

Oceanography Chapter 8

Atmosphere

- ◆ Volume of gases, water vapor, and airborne particles enveloping Earth.

Weather- state of the atmosphere at a specific time and place.

Climate- long term average of weather in an area.

Composition of the ATM

$N_2 \Rightarrow 78.1\%$ $O_2 \Rightarrow 20.9\%$ less than 1% \Rightarrow Ar, CO_2 , Ne, He, CH_4

Air is never completely dry- water vapor

Density:

1. Warm air is less dense than cold air
2. Humid air is less dense than dry air
(Why? – molecules of $H_2O_{(v)}$ weigh less than N_2 , O_2)

Air becomes cooler when it expands (like out of a tire).

Compressed air becomes warmer

(Air descending from high altitude toward the surface is compressed and gets warmer)-

Rainshadow

Figure 8.2

Warmer air can hold more moisture than cold air when air rises, it cools, and will condense.

- ❖ Precipitation

Atmosphere Circulation

- ◆ Powered by SUNLIGHT
(unequal heating)

Only 1 Pt in 2.2 Billion of the sun's energy is captured.

7 million calories/ day or 17 trillion kW
(23 trillion horse power)

Figure 8.3 Global Energy Budget

How much penetrates the ocean? Depends on:

1. Angle of radiation
2. Sea state (surface turbulence)
3. Presence of ice or light- colored foam

The 51% of Shortwave radiation striking land is converted to longer wave and then is transferred via conduction, radiation, or evaporation to the atmosphere.

Heat Budget – SW in, LW out

The earth is in thermal Equilibrium.

But it is heated unevenly – Figure 8.4

1. Energy is spread over a great area in the poles
2. In the poles, there is more atmosphere to go through
3. The energy comes in at a higher angle favoring reflection
4. Poles receive 24/0 summer/winter

Figures 8.4/8.5

Uneven Solar Heating and the Seasons

At mid-latitudes, a hemisphere will receive 3x more energy in the summer than at winter.

❖ Difference is due to 23 1/2° tilt of the axis of the Earth

Figure 8.6- Solstices and Equinox

Circle of Illumination – Equinox – everybody gets 12

Solstice – long summer days, short winter days (Here: *Day*__
*Nite*__

Uneven Solar heating and Atmospheric Circulation

Convention currents- gravity heating figure 8.7

Idealized Model of Earth's Air circulation – Figure 8.8

- not what happens- Mr. Coriolis

The Coriolis Effect

Northern hemisphere – clockwise – to the right

Southern hemisphere – counter clockwise – to the left

All free moving objects or fluids, including the wind are deflected to the right of their path of motion in the northern hemisphere (and to the left in the southern)

Atmospheric Circulation Cells – Generate figure 8.13

Hadley Cells (George Hadley) – tropical

Ferrel cell

Polar cell

Wind Patterns

Doldrums, ITCZ

Trade Winds

Horse Latitudes

Westerlies

Geographical Equator vs. Meteorological Equator

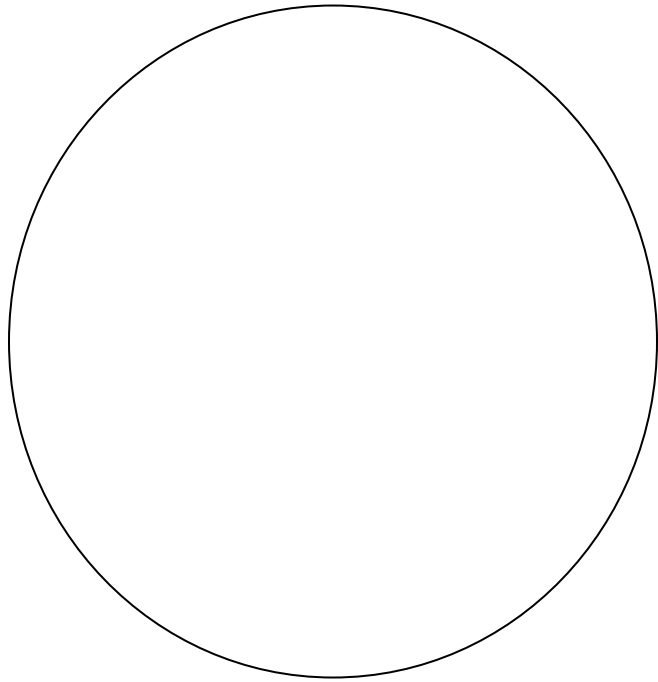
- ♦ Follows the moon sun - July $\approx 5^\circ$ N
Jan $\approx 5^\circ$ S

Winds shift as well.

Great wind Patterns – responsible for 2/3 heat transfer from the tropic to the poles.

Ocean currents are the other 3rd.

Insert your gorgeous drawing
here:



Medium winds- Monsoonal- wet summer, dry winter.

Spring – land heats up faster, air rises, and is replaced by Low-Pressure cooler weather air, which easily condenses when it rises (precipitation)

Fall – Land cools down faster, air sinks and is compressed High Pressure.

The location of the ITCZ will determine how nasty the monsoonal season will be.

Most intense in Asia

Why?

♦ Cherrapunji (10m of rain/yr - 425 inches)

Local Winds – Sea Breeze, Land Breeze: Diurnal Cycle

Storms – regional atmospheric disturbances characterized by strong winds often accompanied by precipitation.

Hurricanes/Tornadoes/Mid Latitude cyclone (extra tropical cyclones) (tropical cyclone)

Bangladesh (1970) – 300 k – 40' wall of water
1991 – another – 200k

cyclones – large rotating
masses of Low Pressure

1993 March Storm – 50 inches
(40 inches in Athens, OH)

Air Mass- Large body of air with relatively uniform characteristics
cP, mP, cT, mT, where c=continental, m=maritime, T=tropical, P=polar

cP:

mP:

cT:

mT:

Front- Boundary between air masses – Vilhelm Bjerknes

Extra Tropical Cyclones (MLC) – Polar Front – cP, mT

Cold Fronts

Warm Fronts

Occluded Front

Stationary Front

Tropical Cyclones

Huracan (God of wind in the Caribbean)- Hurricane

Tai Fung (Chinese for great wind) – Typhoon

Willi- Willis

Less than Tropical Cyclones- Tropical storm, Tropical depression

Hurricanes start with a depression \Rightarrow air is heated by warm tropical water

- ◆ Move along equatorial belt westward

Galveston Disaster - 1900

Storm Surge – mass of water driven by the storm.

Low Pressure produces a dome on the water – up to a 1m high

Bangle desh- 40ft, Galveston

Latent Heat of Vaporization (540 cal/y)

- ◆ Energy is related as the moisture is changed from gas to liquid
(2.4 trillion kW of power in one day by a big storm)
 - enough to power the US for a year.