

# Extreme Weather

Chapter 7: Weather

# Incoming Fronts

- Speed of incoming fronts dependent on pressure gradient

> ALERT DIFFERENCES		12 NEWS STORMTRAC WEATHER
<b>WARNING</b>	Severe weather has been observed or detected by doppler radar. Take action immediately!	
<b>WATCH</b>	Conditions favorable for development of severe storms/tornadoes. Be prepared to take action.	
<b>OUTLOOK</b>	Heads up that severe weather is possible on a given day. Check back for updates.	

# Shelf Clouds and Wall Clouds

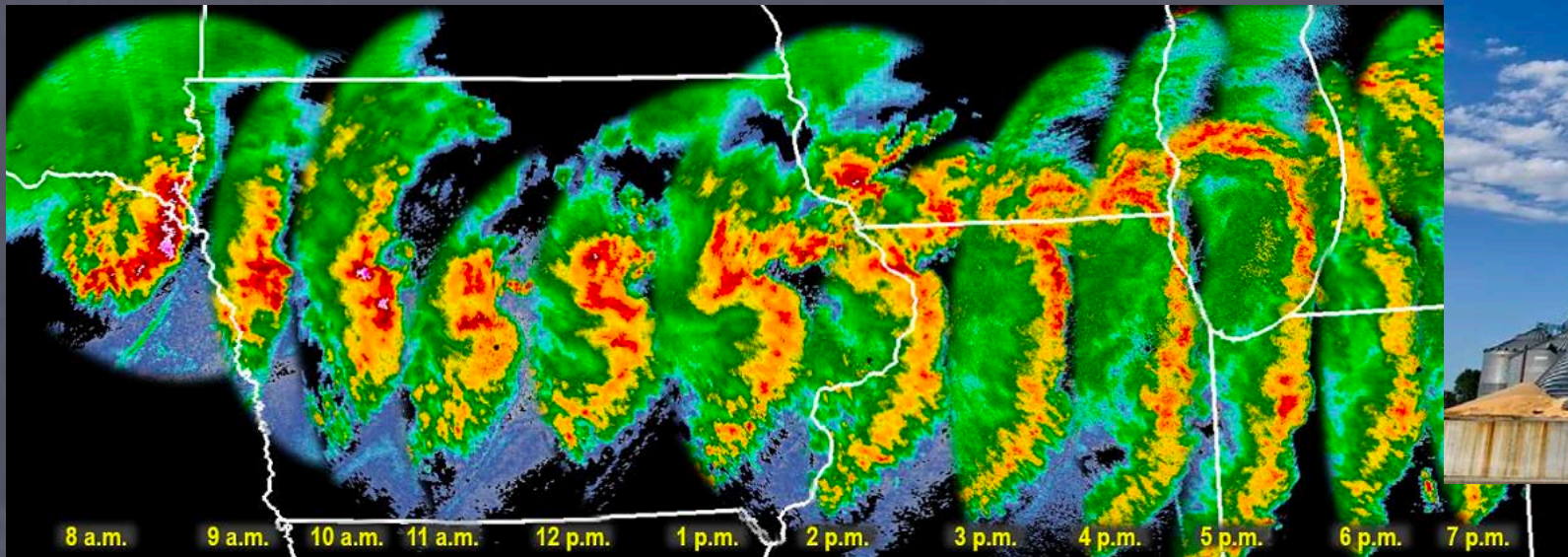
- Shelf Clouds are the leading edge of incoming fronts
- Wall clouds are the lowered bases of supercell storms (cumulonimbus)





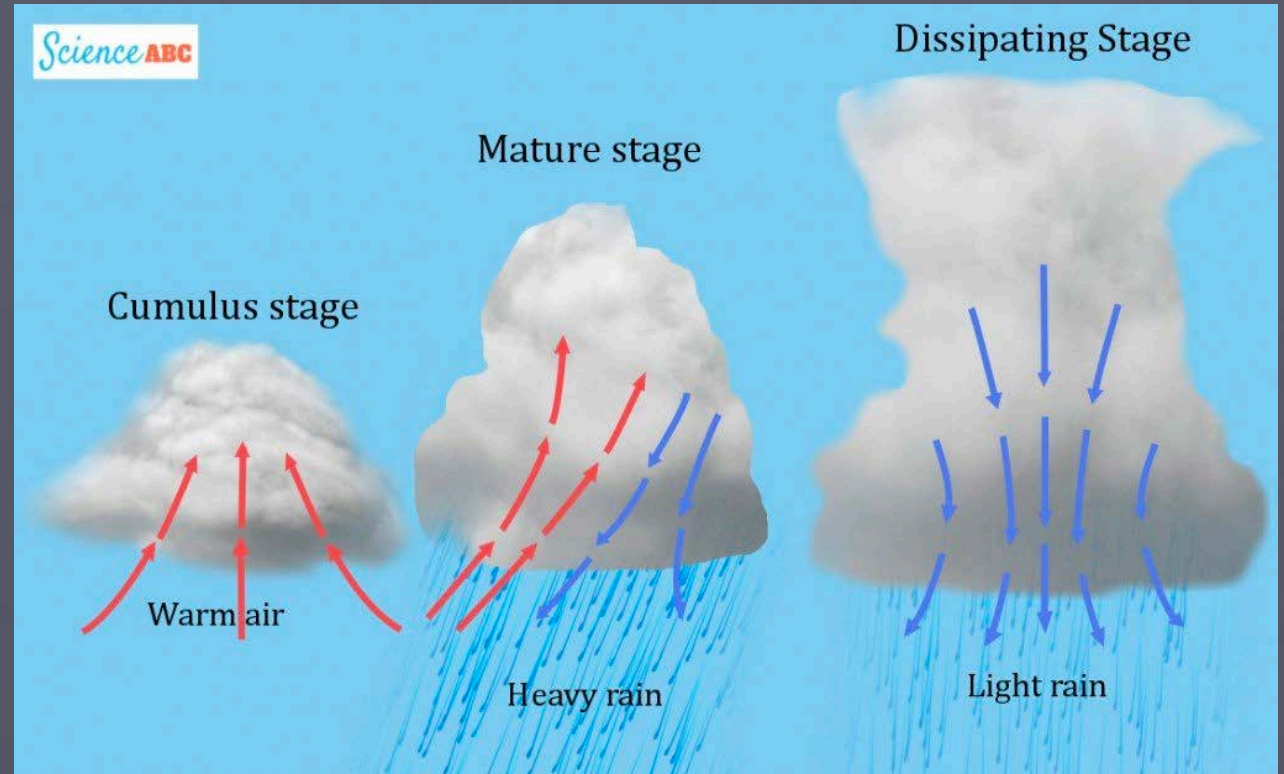
# Derecho

- Widespread windstorm
  - Sustained winds over 50 miles an hour
    - Essentially a land hurricane
  - Rapidly moving so it is intense, but only stays in one area a short while



# Thunderstorm

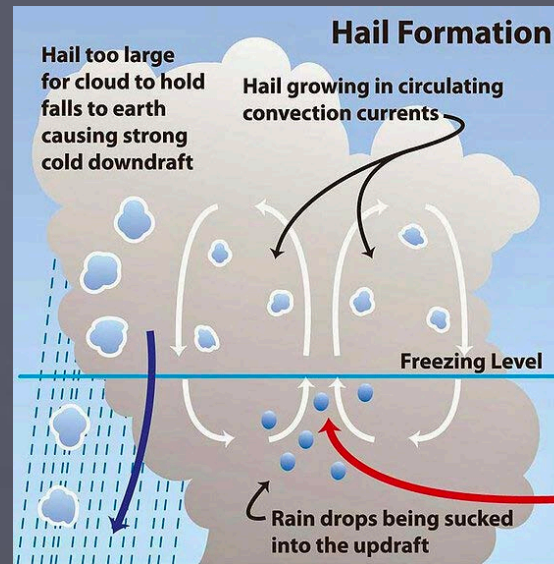
- Require Moisture, unstable air, and lift
- Rapidly lifting air (updrafts) reaches high into atmosphere (10 miles or so)
  - Causes massive air movements within the storm sending cold air filled with moisture down (Downdrafts)





