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ENGINEERING HYDROLOGY & WATER MANAGMENT

MODULE #2

Meteorology

Meteorology is the science that Studies atmospheric phenomena, especially those relate to whether.

Meteorology is a branch of atmospheric Sciences which includes atmospheric chemistry & atmospheric physics with major focus on whether forecasting.

Meteorology can be also be defined as the Science of atmosphere which deals with, chemistry and dynamics of atmosphere and also their direct and indirect effects upon the earth Surface, occeans and human life.

* Any thing that happens with the whether cies wind, rain, snow, Sun, dew, frost, fog. etc is open for study in meteorology.

Importance & Scope of Meteorology:-

Almost all Social, industrial, agricultural, commerical, transports etc. Activities directly or indirectly are affected by whether and climate.

The atmosphere affects human life, animal, micro-organisms, insects, pests, plants, tree's forests and marine life at all times during every stage of growth and development meteorology has therefore greatest Scope and importance.

The fields of applications are given below to illustrate the scope of meteorology.

(1) Safe Navigation:-

For safe navigation on sea the knowledge of adverse whealher (i-e) large tidal waves, occean waves, high speed wind, cyclonic Storms etc is needed in whealher forcast from meteorology.

(2) Safe Aviation:-

For transport through air, the pilots need the information about atmospheric conditions Such as the electric lightening, high speed winds and their directions, thunder Storms, fogy atmosphere etc - So the pilots can go easily, For this purpose accurate forecasts are needed and are only possible from meteorology

(3) Industry:-

Many industries for their raw material depend on agricultural produce and accordingly location of industry is decided. So it is necessary to consider the whealther and climate (eg) sugar mill.

(4) Fisheries:-

Fisher men need information of atmospheric and occean changes before they proceed on sea for fishing and this is possible from meteorological Knowledge.

(5) Irrigation and Water resources:-

Meteorological and hydrological information assists in planning the location, size and storage capacities of dams to ensure water supply for irrigation and domestic needs.

When and how much to irrigate is also decided in meteorogical information.

(6) Human Life:-

Human being tries to acclimatize/adjust himself with the prevailing whealther Conditions, for this they manage for type of clothing, housing food habits etc

(7) Commerce:-

Trading of any item is made according to need of the people in relation to whealher prevailing (eg) Gum shoes, umberalla, and rain coats are generally traded in rainy Season only, woolen cloths in winter season and white cottons cloths, cold drinks etc are in more demand in summer season.

The Atmosphere & its Composition

Atmosphere:-

The dynamic layer Surrounding the earth above its Surface containing various gases, mois-ture, aerosols etc is called atmosphere. It is protective layer around the earth. Atmosphere can be defined as the gaseous envelope Surrounding the earth.

* The estimated mass of the atmosphere is 5.6×1014 metric tones.
* It extends over about 100 km height
* Meteorological events and effects occur in it.
* The thickness of gaseous envelope is equal to 1% of the earth's mean radius.

Usefullness of Atmosphere :-

① It fulfils the biological oxygen demand (BOD) of the animal life.

② It supplies the necessary precipitation or moisture.

③ It protects the biological life on the planet from harmful radiation like ultra Voilent rays.

④ The earth's temperature in the absence of atmosphere would have been +950 c° (day) and 1450 c° (Night).

⑤ Atmosphere is a big reservior of nitrogen. Some plants and microbes can fix this nitrogen for plant growth.

Composition of Atmosphere

The atmosphere consists of dry air, water vapor and various kinds of salts and dusts.

- Total amount of dry air is greater than 5600 billion tons.
- Total amount of water vapor is about 146 billion tons.

Gas Name	chemical Formula	Percent Volume
Nitrogen	N_2	78.08 %
Oxygen	O_2	20.95%
Water	H_2O	0 to 4 %
Argon	Ar	0.93%
Carbon Dioxide	CO_2	0.0360 %
Neon	Ne	0.0018%
Helium	He	0.0005%
Methane	CH_4	0.00017 %
Hydrogen	H_2	0.00005%
Nitrous Oxide	N_2O	0.00003%
Ozone	O_3	0.000004%

Atmospheric structure

The Earth's atmosphere is divided into four layers based on air temperature as:-

① Troposphere :-

The lowest atmosphere layer extending upto 11 km above mean sea level is called troposphere.

* The temperature in this layer decreases linearly with increasing elevation at lapse rate of 6.5 °C/km

Lapse Rate:- The rate of decrease of temperature over a unit distance along the vertical is called the lapse rate.

* Almost all meteorological phenomena like cloud formation and thunder storms are in the troposphere.
* Since this layer contains almost 100% of atmospheric water vapour, the interest of hydrologist lies in this layer.
* The **Tropopause**, extending from 11 to 20 km is an isothermal layer in the atmosphere where temperature remains constant over a distance of about 9 km.

(2) Stratosphere:-

Above the tropopause is the stratosphere. This layer extends from an average altitude of 20 to 48 km above the Earth's Surface.

* In the stratosphere, temperature increases with increases height. b/w ozone gas molecules absorbs ultra voilet sunlight creating heat energy.

* Ozone is primarily found in the atmosphere at varying concentrations between the altitudes of 10 to 50 km - This layer of ozone is also called the ozone layer.

* The ozone layer is important to organisms at earth's surface as it protects them from the harmful effects of the sun's ultra violet radiation.

