

Weather and Climate

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Definition of weather and climate

The air (Atmosphere) is made of gases.

The Atmosphere is formed of layers such as the **Troposphere, Stratosphere** and the **Mesosphere**.

Life and weather exist within the **Troposphere**. **Weather** means the condition of temperature, wind, air pressure, humidity and precipitation that recorded in specific time (**one hour or half a day**).

Climate means the elements of weather that gathered over extended period of time, i.e. **35 years**.

Air Temperature:

The **sun** is the main source of energy on earth and it is called **solar energy**.

It is also called **solar radiation** or **insolation**.

It is transformed into **heat** at the earth's surface or the atmosphere.

Its availability depends on the **intensity** and **duration** of radiation from the sun.

The intensity is determined by the angle at which the sun's rays strike the earth.

The duration of radiation is determined by the number of daylight hours.

High solar intensity is found at the equator and decreases towards the poles.

Earth Inclination:

The earth spins on its axis which is tilted 23.5 away from the perpendicular.

Every 24 hrs the earth rotates once on its axis which results in day and night, and it is revolving around the sun in one year and this brings us the different seasons. Because of the inclination of the earth's axis, solar energy which is received at a given latitude is not the same during the course of the year. Vertical rays of the sun will be felt at lat. 23.5 N in June 21 (summer solstice of N. Hemisphere and winter solstice of S. Hemisphere). On Sept. 21 and March 21 (Equinoxes) rays of the sun strike the equator. In these days hours of day and night will be equal everywhere in the world. About December 21 rays of the sun strike near lat. 23.5 S which marks the first day of the summer solstice of the S. H. and winter solstice of the N. H.

The inclination of the earth's axis also means the length of day and night varies during the year. At the equator the daylight extends for 12 hrs. each day of the year. In the northern summer daylight becomes 24 hrs in the N. Pole and darkness becomes 24 hrs in the S. Pole.

Reflection and Reradiation:

Solar radiation is lost through reradiation and reflection. Rays of the sun come to earth as shortwave energy (**light**) and reflected back to the atmosphere as long- wave terrestrial radiation (**heat**).

Therefore, atmosphere is heated **from the ground** and not directly from the sun.

68% of the solar energy will be absorbed by the earth and atmosphere, and **32%** will be reflected back to the space and atmosphere.

Lapse rate:

It means the decrease of temp. with altitude in an average of:

6.4 C per **1000** meters, or

3.5 F per **1000** ft.

Sometimes **rapid reradiation** causes temp. to be higher above the earth's surface than at the surface itself.

This is what is called **temperature inversion**.

Air Pressure and Winds

Air is made of gases and it has a weight. One cubic inch of air with the height of 6 miles weigh **14.7lbs** or **6.67 kgs**. Areas of cold and warm air are both found on the earth surface. Since **cold** air is **heavy**, it is always descending and creates an area of **high air pressure**. Since **warm** air is **lighter** it has the tendency to ascend and creates an area of **low air pressure**.

Winds flow from the area of H.P to the area of L.P. The greater the differences in air pressure between places the greater the wind (pressure gradient force).

Convection system:

The motion of descending cool air and ascending warm air is called Convection.

A good example of a convectional system is land and sea breezes as well as mountain and valley breezes.

A - Sea breeze:

- 1- During the **day** warmer air in the land rises up and creates an area of low air pressure.
- 2- Air over the sea is cooler. Since it is heavier it descends and creates an area of high air pressure on the sea.
- 3- Therefore, wind will be moving from the area of H.P.(**Sea**) to the area of L.P.(**Land**).
- 4- This wind movement from sea to land is called **Sea Breeze**.

B- Land breeze:

- 1-During the **night** warmer air rises up over the sea and creates an area of low air pressure on the sea.
- 2-Air over the land is cooler. It descends and creates an area of high air pressure over the land.
- 3-Wind moves from the area of H.P. (**land**) to the area of L.P. (**sea**).
- 4-Such movement of wind from land to sea is called **Land Breeze**.

