

# WEATHER AND CLIMATE



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# WEATHER AND CLIMATE

- The difference between climate and weather is usefully summarized by the popular phrase “**Climate is what you expect, weather is what you get.**”
- Weather and climate are meteorological terms that are related but not interchangeable.
- Over historical time spans there are a number of nearly constant variables that determine climate, including latitude, altitude, proportion of land to water, and proximity to oceans and mountains.
- These change only over periods of millions of years due to processes such as plate tectonics.

- Other climate determinants are more dynamic: for example, the thermo-haline circulation of the ocean leads to a 5 °C (9 °F) warming of the northern Atlantic ocean compared to other ocean basins.
- Other ocean currents redistribute heat between land and water on a more regional scale.
- The density and type of vegetation coverage affects solar heat absorption, water retention, and rainfall on a regional level.
- Alterations in the quantity of atmospheric greenhouse gases determines the amount of solar energy retained by the planet, leading to global warming or global cooling.
- The variables which determine climate are numerous and the interaction are complex
- While weather defines the conditions of the atmosphere over a short period of time for example, a day or week, it is climate that defines the conditions of the atmosphere over longer periods like an entire year or decade.

# ■ WEATHER

- Weather is the state of the atmosphere, or the sequence of the states of the atmosphere at any given time.
- It is the short term variations of the atmosphere in terms of temperature, pressure, wind, moisture, cloudiness, precipitation and visibility.
- Weather is highly variable.
- It is constantly changing, sometimes from hour to hour and at times from day to day.
- **According to David I Blumenstock :-“Weather is the behavior of the lower atmosphere which effects the land and oceans and have an influence of the organisms which live within them.”**
- Weather is the mix of events that happen each day in our atmosphere including temperature, rainfall and humidity.
- Weather is not the same everywhere.
- Perhaps it is hot, dry and sunny today where you live, but in other parts of the world it is cloudy, raining or even snowing.
- Everyday, weather events are recorded and predicted by meteorologists worldwide.

# ■ CLIMATE

- Climate (from Ancient Greek *klima*, meaning *inclination*) is commonly defined as the weather averaged over a long period of time.
- The standard averaging period is 30 years, but other periods may be used depending on the purpose.
- Climate also includes statistics other than the average, such as the magnitudes of day-to-day or year-to-year variations.
- The **Intergovernmental Panel on Climate Change (IPCC)** glossary definition is:
  - Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (**WMO**). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system

# CLIMATE VS WEATHER

	Climate	Weather
<b>Components</b>	Climate may include precipitation, temperature, humidity, sunshine, wind velocity, phenomena such as fog, frost, and hail storms over a long period of time.	Weather includes sunshine, rain, cloud cover, winds, hail, snow, sleet, freezing rain, floods, blizzards, ice storms, thunder storms, steady rain from a cold front or warm front, excessive heat, heat waves and more
<b>Time frame</b>	Measured over a long period of time	Measured for short term
<b>About</b>	Climate is defined as statistical weather describes the variation of weather at a given place for a specific interval.	Weather is the day to day state of the atmosphere and it is short-term(minutes to weeks) variations.
<b>Forecast</b>	By aggregate of weather statistics over a period of 30 years.	Collecting statistical data.
<b>Study</b>	Climatology	Meteorology

# ELEMENTS AND CONTROLS OF WEATHER AND CLIMATE

When studying weather or climate, the elements and controls of each are interchangeable.

## ELEMENTS

1. Temperature
2. Solar radiation
3. Air pressure
4. Humidity
5. Precipitation
6. Winds
7. Cloudiness
8. Brightness of the Sun
9. Storms
10. Visibility

## CONTROLS

1. Latitudes
2. Altitude
3. Land and water
4. Distance from land and water
5. Low and high pressure cells
6. Winds and air masses
7. Mountains barriers/Relief
8. Ocean currents

# ELEMENTS OF WEATHER AND CLIMATE

- The conditions of the atmosphere at any time or place is expressed by a combination of several elements primarily:-
  - **Temperature:-**
    - Temperature shows how hot or cold a body is.
    - Temperature is the intensity that is, as to how hot or cold the atmosphere is, how many degrees Celsius (centigrade) it is above or below freezing ( $0^{\circ}\text{C}$ ).
    - Temperature is a very important factor in determining the weather, because it influences or controls other elements of the weather, such as precipitation, humidity, clouds and atmospheric pressure.