# Hail

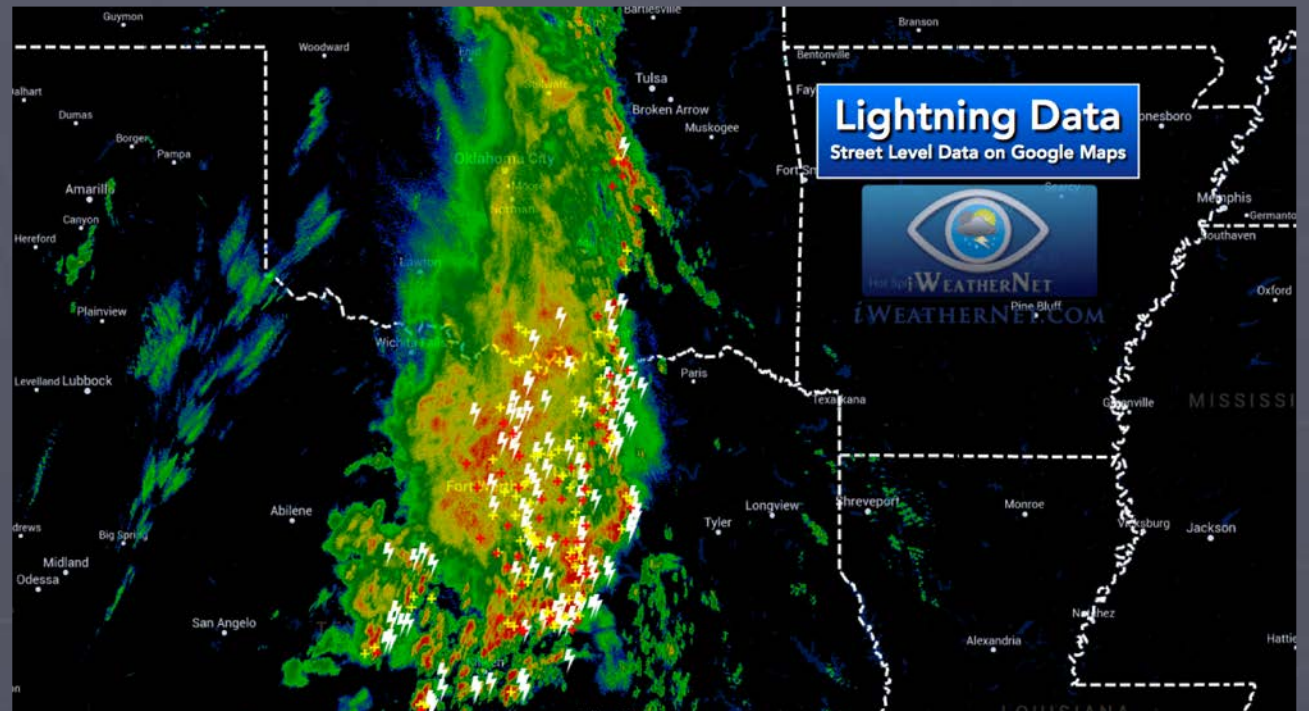
- Causes when rain droplets get re-caught in the updraft of a thunderstorm
  - Quickly refreeze and collect more moisture
  - Fall to earth and are not able to melt before reaching surface



Hail Size Chart			
While the National Weather Service encourages the actual measurement of hail size, oftentimes, an object-to-size conversion can provide important information about hail from a severe weather event. Below, you will find a list of common objects used to describe the diameter of observed hail.			
0.25 inches	Pea	2.00 inches	Hen Egg
0.75 inches	Penny	2.50 inches	Tennis Ball
1.00 inches	Quarter	2.75 inches	Baseball
1.50 inches	Ping Pong Ball	3.80 inches	Softball
1.75 inches	Golf Ball	4.50 inches	Grapefruit

# Lightning

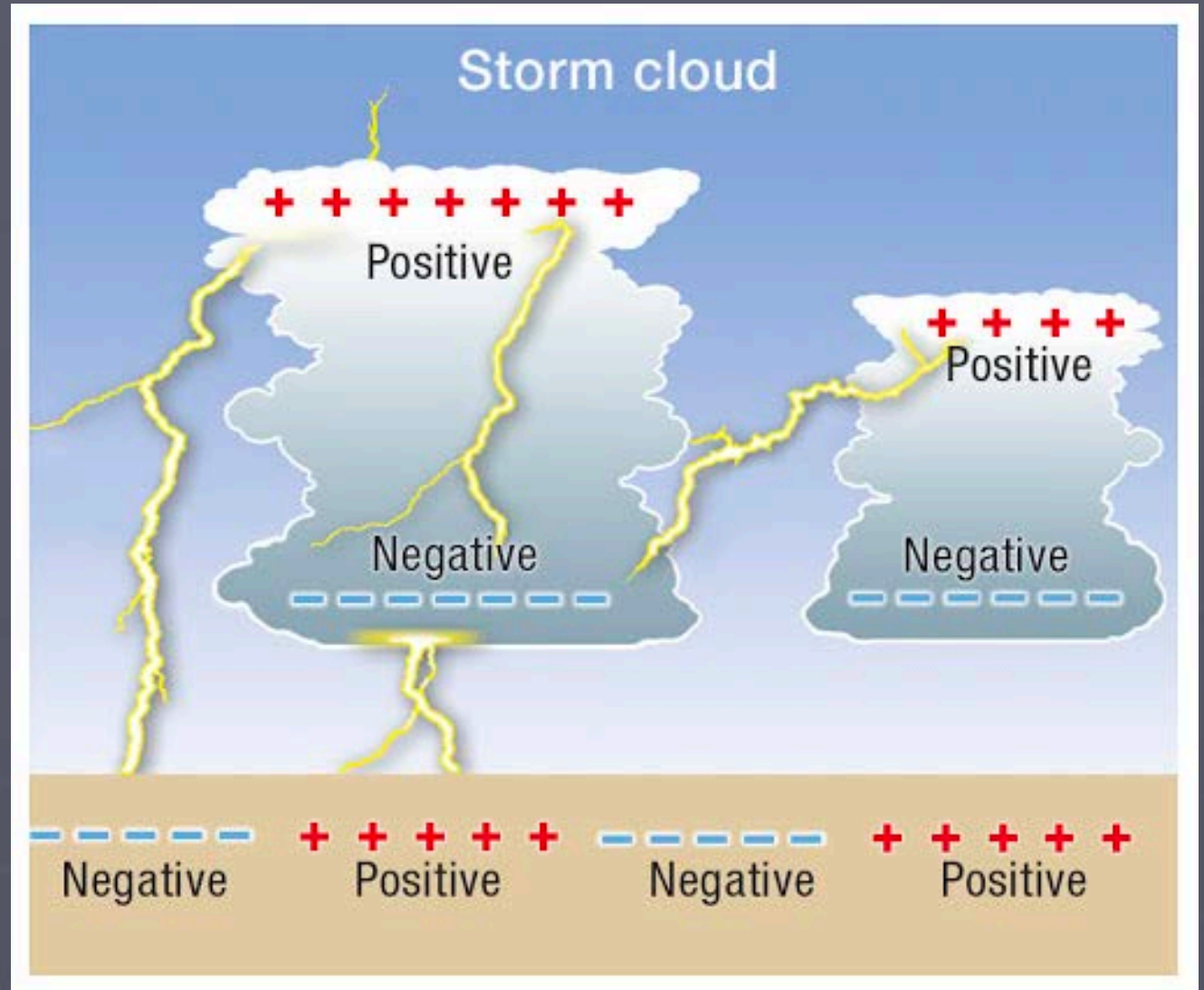
- Interaction between positively and negatively charged particles
  - In a thunderstorm lift warm air includes positively charged particles that interact with negatively charged particles in downdraft





