

Earth moves around the Sun in an **elliptical orbit**

-Aphelion = Earth is at its furthest point from the sun

-Perihelion = Earth is at its closest point to the sun -

Varies between 91 and 96 million miles.

**Circle of illumination** = The line on the earth's surface dividing light from darkness

**Question?** Does the sun rise? Explain.

Planet earth- 71%, water 29% land

Does that cause much of a role **in the** weather on earth?

Does it make a difference if the water is cold or warm?

**Tropic of Cancer** 23.5 degrees N

**Tropic of Capricorn** 23.5 degrees S

**Question?** What does the Tropic's location have to do with the Arctic and Antarctic Circle?

December 21= Southern Hemispheres summer

**Specific heat** = amount of heat energy held at a specific temp. by a substance

Highest specific heat of all liquids except ammonia = H<sub>2</sub>O

-Shallow H<sub>2</sub>O heats up faster than deep H<sub>2</sub>O

**Question?** Is that statement about shallow water always true? Explain.

**Greenhouse effect** = Short wave radiation can go through atmosphere/glass but reflecting Long waves cannot pass through. Why does that phenomenon occur **and** what are the implications to our weather.

Question? What does it have to do with Woburn, Mass being the former carnation growing center of America?

**LCL** = That is the altitude at which clouds form.

**Question?** What is the difference between condensation and precipitation?

90% of **all** Earth's weather happens in the Troposphere

Hot air rises => lighter => holds more moisture

Cold air sinks => *dense* => holds less moisture

**100% RH** (relative humidity) — precipitation

This occurs at dew point temperature and altitude.

Question? What has occurred that causes snow?

**Solar Radiation** = Heated atmosphere

Vaporizes H<sub>2</sub>O = formation of clouds

100% moisture precipitation

Depending on temperature precipitation is either liquid or solid

Moved by upper air movement => Jet stream moves surface air

**Vector** - Direction of wind

Low pressure gives higher temp.

**Question?** What is the relationship between low temperature and high pressure?

**Thermometry** = measurement of infrared heat

-calorie = amount of heat necessary to raise 1 gram by 1 degree Celsius

-Calibrated by Fahrenheit, Celsius, or Kelvin Scales.

**Question?** How are those scales interchangeable? Do they measure the same things?

**Thermometers**

-**Mercury** = silver

-Alcohol = red or blue

-Bio-metallic = aluminum & copper

**Question?** Why are mercury **thermometers becoming** obsolete?

Calories measure energy and the ability to do work

Sun's energy comes to earth as **Lotential ereAm**

**Question?** Is that **the only kind** of energy? Can we create energy?

**Barometers** = **measure** air pressure

- Aneroid => 14.7 psi (BP @ sea level)

- Torricelli —mercury ex. 29.92 inches

-Barograph => graph based on millibars ex. 1013.2

-Hair Hygrometer

Barometric pressure often goes up or down

**Question?** What can cause the barometric tendency to vary?

-Warmer, moisture, **stormy** = Low pressure

-Cooler, drier, clearer = High pressure

-29.92 = neutral point

**Question?** Why is it not only important to observe the difference between mean barometric pressure, but also its prior reading or value?

**Storm** -They may be episodic or long term (gale vs. tornado). It is a condition of the atmosphere that brings an extreme weather condition to a specific area for a different period of time.

- Drought
- Rain
- Wind
- Snow

## 1. Convictional storm

-Dew point has reached the saturation point. Rising air from the surface reaches the condensation point (LCL). While the warm air is rising, cold dense air is sinking or a rain event that results from unequal heating of the land surface such that a rising column of air cools beyond the dew point and becomes unstable producing a cumulonimbus cloud, typically exhibiting violent local wind, high intensity rainfall over a small area and for a short duration, hail, **thunder and** lightening.

## 2. Monsoon

**Any major** seasonal wind system reverses its direction causing wet and dry seasons. **Most** of the large monsoons are in Africa and southern Asia, the smaller ones can be found all over **the world, such** as in the Gulf Coast of the US and Central Europe. **Could be 7 months of wet weather.** It is very regular around 5-15 degrees north or south of the equator. It is **primarily** caused by a reversal of oceanic and land Pressures. Stations on the ground usually experience 10 times normal monthly amount of rain along with a short dry period. This is also used to describe a climate that has monsoon rains.

## 3. Orographic Storm

**-Deals with weather near and around** mountainous regions .It is caused by mountain barriers and mechanically forced rising of winds. They are related to continental location and cold ocean currents.

-Air cools at about 5.5 degrees Fahrenheit for every 1000 feet in altitude. In precipitation it is 3 degrees for every 1000 feet.

-When mountain is near ocean (windward side), the cool moist ocean winds rise up the mountain and cool according to the rise in altitude, once wind reach peak of mountain they fall down dry side (leeward side) and warm according to altitude.