C- Mountain and valley breezes:

During the night heavy cold air over the snow that found at the top of mountains descends to the lower part of the valley. Therefore, the valley will be much cooler than the mountain slopes. This is called **Mountain Breeze**. **Valley Breeze** is caused by warm air moving up slopes during the day in mountainous regions.

Coriolis Effect means the wind that moves from H.P. to L.P, **deflects** to the **right** in the **N. hemisphere** and to the **left** in the **S. H**. This takes place because of the **rotation** of the earth on its axis.

Wind Belts

There are **3 main wind belts** in each Hemisphere. An example from N. H.

1- Northeast Trade Wind:

Equatorial areas are zones of L.P. Intense heat causes air to ascend creating an area of L.P. This warm air cools in the high altitudes and becomes heavy and falls in areas **30 degrees N. and S.** of the equator forming areas of H.P. This H.P. area is called **Sub-Tropical High Pressure**.

When the air of the **Sub-Tropical H. P.** reaches the surface, some of it moves towards the equator forming the NE Trade Winds (**lower latitudes 0-30 N**).

- 2- The other part of the Sub-Tropical H flows towards the pole between 30 and 60 N (**mid latitudes**) forming the second wind belt. This wind is called the **Westerlies**. The names refer to the direction from which the wind comes. Most of USA lies within this second belt.

- 3- **The 3rd wind belt** is found in the **upper latitudes** between 60 N to 90 N. It is called the **Polar Easterlies**. In this belt wind moves from the areas of **High Polar Pressure** to **Sub-Polar Low Pressure** along Latitude 60 N.

Types of Precipitation

Precipitation means water in any form (rain; snow and hail) deposited on the earth's surface.

There are three types of precipitation:

These are **Convectonal**, **Orographic** and **Cyclonic or Frontal**.

1- Convectonal Precipitation:

It results from the rising of the warm moisture-laden (warm air + water vapor) air. When it reaches higher altitudes, it cools. When it reaches the **dew point, condensation** (cloud formation) start and then followed by precipitation. This process is typical of the **summer showers** of the continental climates and the tropical storms that fall in afternoons. They are highly localized and last for a short period of time. They are also accompanied by lightning, thunder and heavy rainfall.

2 - Orographic Precipitation:

It occurs when a warm moisture-laden air is blocked by the existence of a **hill** or a **mountain**. Therefore, such air will be forced to rise. Accordingly, the process of **cooling, condensation** and **precipitation** will take place at the **Windward** side. **Dry wind** will pass over the mountain and it **doesn't bring rain** to the other side which is called **Leeward** side (**Dry side**) or **Rain Shadow**.

3- Cyclonic or Frontal Precipitation:

This type of precipitation is common in the **mid-latitudes**, where **cold** and **warm air masses** meet. Air masses are large bodies of air with similar **temperature** and **humidity**. They are formed over a **source region**, such as the cold land area of Canada (**cold** and **dry** air mass) and the tropical areas (**warm** and **humid** air mass). The leading edge of the air mass is called **Front**. When the two air masses meet together, the **heavy cold** air mass forces the **light warm** air mass to rise. The rising air forms an area of **low pressure**. With the rising warm air, the process of cooling, condensation and frontal or cyclonic precipitation occurs. This is called a **storm** or a **mid-latitude cyclone**. A cyclone may be a weak storm or one of great intensity. The **Hurricane** is an intense **tropical storm or cyclone**.

Climates of the World

The two important criteria of climatic classification are **temperature** and **precipitation**. In climate the year is divided into halves (winter and summer).

- 1- **Tropical Rain Forest** is a hot climate that receives rainfall the year round. Although it has dense forests, but it has been greatly affected by **Deforestation**.
- 2- **The Savanna** is also a hot climate that receives rainfall during the summer. Since it is rich of grasses it is also rich of animal resources. This is the climate in which farmers practice traditional farming.
- 3- **The Semi-Arid** is a hot climate that receives rainfall during the summer. The amount of rainfall allows the growth of grasses and not crops.
- 4- **The Hot Desert** is a hot dry climate. Rainfall is rare and sporadic. Trees and shrubs are found along the dry streams.
- 5- **The Mediterranean** is a hot and dry climate during the summer. The **Westerlies** are responsible for bringing rainfall in **winter**.