## ➤ **Solar radiation:-**

- Solar radiation is probably the most important element of climate.
- Solar radiation first and foremost heats the Earth's surface which in turn determines the temperature of the air above.
- The receipt of solar radiation drives evaporation, so long as there is water available. Heating of the air determines its stability, which affects cloud development and precipitation.
- Unequal heating of the Earth's surface creates pressure gradients that result in wind.
- All the characteristics of climate can be traced back to the receipt of solar radiation.

## ➤ **Air pressure:-**

- Air pressure is the weight of air resting on the earth's surface.
- Air has specific weight.
- This weight exerted by the air is atmospheric pressure.
- Atmospheric pressure is defined as the force per unit area exerted against a surface by the weight of air above that surface in the Earth's atmosphere.
- It is used primarily by meteorologists to monitor developing storms that can seem to come out of nowhere.
- While typically considered an aspect of weather, certain regions of the world exist in zones where changing atmospheric pressures form a part of the predictable climate.
- Because of their proximity to large bodies of water (a major factor in atmospheric pressure changes), places like coastal regions and islands experience severe storms on a regular basis.

## ➤ Humidity:-

- Atmospheric moisture is the most important element of the atmosphere which modifies the air temperature.
- Humidity is the measurable amount of moisture in the air of the lower atmosphere.
- There are three types of humidity:-
  - a) Absolute humidity:-** The total amount of water vapor present in per volume of air at a definite temperature
  - b) Relative humidity:-** Is the ratio of the water vapors present in air having a definite volume at a specific temperature compared to the maximum water vapors that the air is able to hold without condensing at that given temperature.
  - c) Specific humidity:-** Is defined as the mass of water vapor in grams contained in a kilogram of air and it represents the actual quantity of moisture present in a definite air.

## CONT.:-

- The humidity element of weather makes the day feel hotter and can be used to predict coming storms.
- The humidity element of climate is the prolonged moisture level of an area that can affect entire ecosystems.
- For instance, tropical jungles can sustain different forms of life than dry, arid climates because of the overall humidity from rainfall and other factors.
- This is an aspect of climate rather than weather, in that the typically high humidity levels of these regions is predictable over periods of decades

## ➤ Precipitation:-

- Precipitation is the term given to moisture that falls from the air to the ground.
- Precipitation includes snow, hail, sleet, drizzle, fog, mist and rain.
- Precipitation is simply any water form that falls to the Earth from overhead cloud formations.
- As an element of weather, precipitation determines whether outdoor activities are suitable or if the water levels of creeks and rivers will rise.
- As an element of climate, precipitation is a long-term, predictable factor of a region's makeup.
- For instance, a desert may experience a storm (weather) though it remains a typically dry area (climate).

## ➤ Winds :-

- The horizontal movement of the atmosphere is called wind.
- Wind can be felt only when it is in motion.
- Wind is the result of the horizontal differences in the air pressure.
- Wind is simply the movement of air from high pressure to low pressure.
- The speed of the wind is determined by the difference between the high and low pressure.
- The greater the difference the faster the wind speed.
- Closer the isobars stronger the winds.
- The wind brings with it the temperature of the area it is coming from, therefore a high pressure in a warm region will make the temperature in the low pressure area higher.
- Wind-chill is the effect of the wind making it feel colder than it actually is.
- As the wind speed increases air is moving more quickly and therefore removes warm air therefore making it seem colder than the actual temperature.

# Cloudiness

- Clouds are suspended water in the atmosphere.
- Clouds are usually the most obvious feature of the sky
- Clouds give us a clue about what is going on in our atmosphere and how the weather might change in the hours or even days to come.
- Each type of cloud forms in a different way, and each brings its own kind of weather.
- Clouds play multiple critical roles in the climate system.
- In particular, being bright objects in the visible part of the solar spectrum, they efficiently reflect light to space and thus contribute to the cooling of the planet.
- A small increase in cloud cover could, in principle, balance the heating resulting from greenhouse gases.
- Clouds are the base for precipitation.
- In summer cloudy days provide protection from the rays of the sun.
- In winter cloudy skies at night diminish nocturnal radiation and check the fall of temperature.
- Clear calm winter nights are usually the coldest and helps in condensation.
- The amount of cloud controls the duration of sunshine, the brightness of the sky and the amount of diffused day-light.

