PLATEAU...RIO GRANDE VALLEY...AND DEEP SOUTH

» For additional details, see the latest [Day 1 Fire Weather Forecast](#).

Overview | Conv. Outlook | Watches | MDs | Storm Reports | Mesoanalysis | Fire | Hazards



Hazard	Wed (01/25)	Thu (01/26)	Fri (01/27)	Sat (01/28)	Sun (01/29)	Mon (01/30)	Tue (01/31)	Wed (02/01)
Severe	No Severe	No Thunder	No Thunder	No Area	No Area	No Area	No Area	No Area
Fire	Critical	No Critical	No Area	No Area	No Area	No Area	No Area	No Area

All Products | Watches | MDs | Outlooks | Fire

- [Thunderstorm Outlook](#)
- Issued: 01/26/2017 at 0102Z
- [Day 1 Convective Outlook](#)
- Categorical Risk: **No Severe**
- Issued: 01/26/2017 at 0057Z
- [Day 3-8 Fire Weather Outlook](#)
- Categorical Risk: **No Areas**
- Issued: 01/25/2017 at 2116Z
- [Day 2 Fire Weather Outlook](#)
- Categorical Risk: **No Critical**
- Issued: 01/25/2017 at 1746Z
- [Day 2 Convective Outlook](#)
- Categorical Risk: **No Thunder**
- Issued: 01/25/2017 at 1654Z
- [Day 1 Fire Weather Outlook](#)
- Categorical Risk: **Critical**

Severe Weather Climatology (1982-2011)



Severe Hail Probabilities: 26 Jan

2017 Tornado Watch Summary



Did You Know?

Categorías de Riesgo de Tormentas Severas

1 - NACIONAL (N)	2 - LEVE (L)	3 - ELEVADO (E)	4 - MODERADO (M)	5 - ALTO (H)
Tormentas sin categorías. Se esperan tormentas severas.	Posibles tormentas severas aisladas.	Posibles tormentas severas.	Posibles tormentas severas.	Se esperan tormentas severas de gran intensidad.
Mayor nivel de amenaza de tormentas severas en todo el territorio.	De alta amenaza de tormentas severas en algunas zonas del territorio.	De alta amenaza de tormentas severas en algunas zonas del territorio.	De alta amenaza de tormentas severas en algunas zonas del territorio.	Mayor nivel de amenaza de tormentas severas de gran intensidad en algunas zonas del territorio.

National Weather Service
www.spc.noaa.gov

La tormenta factor de riesgo.





SPC'S Thunderstorm Categories

THUNDERSTORMS (no label)	1 - MARGINAL (MRGL)	2 - SLIGHT (SLGT)	3 - ENHANCED (ENH)	4 - MODERATE (MDT)	5 - HIGH (HIGH)
<p>No severe* thunderstorms expected</p>	<p>Isolated severe thunderstorms possible</p>	<p>Scattered severe storms possible</p>	<p>Numerous severe storms possible</p>	<p>Widespread severe storms likely</p>	<p>Widespread severe storms expected</p>
<p>Lightning/flooding threats exist with <u>all</u> thunderstorms</p>	<p>Limited in duration and/or coverage and/or intensity</p>	<p>Short-lived and/or not widespread, isolated intense storms possible</p>	<p>More persistent and/or widespread, a few intense</p>	<p>Long-lived, widespread and intense</p>	<p>Long-lived, very widespread and particularly intense</p>
					
<ul style="list-style-type: none"> • Winds to 40 mph • Small hail 	<ul style="list-style-type: none"> • Winds 40-60 mph • Hail up to 1" • Low tornado risk 	<ul style="list-style-type: none"> • One or two tornadoes • Reports of strong winds/wind damage • Hail ~1", isolated 2" 	<ul style="list-style-type: none"> • A few tornadoes • Several reports of wind damage • Damaging hail, 1 - 2" 	<ul style="list-style-type: none"> • Strong tornadoes • Widespread wind damage • Destructive hail, 2" + 	<ul style="list-style-type: none"> • Tornado outbreak • Derecho

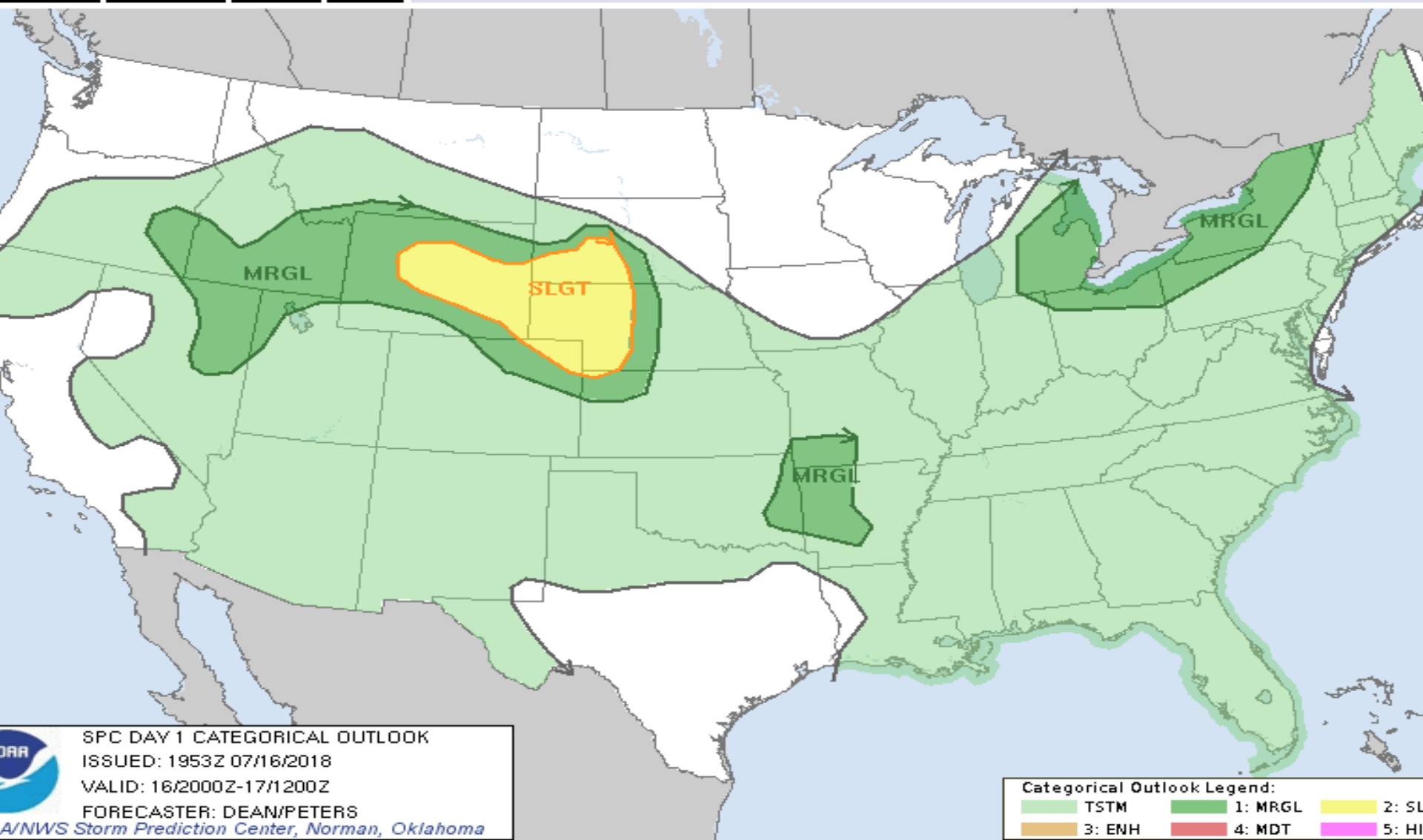
* NWS defines a severe thunderstorm as measured wind gusts to at least 58 mph, and/or hail to at least one inch in diameter, and/or a tornado. All thunderstorm categories imply lightning and the potential for flooding. Categories are also tied to the probability of a severe weather event within 25 miles of your location.


Jul 16, 2018 2000 UTC Day 1 Convective Outlook

Updated: Mon Jul 16 19:53:57 UTC 2018 ([Print Version](#) |  | )

[Probabilistic to Categorical Outlook Conversion Table](#)

Categorical
 Tornado
 Wind
 Hail
 Population
 Cities/Towns
 CWAs
 Interstates
 Counties
 ARTCC
 FEMA Regions




SPC DAY 1 CATEGORICAL OUTLOOK
 ISSUED: 1953Z 07/16/2018
 VALID: 16/2000Z-17/1200Z
 FORECASTER: DEAN/PETERS
 NWS Storm Prediction Center, Norman, Oklahoma


Categorical Outlook Legend:

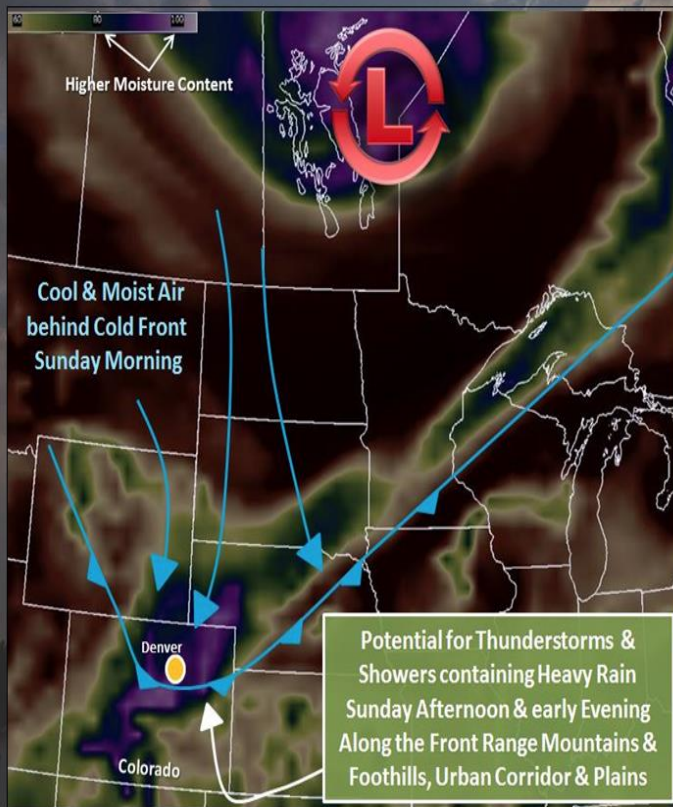
TSTM	1: MRGL	2: SLGT
3: ENH	4: MDT	5: HI

Categorical Day1 2000Z Outlook

Day 1 Risk	Area (sq. mi.)	Area Pop.	Some Larger Population Centers in Risk Area
SLIGHT	89,440	437,180	Casper, WY...North Platte, NE...Scottsbluff, NE...Sterling, CO...Riverton, WY...

Weather Story/Hazardous Wx. Outlook

 **Denver/Boulder** **Thunderstorms with Locally Heavy Rain Today**






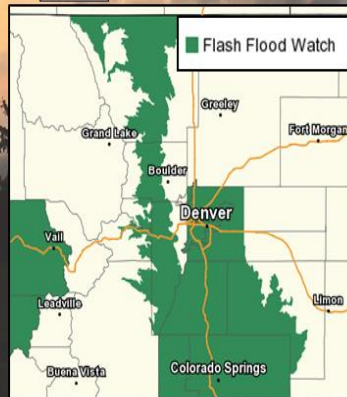
Higher Moisture Content

Cool & Moist Air behind Cold Front Sunday Morning

Potential for Thunderstorms & Showers containing Heavy Rain Sunday Afternoon & early Evening Along the Front Range Mountains & Foothills, Urban Corridor & Plains



Potential Hazards

-  Heavy rainfall & flash flooding
-  Wind gusts to 60 mph
-  Hail up to 1"



Flash Flood Watch

Grand Lake, Greeley, Fort Morgan, Boulder, Denver, Vail, Leadville, Breckenridge, Colorado Springs, Union

weather.gov/Denver |  NWS Boulder |  @NWSBoulder | Updated: 7/16/2018 4:03 PM

Thunderstorms with locally heavy rainfall will occur today. Storms will first develop across the mountains and foothills late this morning, and then spread eastward across the plains this afternoon and evening. Stronger storms will be capable of producing 1 inch of rain in 30 minutes, and up to 2 inches in an hour from a slower moving storm. Burn scars will be most prone to flash flooding, but the Palmer Divide area may also see very heavy rain from thunderstorms through this evening. In the I-25 Corridor, locally heavy rain may also occur and some street flooding would be possible should a stronger storm move through. Isolated severe storms are also possible in and near the Front Range with 1 inch diameter hail and wind gusts to around 60 mph.

.SPOTTER INFORMATION STATEMENT...

Spotter activation is not anticipated today or tonight. However, any heavy rain or severe weather reports would be appreciated.