# Types of Lightning

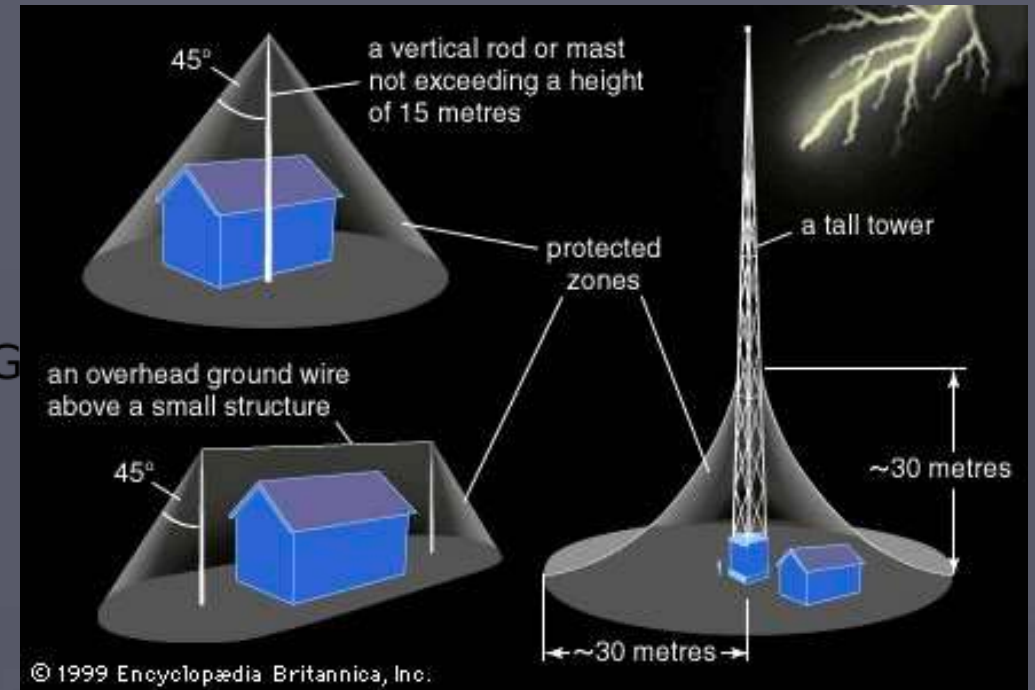
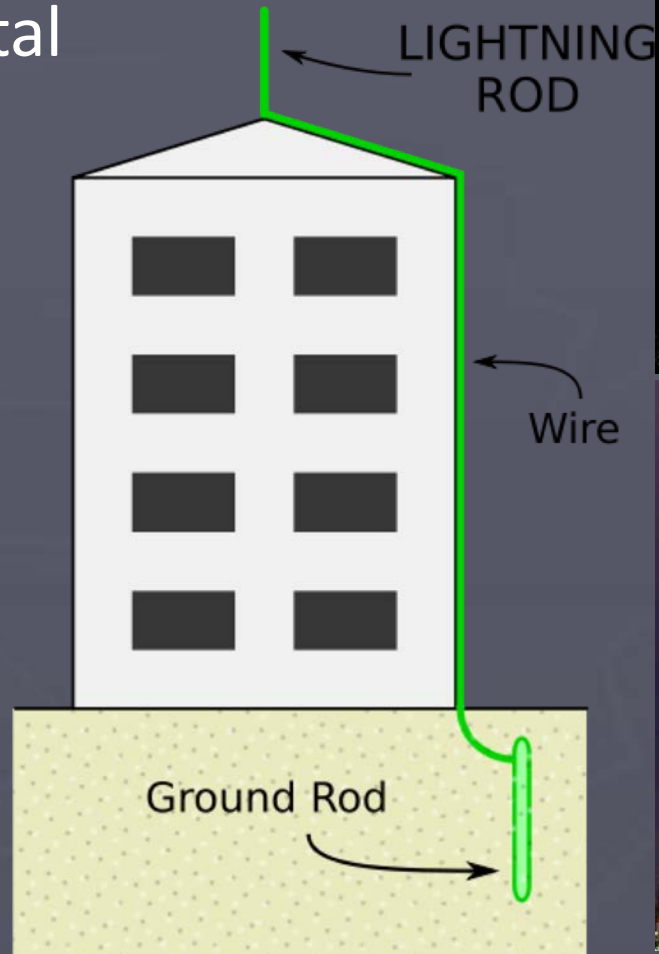
- Cloud to Cloud
- Cloud to sky
- Cloud to ground





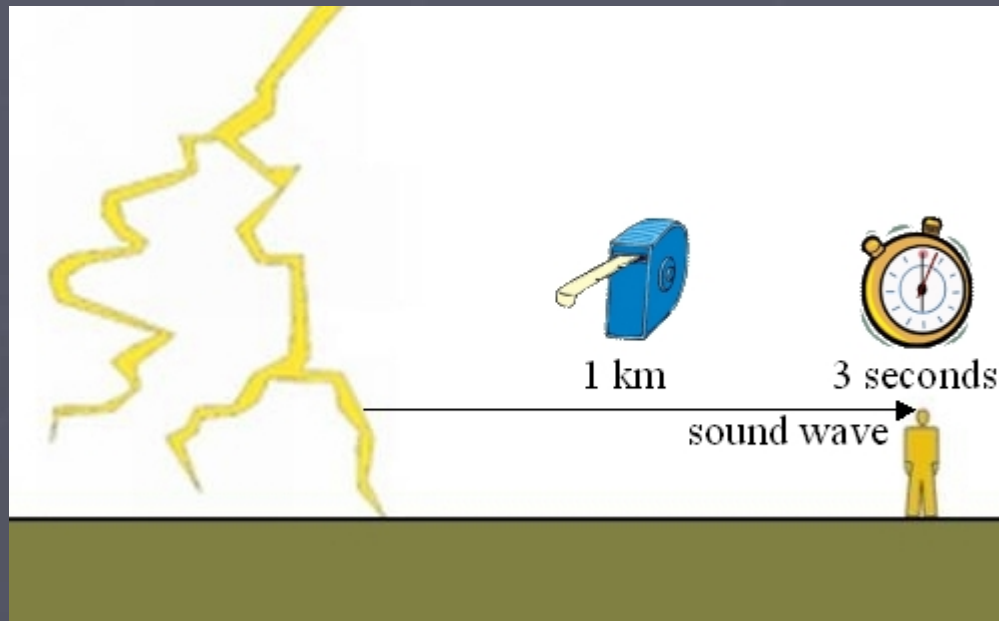
# Lightning

- Attracted to metal
- Taller objects more in danger
  - Lightning rods used to direct away from structure



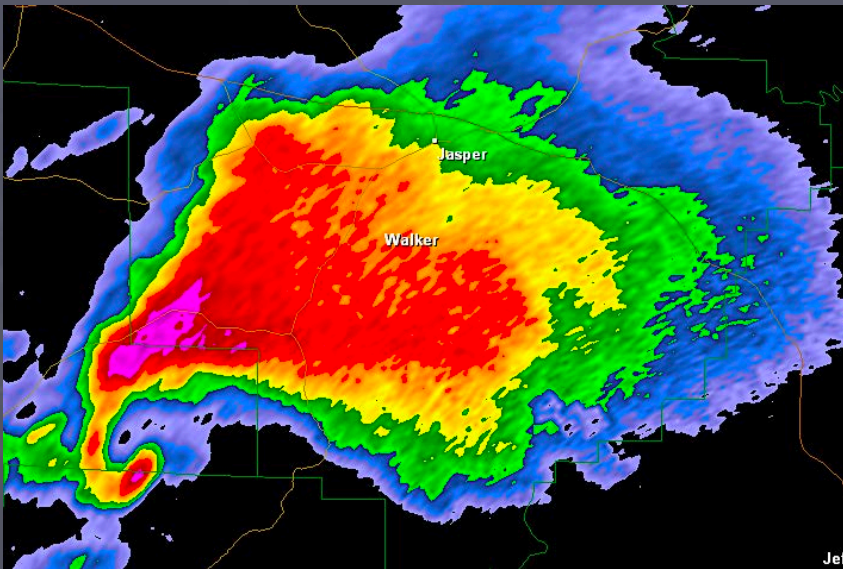
# Thunder

- Lightning rapidly heats surrounding air, causing it expand. Resulting shock wave propagates as a sound wave through atmosphere.
- Sounds travels at about 1 km/3 seconds or 1 miles/5 seconds.