## ➤ **Brightness of the Sun**

- The amount of sunshine at a certain place can influence its temperature.
- The amount of sunshine can be measured in sunshine hours.
- That is worked out by the number of hours of daylight and how many of these are cloud free.
- Sunshine is variable due to daylight hours as during the night there is no sunshine as the Earth is pointing away from the sun at the given spot.
- Also due to the Earth's tilt some times of the year have more sunshine (summer) and some less (winter).

## ➤ Storms:-

- Tornadoes, hail storms and fog are all examples of meteorological phenomena that are hard to predict.
- As an element of weather, these occurrences can seem random and are a result of a set of unique circumstances.
- However, some regions of the world can factor meteorological phenomena into their climate.
- For instance, the American Midwest's "Tornado Alley" (tornadoes), the Great Lakes region (lake effect snow), and places like London (fog) and Bangladesh (drastic and rapid climate changes) have these occurrences so often that they are an almost predictable part of the region's climate

# ➤ Visibility

- The most critical weather element is that of visibility.
- Critical obstructions to visibility include clouds, fog, smoke, haze, and precipitation.
- a) the greatest distance at which a black object of suitable dimensions, situated near the ground, can be seen and recognized when observed against a bright background;
- b) the greatest distance at which lights of 1,000 candelas can be seen and identified against an unlit background.
- The two distances have different values in air of a given extinction coefficient:-
  - a) is represented by the meteorological optical range (MOR).
  - b) varies with the background illumination.

## •Cont.:-

- In extremely clean air in Arctic or mountainous areas, the visibility can be up to 70 kilometres (43 mi) to 100 kilometres (62 mi).
- However, visibility is often reduced somewhat by air pollution and high humidity. Various weather stations report this as haze (dry) or mist (moist).
- Fog and smoke can reduce visibility to near zero, making driving extremely dangerous.
- The same can happen in a sandstorm in and near desert areas, or with forest fires. Heavy rain (such as from a thunderstorm) not only causes low visibility, but the inability to brake quickly due to hydroplaning.
- Blizzards and ground blizzards (blowing snow) are also defined in part by low visibility.

# CONTROLS OF WEATHER AND CLIMATE

- Climatic controls are those factors of the atmosphere that causes different weathers and climates over the surface of the Earth:-

## ➤ Latitude

- Latitude is the distance of a location from the equator.
- The hottest temperatures on Earth are found near the equator.
- This is because the sun shines directly on it for more hours during the year than anywhere else.
- As you move further away from the equator towards the poles, less sun is received during the year and the temperature become colder.

- **Cont:-**

- Latitude is the angular measurement in degrees of the distance from the equator to any location on the Earth.
- Depending on the latitude of a location determines the amount of sunlight that a location receives.
- The higher your latitude the less sunlight you will receive throughout the year, and the cooler will be your climate.
- Locations near the equator receive vast amounts of sunlight throughout the year, and as a result are warm year round. Locations near the poles get very little sunlight and as a result are cool year round.
- There is great imbalance between latitude and heat balance

## ➤ Altitude:-

- Altitude is the difference in the vertical height of the atmosphere.
- Altitude is the height you are above sea level.
- Altitude controls temperature and pressure density.
- The higher up you are the lower the temperature will be.
- The temperature decreases with altitude and this temperature phenomena is known as the Lapse Rate.
- This is because air that is higher altitudes is less dense than it is at lower altitudes and air temperature depends on its density.
- The normal lapse rate is  $6.5^{\circ}\text{C}$  per km.
- The rate of decrease of pressure with altitude is not constant.
- The rate of decrease is about .34 millibars for 300 meters of altitude.
- Different types of clouds are found at different altitudes which controls different types of precipitation.
- Jet streams are located at high altitudes and these fast moving rivers of air controls extreme and sever weather conditions.

## ➤ Land and water

- The distribution of water and land across the surface of the Earth is another important control that regulates climate.
- Water responds to temperature change much more slowly than does land.
- It takes longer to heat water, and longer for it to cool down.
- As a result, locations near the oceans experience milder changes in climate than location near the land.
- Variations in air temperature are much greater over land than over water.
- It is the differential heating of land and water that effects for the distinct types of marine and continental types of climate.

