

Distribution of Temperature in the Earth's Atmosphere

The interaction of insolation with the atmosphere and the earth's surface creates heat, which is measured in terms of temperature. While heat represents the molecular movement of particles comprising a substance, temperature is the measurement in degrees of how hot (or cold) a thing (or a place) is. The distribution of temperature varies both **horizontally** and **vertically**.

Heat and Temperature

- Temperature indicates the relative degree of heat of a substance.
- Heat is the energy that makes things or objects hot, while temperature measures the intensity of heat.
- Heat (energy) is the total kinetic energy of all the atoms in a substance. The more atoms present, the greater the heat.
- Temperature represents the average kinetic energy of the atoms in a substance. A few atoms with rapid motion will have a higher temperature than many atoms with slow motion.
- Although quite distinct from each other, yet heat and temperature are closely related because gain or loss of heat is necessary to raise or lower the temperature.
- The movement of heat depends upon the temperature difference between two bodies.
- Heat always moves from a body of higher temperature to that of lower temperature.
- Primarily, it is measured in the kelvin (K) unit in the study of physical sciences.
- Therefore, the temperature is most commonly measured in Celsius (C) or Fahrenheit (F) or Kelvin (K) in day to day uses. They are denoted as °C, °F and °K.

Factors Affecting the Temperature Distribution

The temperature of the air at any place is influenced by the following factors:

1. The latitude of the place;
2. The altitude of the place;
3. Distance from the sea, the air-mass circulation;
4. The presence of warm and cold ocean currents;
5. Local aspects.

Global Temperature Distribution

The temperature distribution globally can be explained in two ways:

1. Horizontal Temperature Distribution
2. Vertical Temperature Distribution

Horizontal Temperature Distribution

- The distribution of temperature across the latitudes over the surface of the earth is called its horizontal distribution.
- On maps, the horizontal distribution of temperature is commonly shown by “**Isotherms**”, lines connecting points that have equal temperatures.

What is an Isotherm?

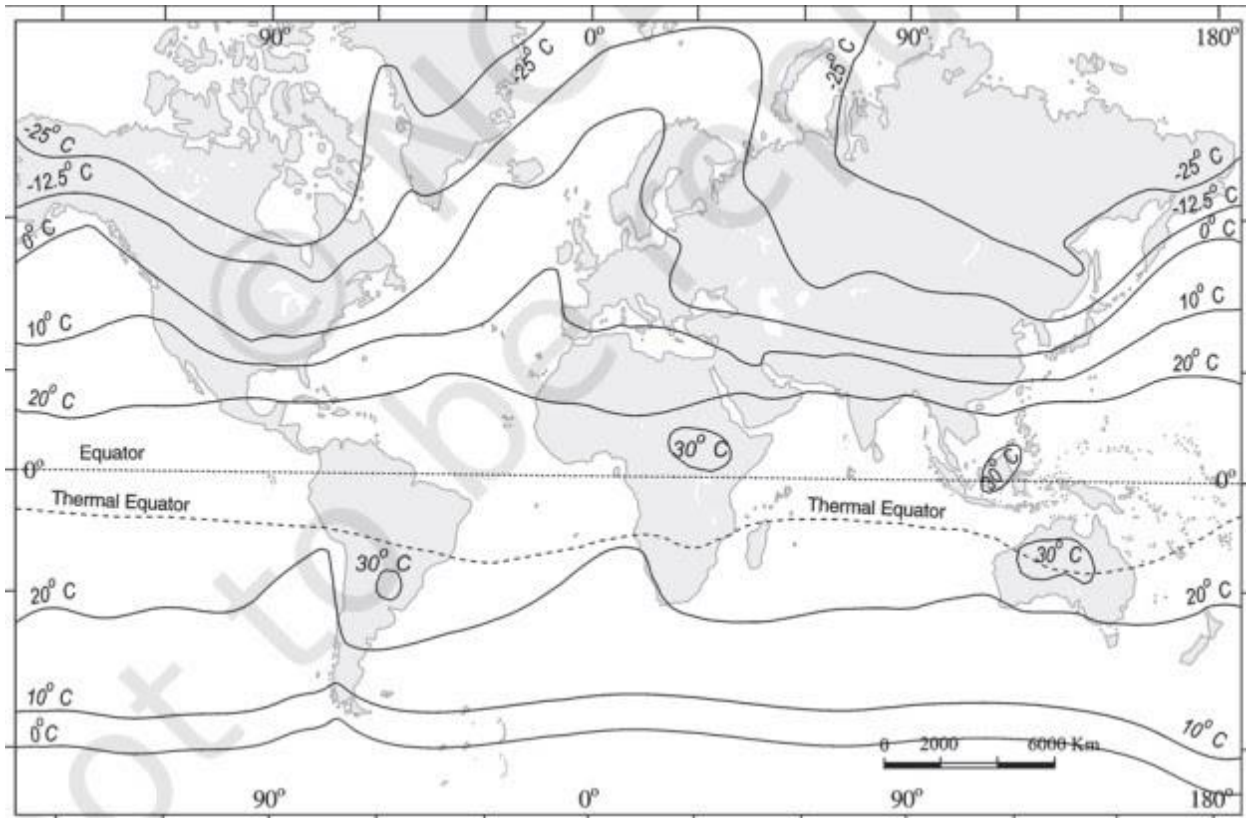
An isotherm is made of two words ‘iso’ and ‘therm’, ‘iso’ means equal and ‘therm’ means” temperature.

