Properties of the Atmosphere :-

The interaction of four elements i.e. heat, Pressure, Wind & moisture, may be observed on several different levels (or) scales.

- According to their geographic range of influence, the scales of motion may be designated as macroscale, mesoscale or microscale.

i) Macroscale :-

→ Atmospheric motion on the macroscale involves the planetary patterns of circulation, the grand - sweep of air currents over hemispheres.

- These phenomena occur on scales of thousands of kilometers and creates semipermanent high- and low pressure areas over oceans and continents.

→ The direction of surface winds is usually controlled by the pressure gradient and rotation of the earth. Because of rotation of the earth along its axis the winds are deflected. The force which deflects the direction of winds is called deflection force.

→ This force is also called Coriolis force. Because of this Coriolis force, all the winds are - deflected to the right in the northern hemisphere while they are deflected to the left in the southern hemisphere with respect to the rotatir earth.

ii) Mesoscale:- Circulation patterns develop over regional geographic scales, primarily because of the influence of regional & local topography.

→ These phenomena occur on scales of hundreds of kilometers.

→ Air movement on this scale is affected by the configuration of the earth's surface - the location of mountain ranges, ocean basins, forestation and urban development.

→ Land breeze and urban heat islands are good examples.

iii) Microscale:-

→ It occur over areas of less than 10 km

→ Phenomena of this scale occur within the frictional layer, the layer of atmosphere at ground level where effects of frictional and thermal changes can cause winds to deviate markedly from a theoretical pattern.

Heat:-

→ Heat is the critical atmospheric variable, the major catalyst of climatic conditions.

→ The heat energy in the atmosphere comes from the sun (or) shortwave radiation (about 0.5 um) mostly in the form of visible light.

→ The earth emits longer wavelengths than it receives, mostly in the form of invisible heat radiation.

→ Four important ways in which heat transfer occur in the troposphere are through the green house effect, the condensation - evaporation cycle, Conduction and Convection.

Pressure:- The perpendicular force per unit area (or) the stress at a point within a confined fluid.

→ The weight of the atmosphere pushing down on each unit area of Earth's surface constitutes atmospheric pressure.

→ At sea level it is 15 pounds per square inch

→ In SI units pressure is measured in pascals.

→ Atmospheric pressure is nearly 100 KPa.

Moisture:- The amount of water vapour present in the air.

Relative Humidity:- The amount of water vapour in the air at any given time is usually less than that required to saturate the air.

→ The relative humidity is the percent of saturation humidity, generally calculated in relation to saturated vapor density.

$$\text{Relative Humidity} = \frac{\text{actual vapor density}}{\text{Saturation vapor density}} \times 100\%$$

→ The most common units for vapor density are gm/m^3.

(OR)

→ Relative humidity is the amount of moisture in air compared to what the air can "hold" at that temperature.

- When the air can't "hold" all the moisture, then it condenses as dew.

logical Factors Influencing Air Pollution:

The degree to which air pollutants discharged various sources concentrate in a particular area pends largely on meteorological conditions.

- The important parameters that influence air pollution can be classified into

i) Primary Parameters ii) Secondary Parameters

i) Primary Parameters:-

1. Wind direction and Speed
2. Temperature
3. Atmospheric Stability
4. Mixing height

ii) Secondary Parameters:-

1. Precipitation
2. Humidity
3. Solar radiation
4. Visibility

Primary:-

1. Wind Direction and Speed:-

The higher the wind speed at (or) near the point of discharge of pollution, the more rapidly are the pollutants carried away from the source.

→ When wind speeds are low, pollutants tend to be concentrated near the area of discharge, and the

longer the periods of such light winds, the greater will be the concentration of pollutants.

2. Atmospheric Stability & Temperature Inversions :-

Lapse Rate :- The rate of change of temperature with altitude (height) is known as lapse rate. This rate will differ from place to place and from time to time even at the same place.

i) Environmental lapse rate (ELR) / Ambient lapse rate :

It can be determined by sending up a balloon equipped with a thermometer. The balloon moves through the air, not with it, and the temperature gradient of ambient air, which the rising balloon measures is called the ambient lapse rate.

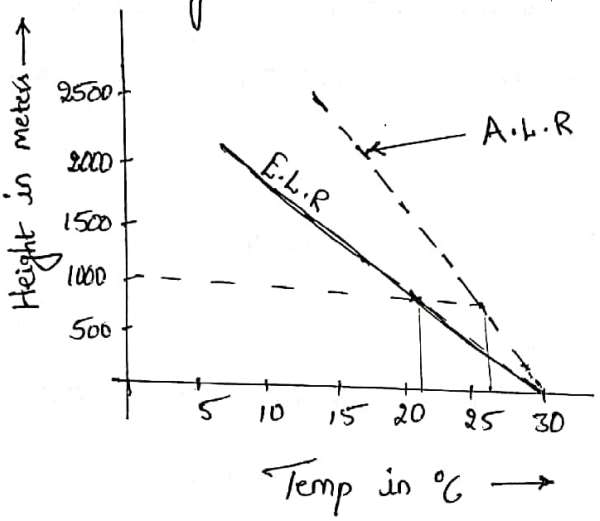
ii) Adiabatic lapse Rate :- When a parcel of air which is hotter and lighter than the surrounding air is released, then naturally it tends to rise up, until of course, it reaches to a level at which its temperature and density becomes equal to that of the surrounding. This rate of decrease of temperature with height is called adiabatic lapse rate.

