

AGRO METEOROLOGY

Meteorology

Greek word “Meteoro” means ‘above the earth’s surface’ (atmosphere) “logy” means ‘indicating science’. Branch of science dealing with that of atmosphere is known as meteorology. Lower atmosphere extending up to 20km from earth’s surface is where frequent physical process takes place.

Meteorology is a combination of both physics and geography Meteorology is a combination of both physics and geography. This science utilizes the principles of Physics to study the behaviour of air. It is concerned with the analysis of individual weather elements for a shorter period over a smaller area. In other words, the physical state of the atmosphere at a given place and time is referred to as “weather”. The study of weather is called ‘meteorology’. It is often quoted as the “physics of atmosphere”.

Weather: Physical state of the atmosphere at a given place and given time. Eg. Cloudy day

Climate: Long term regime of atmospheric variables of a given place or area. Eg. Cold season

Agricultural meteorology

1. A branch of applied meteorology which investigates the physical conditions of the environment of growing plants or animal organisms
2. An applied science which deals with the relationship between weather/climatic conditions and agricultural production.
3. A science concerned with the application of meteorology to the measurement and analysis of the physical environment in agricultural systems. The word ‘Agro meteorology’ is the abbreviated form of agricultural meteorology.
4. To study the interaction between meteorological and hydrological factors on the one hand and agriculture in the widest sense, including horticulture, animal husbandry and forestry on the other (WMO).

Meteorology Vs. Agricultural Meteorology

Meteorology	Agricultural meteorology
Branch of atmospheric physics	Branch of applied meteorology or a branch of agriculture as it deals with agriculture
It is a weather science	It is a product of agriculture and meteorology
It is a physical science	It is a biophysical science
It aims at weather forecasting	It aims at improving quantity and quality of crop production through meteorological skills
Weather service is the concern	Agro advisory service to the farmers is the concern based on weather forecast
It is a linking science to the society	It is a linking science to the farming community

IMPORTANCE TO CROP PRODUCTION

1. Helps in planning cropping patterns/systems.
2. Selection of sowing dates for optimum crop yields.
3. Cost effective ploughing, harrowing, weeding etc.
4. Reducing losses of applied chemicals and fertilizers.
5. Judicious irrigation to crops.
6. Efficient harvesting of all crops.
7. Reducing or eliminating outbreak of pests and diseases.
8. Efficient management of soils which are formed out of weather action.
9. Managing weather abnormalities like cyclones, heavy rainfall, floods, drought etc. This can be achieved by
 - (a) Protection: When rain is forecast avoid irrigation. But, when frost is forecast apply irrigation.
 - (b) Avoidance: Avoid fertilizer and chemical sprays when rain is forecast
 - (c) Mitigation: Use shelter belts against cold and heat waves.
10. Effective environmental protection.
11. Avoiding or minimizing losses due to forest fires.

FUTURE SCOPE

1. To study climatic resources of a given area for effective crop planning.
2. To evolve weather based effective farm operations.
3. To study crop weather relationships in all important crops and forecast crop yields based on agro climatic and spectral indices using remote sensing.
4. To study the relationship between weather factors and incidence of pests and diseases of various crops.
5. To delineate climatic/agro ecological/agro climatic zones for defining agro climatic analogues so as to make effective and fast transfer of technology for improving crop yields.
6. To prepare crop weather diagrams and crop weather calendars.
7. To develop crop growth simulation models for assessing/obtaining potential yields in different agro climatic zones.
8. To monitor agricultural droughts on crop-wise for effective drought management.
9. To develop weather based agro advisories to sustain crop production utilizing various types of weather forecast and seasonal climate forecast.
10. To investigate microclimatic aspects of crop canopy in order to modify them for increased crop growth
11. To study the influence of weather on soil environment on which the crop is grown
12. To investigate the influence of weather in protected environment (eg. Glass houses) for improving their design aiming at increasing crop production.

COORDINATES OF INDIA- ATMOSPHERE – COMPOSITION OF ATMOSPHERE - VERTICAL LAYERS OF ATMOSPHERE BASED ON TEMPERATURE DIFFERENCE / LAPSE RATE.

Coordinates of India

Lies between $^{\circ}$ N and $^{\circ}$ N latitude

$^{\circ}$ E and $^{\circ}$ E longitude

Earth is elliptical in shape and has three spheres

Hydrosphere - the water portion

Lithosphere - the solid portion

Atmosphere - the gaseous portion

Atmosphere

The atmosphere is the colourless, odourless and tasteless physical mixture of gasses which surrounds earth on all sides. It is mobile, compressible and expandable. It contains huge number of solid and liquid particles called aerosol. Some gases are permanent atmospheric constituents in fixed proportions to the total gas volume. Others vary from place and time to time. The lower atmosphere where the chemical composition of gas is uniform is called homosphere. At higher levels the chemical composition of air changes considerably and known as heterosphere.