- In general, the equatorial region is hot, and its temperature is high throughout the year.
- Generally, from the equator to polewards, the temperature keeps on declining.
- The lowest temperature is at and near the poles.
- The horizontal distribution of temperature over the globe can be studied easily from the maps of the **January and July months** since the seasonal extremes of high and low temperature are most obvious in both northern and southern hemispheres during these months.

Horizontal Distribution of Temperature - January

- The sun is overhead at the Tropic of Capricorn by the end of the third week of December (December 21st).
- But the maximum average monthly temperature is not recorded in December, but it is so in January.
- The Entire Southern Hemisphere witnesses bright sun, greater insolation, leading to high temperature throughout.
- Both major continents – South America and Africa, are tapered towards the south. There is no wide and large landmass in Southern Hemisphere as compared to the northern.

- The maximum mean temperature of January is about 32 °C over a small area of the Western Australian desert.
- The mean January temperature along 60° E longitude is minus 20° C both at 80° N and 50° N latitudes.
- The mean monthly temperature for January is over 27° C, in equatorial oceans over 24° C in the tropics and 2° C - 0° C in the middle latitudes and -18° C to -48° C in the Eurasian continental interior.

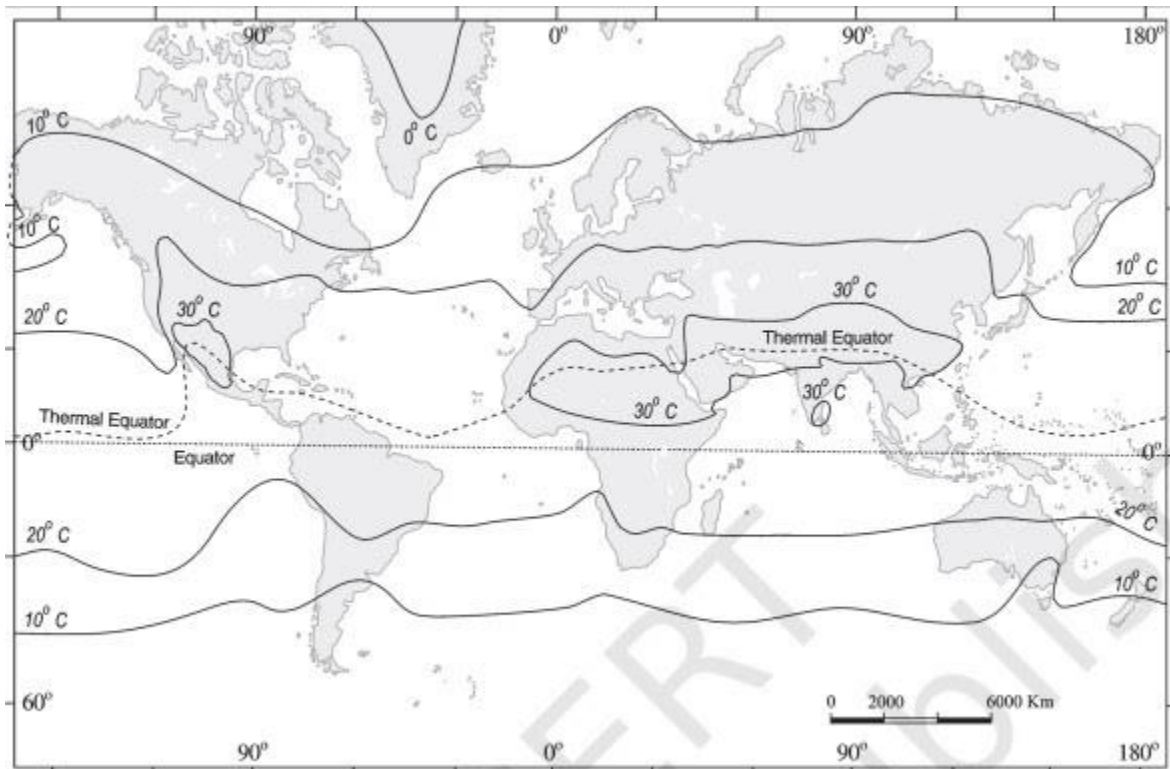


Source - NCERT

Horizontal Distribution of Temperature - July

- The sun is overhead at the Tropic of Cancer by the end of the third week of June (June 21st) at 23.5 °N.
- But the maximum average monthly temperature is not recorded in June, but it so in July.
- The entire Northern Hemisphere experiences bright sun, greater insolation, leading to high temperature throughout.
- Isotherm of 30 °C passes between 10° N and 40° N latitudes.
- In July the isotherms generally run parallel to the latitude.

