Weather and Climate Final Review

Extra-tropical wave cyclones

-low pressure center

-in the mid-latitudes, the dominant form of weather system is the extra-tropical wave cyclone (*Bjerknes*)

-storms that form along the polar front

-a large *inspiral* of air that repeatedly forms, intensifies, and dissolves along the polar front

-low pressure center, fronts are associated with the low

-**cyclogenisis** → birth of a cyclone

-Pacific, Alberta, Colorado, Panhandle, Hatteras, Gulf

Monsoons

Monsoons

-A seasonal reversal of wind

-120 degree change in wind direction

-ex: from NE to SW

-brings air from over continent and 1 time of year and air from over ocean at the other time of year

-Arabic word *mausin* meaning season

Dry Season → winter

-*Low sun*

Wet Season → summer

-*High sun*

Location of Monsoon Climates

-Eastern Asia, around Equator, Africa, India, China, Australia

-*shift in ITCZ causes winds to shift*

Indian Monsoon

-Seasonal shift in ITCZ

-Seasonal surface pressure changes

-jet streams aloft → tropical easterly jet and westerly subtropical jet

-<u>Winter Monsoon</u>:

-ITCZ in S Hemisphere

-high pressure over Asia

-Westerly subtropical jet → convergence aloft

-subsidence→ downward movement of air

-winds blow offshore

-dry monsoon

-<u>Summer Monsoon</u>:

-ITCZ in N Hemisphere (over Asia)

-low pressure over Asia

-Tropical Easterly Jet → divergence aloft

-winds blow onshore (from SW)

-wet monsoon

-Cherapunji, Indiaover 1000 inches of rain in 1 year, mainly in wet monsoon season (record rainfall)

Thunderstorms

Thunderstorms

-Storm that generates lightning and thunder → cumulonimbus clouds

Favorable Environment to Form

-When warm, humid air rises in an unstable environment

-most commonly form in *maritime tropical* air

Thunderstorm Frequency

-All the time: 2,000 thunderstorms in progress

-45,000 every day

-16 million annually around the world

-Lightening strikes earth 100 times each second

-highest frequency around Atlantic and Gulf of Mexico

-Florida, Georgia, Alabama, Mississippi, Louisiana

-also high frequency around Rocky Mtns in Colorado, New Mexico

-Tampa, FL → thunderstorm capital of US – over 100 days/year of thunderstorms

Thunderstorm Formation

-typically form in humid air masses in summer

-maritime tropical

-air mass thunderstorms

-day in and day out in the summer

-afternoon thunderstorms

-Three stages of development:

-Cumulus stage

-Mature stage

-Dissipating stage

Cumulus Stage

-Moisture supply and updrafts continue

-warm, humid air rising

-continuous release of latent heat

-condensation → releases energy

-Expanding the cloud into colder air → unstable atmosphere

-large snowflakes fall and melt

-Large droplets grow → coalition and coalescence

-dominated by updrafts

Mature Stage

-Downdrafts and falling precipitation

-updrafts and downdrafts present

-Cloud grows to the tropopause

-Strom produces heavy rain, lightening and thunder, occasionally hail

Dissipating Stage

-dominated by downdrafts

-Upward supply of moist air is blocked

-Thunderstorm weakens

-precipitation decreases
-cloud dissipates

Severe Thunderstorms

-produces very heavy downpours, flash floods, very strong winds, frequent lightning, and perhaps tornados
-winds must exceed 58 mph, produce hail, 0.75 inches in diameter, or a tornado
-vertical wind shear
-change in wind speed or direction with height
-separates areas of updrafts and downdrafts → storm intensifies
-Types of severe thunderstorms:
-Supercells
-Squall line
-Mesoscale convective complexes (MCCs)
-Microbursts

Supercells

-Small fraction of all thunderstorms
-*most tornados develop from supercells*
-single, very powerful cell
-can be 10-30 miles wide and extend up to 60,000 feet
-Vertical wind profile cause updraft to rotate → mesocyclone
-warm, humid air at the surface with a *temperature inversion* above

Squall Lines

-Long lines of individual storm cells
-Common in advance of cold front
-can develop along dryline
-Southern Great Plains – Texas, Kansas, Nebraska
-*tornado alley*

Mesoscale Convective Complexes (MCC's)

-Very large cluster of self-propagating storms

Microbursts

-Strong localized downdrafts
-hazard for airplanes taking off and landing

Lightning and Thunder

-lightning occurs first
-Lightning equalizes electrical differences
-Thunder is the sound heard when air expands quickly due to intense heating by lightning
-every 5 seconds between lightning and thunder = 1 mile away

Lightening Components

-Flash → what we see
-strokes
-80% of all lightning is cloud-to-cloud = sheet lightning

Lightening Formation

-Electrical charge differences occur as a result of the freezing of ice in the cloud

Tornados

Tornados