On the Day of Storms

- **Watch** – Tornado, Severe Thunderstorm
 - Issued by Storm Prediction Center (SPC)
 - Conditions become favorable for organized severe storms
 - Issued for multiple counties for 4-6 hours
 - Exception: Flood (Issued by WFO/local forecast offices)
- **Warning** – Flash flood, tornado, severe thunderstorm.
 - Issued by local National Weather Service Office
 - Severe weather is occurring or imminent.
 - Issued for usually one or two counties
 - for an hour or less (longer for flooding)



On the Day of Storms

Severe Thunderstorm Watch

Valid Until
9:00 PM MDT Saturday
June 30, 2018

Threat Information



TORNADOES

A Couple Tornadoes
Possible



HAIL

Scattered Hail Up To
Lime Size Possible



WIND

Scattered Gusts
Up To 70 MPH Possible

Potential Exposure



Population: 2,608,592
Schools: 896
Hospitals: 45



Severe Thunderstorm Warning

Valid Until
5:30 PM MDT Saturday
June 30, 2018

Threat Information



WIND

Up to
50 MPH



HAIL

Quarter
Sized Possible

Potential Exposure



Population: 90,924
Schools: 26
Hospitals: 1



Types of warnings

- Tornado
- Severe Thunderstorm
 - (58 mph wind, large hail)
- Flash Flood



One inch hail for Warnings

Severe Thunderstorm Warning
one inch or greater

(SPS)



Reporting Procedures

- Maintain your situational awareness
- Know your position relative to the storm
...ALWAYS
- Know your location on a map ...ALWAYS
- Know what the storms are capable of producing in the current environment
- Reporting: Specific location, Spotter#, report



Making your weather report

1. Dedicated Toll Free number:

- 1-800-287-2498 (Reserved for severe reports only!)
- or local 303-494-2884
- For general, non-severe questions call us at 303-494-4221

2. Internet web page at www.weather.gov/bou



How to submit an on-line report www.weather.gov/bou

NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME FORECAST PAST WEATHER WEATHER SAFETY INFORMATION CENTER NEWS SEARCH ABOUT

Local forecast by "City, St" or ZIP code
Enter location ...
[Location Help](#)

News Headlines

- [New 2015 Spotter training schedule](#)
- [NWS Flood and Wildfire Awareness 2015](#)

Home
[Weather.gov](#) > Denver/Boulder, CO
Denver/Boulder, CO
Weather Forecast Office

Current Hazards Current Conditions Radar Forecasts Rivers and Lakes Climate and Past Weather Local Information

Outlooks [in the map below to zoom in.](#)

Submit a Storm Report

Storm and Precipitation Reports

Watches, Warnings & Advisories

- Fire Weather Watch
- Hazardous Weather Outlook

Zoom Out

Aspen Fairplay Castle Rock Limon Eads

Fort Collins Greeley Fort Morgan Akron

Georgetown Denver Deer Trail

Gunnison Saguache Canon City Pueblo Ordway

Last Map Update: Sun, Mar. 22, 2015 at 3:49:09 pm MDT

Denver/Boulder
Northeast Colorado

Light Snow Mountains

Today	Mon	Tue	Wed	Thu
Partly Cloudy	Partly Cloudy	Partly Cloudy	Partly Cloudy	Partly Cloudy
69°/44°	72°/44°	63°/39°	58°/35°	58°/35°

5 Day Outlook - Denver, CO

Today	Mon	Tue	Wed	Thu
Light Snow	Light Snow	Light Snow	Light Snow	Light Snow
51°/35°	52°/35°	60°/41°	41°/31°	41°/31°

5 Day Outlook - Winter Park, CO

Weather Story

Local Radar

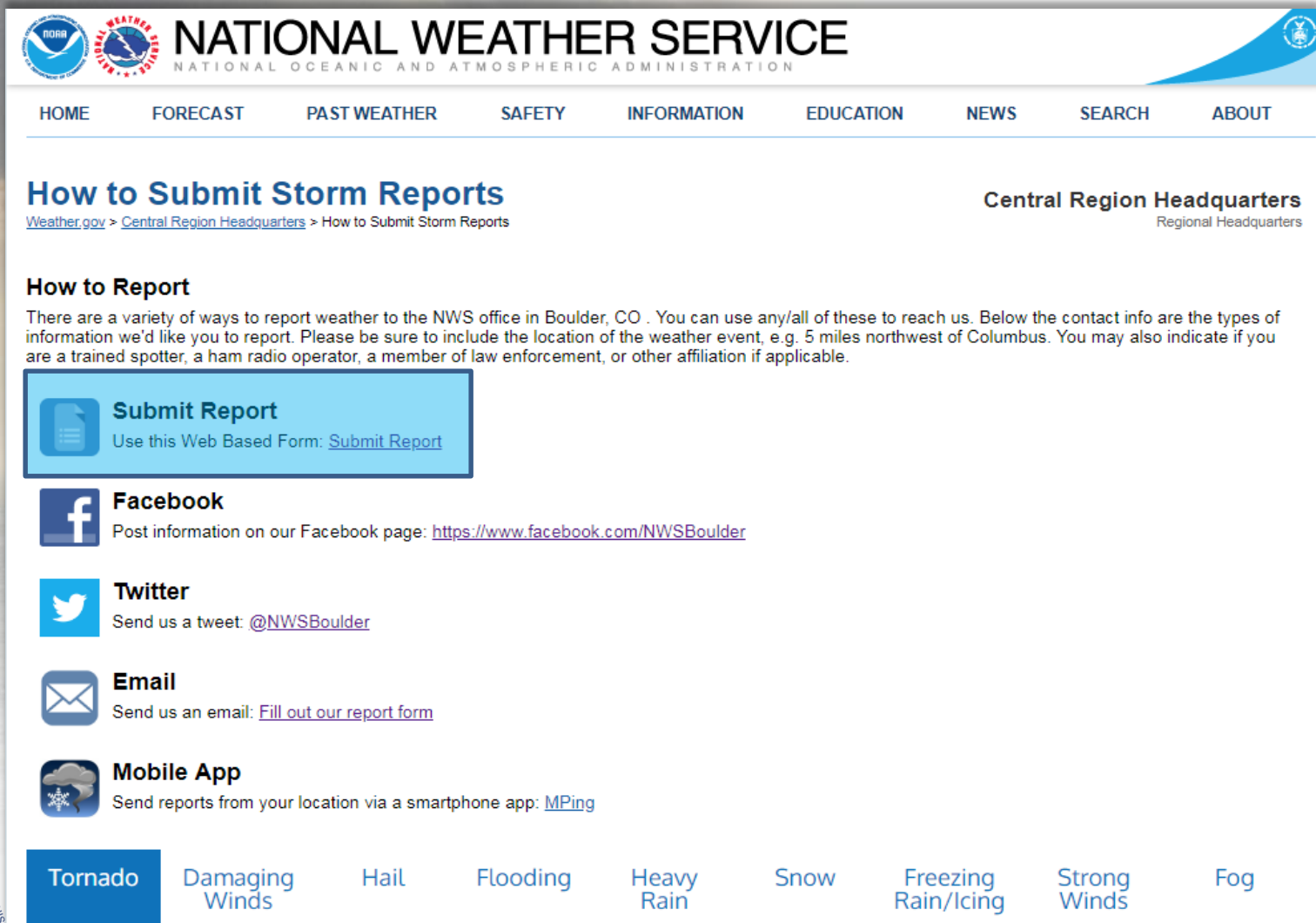
Weather Map

Weather Forecast for Sun, Mar 22, 2015, Issued 4:54 PM EDT
©2015 NOAA/NWS/NCEP/Weather Prediction Center
Prepared by Sarinelli based on WPC, SFC and NHC forecasts



How to send us an on-line report

<https://inws.ncep.noaa.gov/report/>



The screenshot shows the National Weather Service website. At the top, there are logos for NOAA and the National Weather Service, along with the text "NATIONAL WEATHER SERVICE" and "NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION". Below this is a navigation menu with links for HOME, FORECAST, PAST WEATHER, SAFETY, INFORMATION, EDUCATION, NEWS, SEARCH, and ABOUT. The main content area is titled "How to Submit Storm Reports" and includes a breadcrumb trail: "Weather.gov > Central Region Headquarters > How to Submit Storm Reports". On the right side, it says "Central Region Headquarters" and "Regional Headquarters". The "How to Report" section explains that there are various ways to report weather to the NWS office in Boulder, CO, and lists the types of information needed for a report. Below this, there are four main options for reporting: "Submit Report" (with a link to the web-based form), "Facebook" (with a link to the Facebook page), "Twitter" (with a link to the Twitter handle), and "Email" (with a link to the report form). At the bottom, there is a "Mobile App" section with a link to the MPing app. A horizontal menu at the bottom lists various weather events: Tornado, Damaging Winds, Hail, Flooding, Heavy Rain, Snow, Freezing Rain/Icing, Strong Winds, and Fog. The "Tornado" button is highlighted in blue.

NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME FORECAST PAST WEATHER SAFETY INFORMATION EDUCATION NEWS SEARCH ABOUT

How to Submit Storm Reports

Weather.gov > [Central Region Headquarters](#) > How to Submit Storm Reports

Central Region Headquarters
Regional Headquarters

How to Report

There are a variety of ways to report weather to the NWS office in Boulder, CO . You can use any/all of these to reach us. Below the contact info are the types of information we'd like you to report. Please be sure to include the location of the weather event, e.g. 5 miles northwest of Columbus. You may also indicate if you are a trained spotter, a ham radio operator, a member of law enforcement, or other affiliation if applicable.

Submit Report
Use this Web Based Form: [Submit Report](#)

Facebook
Post information on our Facebook page: <https://www.facebook.com/NWSBoulder>

Twitter
Send us a tweet: [@NWSBoulder](#)

Email
Send us an email: [Fill out our report form](#)

Mobile App
Send reports from your location via a smartphone app: [MPing](#)

Tornado Damaging Winds Hail Flooding Heavy Rain Snow Freezing Rain/Icing Strong Winds Fog



How to send us an on-line report



Storm Reports

Alerting the NWS to local weather

Report Type -> Details -> Location -> Review and Send

Please select a report type

Back

Next

[Privacy policy for weather reports](#)



Storm Reports

Alerting the NWS to local weather

Report Type -> Details -> Location -> Review and Send

Time you observed this weather

1233 PM 03/22/2018

1.50 Ping Pong Ball

- I'm estimating the hail size
- I measured the hail
- I don't have a reading, just some details below

Please provide details (if any) of hail damage or depth:

hail is covering the ground

Back

Next

[Privacy policy for weather reports](#)



Storm Reports: Event Types

Report Type -> Details -> Location -> Review and Send

Your report is at:

Latitude: 40.1196

Longitude: -104.9640

Automatically use your device's location:

Search for your address:

4833 Falcon Drive, Frederick, CO 80504

Or, you can click your location on the map:



[Privacy policy for weather reports](#)

Report Type -> Details -> Location -> Review and Send

Here is the information you'll be sending:

Report time: 1233 PM 03/22/2018

Latitude: 40.1196

Longitude: -104.9640

You are reporting 1.50 Ping Pong Ball sized hail (measured).

Details:

hail is covering the ground

If you wish to provide a name, spotter ID, or contact info, you can do so here.

This is optional, and if provided, will only be used if additional information is needed.

W200

[Privacy policy for weather reports](#)

Input
Spotter #



Local Skywarn Page

www.weather.gov/bou/skywarn

For trained, current SKYWARN members, updated information and changes on the program can be found on our web page, via the "news of the day" under the link, [Skywarn Spotter News](#)

What to report:

Severe Weather

- Tornadoes, funnel and wall clouds
- Hail size of half inch diameter or larger [Hail Size Chart](#)
- Winds sustained at 50 mph or higher and any gusts 58 mph or greater
- Heavy Rainfall and/or flooding
 - 1.0" rain/hr or greater for urban areas.
 - 1.5" rain/hr or greater for rural areas.
 - Also Call 911 for flooding
- Significant damage
- River/creek flooding or flash flooding

Winter Weather

- Heavy snow (snowfall rates 1" per hour or greater)
- Blizzard (winds 35 mph or greater, and visibilities less than a 1/4 mile in snow/blowing snow.
- Dense Fog: 1/4 mile or less
- Freezing drizzle (road surfaces becoming icy and slick)
- Rain vs snow (changeover from rain to snow and vice versa
- impassable roads and road closures due to snow and wind
- High winds: 50 mph or higher, sustained and or gusts, 75 mph or greater in the mountains and foothills.

Where to report:

- [Submit a report on the web.](#)
- Use the dedicated, severe weather 800# to call in reports (provided during spotter training).
- local 911 dispatch
- Social Media (great for sending in pictures/videos!)
 - [NWS Denver/Boulder Facebook Page@NWSBoulder](#)
 - [NWS Boulder Twitter @NWSBoulder](#)
 - email to w-bou.webmaster@noaa.gov (use this for after the occurrence or non time sensitive information)

Local Resources

- [Local Storm Reports \(LSR\)](#)
- [Area Forecast Discussion](#)
- [Hazardous Weather Outlook](#)
- [Spotters and COOP Snowfall tables](#)
- [Spotter and COOP Snowfall Maps](#)
- [CoCoRaHs](#)

SKYWARN Amateur Radio Local Groups

- Denver Group (covers Adams, Arapahoe, Broomfield, Boulder, Denver, Douglas, Elbert and Jefferson counties). Frequency: 146.940
- Northern Colorado Group : ARES R3D2 (covers Larimer and Western Weld counties). Frequency: 146.625

On-Line Severe Weather/Training Resources

- [2018 SKYWARN Spotter Presentation Boulder CO](#)
- [Severe Thunderstorm Forecasting Video Lecture Series \(SPC\)](#)
- [Spotters Field Guide \(PDF\)](#)
- [COMET Skywarn Spotter Training \(PDF\)](#)
- [Beaufort Wind Scale](#)
- [CoCoRaHs Training slides](#)

Additional National Resources

- [Storm Prediction Center \(SPC\)](#)
- [National SKYWARN Page](#)
- [Emergency Managers Weather Information Network](#)
- [National Hazards Statistics](#)
- [Storm Chaser's Homepage](#)
- [Spotter Network](#)
- [Severe Studios](#)

Reporting Hail

- Average depth and size of hail (also report largest hailstone)
 - Measure with ruler
 - Compare to coin or ball.
- If 4.5" or larger it could be a record hailstone for Colorado...preserve it and report! Preserve stone in zip lock bag and freeze.

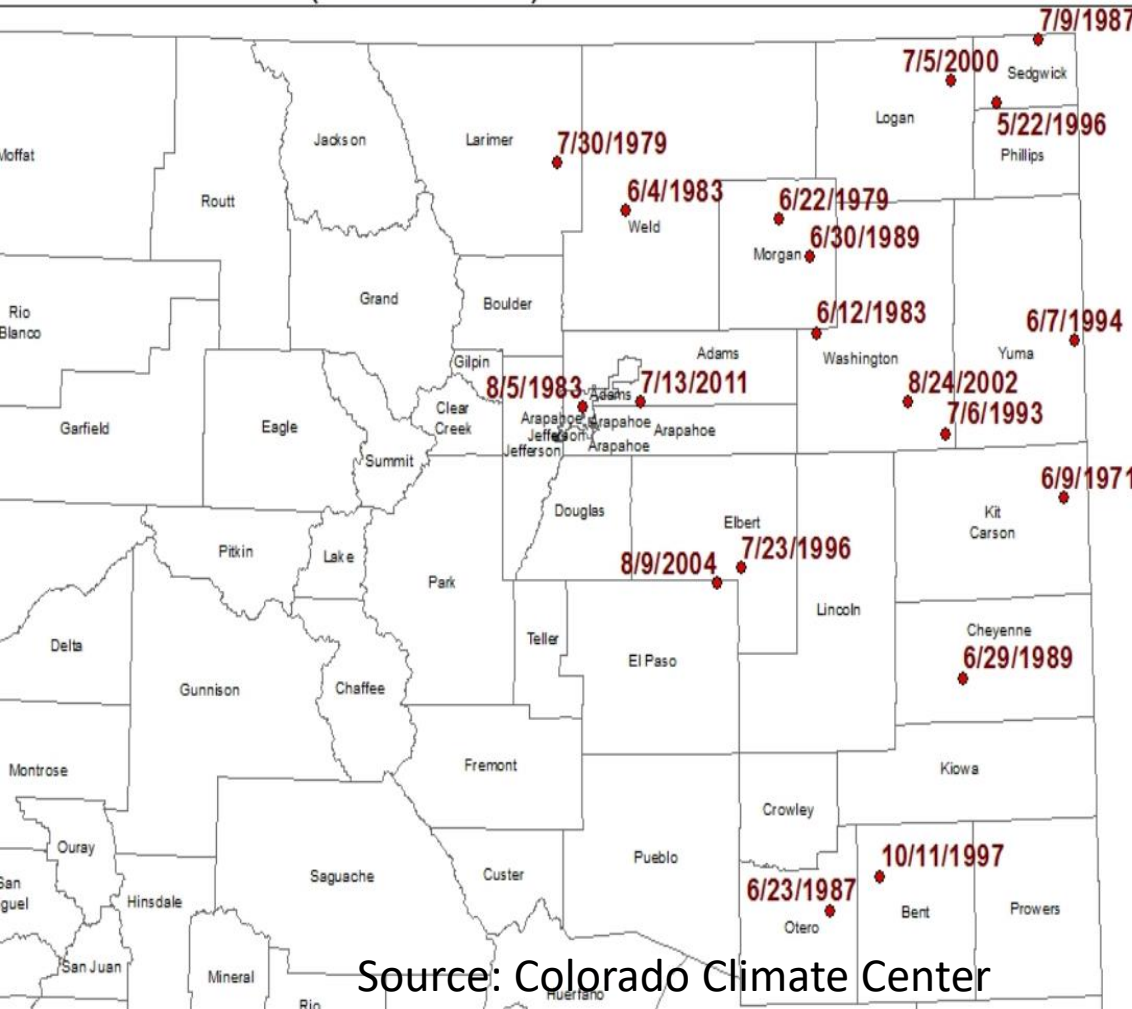
Denver Hailstorm, 5/8, 2017



Grapefruits in Colorado



Colorado Record Hail of 4.5 inches
(1971 - 2013)



