Chapter 11
Lightning, Thunder, and Tornadoes

• Thunderstorms
  – Each produces lightning
  – Steps of lightning formation
    • Charge separation – splitting of electrical charges within the cloud
      – Positive charges aloft, negative upper cloud in lower areas
      – Not sure how charges split
      – Lightning only occurs in clouds extending above freezing level and precipitating clouds
    • ___________ – shaft of negatively charged air
      – Emanates from cloud base in steps
      – Charge build ups and sets up a strong electric field
      – A spark surges upward from the ground
    • Connections causes a return stroke (______________)
    • Lightning flash
      – Combination of all the strokes
  – Types of lightning
    • Forked – standard lightning appearance
    • Sheet –
    • Ball – lightning the size of a basketball and can last for several minutes (web link)
    • St. Elmo’s fire – tall sharp objects glow with a continuous barrage of strikes (web link)
    • ___________ – short-lived electrical bursts from the tops of thunderstorms
    • Blue jets – upward moving electrical jets from the tops of thunderstorms
  – Rapid expansion of air due to excessive heating creates a shock wave
  – Lag between the stroke and resulting thunder due to speed differences between light and sound
    – Time in seconds / 5 yields distance in miles
  – Heat Lightning – lightning without sound
    – Occurs from a storm a great distance away

• Lightning safety
  • The safest area = indoors
  • No contact with electrical appliances or telephones
  • Automobiles also safe
  •
  • Get to low ground
  • If you hair stands on end, get down on all fours to distribute the charges
• Administer CPR for those who are struck

• Air Mass Thunderstorms
  – Localized, short-lived, non-severe thunderstorms
  – Life cycle
    • Contains only updrafts, no precipitation

• Mature stage
  • Dissipation stage
    – only downdrafts, light precipitation

• Severe Thunderstorms
  – Defined

• Mesoscale convective complex’s (MCCs)
  • Self-propagating thunderstorm systems

• Mesoscale convective systems (MCSs)
  • Squall lines
  • A single, extremely powerful single cell thunderstorm
  • Complex array of up- and downdraft relationships
  • Self-sustaining core keeps them from dissipating

• Dryline induced storms
  • Boundary between mT and cT air masses
  • Creates a potential instability situation

• Downbursts- Strong downdraft from storms
  • Winds speed can reach 165 mph

• Derechos
  • MCS induced strong downdraft on a large scale
  • Lasts for hours and produces a bow echo on radar

• Microbursts

• Distribution of Thunderstorms
  • Thunderstorms develop where moist air is forced aloft
  • Most common in the tropics
  • In the U.S. =

• Tornadoes
  • Strong pressure gradients
– Tornado characteristics and dimensions
  • Size ranges from tens of yards to over 2 miles
  • Typically last for a few minutes, some last for hours
  • Movement = 30 mph over 2-2.5 miles

– Tornado formation
  • Squall lines, MCCs, supercells, tropical cyclones
– Supercell tornado development
  • ___________________ – rotating updrafts
    – Wind shear is necessary
    – Updrafts lift the horizontal column of air
    – 20% develop into tornadoes

  – Lowered cloud base hangs down from the base of the cloud (back side of storm)
  • Funnel forms
    – Ground contact indicates tornado
– Non-supercell tornado development
  • Interaction of outflow boundaries
  • Need wind shear
– The location and timing of tornadoes
  • The U.S. has the most tornadoes
    – *Tornado Alley*

  – May = highest frequency month
  • Late spring = greatest overall frequency
– Trends in U.S. tornado occurrence
  • Notable increase in tornadoes over time
  • Population/technology induced observation bias
– Tornado damage
  • Winds = greatest damage
    – Flying debris = greatest injuries

  – Rates the damage caused by tornadoes

  – Explains how some houses are fine while others are destroyed
– Fatalities
  • Relatively few deaths
  • Average of 760 tornadoes = people average 91 deaths
    – Most associated with a few large tornadoes
    – Mobile homes, autos sites of most deaths
– Safest area = building basement
– Watches and warnings
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    – Favorable atmospheric conditions for severe weather development
      • Severe Weather Warning
        –
  – Convective outlooks
    • Maps indicating severe weather potential for an area
  – Tornado outbreaks
    • A single weather system producing a large number of tornadoes

  • Similar to tornadoes
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  • Smaller and weaker than tornadoes

End of Chapter 11