Weather Spotter Training

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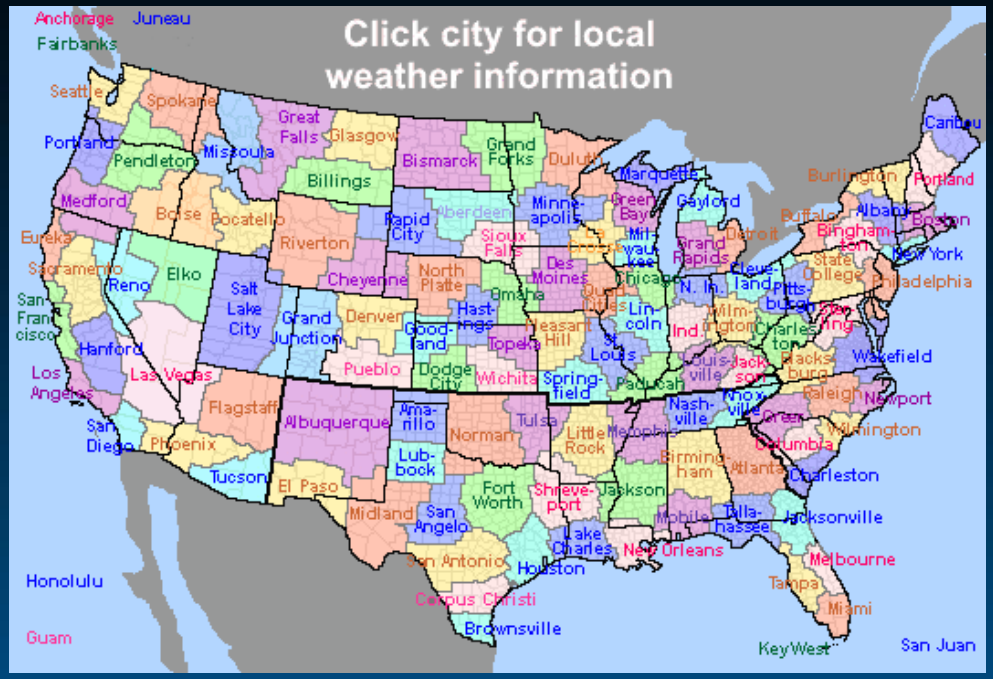
National Weather Service



- 76 Billion Observations
- 1.5 Million Forecasts
- 50,000 Warnings

- Local Forecasts & Warnings
- Work with Local Agencies
- Give Expert Advice
- Provide Awareness and Education

A Typical Year Brings


6 Hurricanes


1270 Tornadoes


5000 Floods


10,000 Violent Thunderstorms


Drought Conditions


58,500 Wildfires burning 6.35M acres

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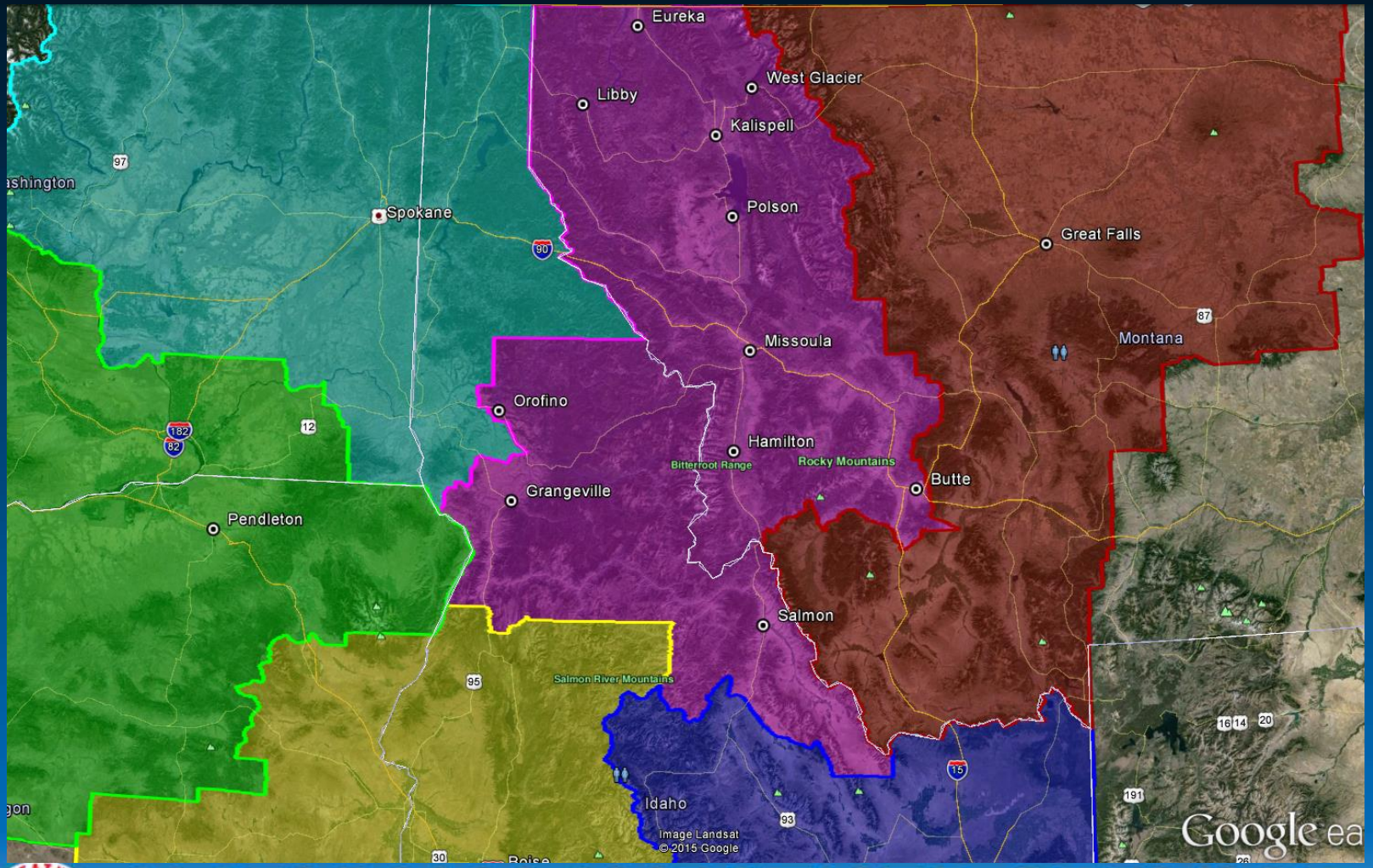
Missoula Forecast Area



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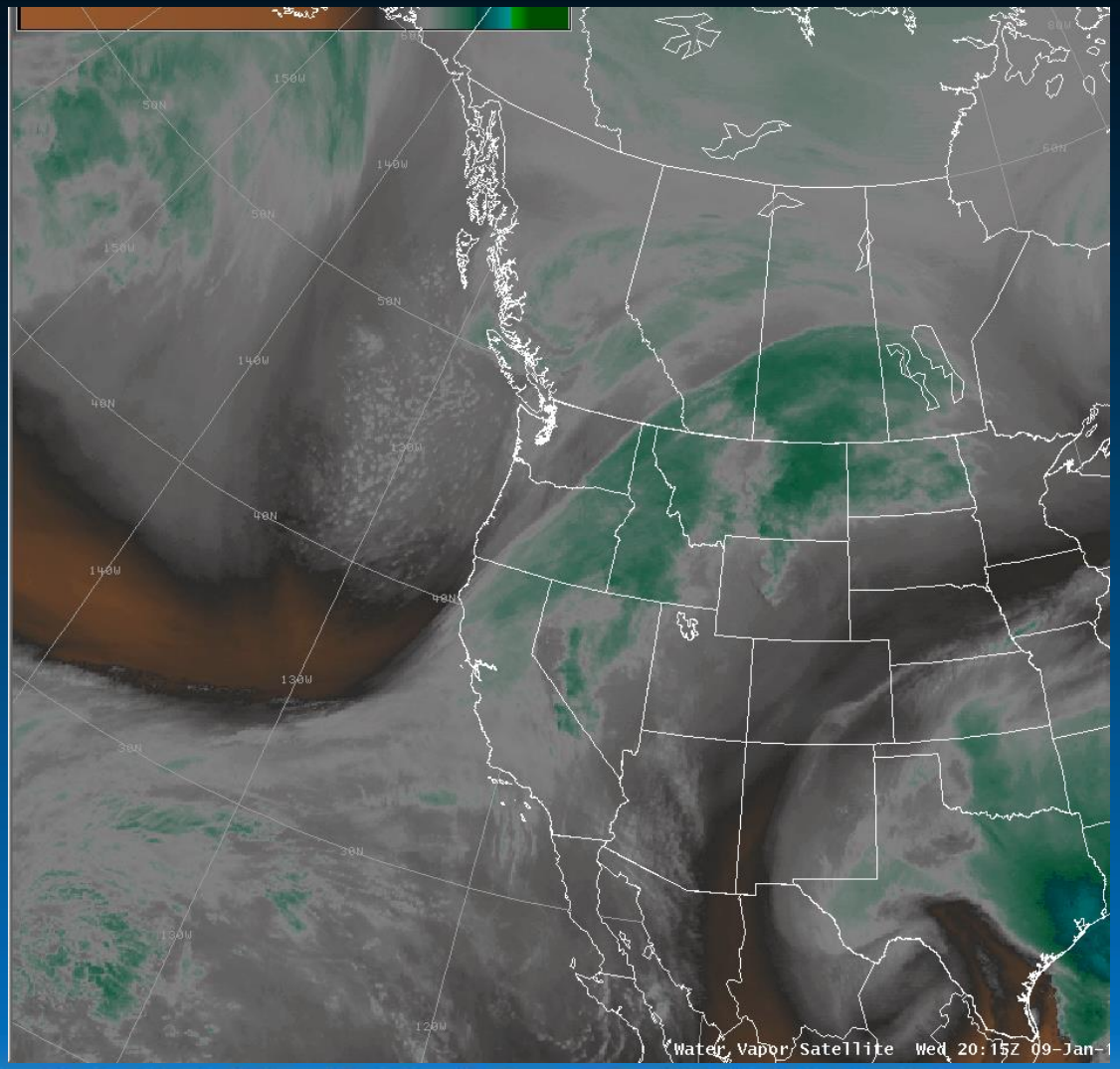
Thunderstorm Ingredients