Source: Colorado Climate Center

Damage may be

JUL 4 1979

By SARA HOFFMAN

Of the Coloradoan

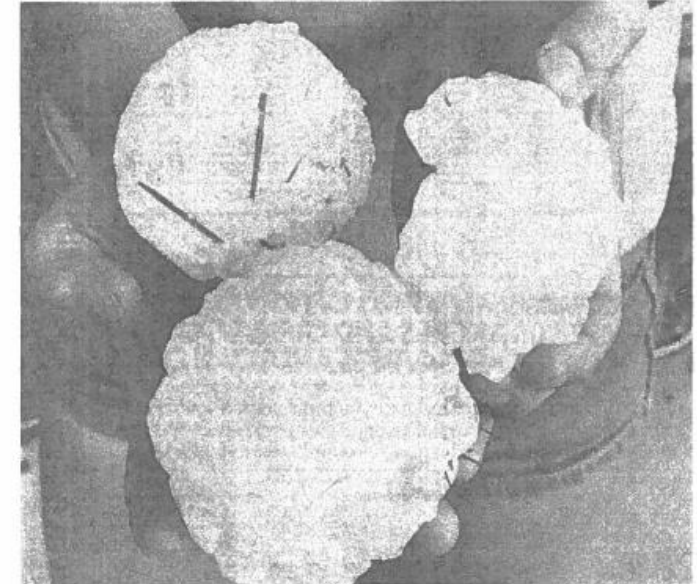
Damage estimates soared to \$20 million today while automobile body repair shops and insurance agents were beset by calls after Fort

Collins was hammered by hail the size of grapefruit.

Two persons — an 84-year-old woman and a 9-month-old baby — were hospitalized with injuries suffered in the 20-minute storm, which

began shortly before 5 p.m. Monday. Twenty others were treated at local hospitals and released, authorities said.

Robert Bischoff, regional vice president for State Farm Insurance,



Coloradoan photo by Bill Powell

Softball anyone? The hailstones that crashed to the ground near 2700 Trenton Way may have been a little wet and cold to play catch with, but they certainly would fit snugly in the glove. Hailstones as large as grapefruits were reported Monday. JUL 3 1979

Out of the Archives:
The Coloradoan, Sara Hoffman



Hail Sizes: What about marbles?

**NO marbles
please!!**





NWS & University of Colorado - Joint study

Thunderstorms that produce large amounts of
hail or...

“Plowable Hail”



[View original](#)

[Flag media](#)

- May 14 Hail Storm from the Pinery
 - Source-Joe Dahlke



Joe Dahlke @TheJoeDahlke

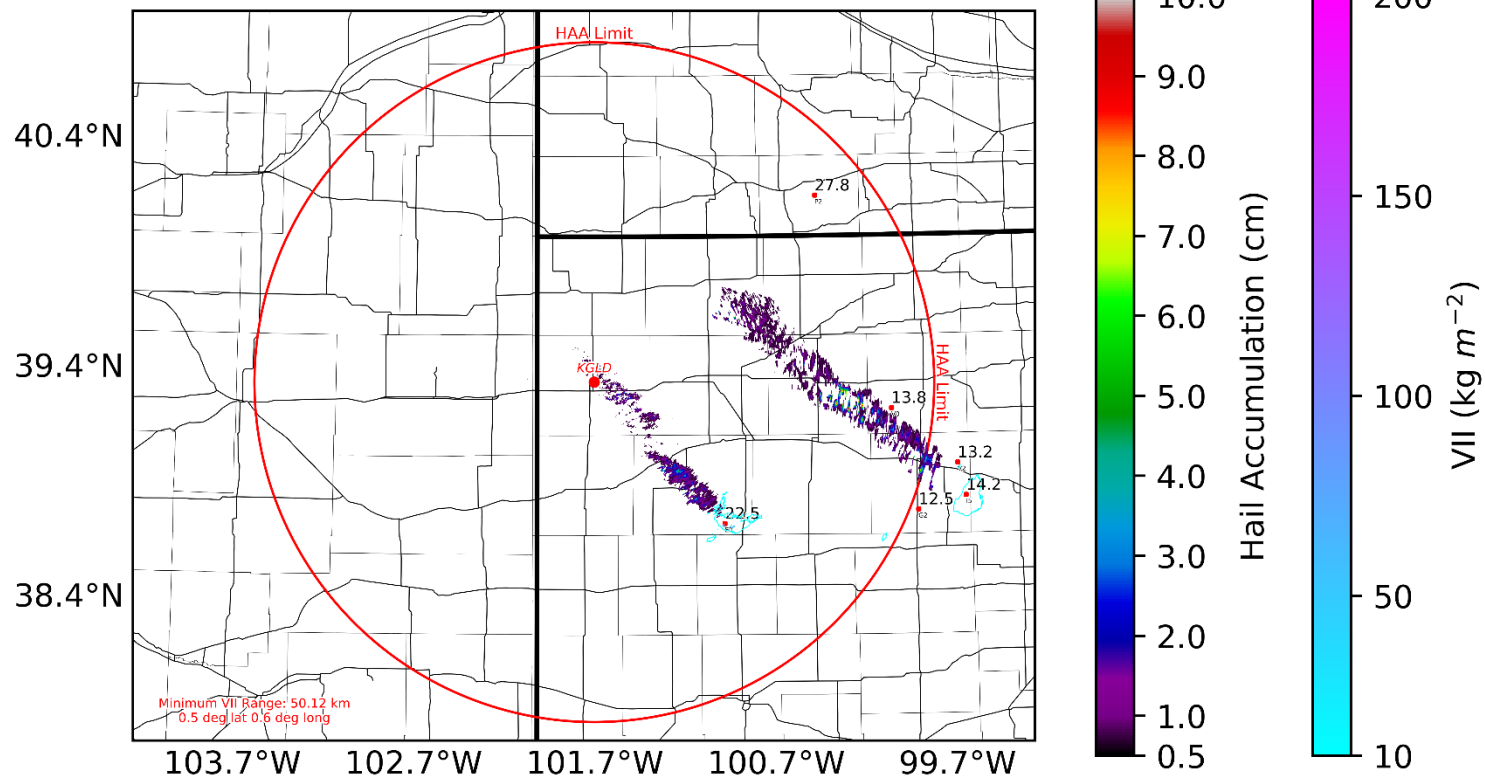
18h

So much hail fell near The Pinery that it looks like it snowed! These are shots from the Pinpoint Weather Beast. #COwx



CU Hail Accumulation Algorithm

Hail Accumulation
10 Aug 2017 17:28Z to 20:14Z



Our Share of Hail- The Pinery-May 14

Katie Sloop @sloopkatie · 13h

Replying to @NWSBoulder

Hail was clearly visible from 12k ft! Picture taken south of Parker on a flight inbound to Denver. #cowx #deephail



[View original](#)

[Flag media](#)



Joe Dahlke @TheJoeDahlke

18h

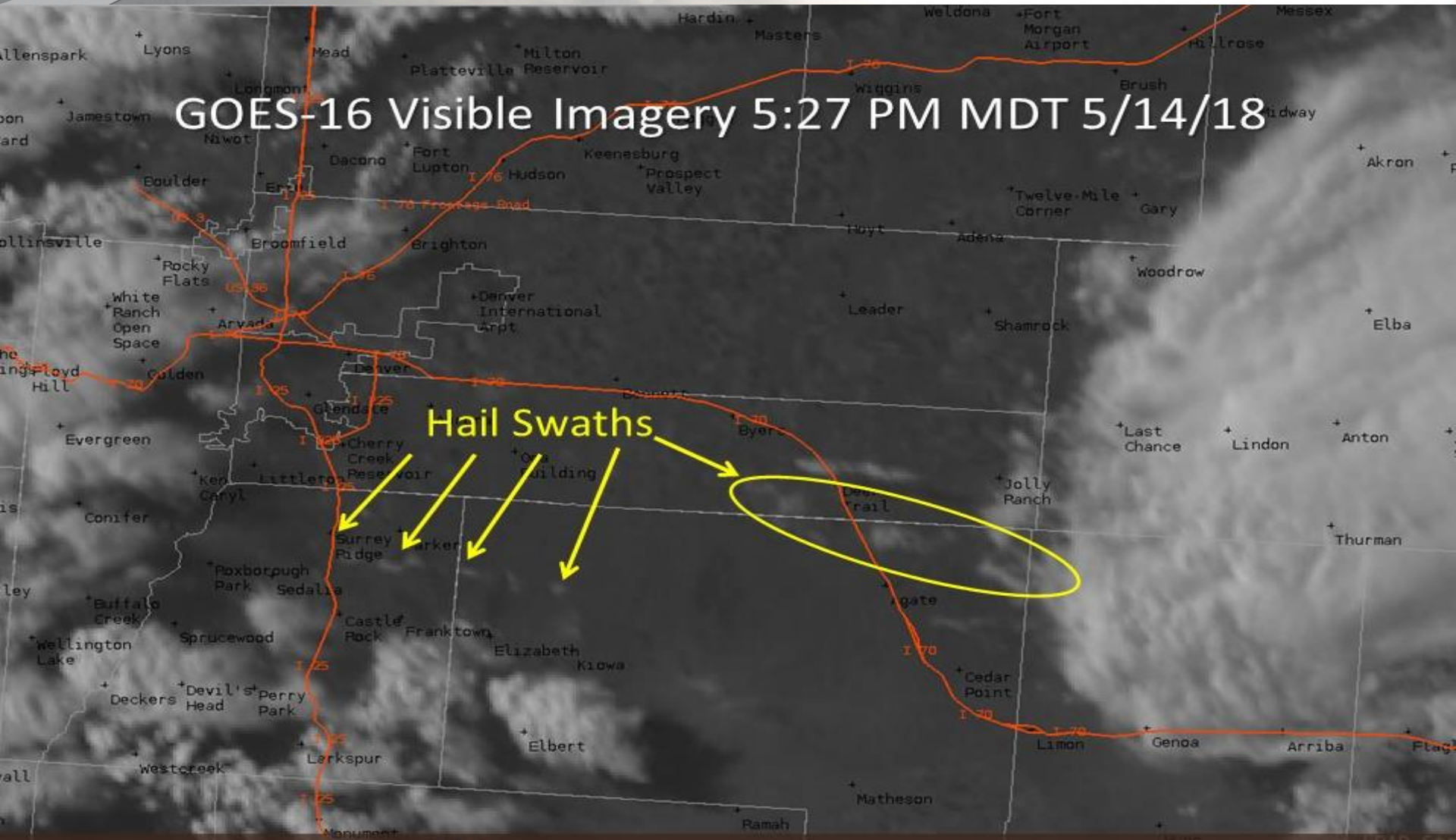
So much hail fell near The Pinery that it looks like it snowed! These are shots from the Pinpoint Weather Beast. #COWx



From the Satellite

GOES-16 Visible Imagery 5:27 PM MDT 5/14/18

Hail Swaths



More Hail Further North...Wellington



[View original](#)

[Flag media](#)

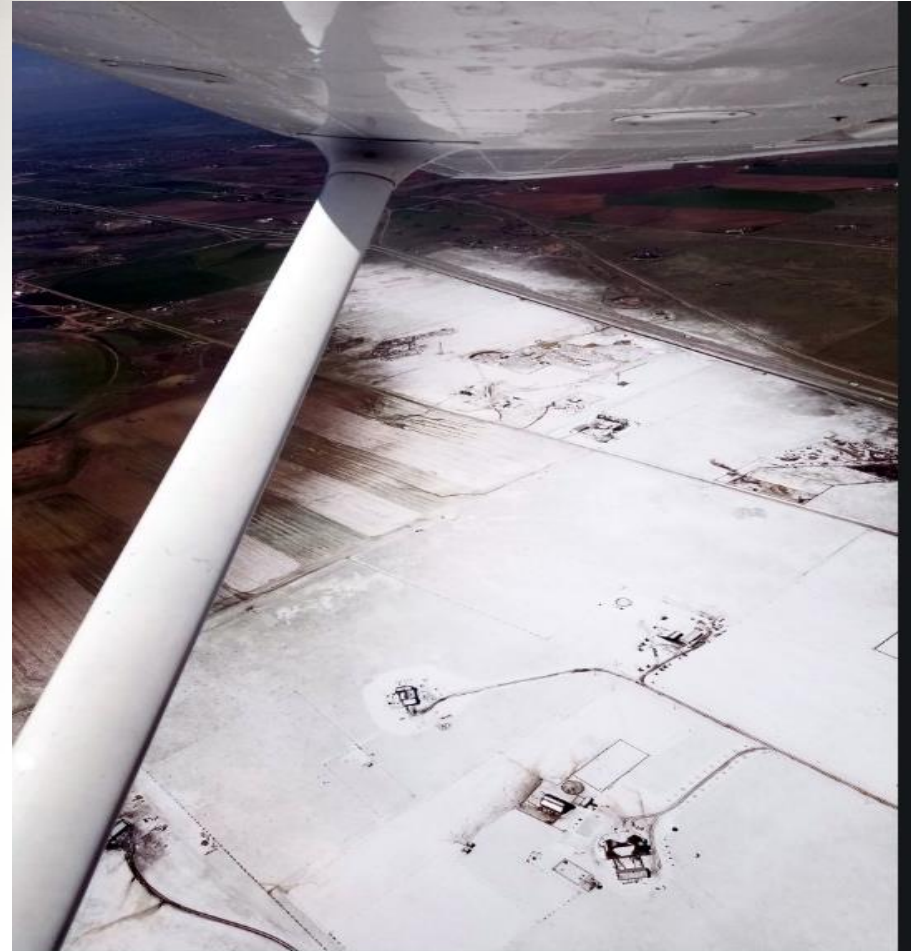


Danielle Grant [@theWXwoman](#)

13h

Incredible birds eye view of the hail swath north of Wellington on Monday! Love seeing it's precise path from above. 📸: Jane Carpenter

#9wx #cowx



[View original](#)

[Flag media](#)



Danielle Grant [@theWXwoman](#)

13h

Incredible birds eye view of the hail swath north of Wellington on Monday! Love seeing it's precise path from above. 📸: Jane Carpenter

#9wx #cowx



CoCoRaHS.org

Community Collaborative Rain, Hail, & Snow Network

The screenshot shows the CoCoRaHS.org website homepage. At the top, the logo features a stylized rain drop with the text 'CoCoRaHS' and 'COMMUNITY COLLABORATIVE RAIN, HAIL & SNOW NETWORK'. Below the logo is a navigation bar with links for 'Home', 'Countries', 'States', 'View Data', 'Maps', 'My Data Entry', and 'Login'. A 'Select Language' dropdown menu is also present. A banner reads: 'Welcome to CoCoRaHS! "Volunteers working together to measure precipitation across the nations."'.

