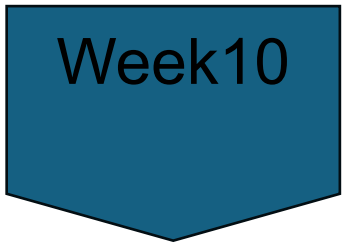
Course: Basics of Environmental Engineering (Climatology)



Main topic: Rainfall

Lecturer: RUTAYISIRE Theoneste

At the end, student will be able to,

- Understand definition of rainfall and how it is measured
- Understand how rainfall is formed
- Understand types and form of rainfall
- Understand impacts of rainfall on environment and human society.

Interactive quiz

- Q1. What is rainfall? How is rainfall measured?
- Q2. What are different types of rainfall
- Q3. What is water cycle and its relationship to rainfall
- Q4. How does rainfall impact agriculture and food production
- Q5. What are some methods for managing and conserving rainfall?

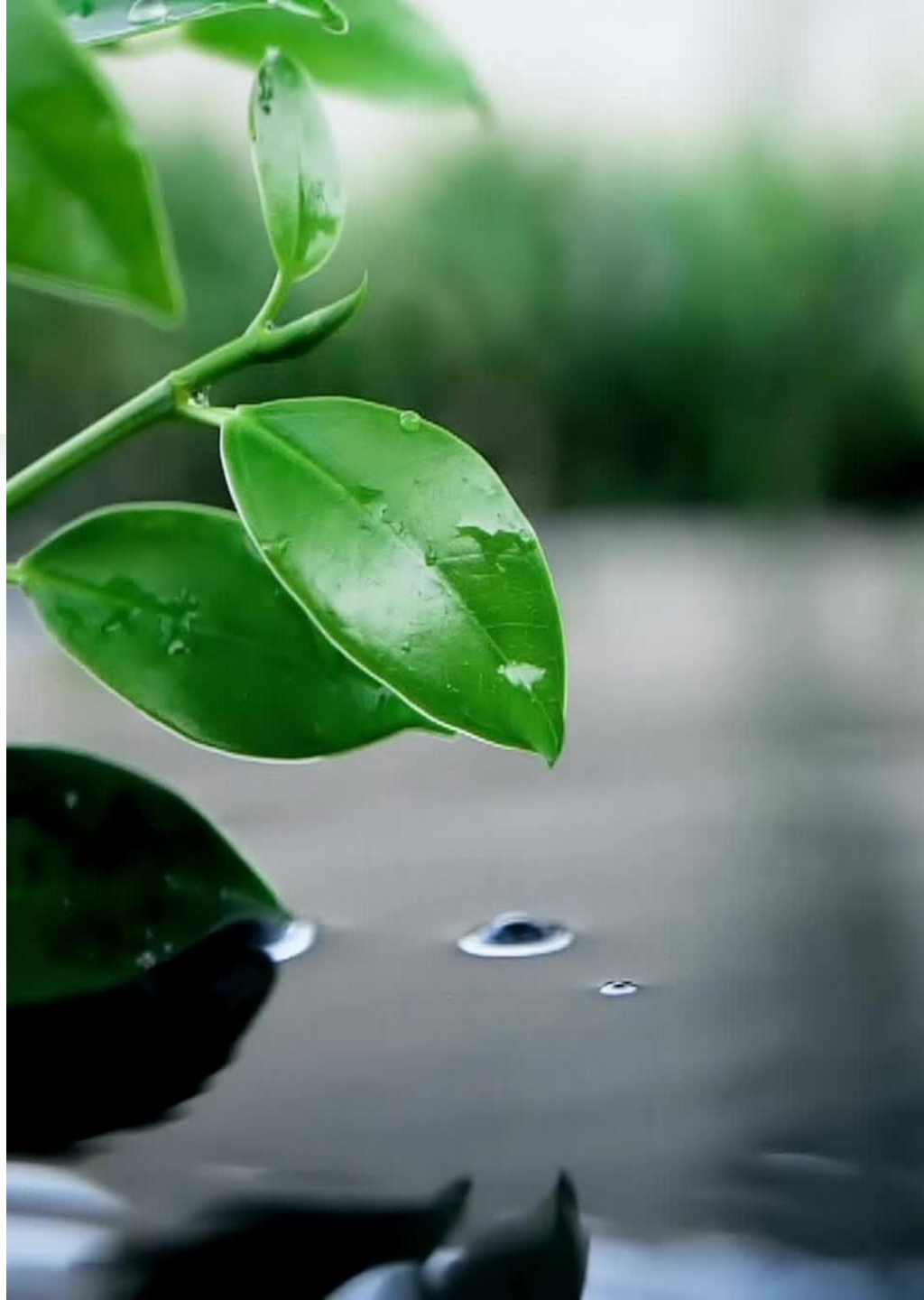


TABLE OF CONTENT

RAINFALL

- Rainfall refers to the precipitation of water in the form of droplets that fall from the atmosphere to the earth’s surface.

- Rainfall occurs when the moisture-laden air cools and condenses, leading to the formation of water droplets or ice crystals within clouds. These droplets or crystals grow in size until they become heavy enough to fall.

Rainfall intensity and how it is measured

Rainfall intensity refers to the rate at which rain falls over a specific period of time. It measured of how much rain received per unit area within a given time interval.

Rainfall intensity is typically measured in millimeters per hour(mm/hr) or inches per hour(in/hr).