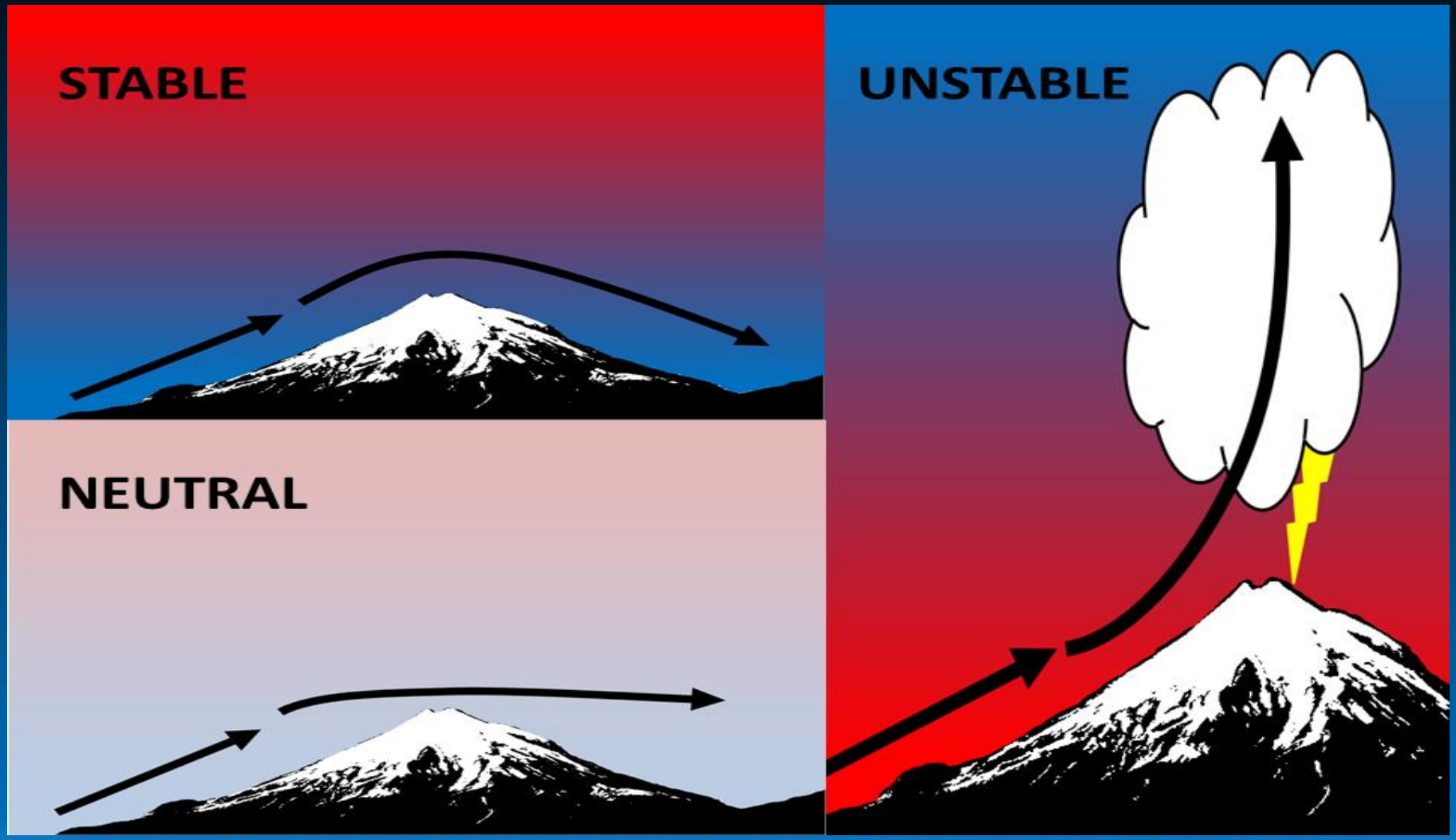
- MOISTURE
  - Preferably in the lower or middle levels of the atmosphere
- INSTABILITY
  - Ability of air to accelerate upward/downward when motion initiated
- LIFT
  - Moist, unstable air acted on by terrain, fronts, storm outflow boundaries, etc…

Moisture

- Upper level low pressure over the eastern Pacific ocean and a ridge inland
- Subtropical jet stream brings Pacific moisture
- Occasional tap into the Southwest monsoon

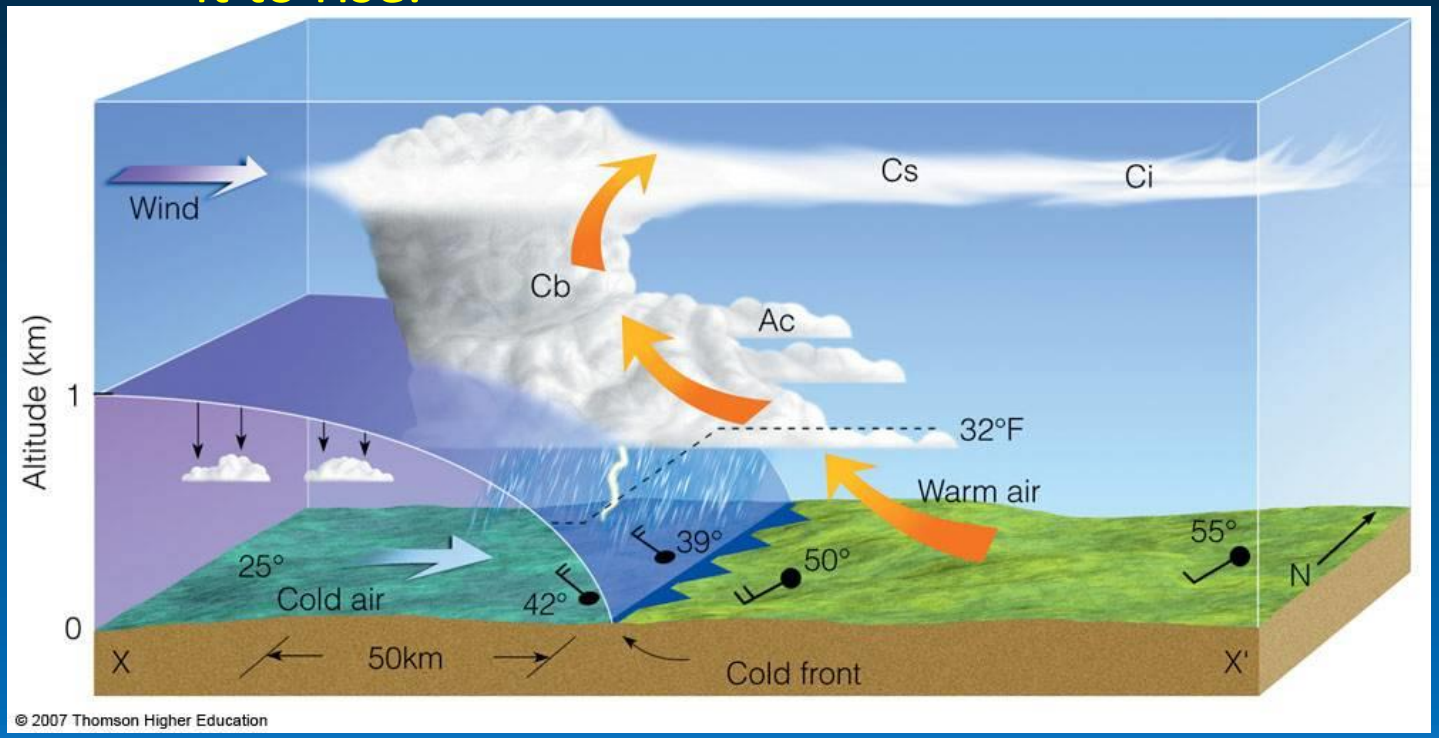


Instability



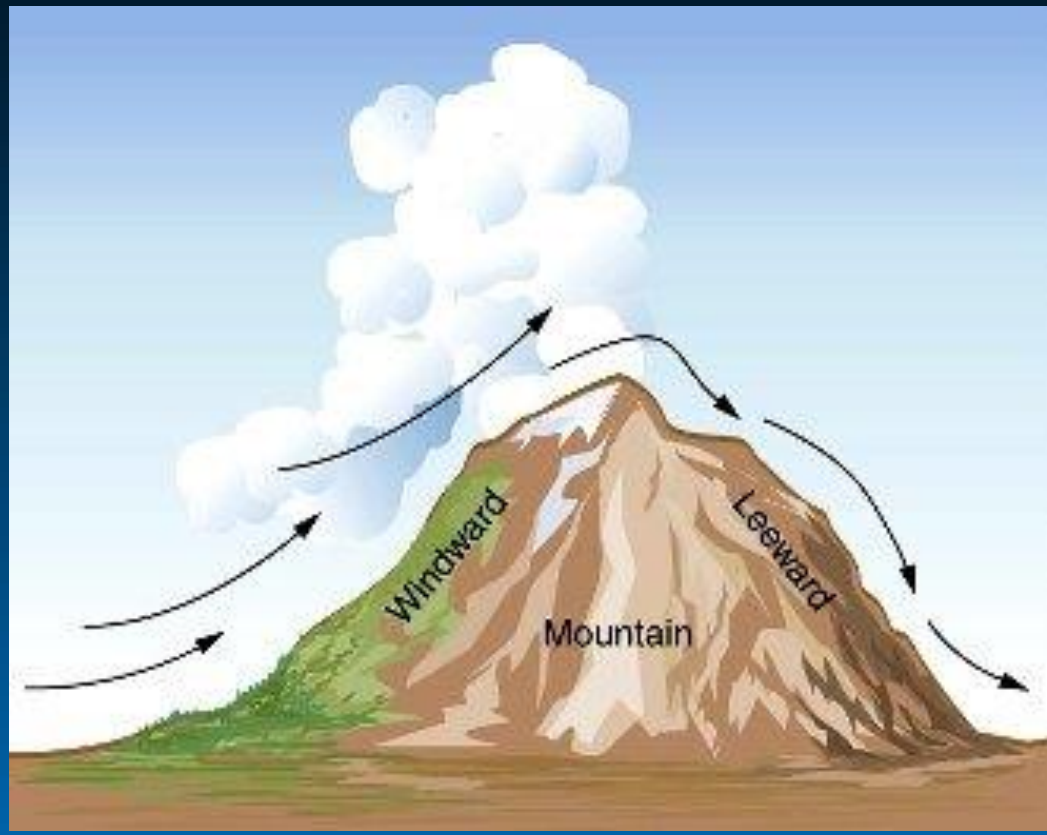
Lift Associated with a Cold Front

- Colder more dense air pushes underneath warmer moist air, creating condensation and cloud development.
- Air converges along a frontal boundary, forcing it to rise.



