# Temperature Distribution on Earth & Heat budget

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.
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## 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

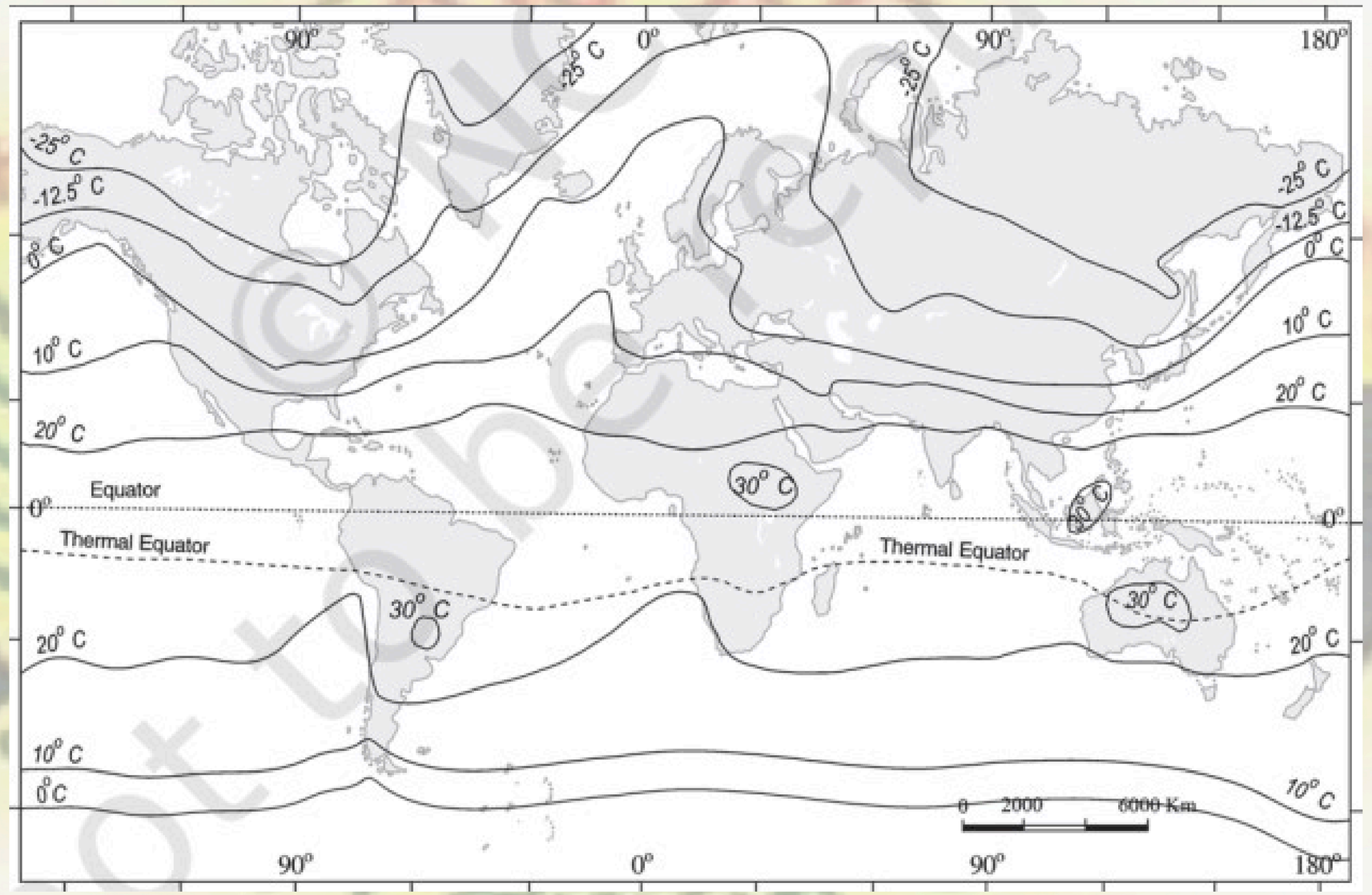