The main content area is divided into several sections:

- Left Sidebar:** Contains a 'Main Menu' with links to Home, About Us, Join CoCoRaHS, Contact Us, and Donate. Below it is a 'Resources' section with links for FAQ/Help, Education, Training Slide-Shows, Videos, Condition Monitoring, and Evapotranspiration. Further down are links for Volunteer Coordinators, Hail Pad, Distribution/Drop-off, Help Needed, and Printable Forms. At the bottom of the sidebar are links for The Catch, Message of the Day, Publications, CoCoRaHS Blog, Web Groups, State Newsletters, Master Gardener Guide, State Climate Series, March Madness, and WxTalk Webinars. At the very bottom of the sidebar are links for Sponsors, Links, and CoCoRaHS Store.
- Center:** A green box asks 'What is your landscape's current CONDITION?' with options 'WET?', 'NORMAL?', and 'DRY?'. Below this, it says 'Tell us by submitting a "CoCoRaHS Condition Report"'. A map of the United States shows precipitation reports for 10/25/2016 at 6:03 PM EDT, with 8,308 reports received. A legend for 'Daily Precipitation (inches x.xx) USA 10/25/2016' shows color-coded ranges: Trace (purple), 0.00 - 0.18 (blue), 0.19 - 0.36 (dark blue), 0.37 - 0.91 (green), 0.92 - 2.18 (light green), 2.19 - 3.27 (orange), and 3.28 - 3.64 (red).
- Right Side:** Includes a 'JOIN CoCoRaHS' button, a 'TRAINING SLIDE-SHOWS' button, a 'Things to know about...' section with icons for Rain (inverted triangle), Hail (triangle with exclamation mark), and Snow (asterisks), and 'Download on the App Store' and 'ANDROID APP ON Google Play' buttons.
- Bottom:** Features a map of the United States with state abbreviations, a 'COCORAHS BAHAMAS' banner, and a 'CoCoRaHS WxTalk Webinar Series' box. A small box at the bottom right says 'Purchase an official CoCoRaHS 4" Rain Gauge' and 'The official CoCoRaHS Rain Gauge supplier' with the website 'WEATHERYOURWAY.COM' and 'Fast, Friendly service from a meteorologist and'.



Photo: Jim Jones

Social Media: Monitoring...

- <https://twitter.com/NWSBoulder>
 - <https://www.facebook.com/NWSBoulder>
 - <http://www.spotternetwork.org/>
 - <http://severestudios.com/>
- #COWX, @NWSBoulder

The screenshot shows the Facebook profile page for the US National Weather Service Denver/Boulder Colorado. The profile picture is a scenic view of a mountain range with yellow autumn foliage in the foreground. The page includes a navigation menu on the left with options like Home, About, Photos, Reviews, Likes, Videos, Posts, and Manage Tabs. The main content area features a status update from 11 hours ago with the text: "Chance of rain and show showers in the mountains today. Showers over the foothills, I-25 corridor, and Palmer Divide this morning/afternoon. A weak frontal passage on Wednesday will lead to a much cooler day. Warmer temperatures Wednesday through Friday. #COWX". Below the status is a "Rain & Snow in the Mountains" graphic with a weather map and a "Today" forecast: "Isolated/scattered rain & snow showers in the mountains" and "Isolated showers over foothills, I-25, & Palmer Divide". An "Outlook" section predicts "Wednesday - Friday: Dry, with warming".

The screenshot displays a Twitter feed with several tweets. The search filter is set to "#COWX @NWSBoulder". The tweets include:

- A tweet from Joanna Bean (@JoannaBean) saying "A delicious rain this afternoon. @UCCS #cowx" with a photo of a tree in the rain.
- A tweet from April Panker (@AprilPanker) replying to William King, mentioning "A rare sight these days - rain showers moving through the Pikes Peak Region. 30 minute loop ending about 5:30 PM. #cowx".
- A tweet from NWS Pueblo (@NWSPueblo) saying "A rare sight these days - rain showers moving through the Pikes Peak Region. 30 minute loop ending about 5:30 PM. #cowx".
- A tweet from Danielle Grant (@DanielleGrant) saying "Thank you so much for catching that I'll change that when I get in today. Have a great weekend!"
- A tweet from Kelly (@goterarchy) saying "Great. Thank you I agree with you. This is an incredibly beautiful place!"
- A tweet from Amy D (@AmyD3115) saying "Great. Thank you I agree with you. This is an incredibly beautiful place!"
- A tweet from Chris Spears (@ChrisCS4) saying "No prob I deleted the tweet".
- A tweet from Kathy Sabine (@KathySabine) saying "Thank you! Sorry our system triggered! Better safe than sorry I guess! Thanks for all you do!"
- A tweet from Mike Nelson (@mnelson...) saying "Do you control of the Vibeo cameras? If so, can you point the Raymer one north? Thanks".
- A tweet from BoulderCAST Weather (@BoulderCAST) saying "Sorry need more characters. It is from the Boulder climate station. On the NOWData page.".
- A tweet from Elbert County OEM (@ElbertCountyOEM) saying "You bet. Thank you!"
- A tweet from Anel Rivera Vazquez (@AnelRiveraVazquez) saying "Arel, you can call 303-434-4473, but I am leaving the office and will be back in later tomorrow morning.".
- A tweet from Lauren Whitney (@LaurenWhitney) saying "Here is a list from a..."
- A tweet from NWS Pueblo (@NWSPueblo) saying "Areas of clouds continue the PM with a few mountain rain and snow showers and possibly a..."
- A tweet from NWS Severn Storm (@NWSSevernStorm) saying "Thunderstorm Warning continues for Grant NE, Madrid NE, Elsie NE until 4:30 PM MDT." with a map showing the warning area.

Skywarn in the field and at the WFO

- During Severe Weather
 - May Have Amateur Radio Presence in our Office!
 - Allows direct communication between spotters in the field and warning forecasters



Skywarn Recognition Day 2018 at the National Weather Service in Boulder, Colorado



SKYWARN Agenda

- NWS Overview
- Weather Safety
- Thunderstorm Basics
- Spotting Storms
 - Cloud features, tornadoes

Break Time!