Lift Associated with Topography

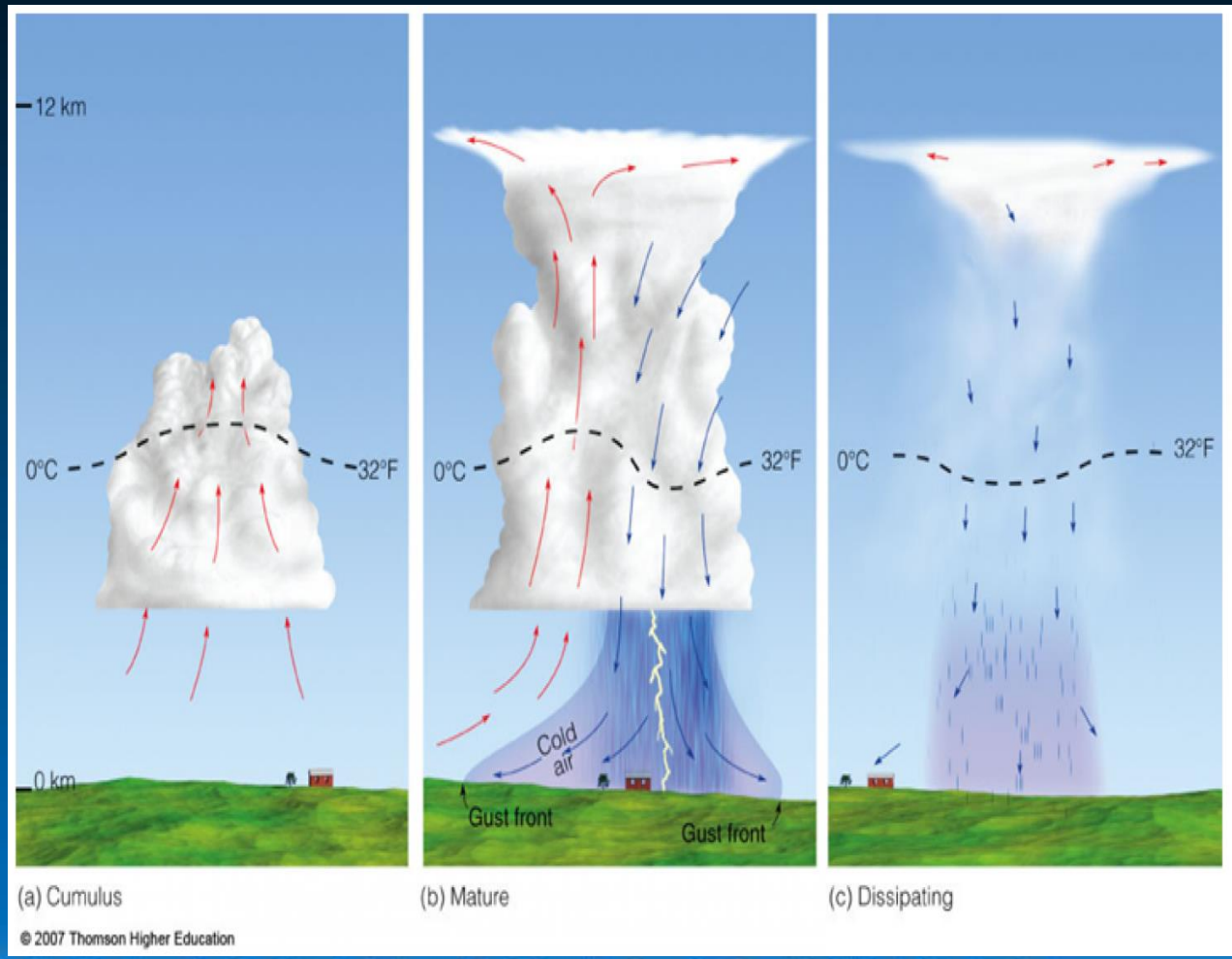
- Air rises on windward side of a mountain
  - Results in cooling and formation of clouds and precipitation
- Air descends on leeward side of a mountain
  - Results in warming and drying
- Prevailing wind direction determines precipitation



Thunderstorm Life Cycle (Air-Mass Thunderstorm)

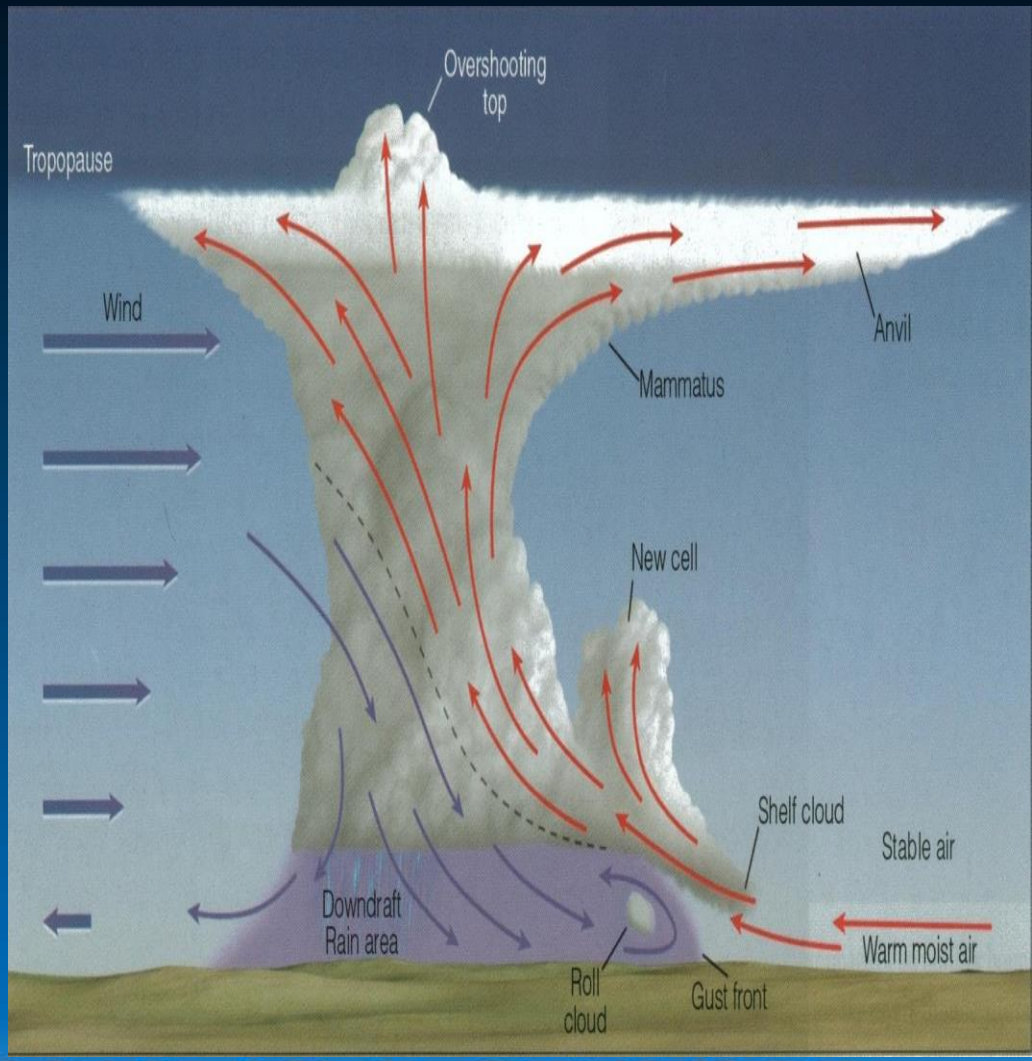
- Three Stages

- Cumulus
  - All updraft
- Mature
  - Updraft and Downdraft
- Dissipating
  - All downdraft



Strong Thunderstorm Structure

- Need strong vertical wind shear
- Tilts the updraft and downdraft
  - Precipitation falls into downdraft region in stead of the updraft
- Updrafts may be strong enough to intrude into the stable stratosphere
- Violet updrafts can suspend hailstones
- Downdraft is fed by precipitation but enhanced by cooling due to evaporation of precipitation