-As the moist wind rises up windward side the condensation point and dew point are reached and the air can no longer hold moisture, thus precipitation will fall. Once wind reaches peak **precip** stops. The wind has now reached the LCL. As the wind goes down the leeward side (Chinook wind) it now warms and expands causing deserts.

**Hadley Cell** = Low latitude air movement toward the equator that with heating, rises vertically, with pole ward movement in the upper atmosphere. This forms a convection cell that dominates tropical and sub-tropical climates.

**Question?** Does this have anything to do with the jet streams and our weather?

**Synoptic Weather** Structure and behavior of atmospheric circulation systems, practical weather analysis and forecasting techniques. This directly involves acquisition, manipulation and display of real-time data sets. This is primarily a descriptive process based on factual observations.

For every 1000 feet air rises in altitude, the temperature drops an average of 5.5 degrees in unsaturated air. The rate differs in saturated air. It is 3.0 degrees/1 000feet.

**Question?** Why are there differences between saturated and un saturated air?

**Saturation point =>condensate => precipitate**

- Solid — snow, **hail, sleet**
- Liquid = rain, drizzle, mist, fog
- Precipitation less than 150mm is drizzle**

**Relative Humidity** = the ratio of the amount of water vapor actually present in the air to the greatest amount possible at the same temperature

**gumiditx** = read by a hydrometer, it is the specific amount of vapor in the air

**Dew point** = the temperature at which a vapor begins to condense is the location at which a cloud becomes saturated, altitude/temperature/ amount of moisture

**Howard's Clouds Classification**

- Lower Altitudes = Sea level to 6500 feet
- Stratus (ST) Stratiform = layers of clouds, low **clouds**
  - Alto Stratus = higher end**
- **Middle Altitudes @6500 feet =>Cumuliform = middle** clouds, fluffy
  - Anvil cloud/ thunderhead = Cumulonimbus**
    - **Point of anvil = direction of cloud movement**
    - **Alto cumuli = up higher**

**High** Altitude c7 20,000 to 75,000 feet. Cirroform are wispy clouds.

**Question? Why do** we have less of the sky covered with high clouds and more of the sky covered with low clouds? How **does that differ for CN clouds?**

**Blanket effect** = Clouds keep in the heat and insulate the earth, especially at night.

**Question?** Why does an early and continuous snow protect ground cover?

**Wind** = horizontal movement of air from a region of high pressure to a region of low pressure

The change in pressure measured across a given distance is called a pressure gradient. The steeper the gradient is, the greater velocity of the wind.

**Question?** Why do hurricane have winds greater than 75 miles per hour?

The pressure gradient for is responsible for triggering the initial movement of air  
-The higher the pressure gradient the greater the wind.

**Question?** How does the Beaufort Scale relate to wind velocity/ Why is it possible that a gale may do more damage to Boston Harbor than a hurricane?

Air also moves vertically, light warm air rises while cold dense air sinks

### Planetary winds

- Between 60 degrees and 90(H) degrees north = Polar easterly -
- Between 30 degrees and 60(L) degrees north = South West Trades -
- Between the equator and 30(H) degrees north – North East Trades -
- Equator = ITCZ(L)
- Between equator and 30(H) degrees south = South East Trades -
- Between 30 degrees and 60(L) degrees south = North West trades -
- Between 60 degrees and 90(H) degrees south = Polar easterly

At this point you should really consult the text for diagrams on planetary winds. Understanding this concept is key to critical understanding of the course.

**Question?** What are calms, doldrums and horse latitudes?

### Local Winds

Winter winds

-Land (H)—>h<sub>2</sub>o (L) = land breeze

Summer winds

-H<sub>2</sub>O(H) ==>land(L) = sea breeze

Those are specific for the northern hemisphere.

**Question?** Will the same be true in the southern hemisphere?

Define Foehn , Chinook, Mistral, Bora, Scirocco and Santa Ana winds.

Nautical mile is equal to 6069 feet (just distance)

**Knots** are computed by nautical distance

The earth completes a full rotation (360 degrees) at a speed of 1000 **mph**

Beaufort Scale is used to determine the force of wind

-Hurricane = wind in excess of 75 mph

-Full gale is 60 mph

-There is also gale, light breeze, full breeze, calm....

#### 4.) Frontal Storms or Air Mass Storms

-The transition zone or interface between two air masses of different density usually means different temperatures. For example, the area of convergence between warm, moist air and cool, dry air will produce a frontal storm.

The clash between a cold frontal air mass and a warm frontal air mass will produce differing forms of precipitation depending upon temperature.

- Cold air travels 2x faster than warm air.

- Degree of frontal slope — wind velocity.

- As fronts approach wind velocity increases, precipitation will occur in collision area, warm front over rides cold front, wind shifts, high pressure takes over and the storm passes and weather clears. In this area it means that the wind now is coming from the northwest.