- Reporting Procedures
- **Advanced Spotter Training**



88D-Doppler Weather Radar

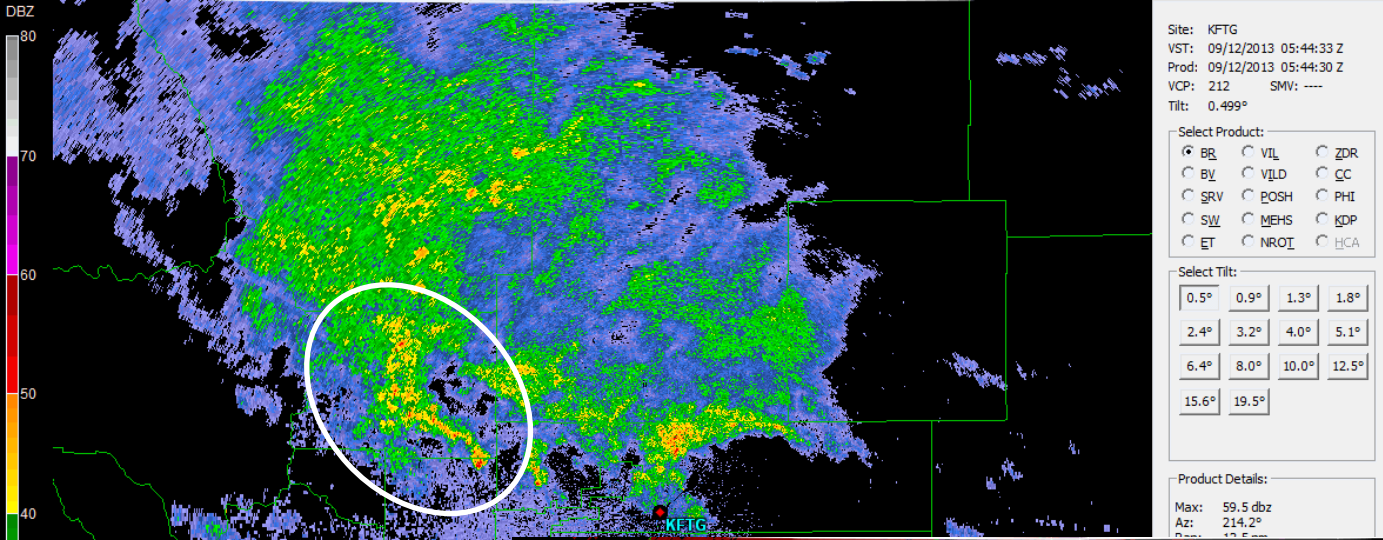


Radar Scanning Pattern



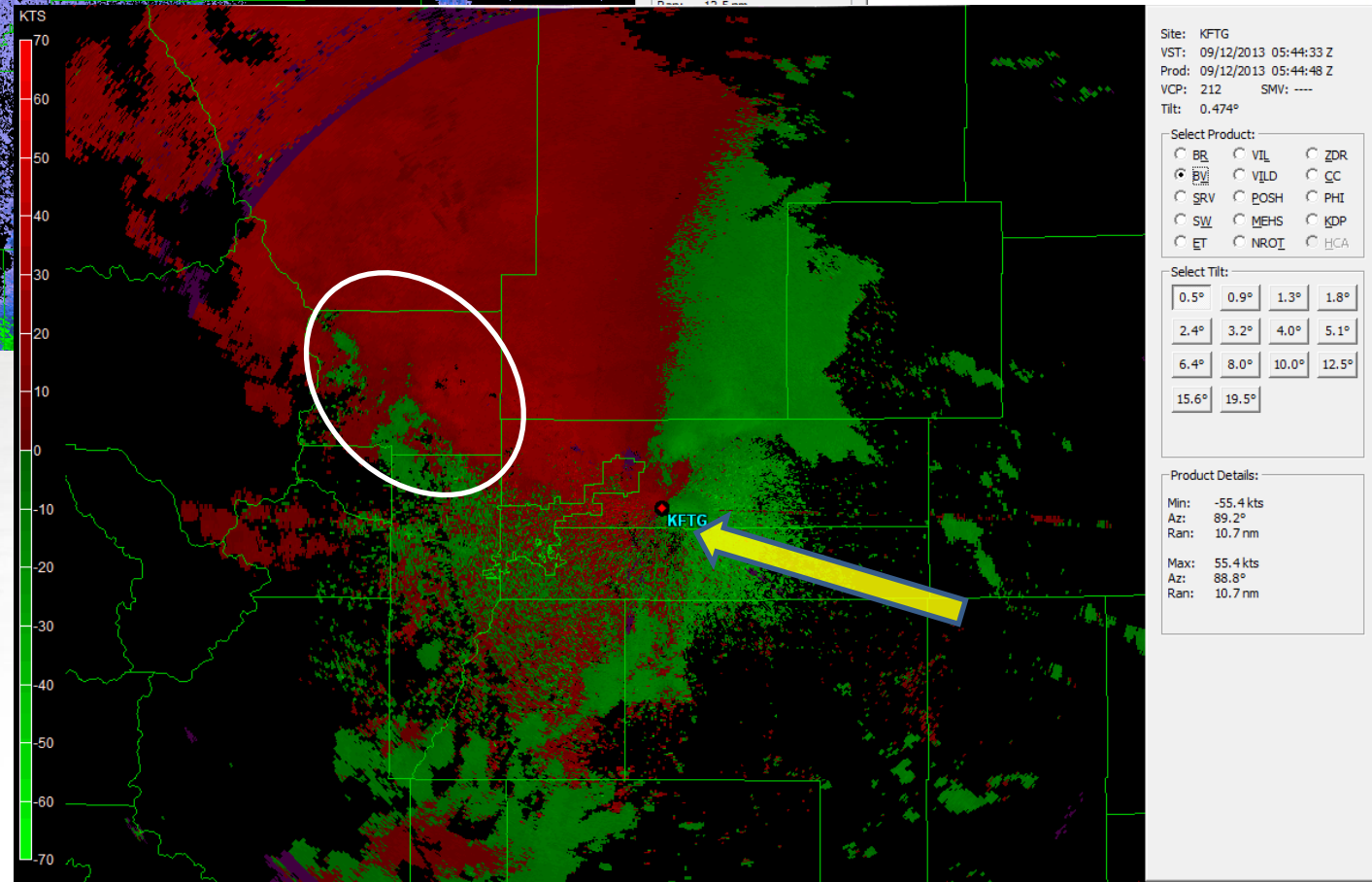
0.5°
Scan angle

Footnote:
Elevation angle and scanning increased to show detail

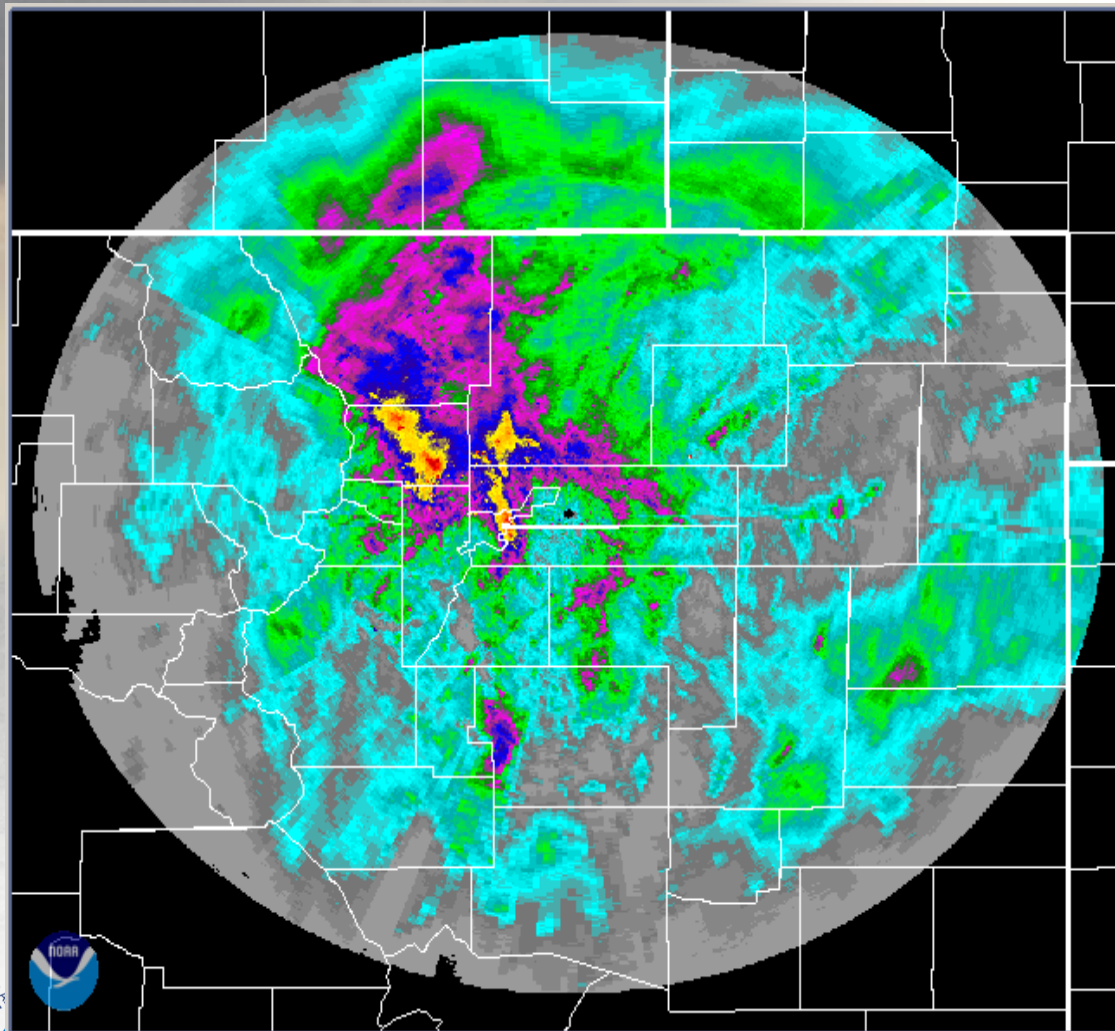


KFTG – 0.5 reflectivity and velocity

05:44 – 08:18 Z on 12 Sept. 2013



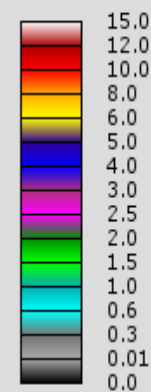
Base Radar Rainfall Estimates



NEXRAD LEVEL-III
DIG. STORM TOT. (D.P.)
KFTG - DENVER, CO
09/12/2013 23:57:34 GMT
LAT: 39/47/09 N
LON: 104/32/45 W
ELEV: 5610 FT
MODE/VCP: A / 212

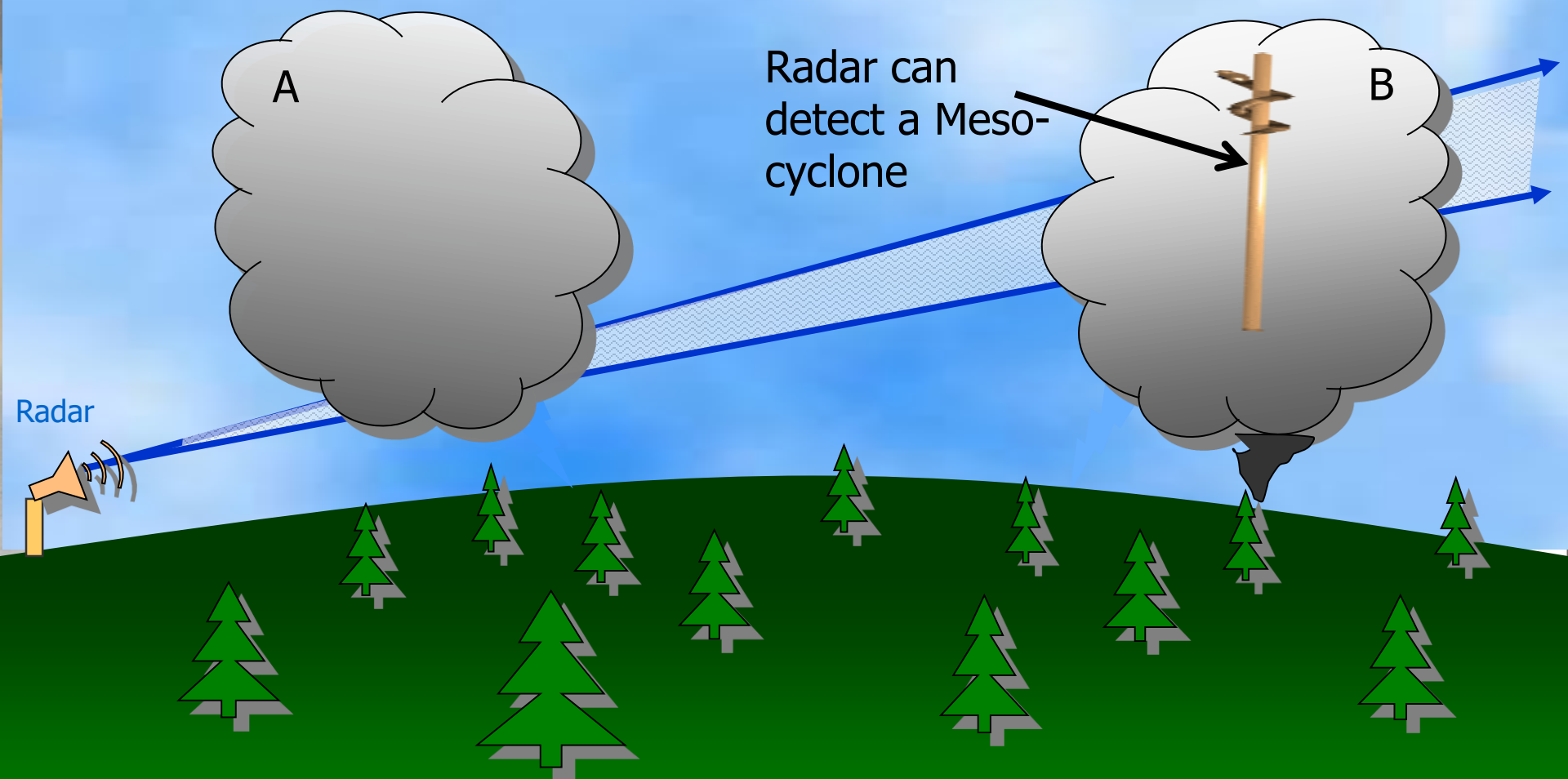
MAX: 29.50 IN
BEG: 09/09/2013 17:39 GMT
END: 09/12/2013 23:58 GMT

Legend: IN





Why we need spotters



Radar beam cannot see lower portion of storm "B"

Fancy Meteorological Terms-AFD

- CAPE (Convective Available Potential Energy)
 - Related to updraft strength
 - 1000-2000j/kg (Front Range)
 - 1500-3000j/kg (Eastern plains)
- CIN (Convective Inhibition)
 - Tied to the strength of the inversion
- Helicity-ability to produce a rotating updraft
 - Speed and directional shear are important



Mountain Tornadoes this Summer!

Jackson Co.-June 29



Weston Pass-July 5



Park County Tornado-July 5, 2018

Weston Pass Tornado



Photo Courtesy: Shell Blanscet, E474

Weston Pass Tornado

- Rating: EF1~ estimated wind speed: 90 mph
- Path Length: 1.5 miles, width~100 yards
- 1" diameter hail



The white dots on both sides of the yellow tornado path indicate the approximate location of fire personnel during this tornado event.

Playing it Safe?



Weston Pass Tornado- Damage

- Aspen trees 12-18" diameter were snapped off/uprooted
- Spruce trees uprooted



Jackson County Tornado- June 24



Photo Courtesy: Dave Martinez: East side
Rabbit Ears Pass

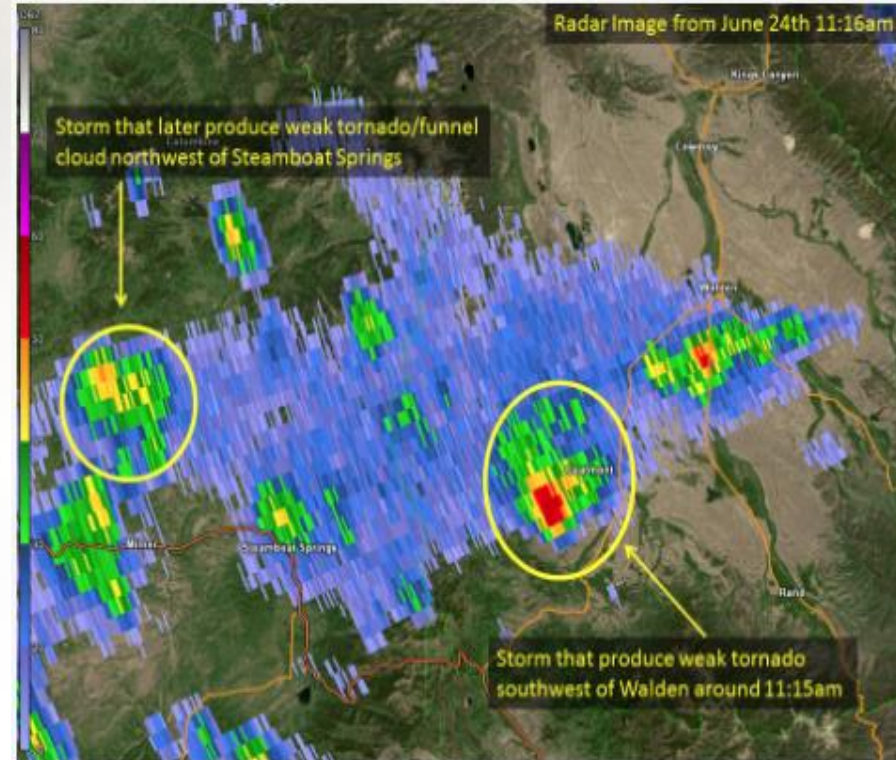
Photo Courtesy of Jeff Walls

Jackson County Tornado



Bell-shape debris cloud

Bottom of condensation funnel



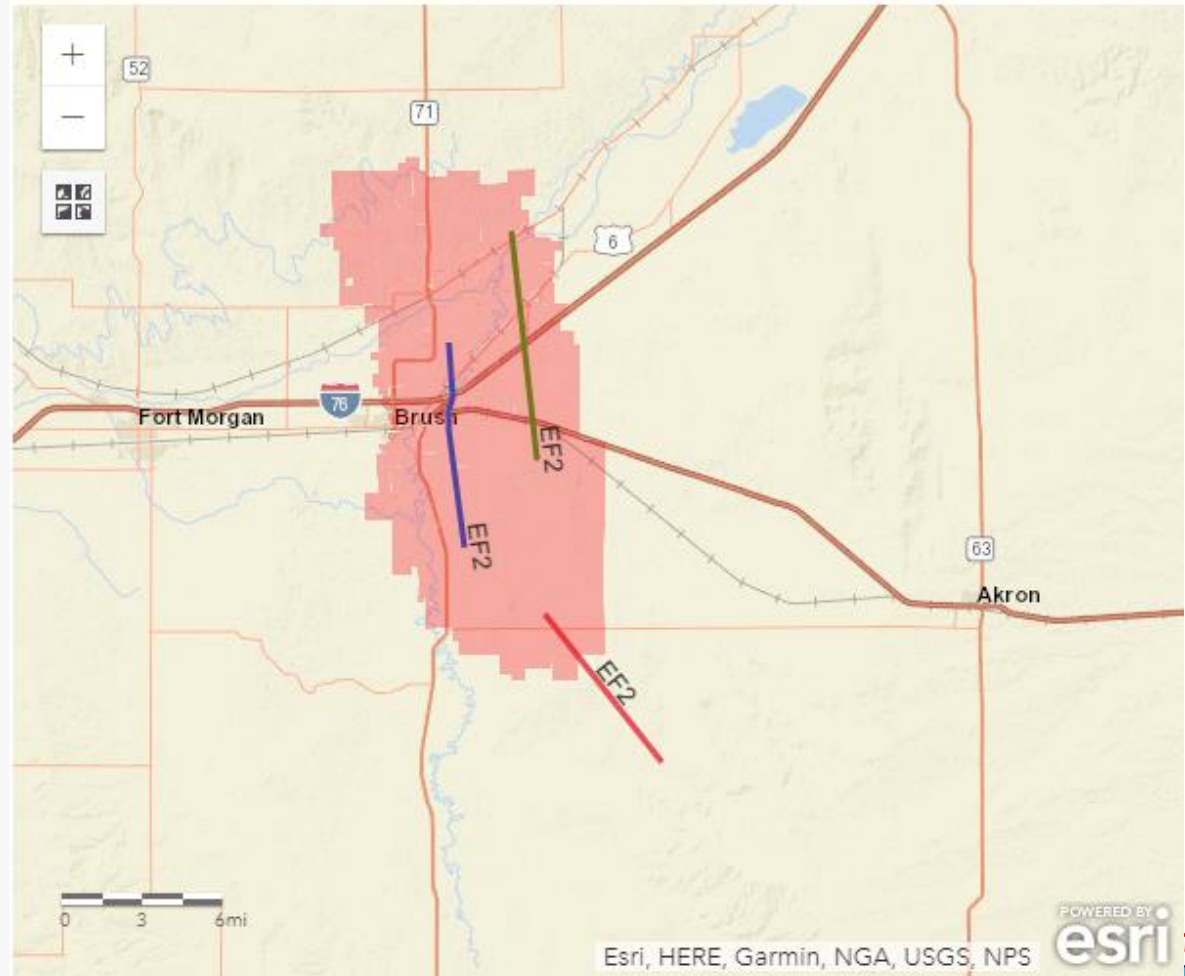
Morgan County Tornadoes

Tornadoes #3 (9 mi southeast of Brush)

Morgan/Washington Counties (red path)

Date	July 29, 2018
Time (Local)	4:50 - 5:00 PM
EF Rating	2
Est. Peak Winds	115 mph
Path Length	7 miles
Max Width	Est. 300 yards
Injuries/Deaths	0/0

Summary: A tornado developed north of County Road K in Morgan county and then moved southeast into Washington county. Numerous power poles were snapped along its path which was indicative of 115 mph winds.