Single Cell “Pulse” Thunderstorm

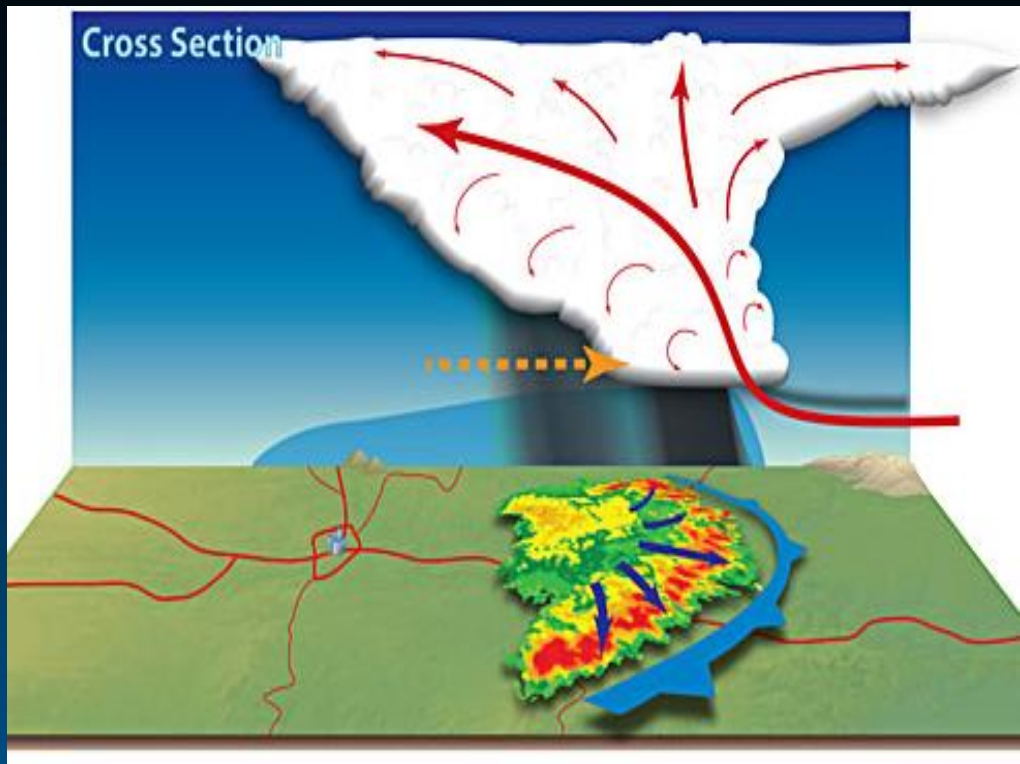
- Goes through the three stages of thunderstorms in less than hour, sometimes in as little of 30 minutes.
- Severity depends on amount
instability and moisture
- Lacks strong vertical wind shear and lift mechanism is thermals

Multi Cell Thunderstorm

- Downdraft (outflow) from one cell can cause another cell to develop
- Mountains can have a similar effect
- Training of storms could cause flooding

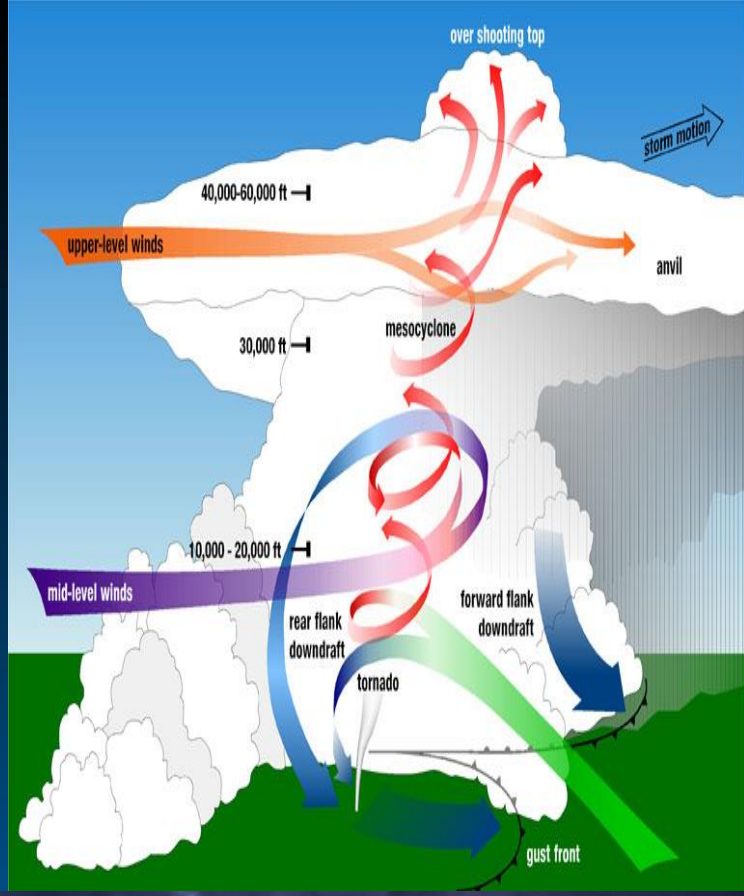
Squall Line

- Narrow, often linear line of thunderstorms. Develops along or usually ahead of a cold front.
- Once thunderstorms develop, the outflow of cold air becomes the lifting mechanism keeping the line alive.
- Lines can persist for six hours, due to the alignment of individual cells do not interfere with each other
- Smaller scale phenomenon is called a Bow Echo



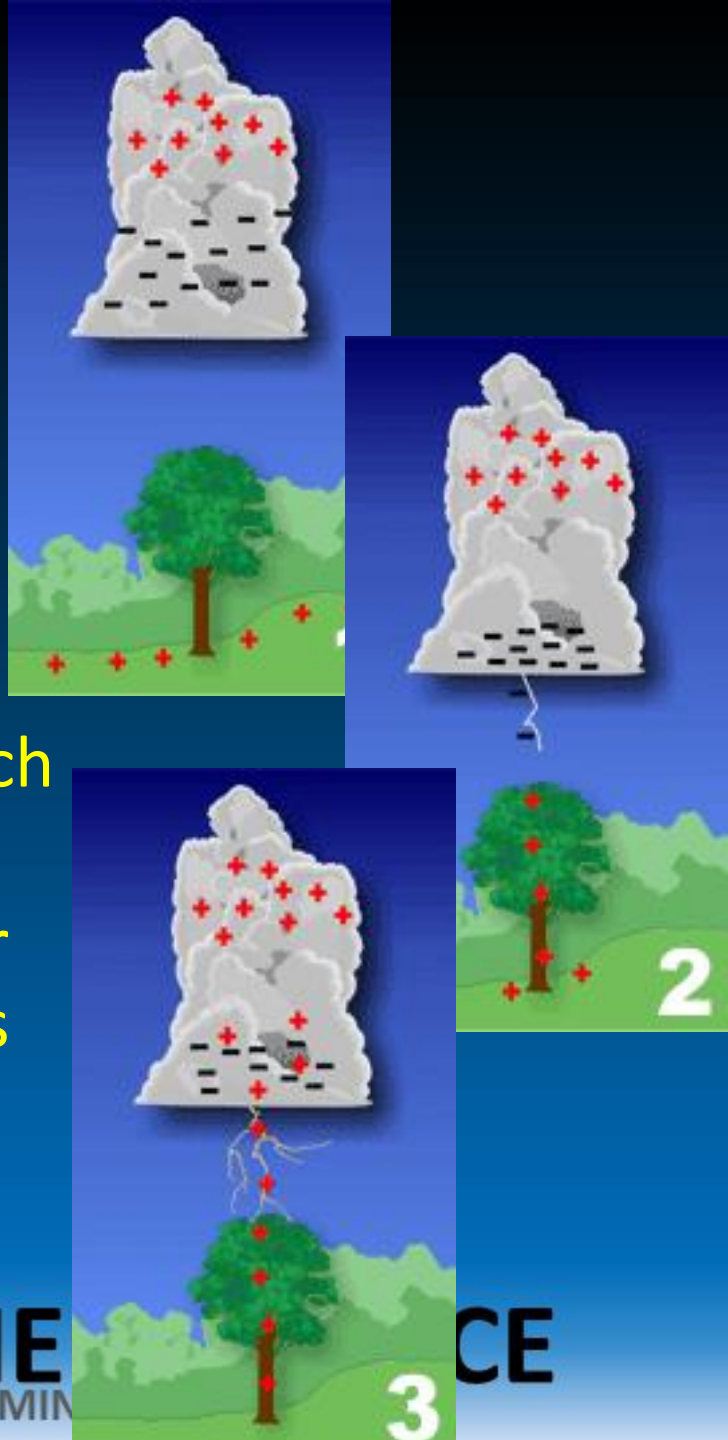
Supercell

- Needs speed and directional wind shear
- One updraft, but two downdrafts
- Can last for several hours, as long as there is a supply of warm surface moisture
- Updraft's vertical velocity can reach 100 mph



Lightning

- Ice and liquid hold different charges
- Charges become imbalance within a thunderstorms
- Positive and negative strikes
- Cloud-to-cloud, cloud-to-ground, or cloud-to-air
- Average 80 fatalities/300 injuries each year
- Thunder is the rapid expansion of air around the lightning bolt that breaks the sound barrier



