

Thunderstorms, Tornados, and Hurricanes

- 1) Thunderstorms
 - a) Requirements
 - i) Warm moist air
 - ii) Lifting mechanism
 - iii) Most Probable Location?
 - b) Formation
 - i) 3 stages:
 - (1) Cumulus Stage
 - (a) warm air is forced vertically upward cooling quickly, creates updrafts
 - (b) formation of a cumulus cloud as warm air rises and expands
 - (c) no precipitation occurs during this stage
 - (2) Mature Stage
 - (a) condensation in uppermost reaches produces ice crystals (which can merge)
 - (b) Falling precipitation generates friction against updrafts – creates a downward column of movement – downdraft
 - (c) Falling air warms – melts some ice to produce rain other ice falls as hail
 - (d) Passing updrafts and downdrafts cause polarization of charges between ice particles and droplets in the clouds (causes lightning)
 - (3) Dissipating Stage
 - (a) Cloud formation ends
 - (b) Evaporation of some of the falling rains removes energy from the system, cooling the air
 - (c) Cool air is more stable and prevents updrafts
 - (d) Light rain and dissipation of clouds
 - c) Lightning
 - i) Lightning joins centers of opposite charges.
 - ii) Top of cloud to middle-bottom
 - iii) Bottom of cloud to land surface
 - 2) Tornados
 - a) Narrow, funnel-shaped spirals of rapidly converging and rotating air associated with thunderstorms
 - b) Center around low-pressure
 - c) Winds are associated with high pressure gradients
 - i) Midlatitude cyclones have gradients of 0.04 mbar/km
 - ii) Hurricanes have gradients of 0.2 mbar/km
 - iii) Tornados have gradients up to 100 mbar/km
 - iv) The higher the gradient the greater the winds
 - d) Tornado formation
 - i) 3 stages
 - (1) Early – slow air movement at the ground surface shears with rapid vertical movement, produces rolling spiral of wind
 - (2) Updraft – updraft of thunderstorm pulls the spiraling air up vertically, creates mesocyclone
 - (3) Tornado – rotation becomes tighter and faster, air extends downward
 - 3) Hurricanes

- a) Characterized by high sustained winds
- b) Heavy rainfall
- c) Storm surges (elevated water levels) along coastlines
- d) Occur over the globe, but have different names
 - i) Pacific Ocean – typhoons
 - ii) Indian Ocean - cyclones
- e) Formation
 - i) Our “hurricanes” begin as winds coming off of northern Africa
 - ii) Air moves over warm water (at least 27 °C)
 - iii) Ocean water evaporates and subsequently condenses in the atmosphere (What has happened in terms of energy and temperature?)
 - iv) Warm humid air continues to be drawn into the air mass and is forced upwards (creating a greater pressure gradient).
 - v) Prevailing winds create cyclonic rotation (counterclockwise)
 - vi) Lowest pressure develops at the center where air is being forced upwards
 - vii) Continued evaporation of warm waters increases the movement of air and strengthens the storm