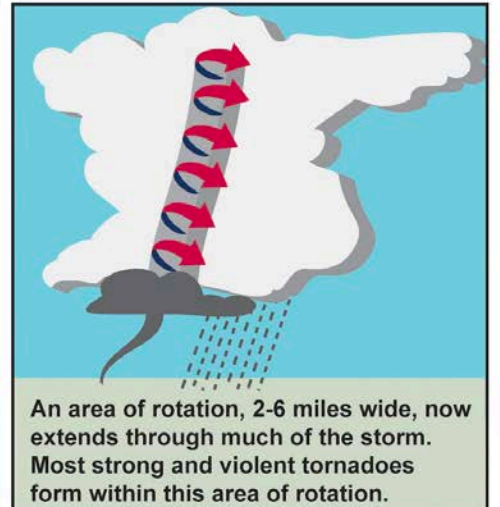
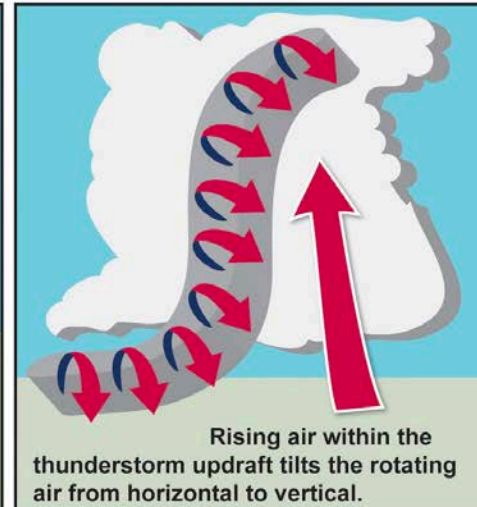
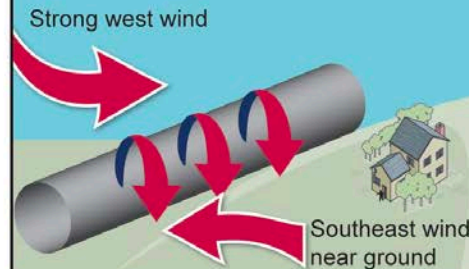
# Tornados

- Tornados formed by wind sheer (two different speeds of wind)
  - Tornados are essentially a cloud of debris and dust with intense winds that reach the ground
- Warming of ground in front of moving storm can create lift causing rotation to move vertical



## How Tornados Form

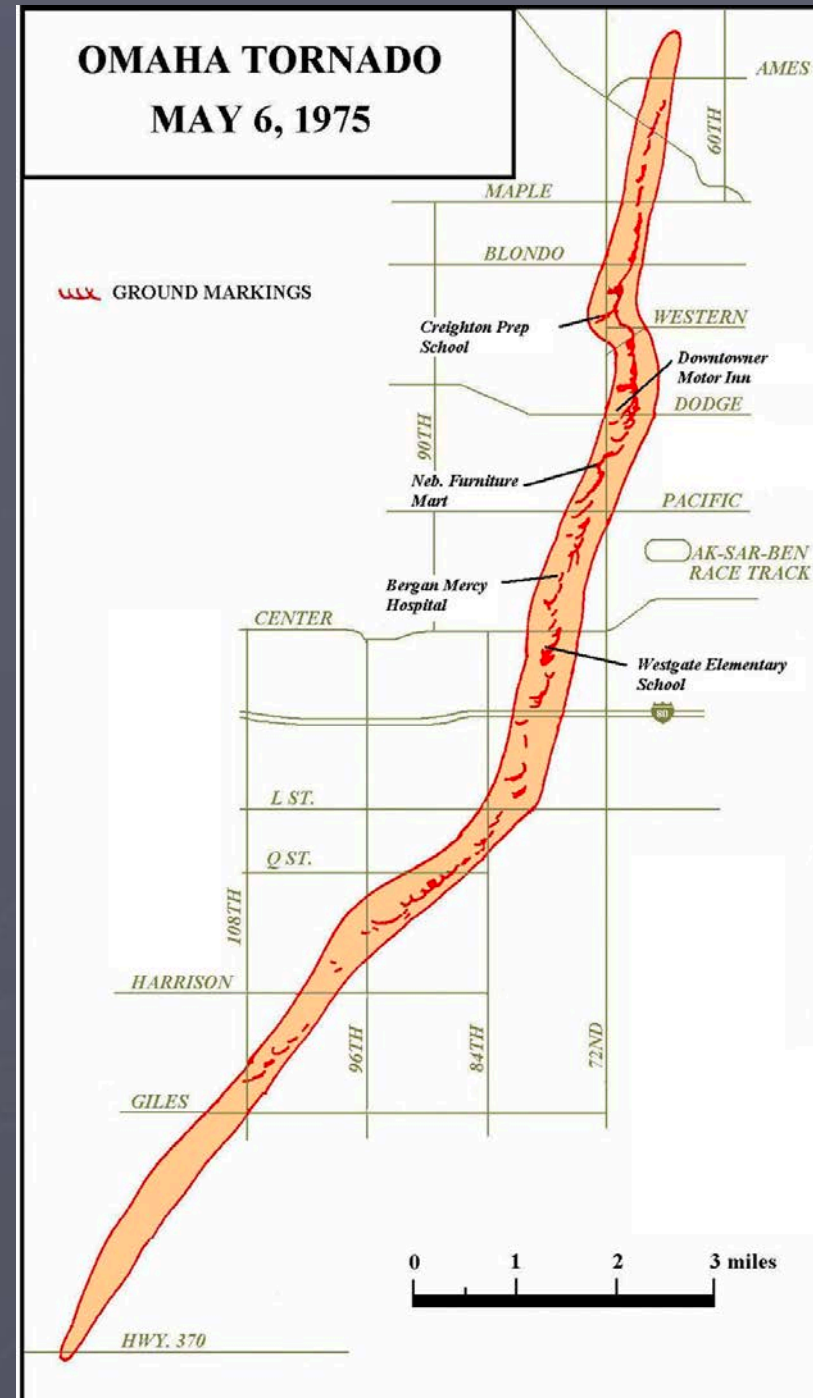
Before thunderstorms develop, a change in wind direction and an increase in wind speed with increasing height creates an invisible, horizontal spinning effect in the lower atmosphere.



Source: National Oceanic and Atmospheric Administration (NOAA). Graphic by Funnel, Inc. and NRECA



# Aksarben Tornado (1975)



# Enhanced Fujita Scale

## Enhanced Fujita Scale for Tornadoes

The Enhanced Fujita Scale (EF), introduced in 2007, provides estimates of tornado strength based on damage surveys. The original scale was developed by Dr. Theodore Fujita and implemented in 1971.

Wind Speed	EF Scale	Typical Damage
65-85 mph	0	Peels surface off some roofs, some damage to gutters or siding
86-110 mph	1	Roof severely stripped, mobile homes overturned or badly damaged, loss of exterior doors, windows and other glass broken
111-135 mph	2	Roofs torn off well-constructed homes; foundations of frame homes shifted; mobile homes completely destroyed
136-165 mph	3	Entire stories of well-constructed homes destroyed; severe damage to large buildings such as shopping malls
166-200 mph	4	Well-constructed houses and whole-frame homes completely leveled
200+ mph	5	Strong frame houses leveled off foundations and swept away; high-rise buildings have significant structural deformation

Source: Weather Underground ([www.wunderground.com/resources/severe/fujita\\_scale.asp](http://www.wunderground.com/resources/severe/fujita_scale.asp))