Lightning

- **Temperature**

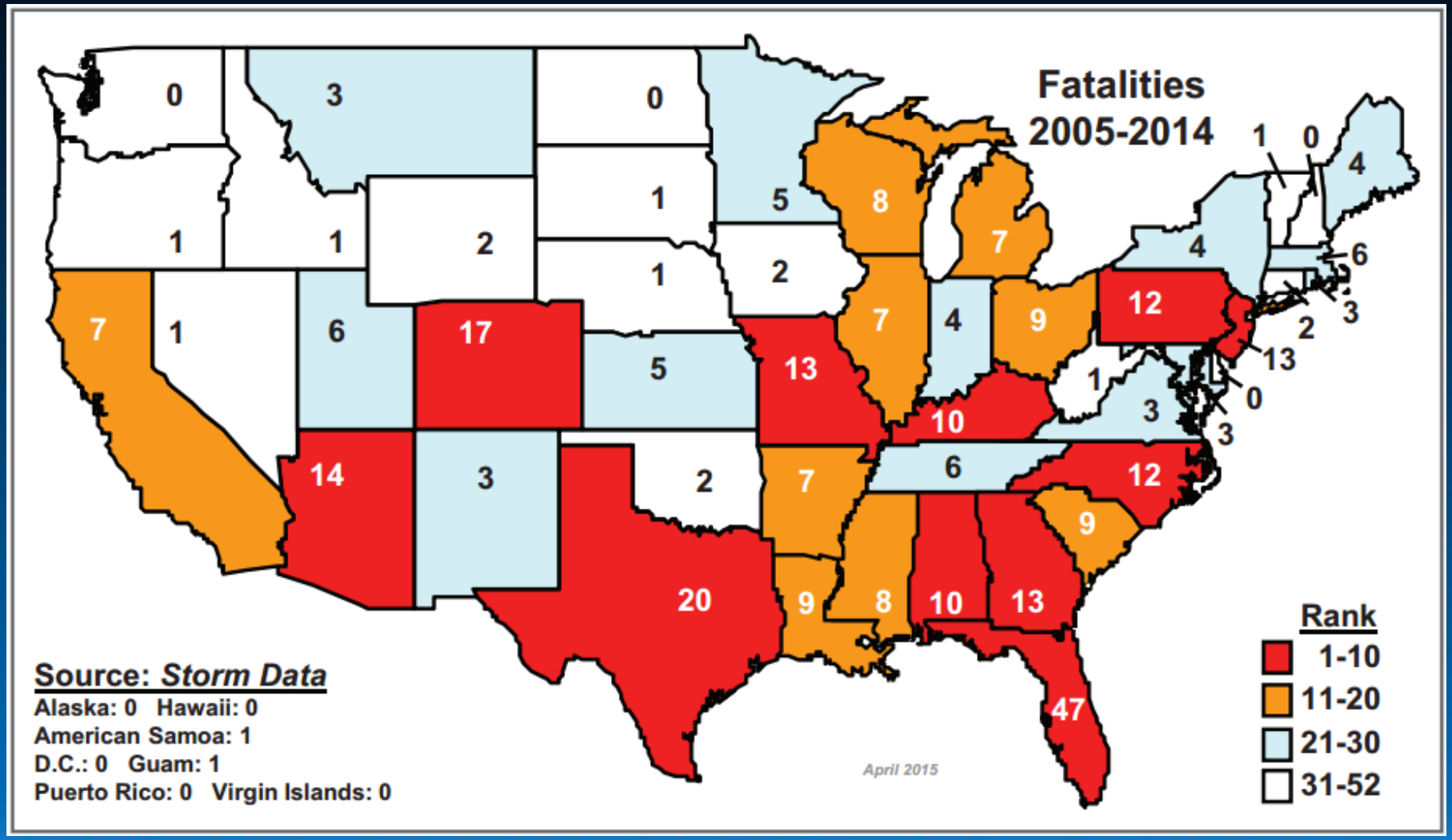
  50,000 degrees F
- **Intensity**

  200,000,000+ volts

  20,000 amperes
- **Size**

  One inch in diameter

Fatalities by State 2005-2014



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Hail

- Strong updraft to keep large chunks of ice aloft
- Circulates within a thunderstorm to collect a layer of water or smaller hail then freezes it on
- Can fall to the ground at >100 mph

Microburst & Straight Line Wind

- Downdraft or precipitation can drag strong mid level winds down to the surface
- Evaporation can cool a parcel of air causing to become heavier (more dense)
- Accelerates at the speed of gravity. The farther of distance, the faster the speed
- Wet microburst and dry microburst

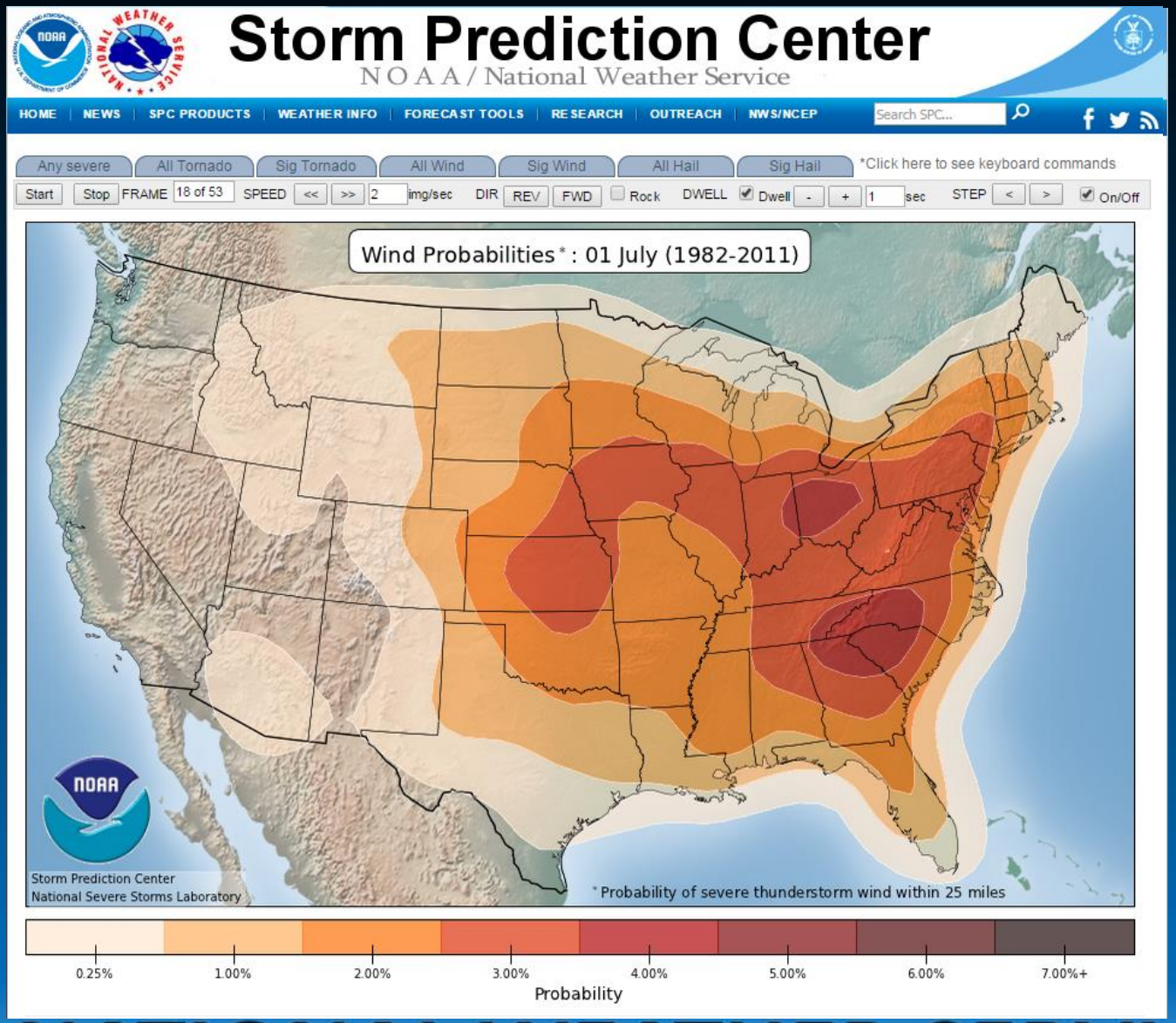
Non-Supercell Tornado

- A boundary causing an spinning eddy or a rolling horizontal column
- Strong enough convection to pull and stretch the eddy or column into the vertical
- Stretching causing the air to spin faster
- Typically only rate EF0-EF2

Supercell Tornado

- Supercell is already spinning need some low level spinning to be stretched upward
- Interaction of the rear flank downdraft (RFD) and updraft creates this spin
- If RFD can not be to cold or the air will be to dense to be pulled upward
- Can rate from EF0 to EF5
- EF5s records:
  - 2.6 miles wide (May 2013)
  - 301 mph (May 1999)
  - 235 miles (March 1925)

Probability of Severe Weather



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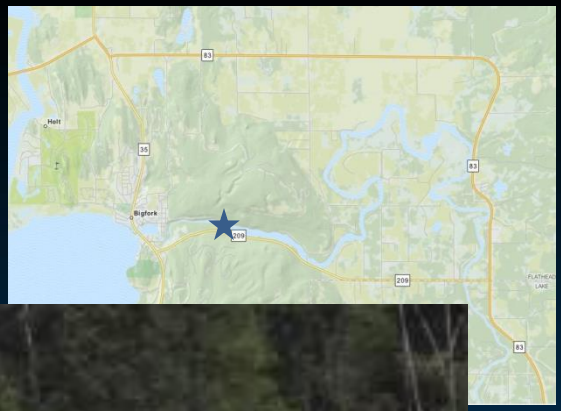
River Flooding

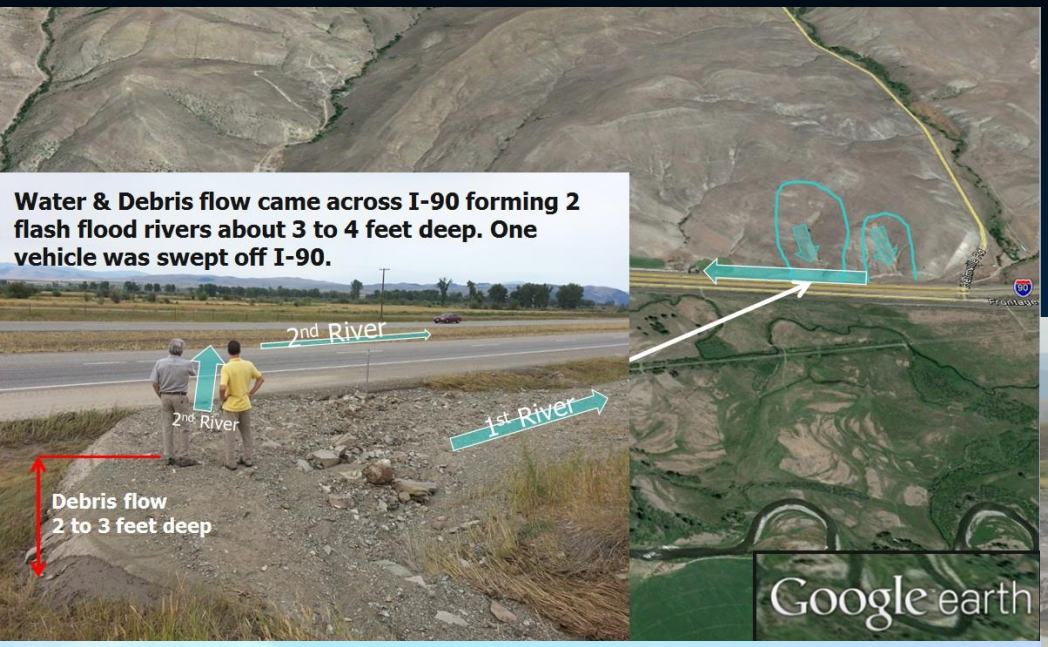
- **November through June**
- **The peak hits in May and June with the melting of the snowpack**