Horizontal Temperature Distribution

- 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?***

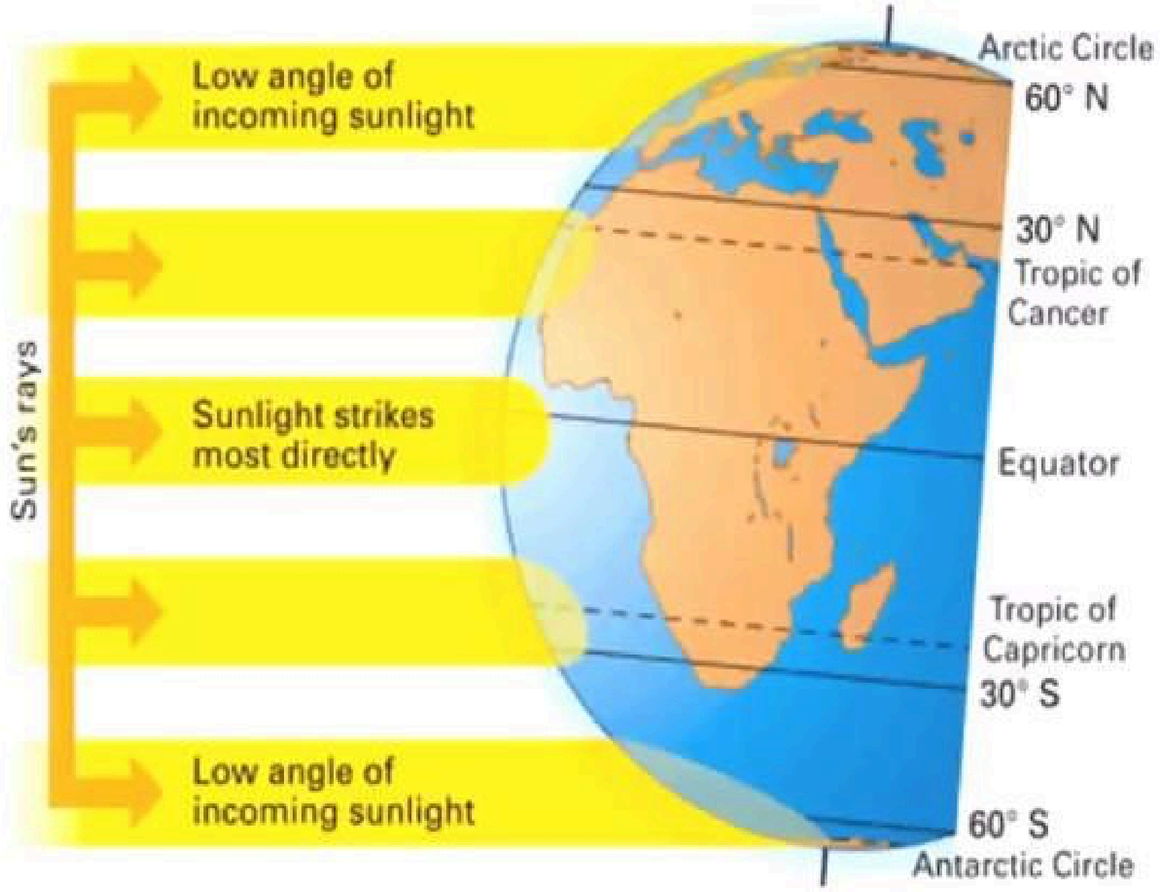
***An isotherm is made of two words, 'iso' and 'therm'. 'Iso' means equal and 'therm' means" temperature.***