# Joplin Tornado

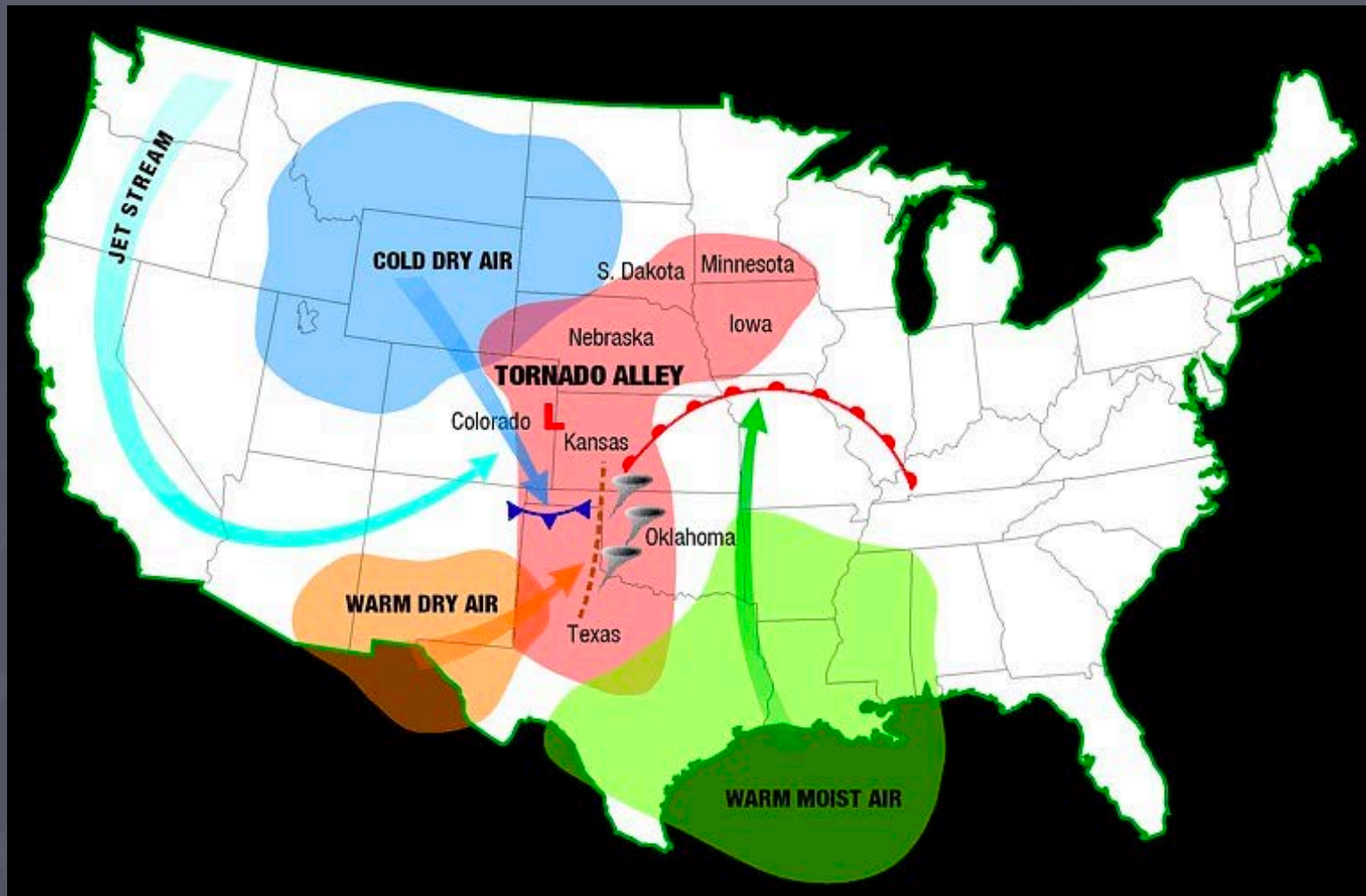




# Joplin Tornado (2011 – EF5)

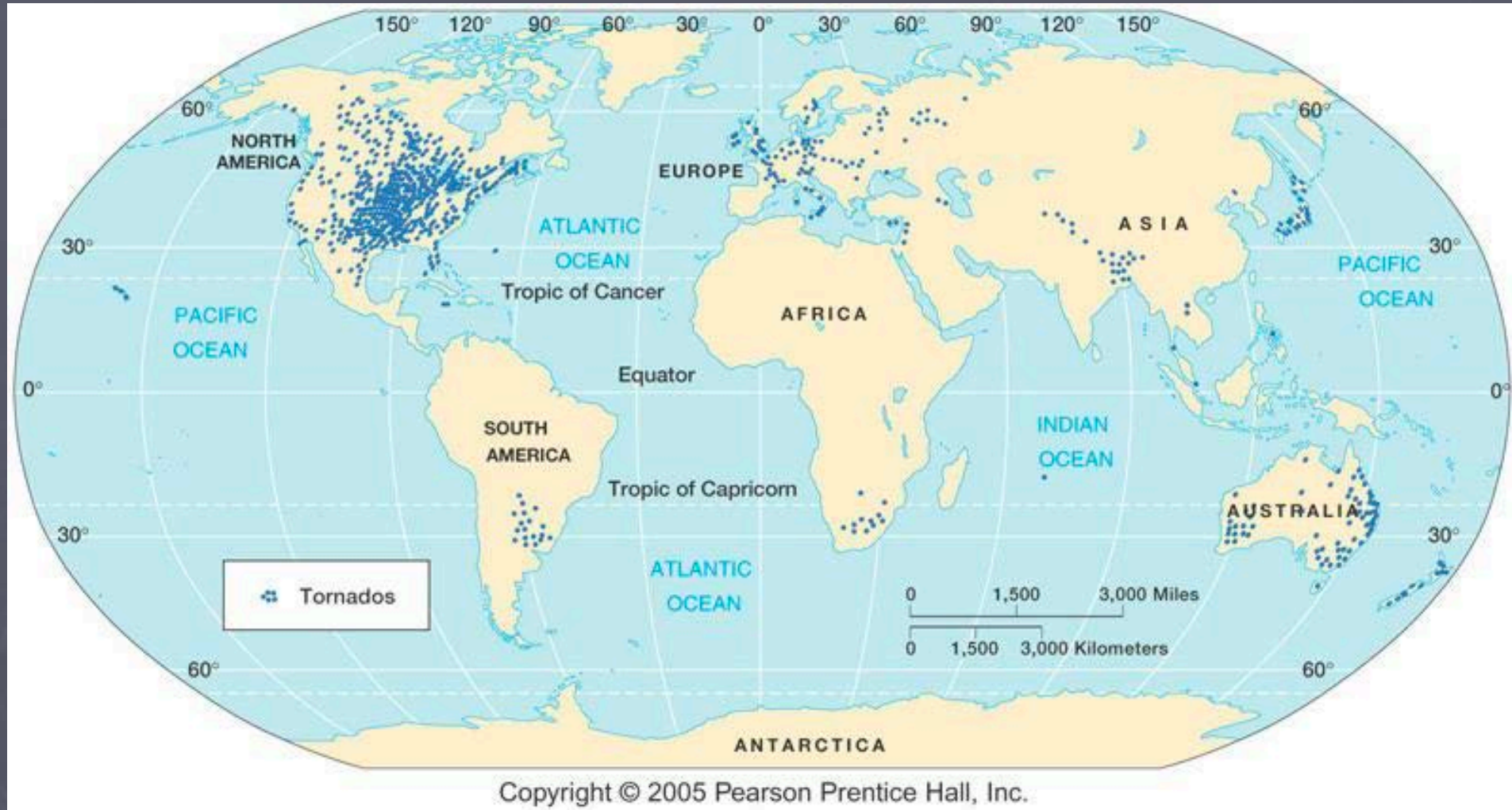


# Tornado Alley





# Global Tornadoes





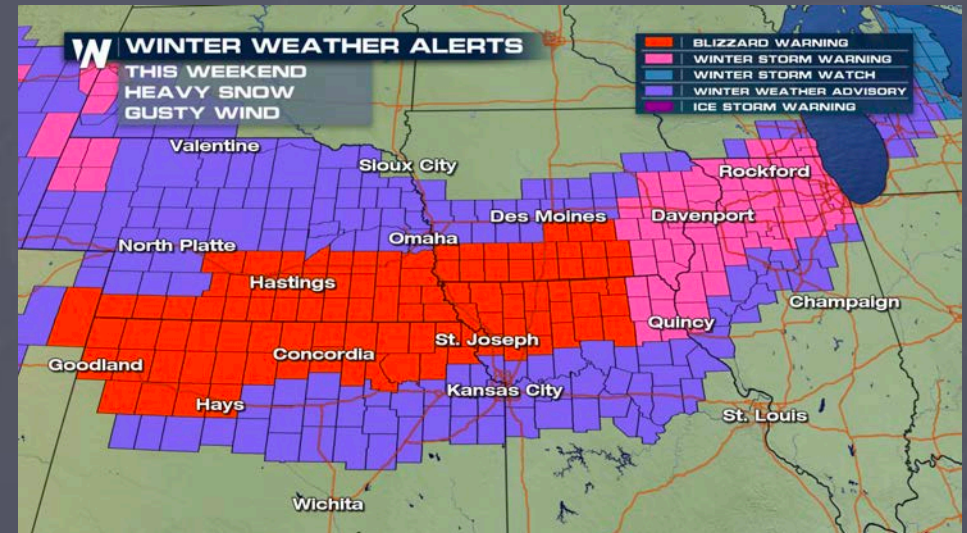
# Tornado Dynamics

- Very difficult to forecast since they form out of supercells (but very small sections of them)
  - Some watches will include areas as big as 25,000 miles
  - Watches for where conditions are favorable
  - Warnings for sightings and radar movement