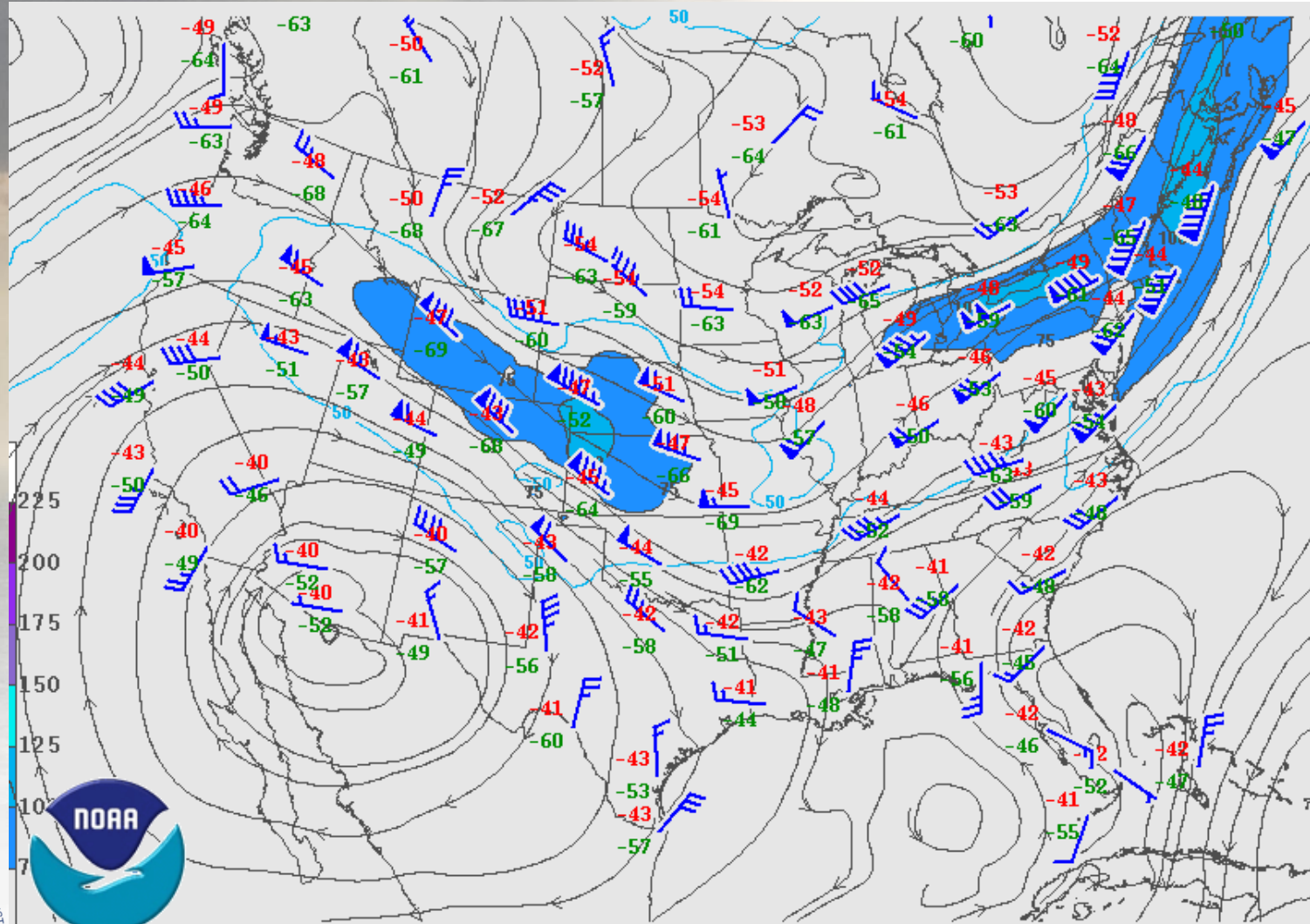


POWERED BY

esri



250mb, July 29, 5 pm



National Weather Service
Storm Prediction Center

180730/0000 250 MB UA OBS AND ISOTACHS



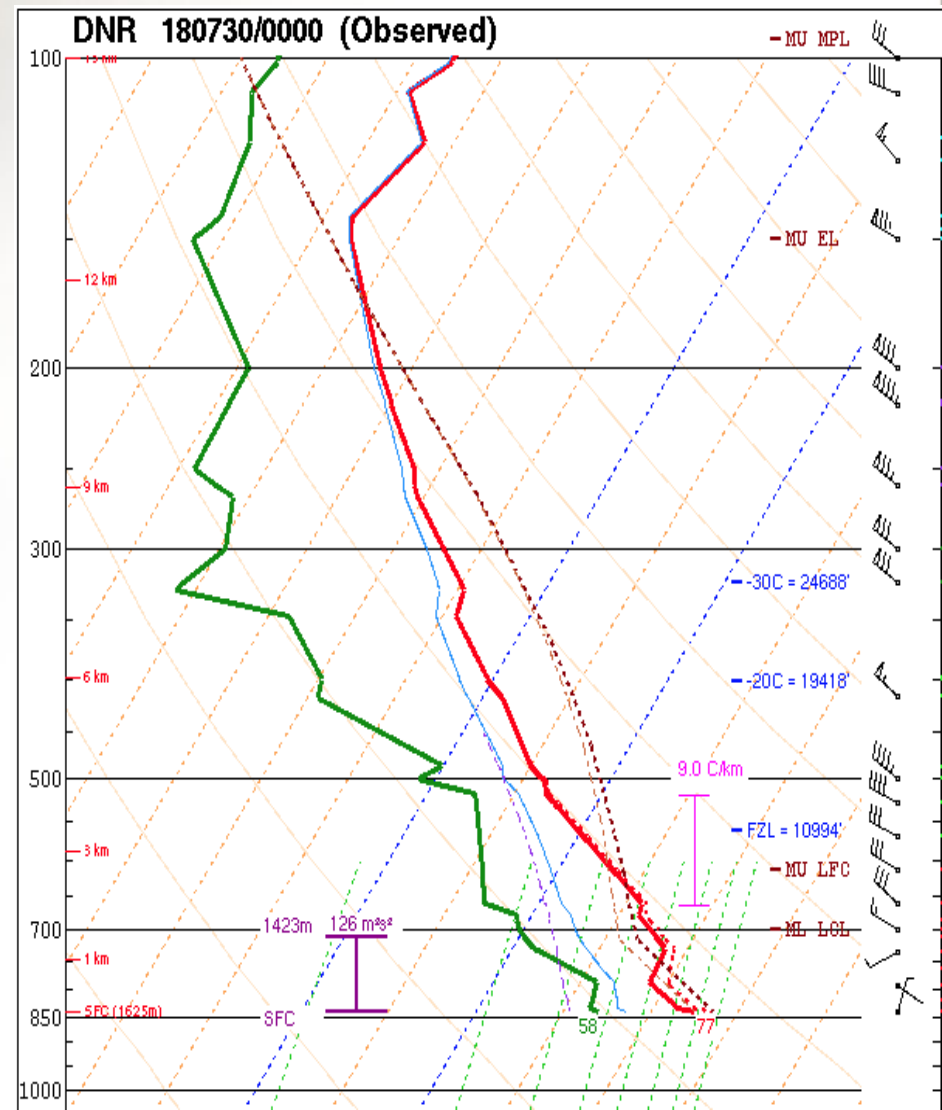
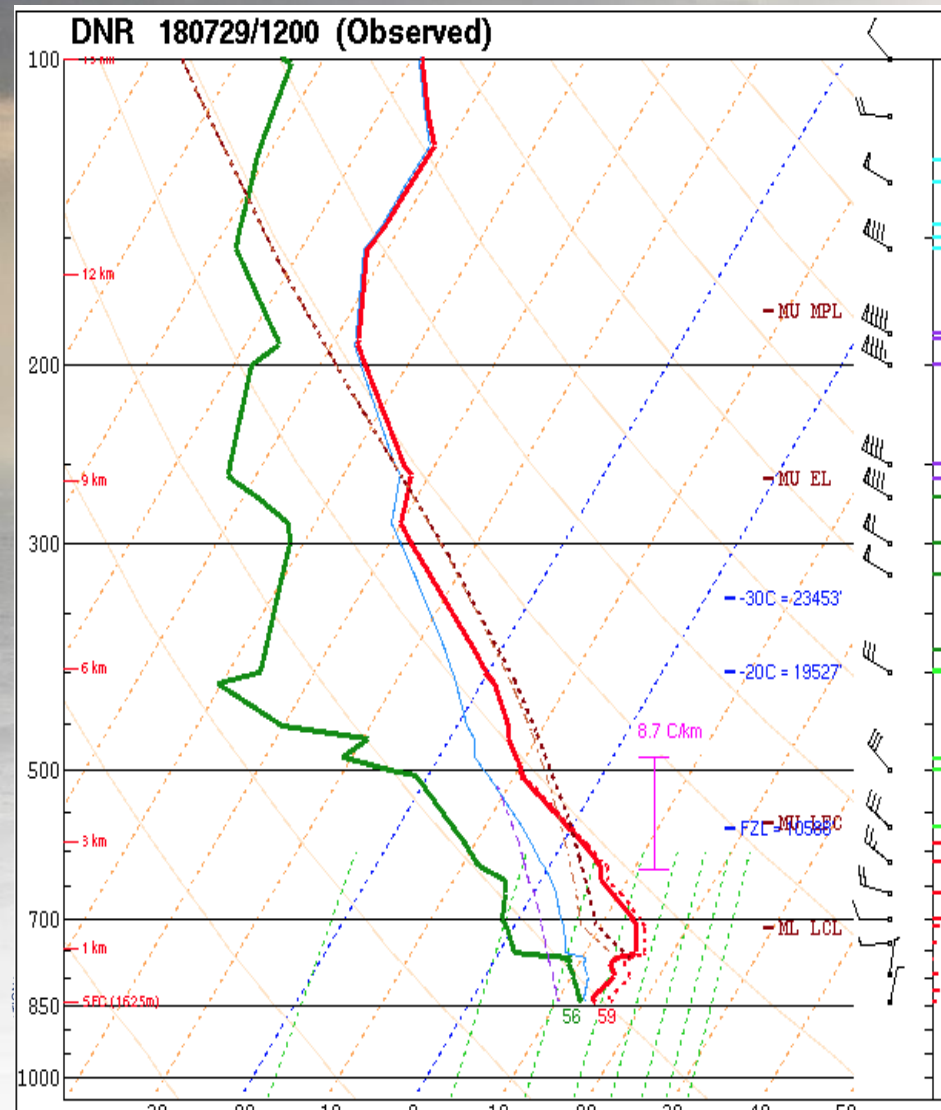
Denver Soundings 7/29/2018

6 AM

6 PM

DNR 180729/1200 (Observed)

DNR 180730/0000 (Observed)

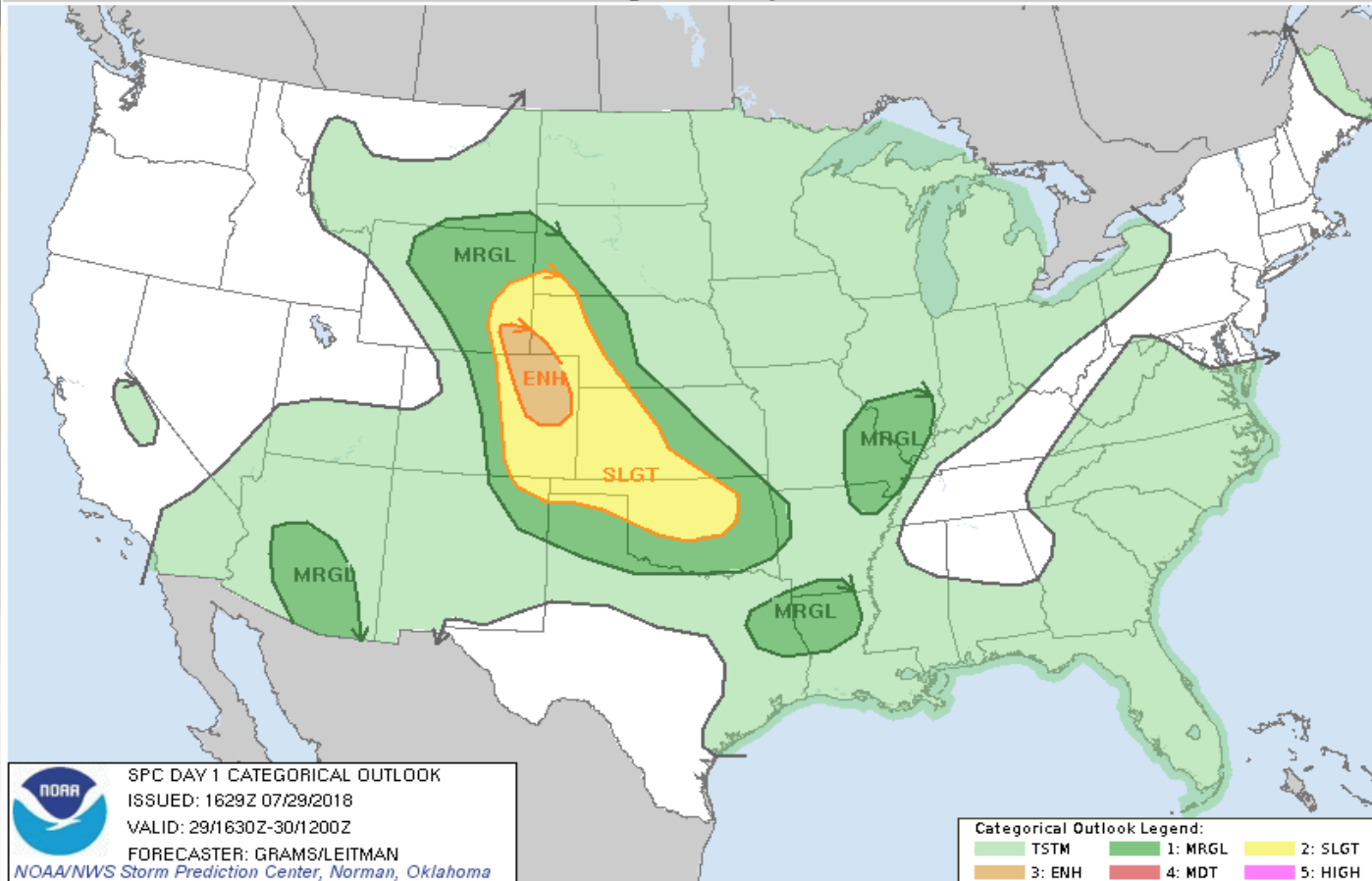


SPC DAY 1 Outlook

Jul 29, 2018 1630 UTC Day 1 Convective Outlook

Updated: Sun Jul 29 16:29:58 UTC 2018 (|)
 Probabilistic to Categorical Outlook Conversion Table

Categorical Graphic




NOAA SPC DAY 1 CATEGORICAL OUTLOOK
 ISSUED: 1629Z 07/29/2018
 VALID: 29/1630Z-30/1200Z
 FORECASTER: GRAMS/LEITMAN
 NOAA/NWS Storm Prediction Center, Norman, Oklahoma

Categorical Outlook Legend:
 TSTM 1: MRGL 2: SLGT
 3: ENH 4: MDT 5: HIGH

Day 1 Risk	Area (sq. mi.)	Area Pop.	Some Larger Population Centers in Risk Area
ENHANCED	21,987	243,364	Greeley, CO...Cheyenne, WY...Evans, CO...Sterling, CO...Fort Morgan, CO...
SLIGHT	143,372	6,931,571	Denver, CO...Oklahoma City, OK...Tulsa, OK...Colorado Springs, CO...Aurora, CO...
MARGINAL	288,891	15,551,394	Phoenix, AZ...Tucson, AZ...Mesa, AZ...Wichita, KS...St. Louis, MO...