River Flooding



Click on picture to play video

Flash Flooding



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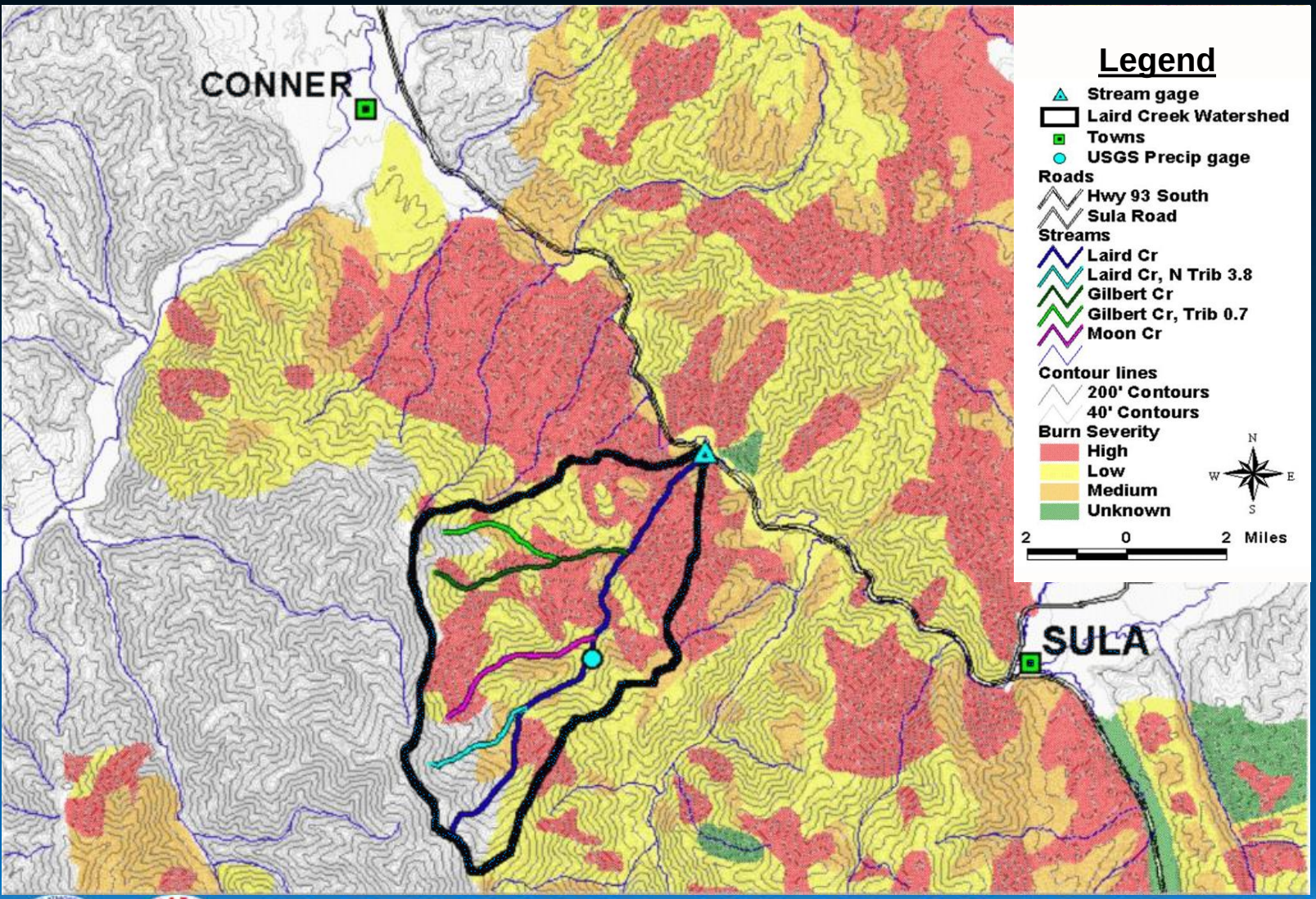
Burn Area Flash Flooding



Burn AreaFlash Flooding

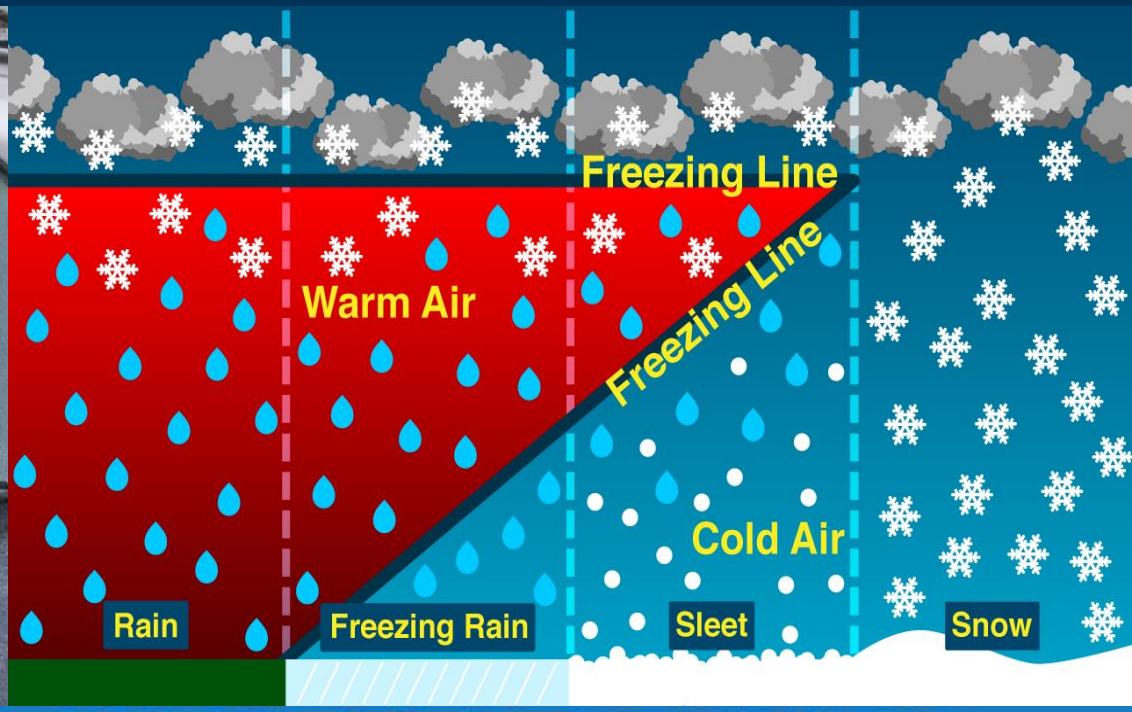
Land Slides

Snow

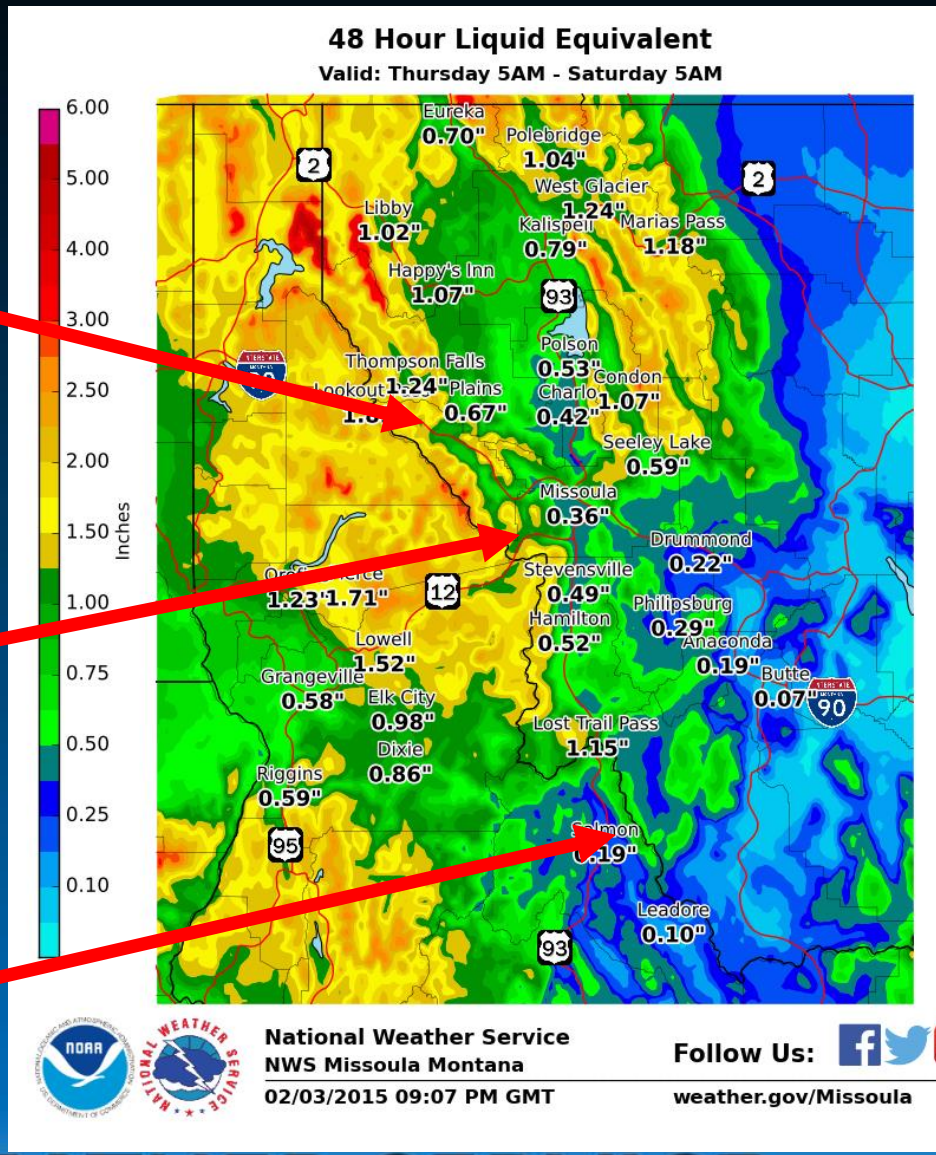
- Temperature plays a big role on snow type
- Not surface temperature but temperatures aloft
- Snow types determine snow to liquid ratio
- Dendrite in the -10 to -18^{o} C range generally produces the largest amounts of snow.