Uses of atmosphere

1. Provides oxygen which is useful for respiration in crops
2. Provides carbon-dioxide to build biomass in photosynthesis.
3. Provides nitrogen which is essential for plant growth.
4. Acts as a medium for transportation of pollen.
5. Protects crops plants on earth from harmful U.V.rays.
6. Maintains warmth to plant life and
7. Provides rain to field crops as it is a source of water vapour, cloud, etc.

Composition of atmosphere

The following all the different gases that are present in percentage by volume approximately.

Nitrogen (N₂) = 78.08

Oxygen (O₂) = 20.95

Argon (Ar) =0.93 CO₂ =0.03

Neon (Ne) = 0.0018 Helium(He) =0.0005

Ozone(O₃) =0.00004 Hydrogen(H₂) =0.00006

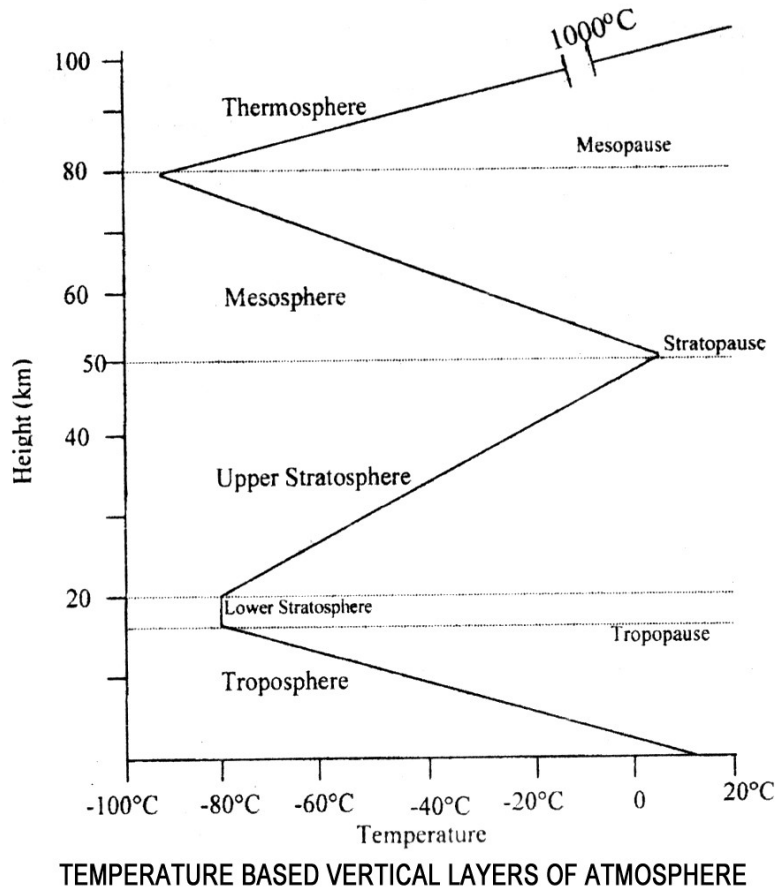
Methane (CH₄) =0.00017

Vertical Layers of atmosphere based on temperature

On the basis of vertical temperature variation the atmosphere is divided into different spheres or layers.

A. Troposphere

1. The word "Trop" means mixing or turbulence and "sphere" means region.
2. The average height of this lower most layer of the atmosphere is about 14 km above the mean sea level; at the equator it is 16 km and 7-8 km at the poles.
3. Under normal conditions the height of the troposphere changes from place to place and season to season.
4. Various types of clouds, thunderstorms, cyclone and anticyclones occur in this sphere because of the concentration of almost all the water vapour and aerosols in it. So, this layer is called as "seat of weather phenomena".
5. The wind velocities increase with height and attain the maximum at the top of this layer.
6. Another striking feature of the troposphere is that there is a decrease of temperature with increasing elevation at a mean lapse rate of about 6.5°C per km.
7. Most of the radiation received from the sun is absorbed by the earth's surface. So, the troposphere is heated from below.
8. In this layer, about 75 per cent of total gases and most of the moisture and dust particles present.
9. At the top of the troposphere there is a shallow layer separating it from the stratosphere which is known as the "Tropopause".
10. The tropopause layer is thin and its height changes according to the latitudes and it is a transitional zone and distinctly characterized by no major movement of air.



B). Stratosphere

- 1). This layer exists above the tropopause (around 20 km onwards) and extends to altitudes of about 50-55 km.
- 2). This layer is called as "Seat of photochemical reactions"
- 3). The temperature remains practically constant at around 20 km and is characterized as isothermal because air is thin, clear, cold and dry near tropopause.
- 4). The temperature of this layer increases with height and also depends upon the troposphere because the troposphere is higher at the equator than at the poles.
- 5). In the upper parts of the stratosphere the temperatures are almost as high as those near the earth's surface, which is due to the fact that the ultra-violet radiation from the sun is absorbed by

ozone in this region. The air density is so much less that even limited absorption of solar radiation by the atmospheric constituents notably ozone produces a temperature increase.