→ Dry adiabatic lapse rate 9.8 °C / km, whereas wet adiabatic lapse rate 6 °C / km.

a) Super Adiabatic Lapse Rate:-

→ When the ELR (Environment Lapse Rate) is more than the ALR then ambient lapse rate is Super adiabatic and the environment is said to unstable.

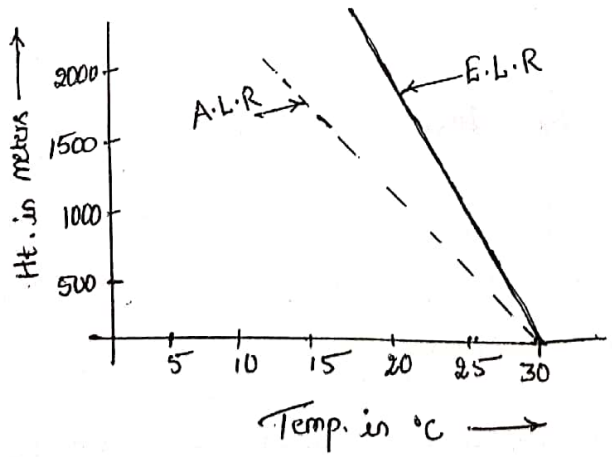
→ Dispersion of pollutants will be rapid due to rapid vertical mixing of the air making the environment unstable.



ELR > ALR

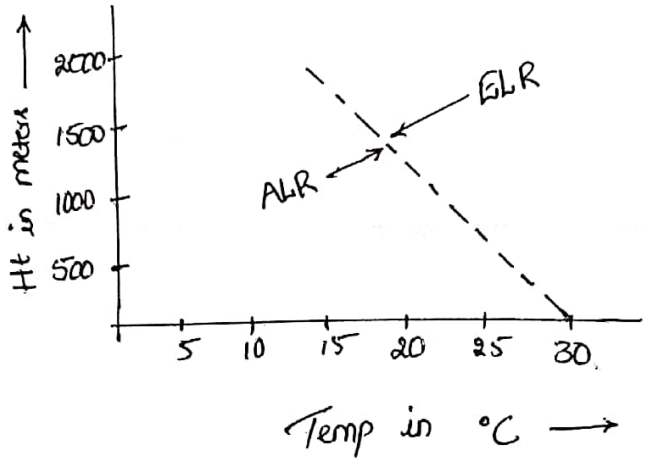
b) Sub-adiabatic:-

→ When ELR is less than the ALR the environment set to be stable and this prevailing environmental lapse rate is called the Sub-adiabatic lapse rate.



ELR < ALR

c) Neutral :- When ELR equals the ALR and both the lines coincide the environment in such a case is called neutral.



ELR = ALR

iii) Negative Lapse Rate & Inversion :-

→ When the temperature of the environment increases with altitude then the lapse rate becomes inverted (or) negative from normal state.

→ Negative lapse rate occurs under conditions usually referred to as inversion (a state in which the warmer air lies over the cold air below)

→ Such situation may occur near the earth's surface (or) at greater height in troposphere.

→ At the time of inversions, visibility is greatly reduced and contaminants are at maximum.

Types of Inversion:-

a) Radiation Inversion:- It usually occurs at night, when the earth loses heat by radiation and cools the air in contact with it. If the air is moist and its temperature is below the dew point, fog will form.

b) Subsidence Inversion:-

It is caused by sinking (or) subsiding of air in anti-cyclones (high-pressure areas surrounded by low pressure areas)

→ It occurs at modest attitudes and often remains for several days.

4) Mixing Height:- The height above the earth's surface to which related pollutants will extend, primarily through the action of atmospheric turblence.

→ It may related to one (or) more of the 3 factors

i) Wind Direction
ii) Wind Speed
iii) Wind turblence.

Secondary Parameters:-

1) Precipitation: It exerts a two-fold cleansing action on the pollutants discharged into the atmosphere.

→ It accelerates the deposition of particulate m on the ground & hence its removal from atmosphere.

→ It also helps to remove the concentration gaseous pollutants which are soluble in water.

2) Humidity:- The moisture content of the atmosphere influences the corrosive action of the air pollu and indicates the potentiality for fog formatio in relation to the degree of air pollution.

→ Relative humidity is most frequently used to represent humidity.

3) Solar Radiation:- Depending on the location, sol radiation can have a pronounced effect on the type and rate of chemical reactions the atmosphere.