Freezing Rain

- A layer of warm (above freezing) air moves into an area.
- Depth of cold air under the warm layer determines precipitation at the surface
- Water can stay liquid until -40° F, water below freezing is called super cooled



Where are the Impacts?



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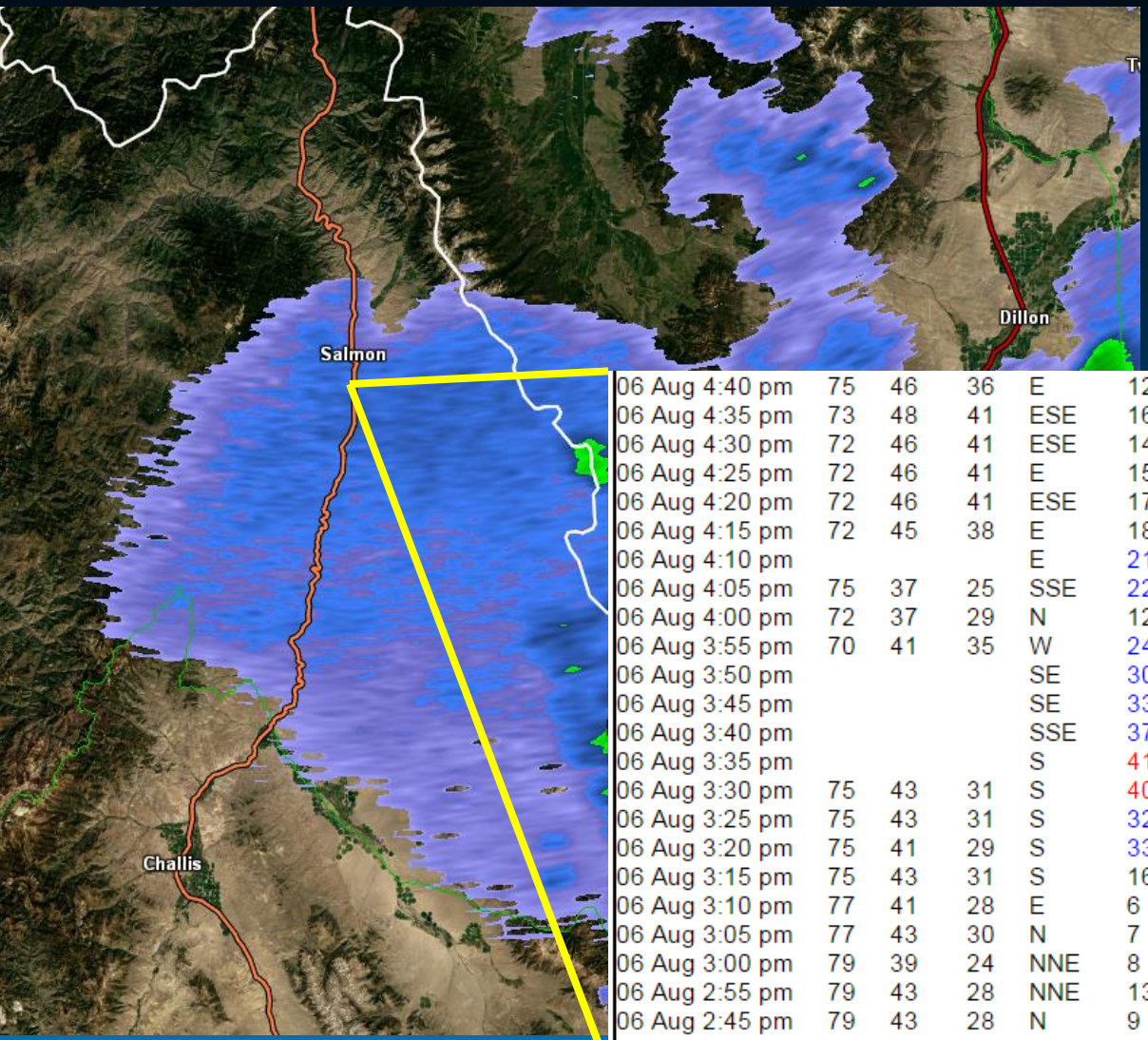
The Need For Spotters



06 Aug 4:40 pm	75	46	36	E	12G22	10.00	CLR	29.90	25.788
06 Aug 4:35 pm	73	48	41	ESE	16G22	10.00	CLR	29.90	25.788
06 Aug 4:30 pm	72	46	41	ESE	14	10.00	CLR	29.90	25.788
06 Aug 4:25 pm	72	46	41	E	15	10.00	CLR	29.90	25.788
06 Aug 4:20 pm	72	46	41	ESE	17	10.00	FEW075 FEW090	29.90	25.788
06 Aug 4:15 pm	72	45	38	E	18G30	10.00	FEW075 SCT090	29.89	25.779
06 Aug 4:10 pm				E	21G30	10.00	FEW075 SCT090 SCT110	29.88	25.770
06 Aug 4:05 pm	75	37	25	SSE	22G31	10.00	FEW026 FEW070 BKN090	29.88	25.770
06 Aug 4:00 pm	72	37	29	N	12G49	9.00	FEW026 SCT050 BKN090	29.84	25.734
06 Aug 3:55 pm	70	41	35	W	24G49	10.00	FEW050 FEW080 OVC100	29.89	25.779
06 Aug 3:50 pm				SE	30G46	10.00	FEW050 BKN100 OVC120	29.91	25.797
06 Aug 3:45 pm				SE	33G46	8.00	FEW050 OVC110	29.91	25.797
06 Aug 3:40 pm				SSE	37G64	5.00	FEW050 OVC110	29.92	25.805
06 Aug 3:35 pm				S	41G64	7.00	FEW050 OVC110	29.94	25.823
06 Aug 3:30 pm	75	43	31	S	40G53	10.00	SCT085 OVC120	29.94	25.823
06 Aug 3:25 pm	75	43	31	S	32G43	9.00	SCT085 BKN120	29.93	25.814
06 Aug 3:20 pm	75	41	29	S	33G43	9.00	FEW085 BKN120	29.93	25.814
06 Aug 3:15 pm	75	43	31	S	16G24	10.00	FEW085 BKN120	29.94	25.823
06 Aug 3:10 pm	77	41	28	E	6	10.00	FEW085 SCT120	29.92	25.805
06 Aug 3:05 pm	77	43	30	N	7	10.00	SCT120	29.90	25.788
06 Aug 3:00 pm	79	39	24	NNE	8	10.00	FEW120	29.88	25.770
06 Aug 2:55 pm	79	43	28	NNE	13	10.00	FEW120	29.88	25.770
06 Aug 2:45 pm	79	43	28	N	9	10.00	CLR	29.88	25.770
06 Aug 2:35 pm	79	45	30	NNW	12	10.00	FEW110	29.87	25.761

Lake Effect

- A cold air mass moves over a warm large body of water
- Creates an unstable environment allowing for convection to develop
- Convection generally develops in bands and are fairly narrow
- Snow fall rates can be heavy and conditions can change quickly

Spotter Reporting Criteria

- Tornado, funnel cloud and waterspout
- High wind - estimated or measured >40 mph
- Heavy rain - ½” or more per hour
- Flooding - of any kind
- Hail – ¼” or larger
- Visibility reduced to less than ¼ mile
- Heavy snow - one inch or more per hour
- Weather related damage or injuries
- Moderate to High impacts

Missoula Spotter Number
1-800-676-6975

When leaving a message:
Please leave your name, approximate location, date/time of your observation and what you are reporting.

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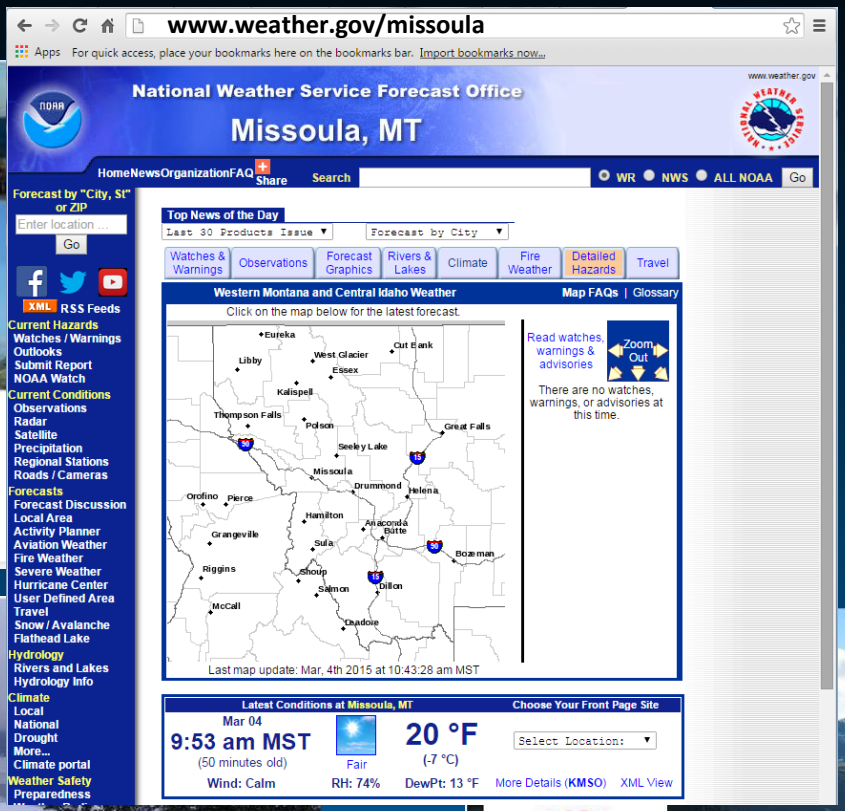
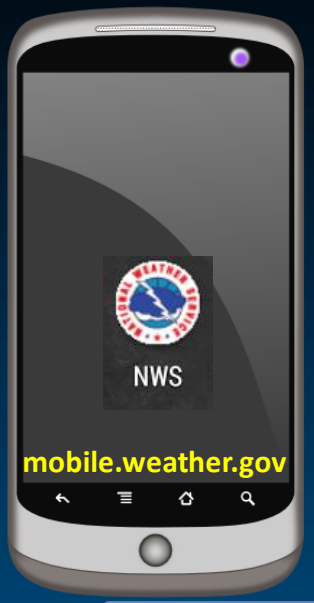
Where to find information