6). Less convection takes place in the stratosphere because it is warm at the top and cold at the bottom.

7). There is also persistence of circulation patterns and high wind speeds.

8). The upper boundary of the stratosphere is called the stratopause.

C). Mesosphere/Ozonosphere

1. There is a maximum concentration of ozone between 30 and 60 km above the surface of the earth and this layer is known as the ozonosphere.

2. A property of the ozone is that it absorbs UV rays. Had there been no layer of the ozone in the atmosphere, the ultraviolet rays might have reached the surface of the earth and no life can exist.

3. Temperature of the ozonosphere is high (warm) due to selective absorption of U.V radiation by ozone.

4. Because of the preponderance of chemical process this sphere is called as the "chemosphere"

5. In this layer the temperature increases with height at the rate of 5°C per km.

6. According to some leading scientists the ionosphere is supposed to start at a height of 80 km above the earth's surface. The layer between 50 and 80 km is called as "Mesosphere". In this layer the temperature decreases with height. The upper boundary of this layer is called the "Mesopause".

7. Mesosphere is the coldest region in the atmosphere with temperature reaching the lowest value of nearly -95°C at the mesopause (80km)

D). Thermosphere(Ionosphere)

1) The thermosphere layer lies beyond the ozonosphere (mesosphere) at a height of about 80 km above the earth's surface and extends upto 400 km.

2) The atmosphere in the ionosphere is partly ionised enriched ion zones exist in the form of distinct ionised layers. So, this layer is called as the ionosphere.

3) Above the mesosphere the temperature increases again and is in the order of 1000°C .

4) The ionosphere reflects the radio waves because of one or multiple reflections of shortwave radio beams from the ionised shells. So, long distance radio communication is possible due to this layer.

E). Exosphere.

1) The outer most layer of the earth's atmosphere is named as the exosphere and this layer lies between 400 and 1000 km.

2) At such a greater height the density of atoms in the atmosphere is extremely low.

3) Hydrogen and Helium gases predominate in this outer most region.

4) At an altitude of about 500 to 600 km the density of the atmosphere becomes so low that collisions between the natural particles become extremely rare.

Lapse rate

The decrease in air temperature with height is known as the normal / environmental lapse rate and it is $6.5^{\circ}\text{C}/\text{km}$.

Adiabatic lapse rate

The rate of change of temperature in an ascending or descending air mass through adiabatic process is called as adiabatic lapse rate. The thermodynamic transformation which occurs without exchange of heat between a system and its environment is known as adiabatic process. In adiabatic process, adiabatic cooling accompanies expansion, and adiabatic warming accompanies compression.

Monsoon Rainfall Variability

Indian continent receives its annual rainfall by the peculiar phenomenon known as monsoon. It consists of series of cyclones that arise in India Ocean. These travel in northeast direction and enter the Peninsular India along its west coast. The most important of these cyclones usually occur from June to September resulting in summer monsoon or southwest monsoon. This is followed by a second rainy season from October to December. A third and fourth rainy seasons occur from January to February and from March to May respectively. Of the four rainy seasons, southwest monsoon is the most important as it contribute 80 – 95% of the total rainfall of the country.

Two types of monsoon systems are a) South West Monsoon, b) North East Monsoon.

(a) South West Monsoon

Beginning of the year temperature of the Indian Peninsular rapidly rises under the increasing heat of the sun. A minimum barometric pressure is established in the interior parts of the Peninsular by the month of March. Westerly winds prevail on the west Kerala and south winds on the west of northern Circars, Orissa and Bengal. During April and May the region of high temperature is shifted to north viz., upper Sind, lower Punjab and Western Rajasthan. This area becomes the minimum barometric pressure area to which monsoon winds are directed.

The western branch of South West monsoon touches North Karnataka, Southern Maharashtra and then it make its way to Gujarat. When the South West Monsoon is fully operating on the Western India, another branch of the same is acting in the Bay of Bengal. It carries rains to Burma, Northern portions of the east coast of India, Bengal, Assam and the whole of North India in general.

b) North east Monsoon

During September end, the South West Monsoon penetrates to North Western India but stays on for a full month in Bengal. On account of the increase in barometric pressure in

Northern India, there is a shift of the barometric pressure to the South East and North Easterly winds begin to flow on the eastern coast. These changes bring on heavy and continuous rainfall to the Southern and South Eastern India.

c) Winter Rainfall

It is restricted more to Northern India and is received in the form of snow on the hills and as rains in the plains of Punjab, Rajasthan and central India. Western disturbance is a dominant factor for rainfall during these months in northwestern India.

d) Summer Rainfall

The summer Rainfall is received from March to May as local storms. It is mostly received in the South East of Peninsular and in Bengal. Western India does not generally receive these rains.