## ➤ Distance from land and water

- Sea temperature changes slower than land temperature.
- If the temperature on land drops then the area next to the sea will be kept warmer for longer than areas inland.
- Islands have a less dramatic climate than continents.
- Continents have extreme weather conditions.
- Areas located near the water bodies will have mild climates and the areas located in the interior of the continent will have severe climatic conditions.
- Different seas have different temperatures therefore allowing one side of an island to be having different temperatures than the other side.

## ➤ Low and high pressure cells

- Pressure systems have a direct impact on the precipitation characteristics of different climate regions.
- In general, places dominated by low pressure tend to be moist, while those dominated by high pressure are dry.
- The seasonal changes of precipitation is affected by the seasonal movement of global and regional pressure systems.
- Climates located at  $10^{\circ}$  to  $15^{\circ}$  of latitude experience a significant wet period when dominated by the Inter-tropical Convergence Zone and a dry period when the Subtropical High moves into this region.
- The climate of Asia is controlled by the annual fluctuation of wind direction due to the monsoon.
- Pressure dominance also affects the receipt of solar radiation.
- Places dominated by high pressure tend to lack cloud cover and hence receive significant amounts of sunshine, especially in the low latitudes

## ➤ Winds and air masses

- Air masses as a control of climate subsumes the characteristics of temperature, humidity, and stability.
- Location relative to source regions of air masses in part determines the variation of the day-to-day weather and long-term climate of a place.
- For instance, the stormy climate of the mid-latitudes is a product of lying in the boundary zone of greatly contrasting air masses called the polar front.
- Movements of air masses often result in moderate to drastic temperature changes, precipitation, thunderstorms, and sometimes tornado activity.
- If the air masses contrast greatly it can result in thunderstorms, and possible formation of tornadoes.
- All this activity is common where the tropics and arctic air masses meet.
- In the subtropical high pressure belt there is a of convergence of both polar and tropical winds.
- when polar and tropical winds meet, storms occur.

## ➤ Mountains barriers/Relief:-

- Topography affects climate in a variety of ways.
- The orientation of mountains to the prevailing wind affects precipitation.
- Windward slopes, those facing into the wind, experience more precipitation due to orographic uplift of the air.
- Leeward sides of mountains are in the rain shadow and thus receive less precipitation.
- Air temperatures are affected by slope and orientation as slopes facing into the Sun will be warmer than those facing away.
- Temperature also decreases as one moves toward higher elevations.
- Mountains have nearly the same affect as latitude does on climate.
- Mountains can often act as barriers, diverting wind and moisture, effecting the climate in the areas around it.
- The side of a mountain facing the wind will have a climate very different from that of the other side of the mountain.
- Often mountains create a vast shadow, where rain can seldom fall.
- With rainfall being blocked by vast mountain ranges, these areas become deserts.

## ➤ Ocean currents

- Ocean currents greatly affect the temperature and precipitation of a climate.
- Those climates bordering cold currents tend to be drier as the cold ocean water helps stabilize the air and do not favor cloud formation and precipitation.
- Air traveling over cold ocean currents lose energy to the water and thus moderate the temperature of nearby coastal locations.
- Air masses traveling over warm ocean currents promote instability and precipitation.

## Cont.:-

- The warm ocean currents raise the temperature of the nearby coastal regions slightly above the mean values during the winter season.
- E.g. the effect of the North Atlantic Drift on the north-western coastal areas of Europe.
- The cold ocean currents lower down the temperatures of the adjacent coastal areas.
- The effect of cold currents are more pronounced in the and in the temperate regions during the summer season.
- Currents are driven by the prevailing winds passing over the surface of the ocean.
- Therefore winds blowing from tropical areas bring warm currents and vice versa.

<b>Climatic control</b>		<b>Climatic elements</b>		
<b>Sun or latitude</b>		<b>Temperature</b>		
<b>Land and water</b>		<b>Solar radiation</b>		
<b>Low and high pressure cells</b>		<b>Air pressure</b>		
<b>Winds and air masses</b>		<b>Humidity</b>		
<b>Altitude</b>		<b>Precipitation</b>		
<b>Mountain barriers</b>	<b>Acting upon</b>	<b>Winds</b>	<b>Produce</b>	<b>Different types and varieties of weather and climate</b>
<b>Ocean currents</b>		<b>Cloudiness</b>		
<b>Distance from land and water</b>		<b>Brightness of the Sun</b>		
		<b>Storms</b>		
		<b>Visibility</b>		

# THANK YOU