#### **Warm front:**

The interface between an advancing mass of air that is warmer than the one it is replacing, usually at the point of contact with the ground surface. This is associated with a low barometric pressure.

#### **Cold Front:**

-The interface between an advancing mass of air that is colder than the one it is replacing, usually at the point of contact with the ground surface. This is usually associated with a high barometric pressure.

#### **Stationary front**

-Locks everything in place for a while creating temperature inversion. Episodic. This is referred to as an occluded front.

**Question?** What is the relationship to public health and summer stationary fronts?

- At night reverse blanket effect.

- Traps Nitrous Oxide in atmosphere (bad air day) -

- Happens in summer: Haze => smaze: photochemical smog

#### **Side note on pollutants:**

**-Iron and steel are brutal on environment, manufacturing of these leads to poor air quality**

- Air quality hazardous occupations: Traffic cop, diesel mechanics**

Due to **temperature inversion**, another type of episodic storm is a Hurricane

- Low-pressure storms originate over warm ocean water and have winds in excess of 75 miles per hour.

- Torrential precipitation

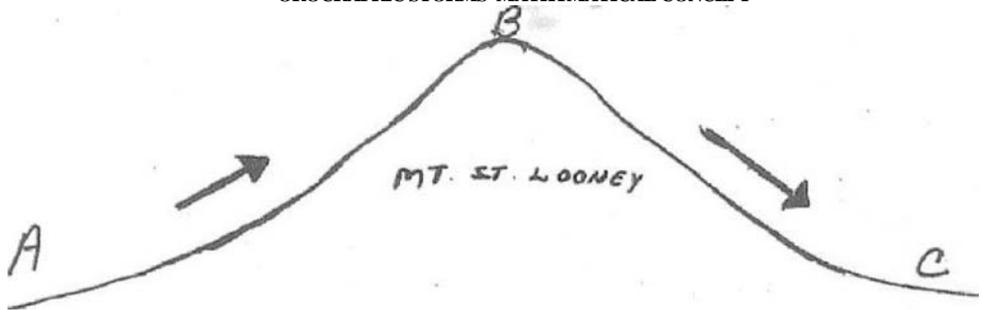
- Seasonal

-Ocean Currents

**Question?** Why are most deserts found on eastern sides of mountain ranges having a north/south axis and located between 20-40 degrees north and south latitudes? Does that have anything to do with deserts being located on western sides of continents?

## The Famous Mt. Saint Looney

OROCRAFRIC STORMS- MATHEMATICAL CONCEPT



Given: A parcel of air has a temperature of \_\_\_\_\_ degrees (P) with an absolute humidity reading of \_\_\_\_\_ grains. As it is forced to rise over a mountain barrier this \_\_\_\_\_ precipitation occurs for 3,500 ft. before descending \_\_\_\_\_ ft. high mountain.

Answer the following questions:

1. Capacity of air mass at A \_\_\_\_\_ grains.

2. Dew point expressed in \_\_\_\_\_ degrees F.

temperature  
Water Vapor Chart

|           |           |  |
|-----------|-----------|--|
| -20 deg.F | 15 grains | <p>3-Dew point altitude rounded to nearest 100 foot level. _____ ft.</p> <p>4. Temperature at B _____ Degrees F.<br/>(Remember precip for 3,500 ft.)</p> <p>5. Estimated capacity at B _____ grains.</p> <p>6. Estimated absolute humidity at B _____ grains.</p> <p>7.5. Estimated relative humidity at B _____ %</p> <p>8. Temperature at C _____ degrees F.</p> <p>9. Approximate capacity at C _____ grains.</p> <p>10. Approximate absolute and relative humidity at C is _____ grains and _____ %</p> <p>Note : Pay close attention to the difference between the windward, leeward and rain shadow location..</p> |
| -10       | 35        |  |
|           | .6        |  |
| 10        | .9        |  |
| 20        | 1.3       |  |
| 30        | 1.9       |  |
| 40        | 2.9       |  |
| 50        | 4.1       |  |
| 60        | 5.7       |  |
| 70        | 8.0       |  |
| 80        | 10.9      |  |
| 90        | 14.7      |  |
| 100       | 19.7      |  |
| 110       | 26.6      |  |
| 120       | 37.0      |  |

New England Blizzard of 78' was actually a hurricane.

- Struck from SE 158 miles offshore
- Extreme Low pressure
- Highest tide of the year

**Hurricane** season is Usually July through October

- Wettest Months in the tropics are August and September
- Northern Hemisphere Cyclone spins counter clockwise.
- Point of intersection is maximum wind and pressure drop
- These storms produce Surplus of electronic energy: lightning and thunder

**Thunderstorms** are episodic 1 to two hours or even 30 minutes

**Twister** or **Tornado** also episodic, usually five minute in one area of path

- Winds in excess of 200 mph
- Over ocean twister is called a water spout

**Question?** Why can tornados be among the most destructive storms?  
Is it possible to find them in New England?

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