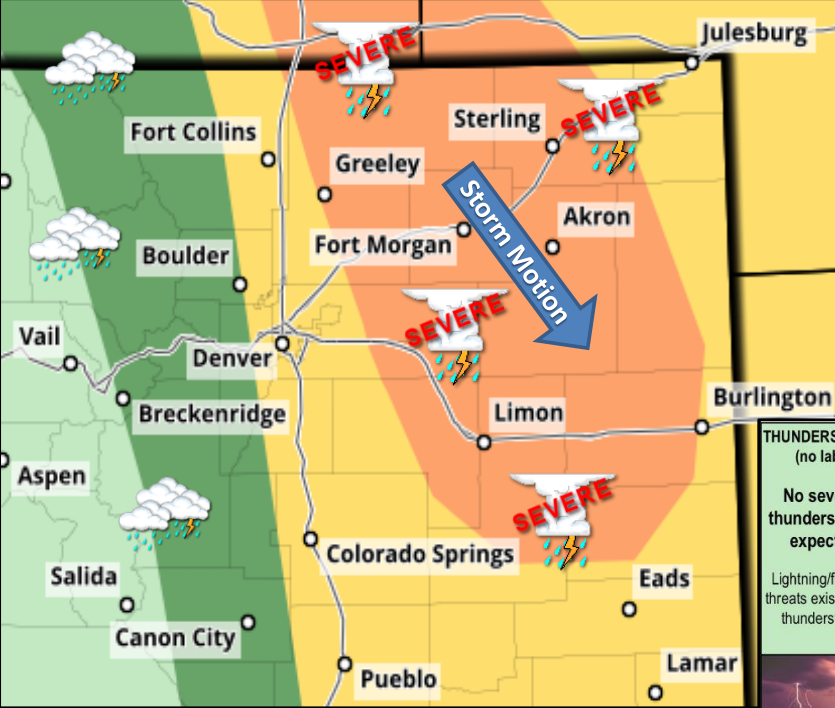
Weather Story/Hazardous Wx Outlook



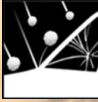


Denver/
Boulder





Severe Storms Likely this Afternoon/Evening


Severe Weather Outlook: Sunday, July 29, 2018





Potential Hazards

- 
Up to baseball sized hail
- 
Wind gusts up to 80 mph
- 
Isolated Tornadoes

THUNDERSTORMS (no label)	1 - MARGINAL (MRGL)	2 - SLIGHT (SLGT)	3 - ENHANCED (ENH)
No severe* thunderstorms expected <small>Lightning/flooding threats exist with all thunderstorms</small>	Isolated severe thunderstorms possible	Scattered severe storms possible	Numerous severe storms possible <small>More persistent and/or widespread, a few intense</small>
			


weather.gov/Denver


[NWS Boulder](https://www.facebook.com/NWSBoulder)


[@NWSBoulder](https://twitter.com/NWSBoulder)

Updated: 11/19/2018 9:28 AM

.SPOTTER INFORMATION STATEMENT...

Spotter activation is expected to be needed over the northeast plains and possibly across the Urban Corridor this afternoon and evening.



Situation Report



National Weather Service
Boulder, CO

Situation Report

Sunday, July 29, 2018 11:17 AM

• SPC Outlook

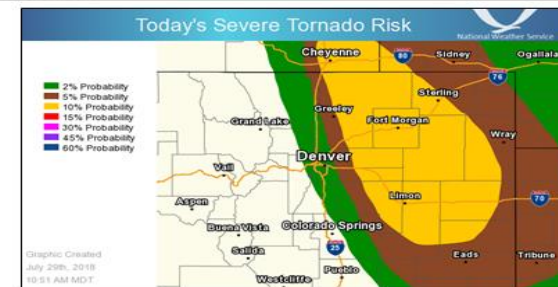
- Enhanced
- Enhanced+10%
tornado
- Moderate or
higher

Today's Tornado, Severe Hail, & Damaging Wind Risk

Key Points



Hazards: Long track severe storms today, with possible tornadoes, very large hail, and damaging winds.



Timing & Duration: 2 PM – 10 PM. Two rounds of storms possible.



Impacts: Damage to vehicles, roofs, windows, crops, and power supply interruptions. Damaging tornadoes possible, too. Isolated flooding from stronger storms.



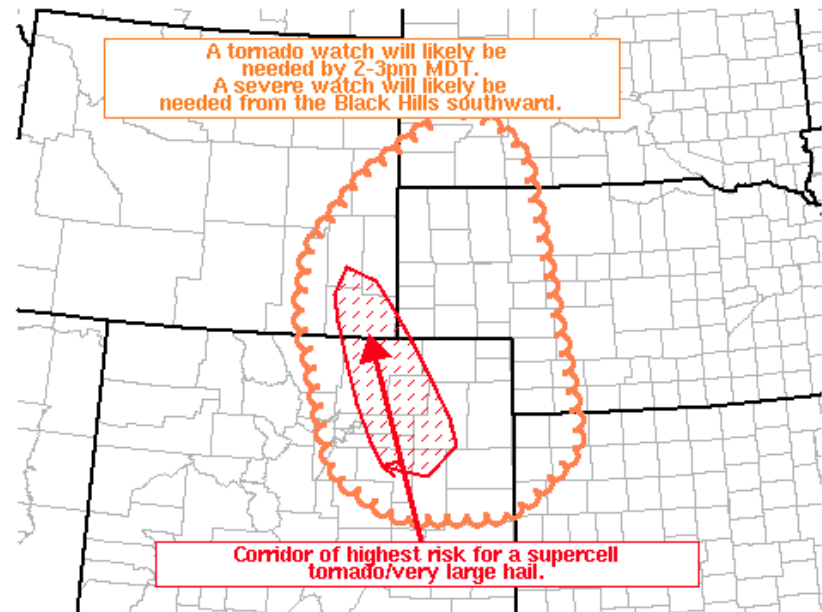
Certainty & Considerations: Moderate Confidence

SPC Mesoscale Discussion/Watch

- Strong Northwest Flow aloft with 100kt jet
- CAPE values up to 2500j/kg
- Higher CIN more stable airmass Further west

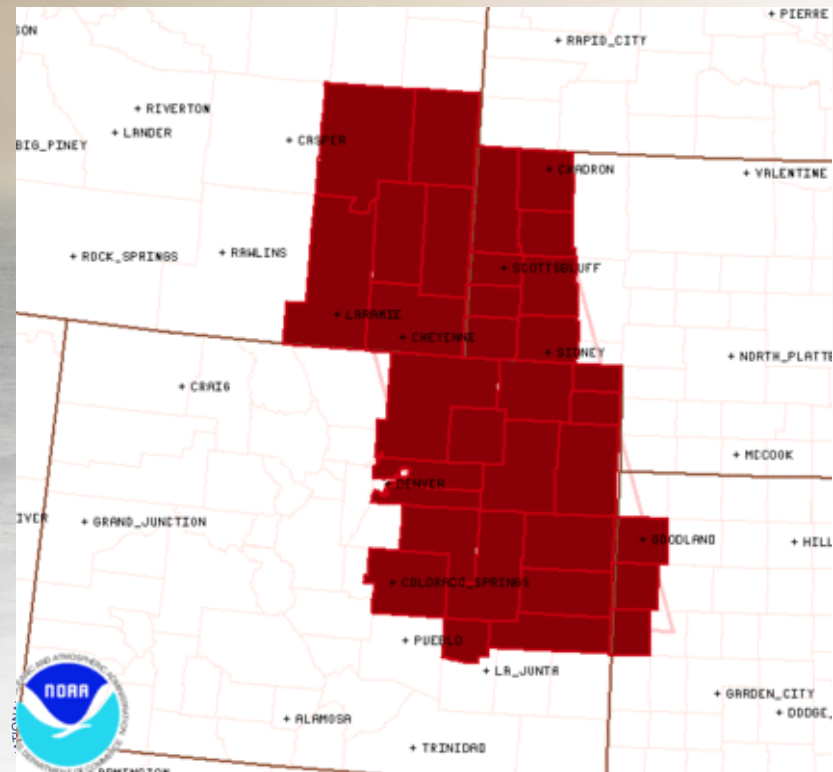
Mesoscale Discussion 1194

< Previous MD Next MD >



Corridor of highest risk for a supercell tornado/very large hail.

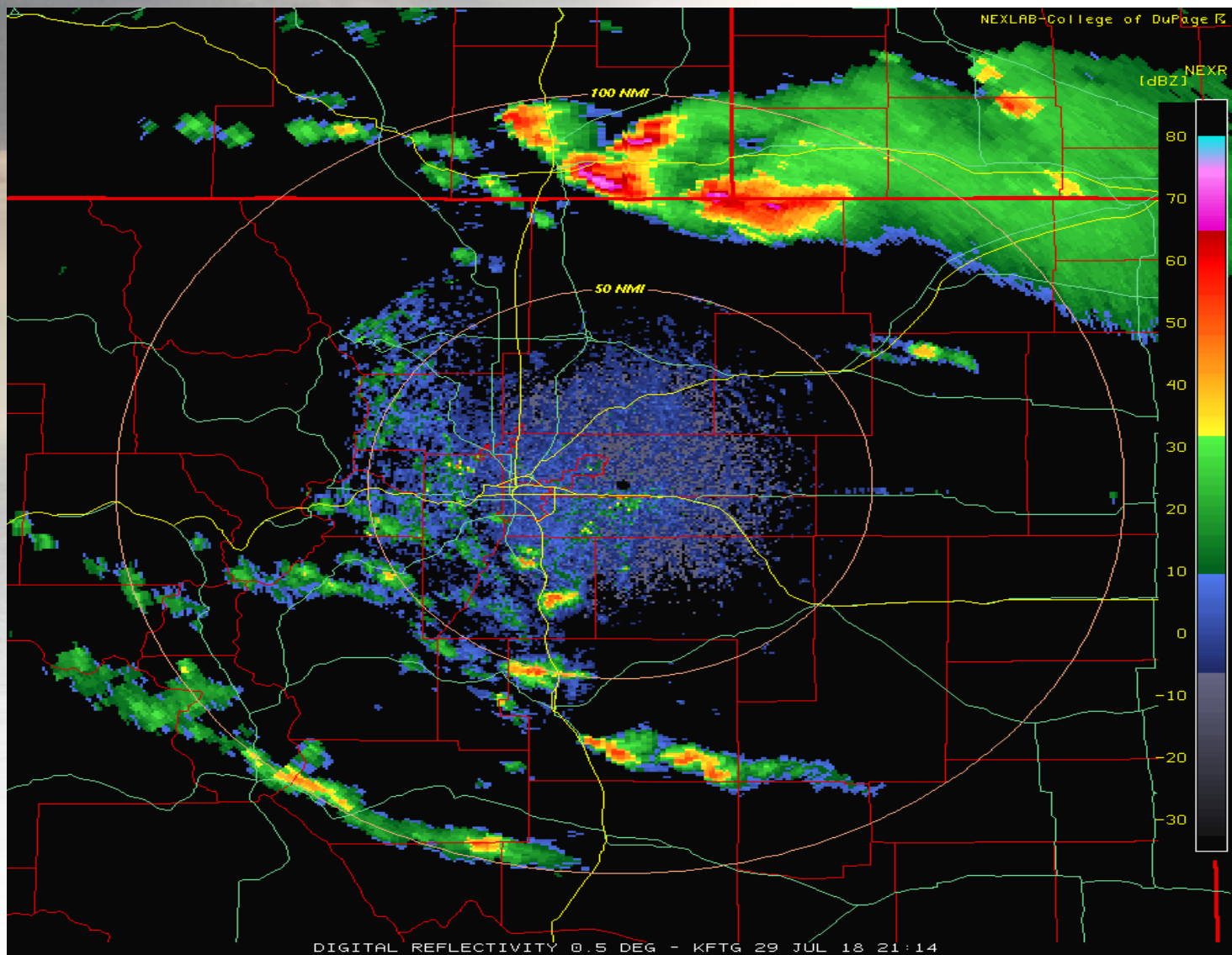
SPC MCD #1194



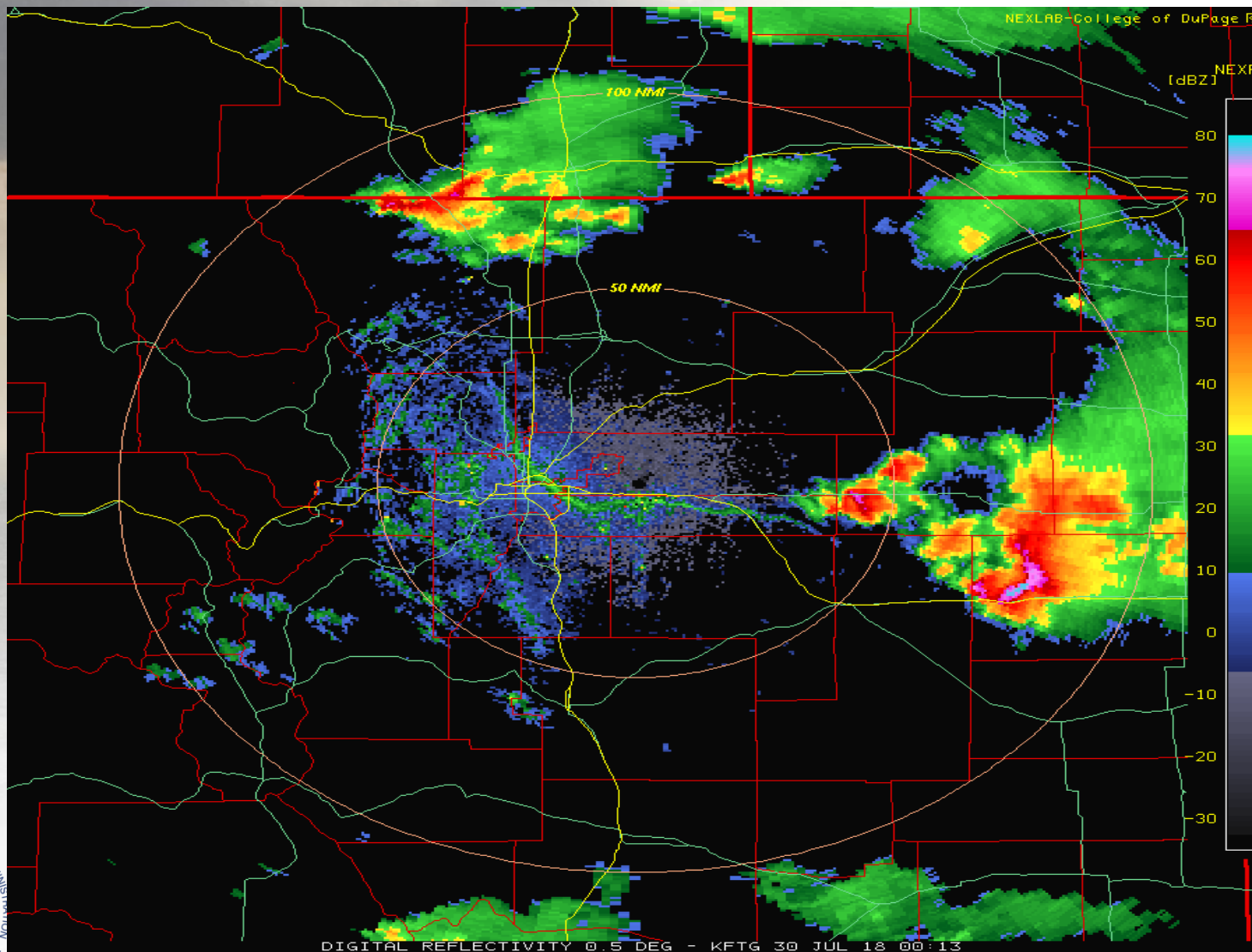
Tornado Watch #322 - Valid from 105 PM until 900 PM MDT