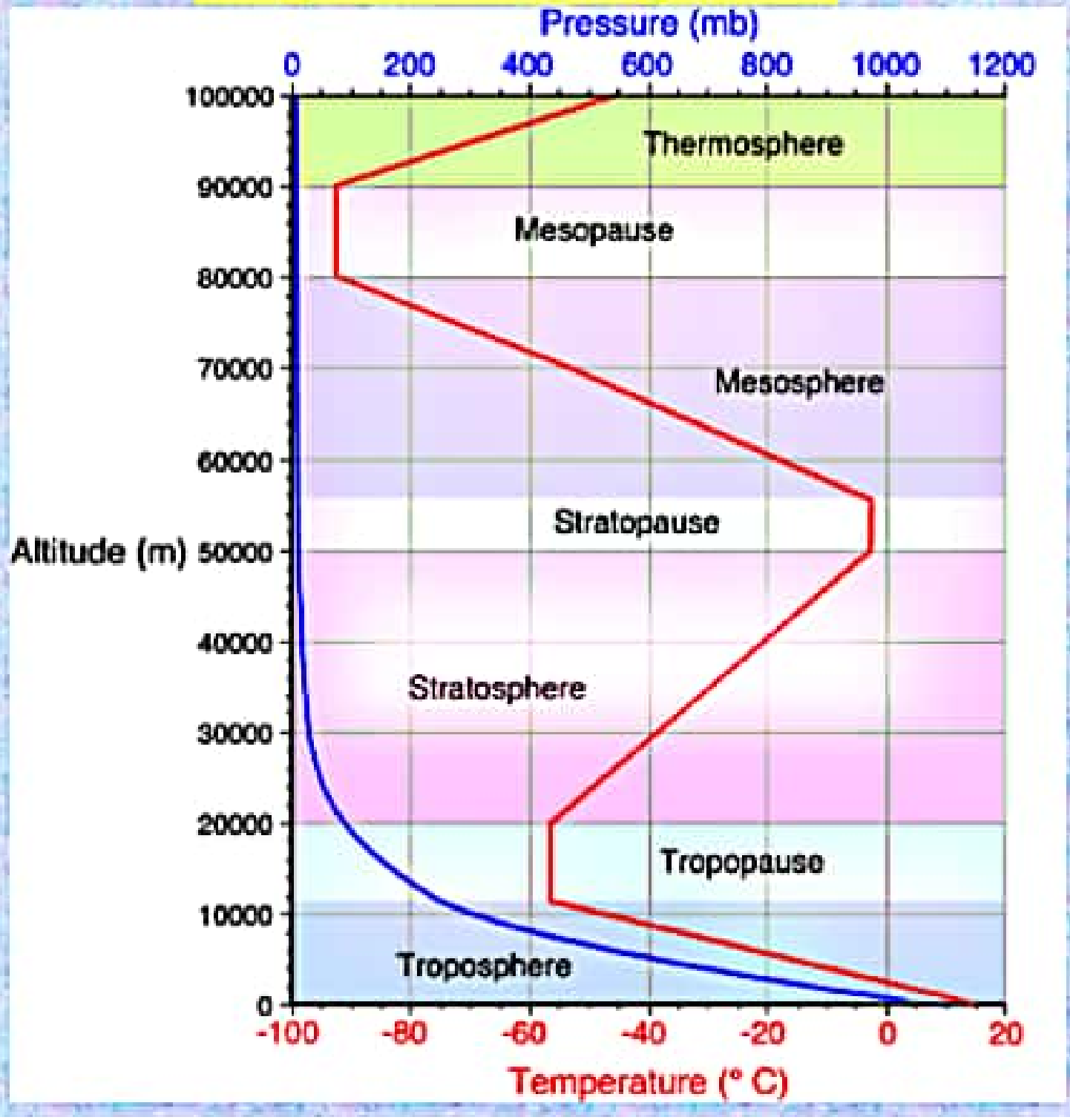
* With out ozone layer life could not exist on the earth's surface. * Above this layer strato pause exist.

(3) Mesosphere :-

In the mesosphere, the atmosphere reaches its coldest temperatures (About 90°c) at a height of approximately 80 km.

Above the mesosphere is another isothermal layer called the mesopause.

Layered Atmosphere



④ Thermosphere:-

* The last atmospheric layer, has an altitude greater than 90 km is called the thermosphere.
* Thermosphere is the hottest layer in the atmosphere.
* Heat is generated from the absorption of Solar radiation.
* Temperature in this layer can reach 1300 to 1800°C

Relative Humidity:-

It is the relative measure of the amount of moisture in the air to the amount needed to Saturate the air at the Same temperature

It is denoted by "f"

Relative humidity = $f = \frac{e}{es} \times 100$

e = actual vapor pressure.

es = Saturated vapor pressure

Thus the relative humidity is 100% when the air is Saturated.

Absolute Humidity :-

Actual amount of water in the air.

It is the mass of water vapor per unit Volume of air at a given temperature and equivalent to the water vapour density.

$$\text{Absolute Humidity} = \frac{\text{mass of water vapour (gm)}}{\text{Volume of air } (m^3)}$$

Dew Point :-

When the air is cooled at a constant atmospheric pressure, the temperature at which air becomes Saturated is called Dew point.

* The Dew point is the temperature of air which is needed for Condensation or dew (at that particular temperature).
* Dew point actually measures how much water vapor is in the air.
* When the air cannot hold any more vapour it is 100% Saturated.