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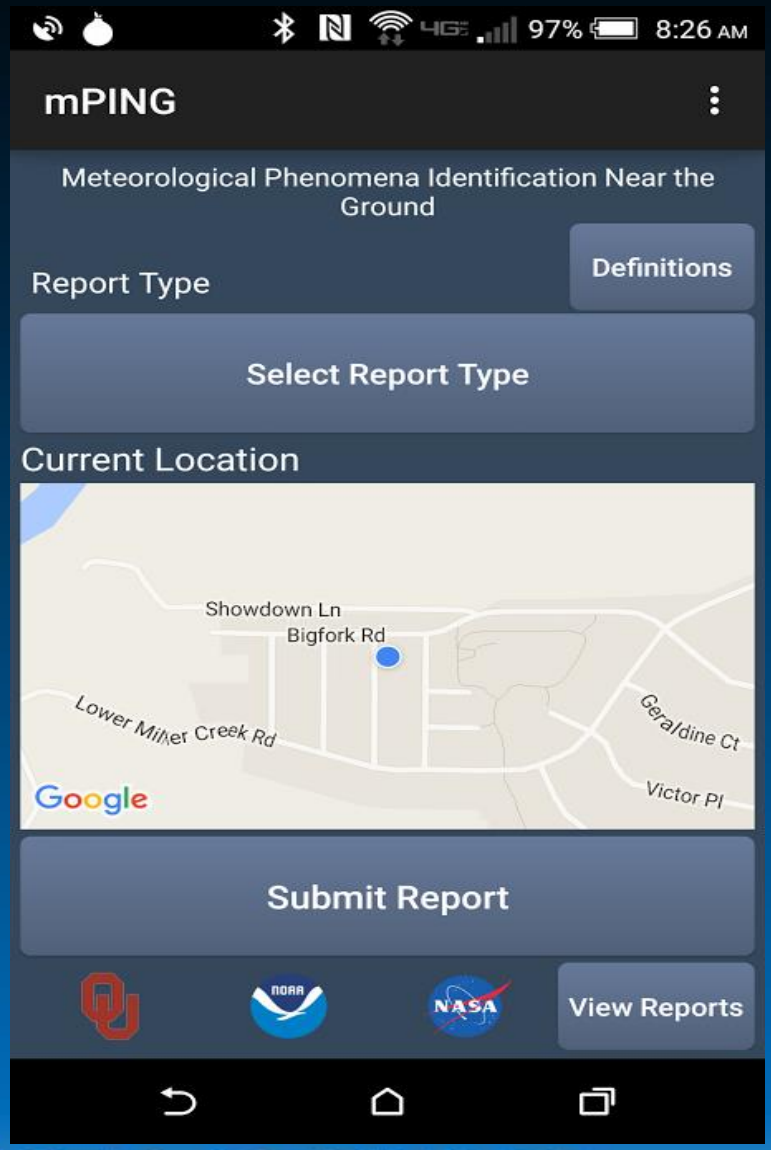
Other Means for Reporting



Help observe precipitation in your community !!

CoCoRaHS

Community Collaborative Rain, Hail & Snow Network

www.cocorahs.org

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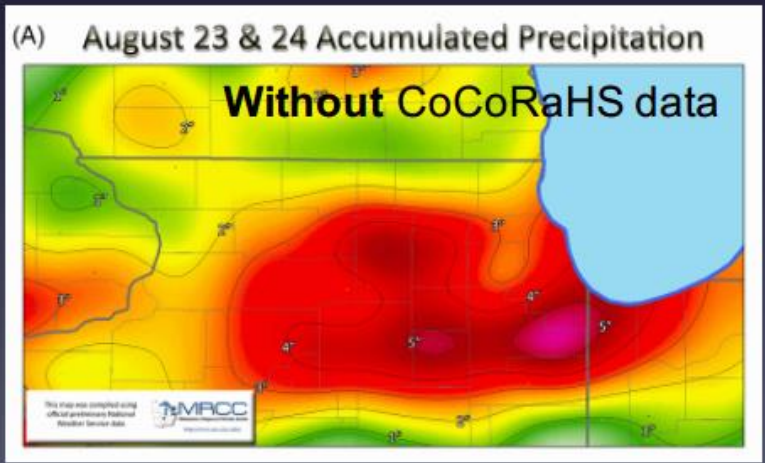
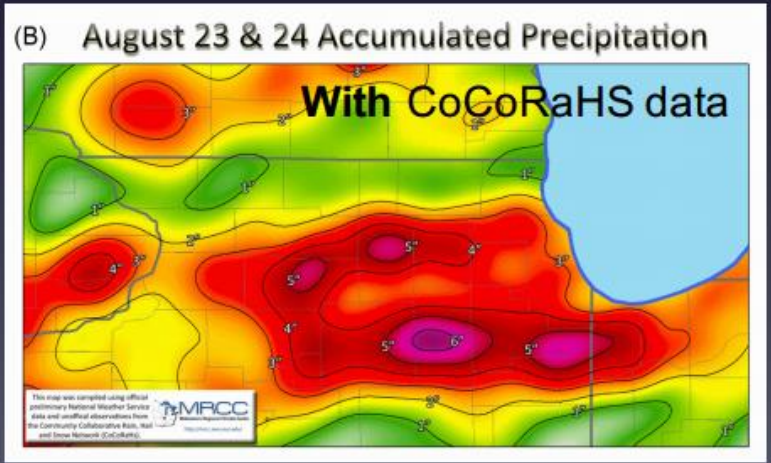
All you need is a simple 4" diameter plastic rain gauge and ten minutes a day!

Volunteers take their readings once a day

Observers can easily transmit their observations using mobile devices

CoCoRaHS observers help provide a much better post-storm analysis picture!





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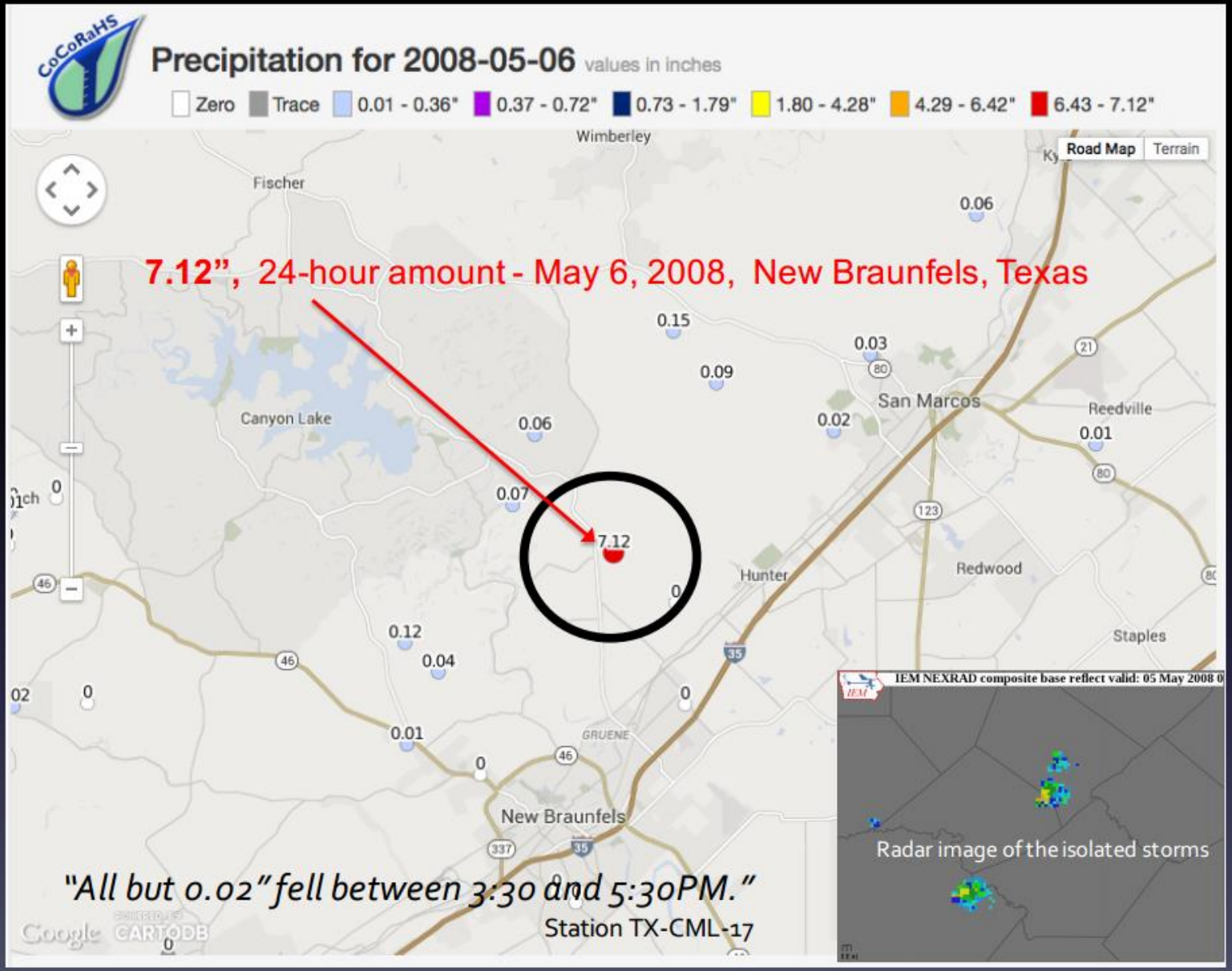

Your observation can make a difference!

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How can I join the network?

Five easy steps

Simply sign-up on the CoCoRaHS web page: www.cocorahs.org

Obtain a 4" plastic rain gauge

View the on-line "training slide show" or attend a training session

Set-up the gauge in a "good" location in your yard

Start observing precipitation and report on-line daily

The End
Questions?