Radar Imagery-July 29th

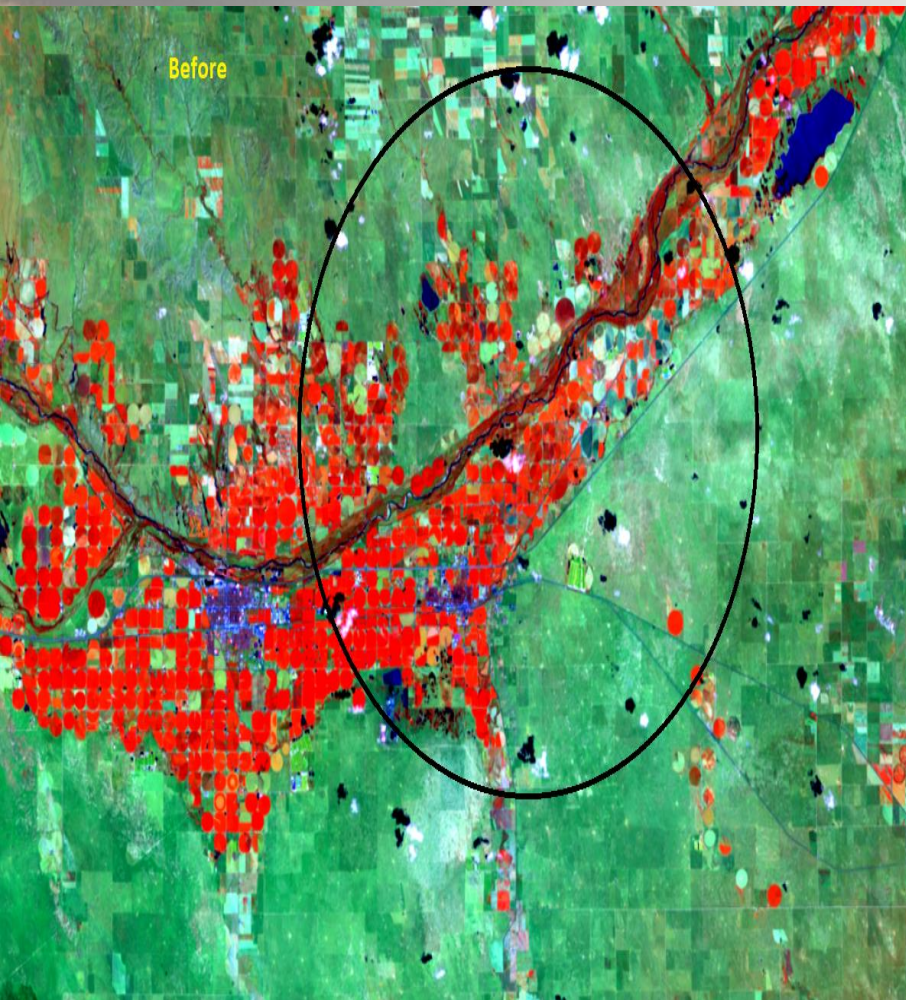


Radar Imagery-July 29th

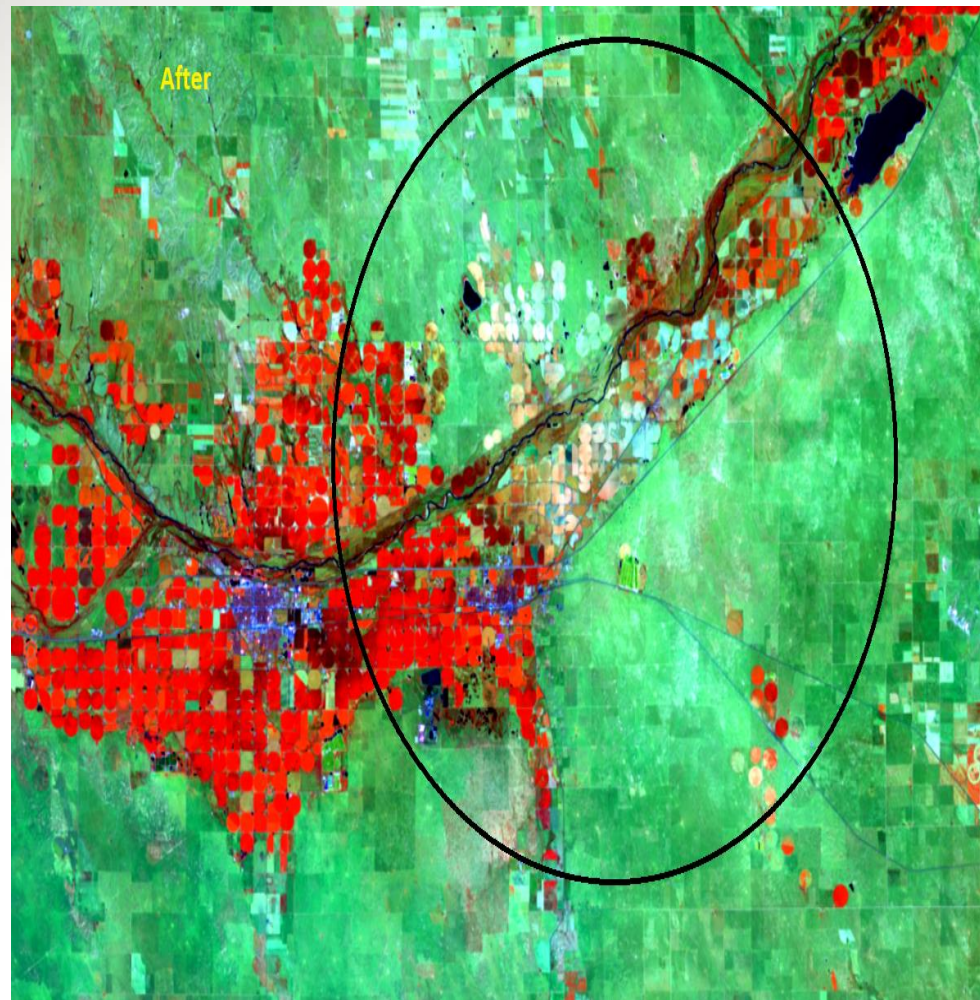


Storm damage to Vegetation

Before

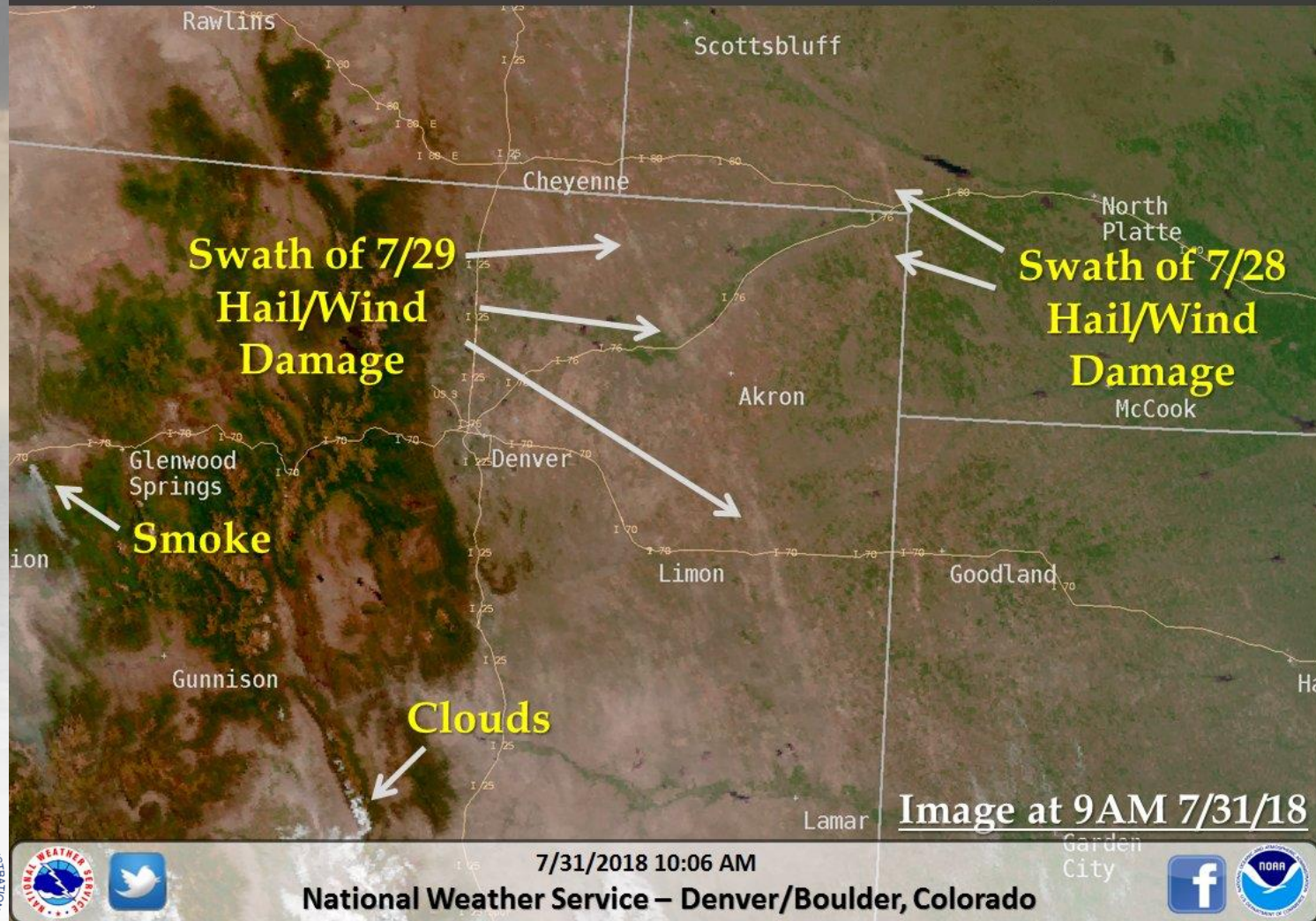


After



Hail/Wind Damage

Synthetic True Color Visible Satellite Image



7/31/2018 10:06 AM

National Weather Service – Denver/Boulder, Colorado



Damage Reports



Brush Airport



- 20 Injuries, some serious
- Numerous trees/power poles blown down or snapped.
- High tension power lines taken out
- Flooding with storms around Brush and Hillrose.
- Direct hit to feedlot with several livestock injured or killed
- Large hail with crop damage
- Wind gusts to 70 mph



What's up with the Green Skies?



[View original](#)

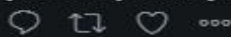
[Flag media](#)



Trevor White @whitephoto

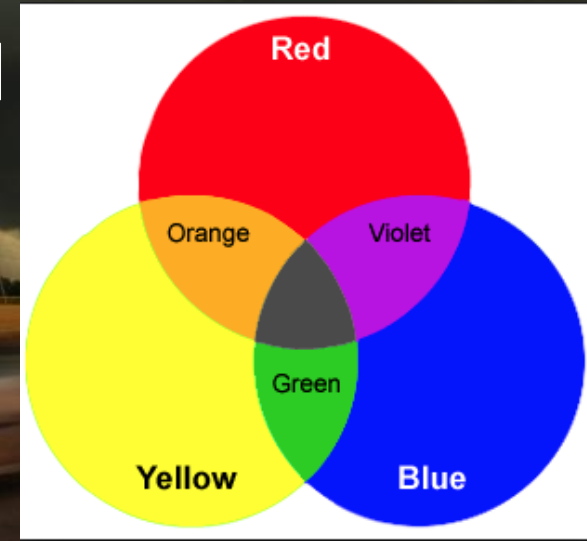
4m

The green monster I saw with @KathrynProciv and @N3MRA yesterday. Shot just north of Arriba, dropping south to avoid hail. #cowx



Green Skies and Severe Weather

- Water droplets absorb red light which makes the scattered light appear blue
- If blue light is set against an environment heavy in reddish light (sunset)
- Net effect can make the sky appear green
- “Green” thunderstorms reported the late day
- No scientific conclusive evidence



SKYWARN Toolbox

- Safety Hazards with thunderstorms
- How to identify cloud types and association with severe thunderstorms
- Determine visual types of thunderstorms and dangers they pose
- Safely and accurately report severe weather to NWS office



For Your Information

- **New Spotters:**

- New spotter letters will be mailed to your location
- Make sure you have signed up on the sheets if you want to be included.
 - Include physical address if you have a P.O. Box
 - If you have Davis Weather Equipment, add your e-mail to the signup sheet and you will be contacted
 - If you do not receive a welcome letter in 30 days, please email Scott.entrekin@noaa.gov

- **Existing, Re-trained spotters:**

- Your information will be updated in our database
- No formal re-notification given

- Spotter guides are available online at: weather.gov/os/brochures.shtml
- On-line spotter training (for review)
meted.ucar.edu/training_course.php?id=23

Questions on training: Contact Greg Hanson (WCM) or Scott Entrekin @noaa.gov