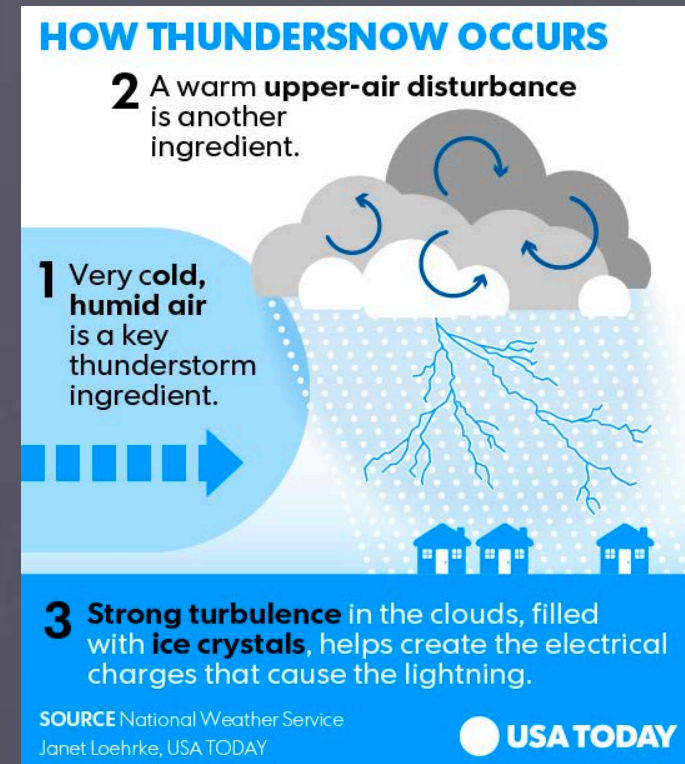
# Blizzards

- Similar processes as a thunderstorm
- Blizzard classified as having sustained winds over 35mph for over 3 hours
  - Falling snow lowers visibility to less than  $\frac{1}{4}$  mile
- Especially common on the Great Plains and in Mountains



# Thundersnow

- Same processes that lead to lightning during rain.
- Usually happens in storms with high intensity (2" of snow per hour or more)

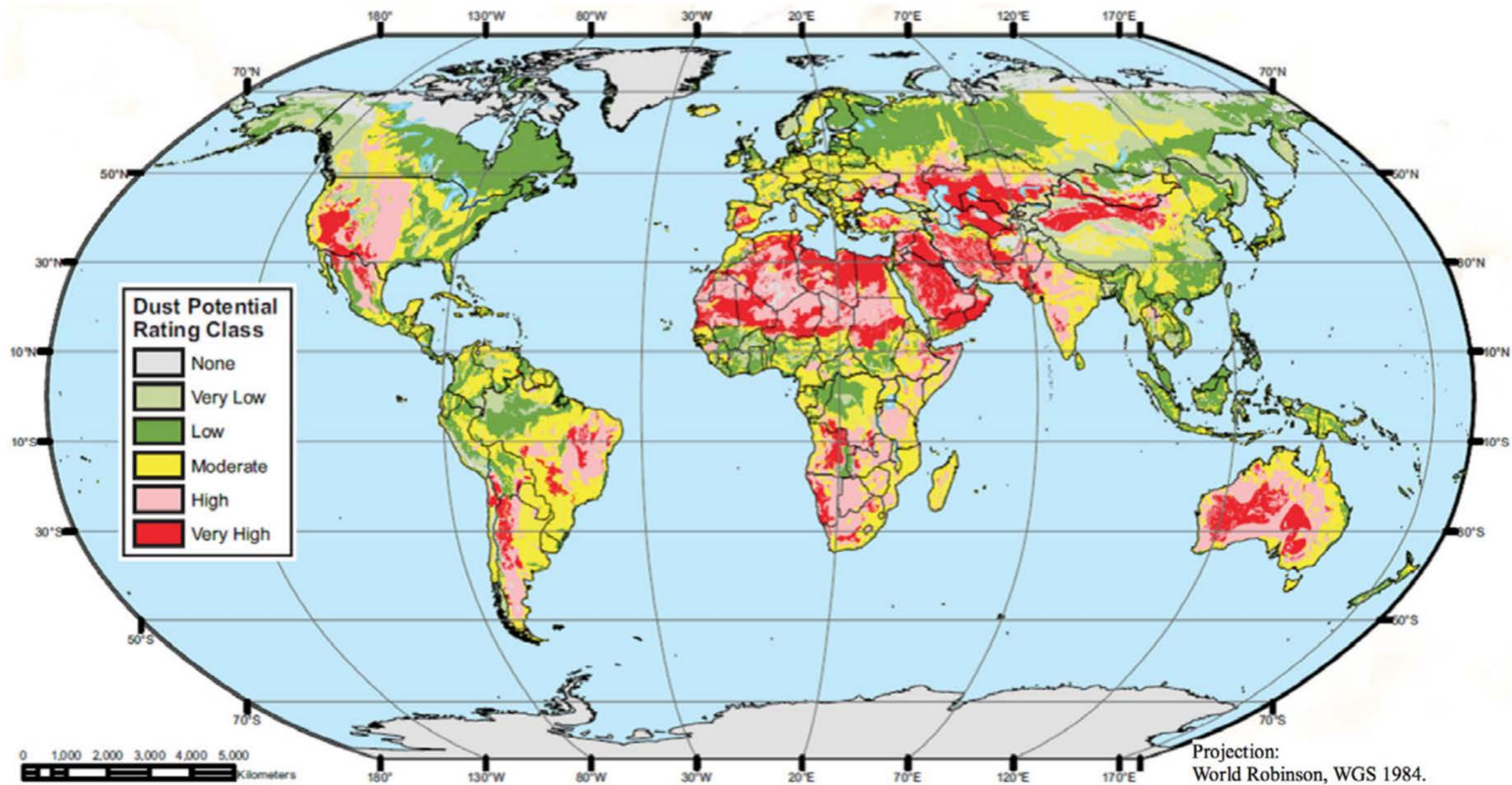




# Dust and Sandstorms

- Caused by high winds passing over large areas with loose soil or sand
  - Contributing factors: minimal precipitation, vegetation, type of soil/sand
  - Issues with public health, agriculture, travel, etc...