- The equatorial oceans record warmer temperatures, more than 27 °C.
- The regions having this temperature include South Western USA, the Sahara, Arabia, Iraq, Iran, Afghanistan, the desert region of India and China.
- However, the lowest temperature of 0 °C is also noticed in the Northern Hemisphere during summer in the central part of Greenland.



Source - NCERT

Vertical Temperature Distribution

- Normally, temperature decreases with an increase in elevation. It is called the **normal lapse rate**.
- The average rate of temperature decrease upward in the troposphere is about 6 °C per km, extending to the tropopause.
- This is also termed as **vertical temperature gradient**.
- The normal lapse rate is not always the same, but it differs depending upon height, season, latitude or other numerous local factors.

Inversion of Temperature

- At times, the situations are reversed and the normal lapse rate is inverted. It is called Inversion of temperature.
- In other words, temperature increases with increasing height, temporarily or locally.

Distribution of Temperature in the Earth's Atmosphere - FAQ for UPSC

What is the annual range of temperature?

The difference between the average temperature of the warmest and the coolest months is known as the annual range of temperature.

Which place is called the 'cold pole' of the Earth?

Verkhoyansk in Siberia records 66°C , the highest annual range of temperature in the world. Its lowest average winter temperature is -50°C . Hence, it is aptly called the 'cold pole' of the earth.

What is solar radiation and insolation?

The sun is the primary source of energy on the earth. This energy is radiated in all directions into space through short waves. This is known as solar radiation. Incoming solar radiation through short waves is termed insolation. The amount of insolation received on the earth's surface is far less than that is radiated from the sun because of the small size of the earth and its distance from the sun.