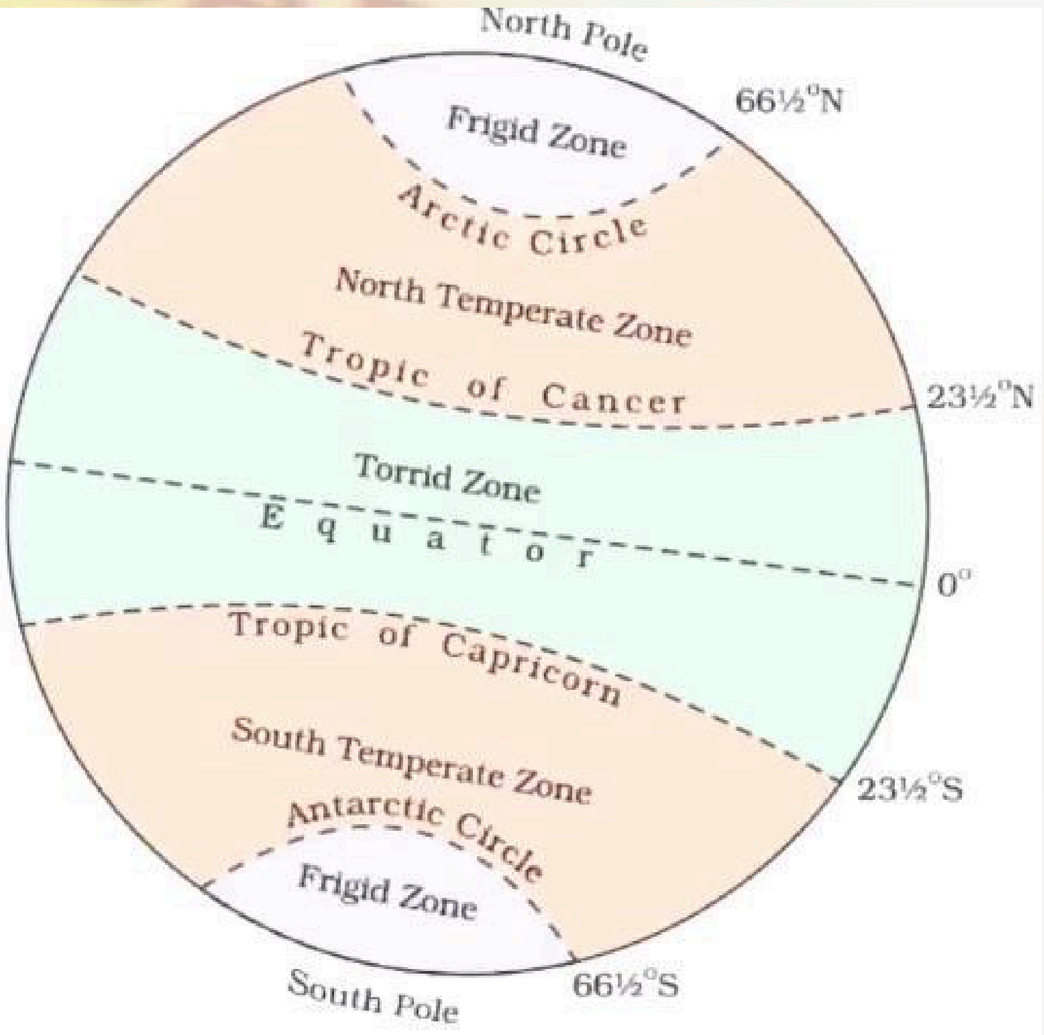
- In general, the equatorial region is hot, and its temperature is high throughout the year.
- Generally, from the equator to polewards, the temperature keeps on declining.
- The lowest temperature is at and near the poles.



## 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.



- **Heat budget of earth**

- A heat budget is a perfect balance between incoming heat (insolation) absorbed by the earth and outgoing heat (terrestrial radiation) escaping it in the form of radiation.
- If the incoming heat and the outgoing heat are not balanced, then Earth would be getting either too warmer or cooler. Since these are perfectly balanced the earth is neither too warm nor too cold.
- The equilibrium that exists between the insolation (short waves) and the terrestrial radiation (long waves) is called the **heat budget of the earth**.

- If the total insolation received at the top of the atmosphere is considered to be 100%, a certain amount of energy is reflected, scattered and absorbed while passing through Earth's atmosphere and only the remaining amount of radiation reaches the earth's surface.
- Approximately 35 units are reflected to space even before reaching the earth's surface.
- Of these, 27 units are reflected from the top of the clouds and 2 units from the snow and ice-covered areas of the earth. The reflected amount of radiation is called the **albedo of the earth**.
- The remaining **65 units** are absorbed, 14 units within the atmosphere and 51 units by the earth's surface. The earth radiates back 51 units in the form of **terrestrial radiation**.
- Of these, 17 units are radiated to space directly and the remaining 34 units are absorbed by the atmosphere
- The 48 units absorbed by the atmosphere (14 units from insolation + 34 units from terrestrial radiation) are also radiated back into space.
- Thus, the total radiation returning from the earth and the atmosphere respectively is 17+48=65 units which balance the total of **65 units received from the sun**.

- **Heat Budget Components**
- Insolation – Insolation refers to the incoming shortwave solar radiation to the earth's surface. The processes involved with insolation in maintaining heat balance include:
- Reflection – Reflection occurs when incoming solar waves bounce back from a surface that it strikes in the atmosphere, on land, or water, and are not transformed into heat.
- Absorption – Absorption of radiation involves the conversion of electromagnetic radiation into heat energy.
- Scattering – Scattering of solar waves takes place when the radiation strikes small objects in Earth's atmosphere, such as air molecules or water droplets or aerosols which disperse the solar waves in all directions.

- **Terrestrial Radiation** – Terrestrial Radiation refers to longwave radiation that is emitted by the Earth's surface or by the atmosphere. The processes involved with Terrestrial Radiation in maintaining heat balance include
  - **Latent heat transfer** – It is the amount of heat transferred during the point where one substance is ready to change its state.
  - Example: From solid to liquid or from liquid to gas,
  - **Sensible heat transfer** – It is the energy that is transferred as heat to an object, without any change in the state
  - **Emission by vapour and clouds** – Huge amounts of terrestrial radiation are also released by the water vapour and clouds.