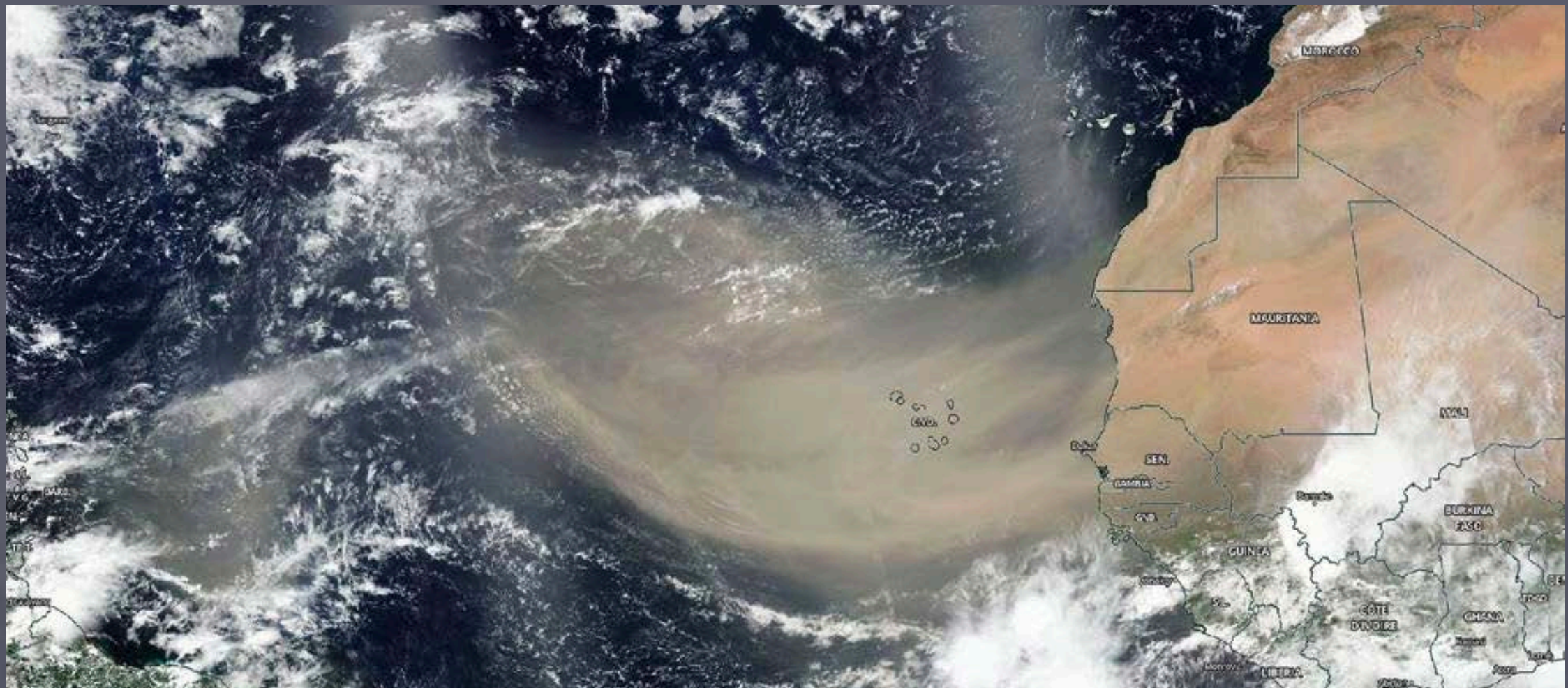






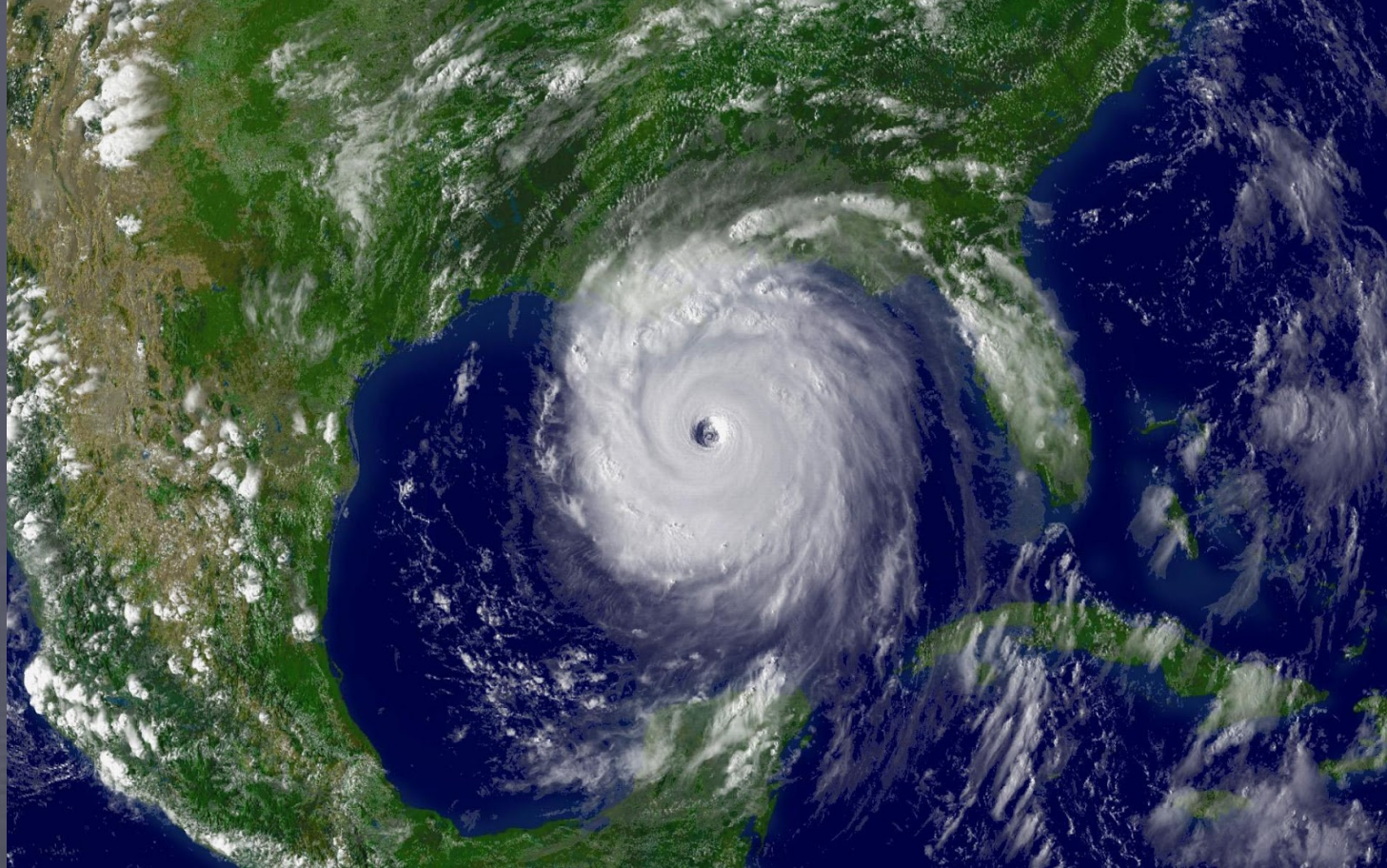


# Sand Storm off the Coast of Africa



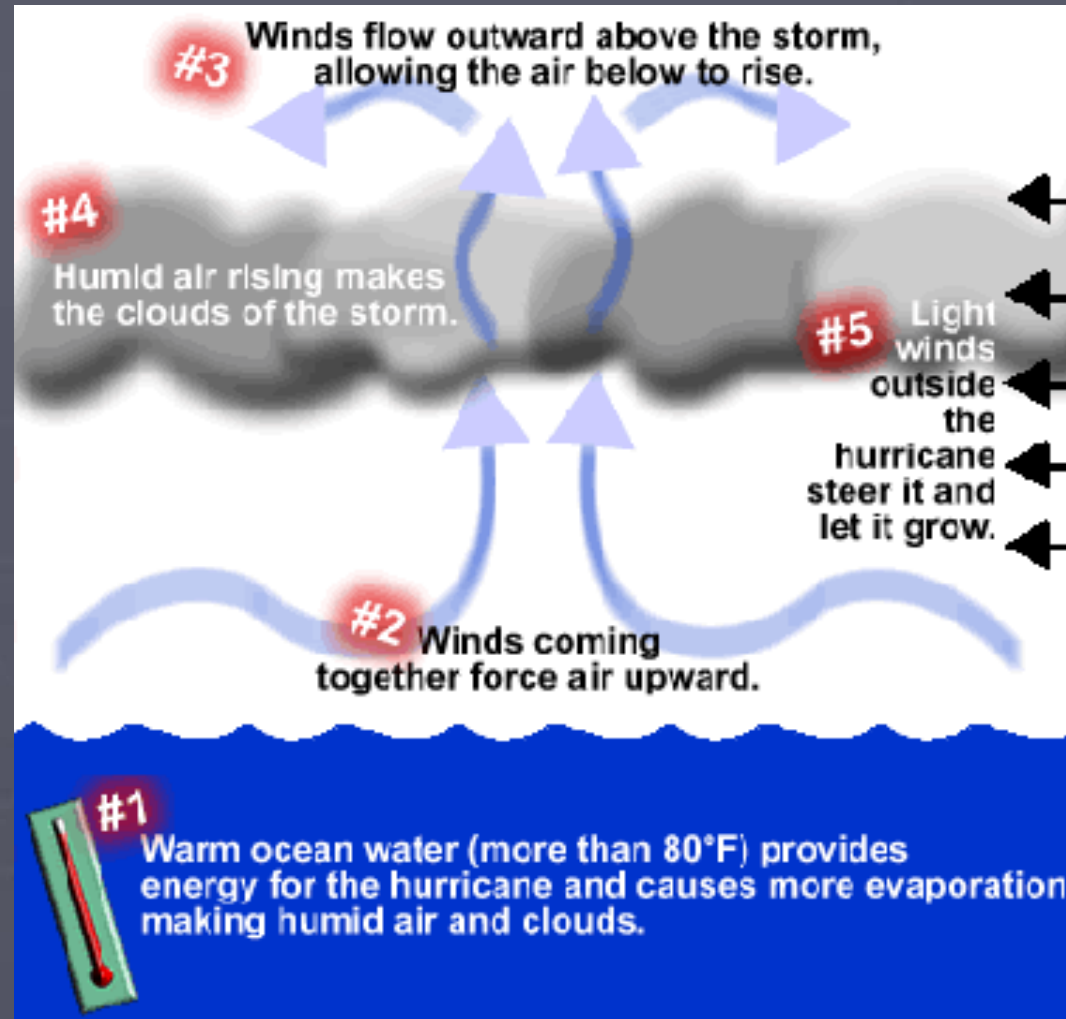


# Hurricanes/Typhoons/Cyclones





# Forming Hurricanes



# Anatomy of a Hurricane

- Winds rotate counter-clockwise around the “eye” of the storm
- Winds reach speeds of 160 mph (250 kmh)
- All start as “Tropical Storms” once winds reach a speed of 75mph (120kmh) it is classified as a hurricane
- Can produce storm surges of water that can be 20 ft high (6m)



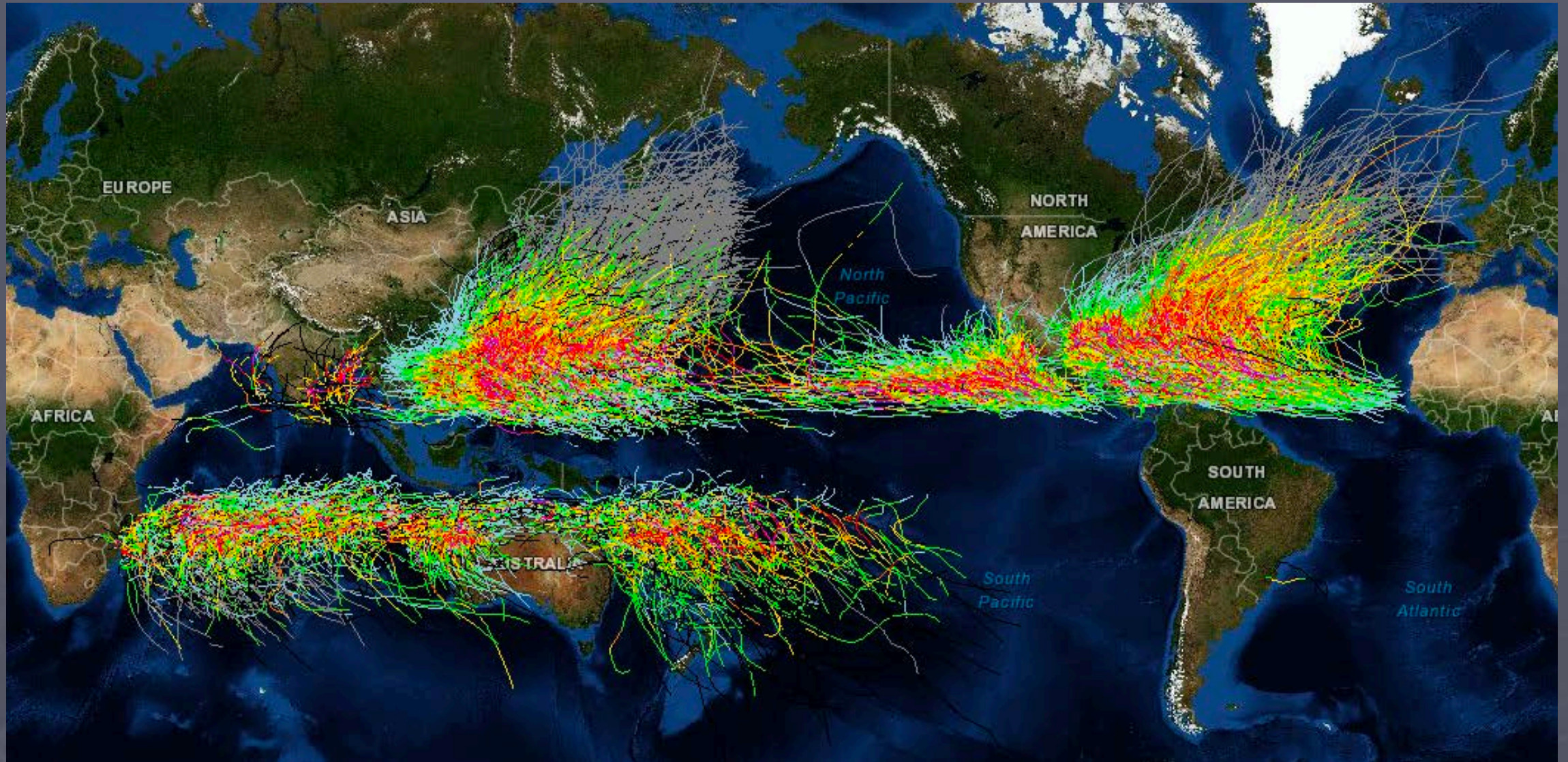


# Braving a Hurricane



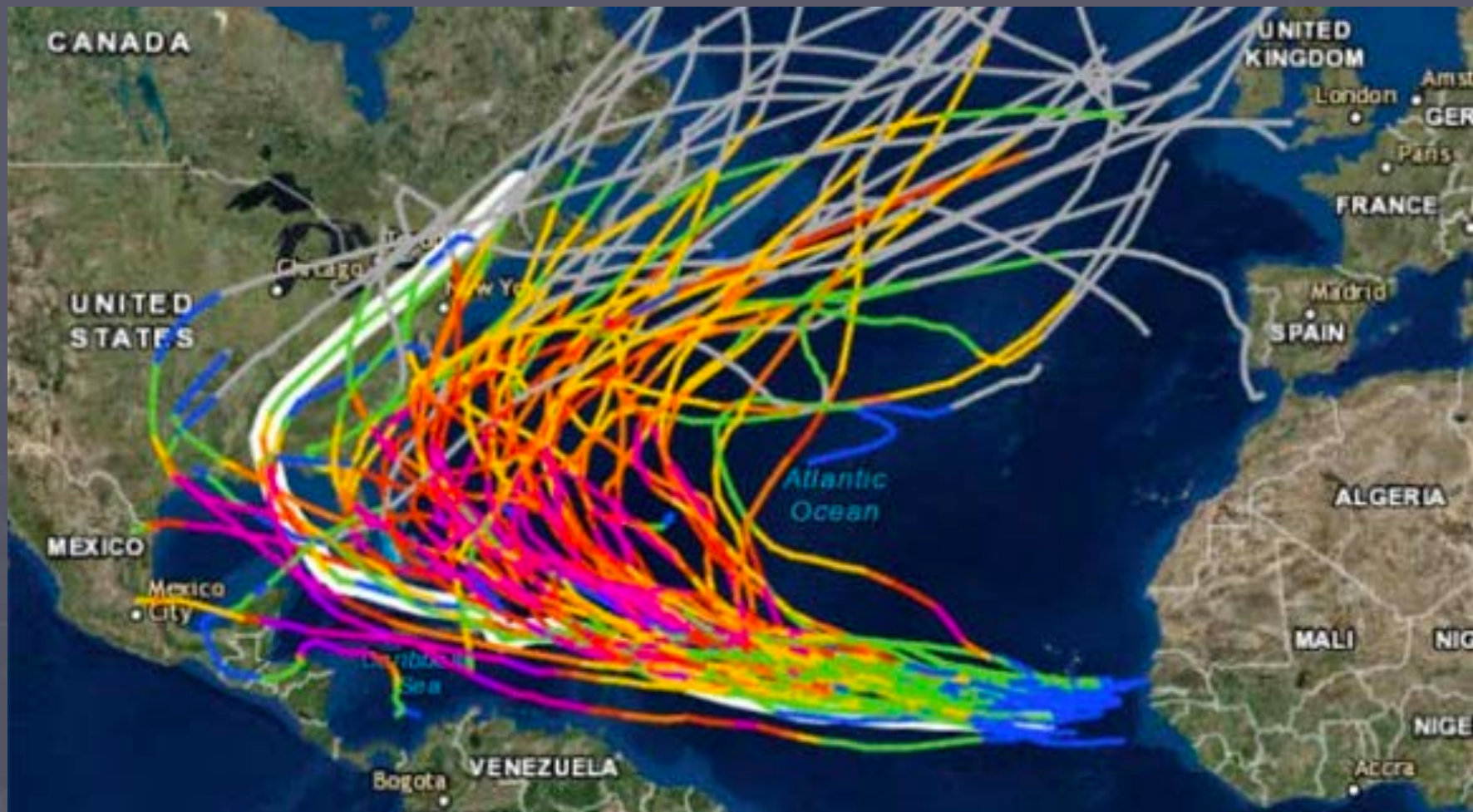


# Hurricanes 1848-2013





# 150 Years of Hurricanes in the US



# Saffir-Simpson Hurricane Wind Scale

## Saffir-Simpson hurricane scale

cat	wind km/h	pressure mbar	surge m	potential damage
1	152	>964	1.2-1.5	trees, shrubbery, mobile homes
2	176	>950	1.8-2.4	roofs, mobile homes
3	208	>930	2.7-3.6	trees stripped, buildings damaged
4	248	>905	3.9-5.4	extreme: flooding, major damage
5	>250	<905	>5.4	catastrophic: houses blown away