There are several methods used to measure rainfall intensity including

1. Rain gauge

The most common method of measuring rainfall intensity. A rain gauge is a cylindrical container with wide opening at top and narrow collecting funnel at bottom.

https://commons.wikimedia.org/w/index.php?title=File:Rain_gauge_Jizersk%C3%A9_hory_2011_1.jpg&oldid=488724821

Tipping bucket rain gauge

They consist of funnel that collects rainwater and diverts it into small bucket. When a specific volume of water(usually 0.2 mm or 0.01 inches) is collected the bucket tip, and the water is discharged.

https://commons.wikimedia.org/w/index.php?title=File:2014-10-03_17_00_23_Eureka_Airport_AWOS_tipping_bucket_rain_gauge.JPG&oldid=873142983.

Disdrometers

Disdrometers are advanced instruments used to measure rainfall characteristics, including intensity. They use sensors, such as laser or acoustic devices, to measure the size and velocity of falling raindrop.

https://commons.wikimedia.org/w/index.php?title=File:Disdrometer_01.jpg&oldid=759530340.

Weather radar

Weather radar systems can estimate rainfall intensity by measuring the intensity of returned radar signals from raindrop or ice particles in the atmosphere. By analyzing the radar data, meteorologist can determine the intensity of rainfall over large area.

https://commons.wikimedia.org/w/index.php?title=File:Doppler_Weather_Radar_Station_on_Kailasagiri_(May_2019).jpg&oldid=850394831.

Factors that affect rainfall

The main factor that affect rainfall is the amount of moisture in the air. The warmer the air, the more moisture it can hold, and the more likely it is to produce rainfall.

Moisture in the air comes from sources such as oceans, lakes and river. The movement of air masses also plays a role in the formation of rainfall.

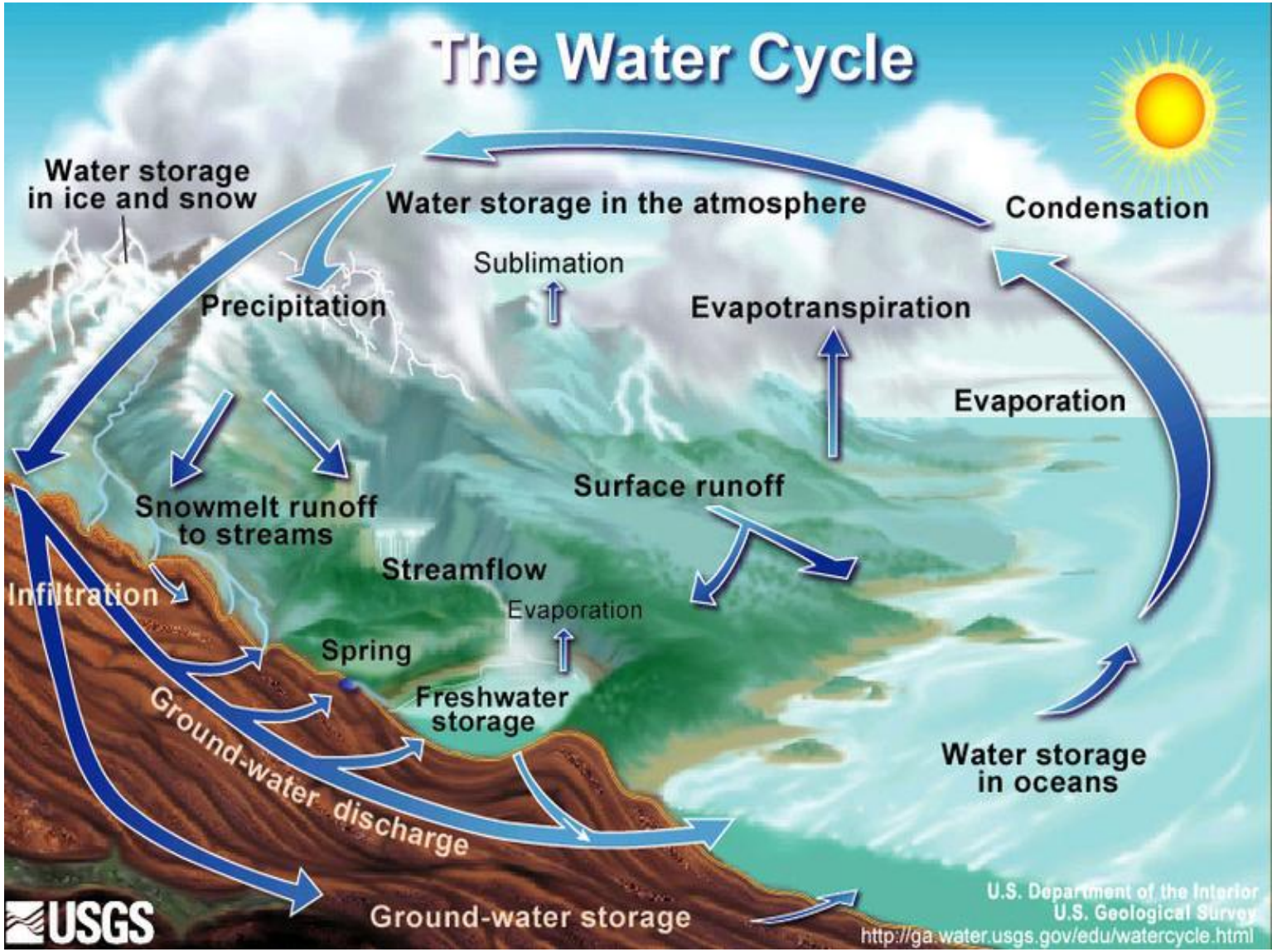
Formation of rainfall

Rainfall is formed through process called the water cycle, which involves the continuous movement of water between earth's surface and the atmosphere.

The formation of rainfall can be summarized in the following steps.

Water cycle

Water cyce is continuous movement and exchange of water between the earth's surface,the atmosphere, and back again.



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1. **Evaporation**: The process begins when the sun's heat cause water from oceans, lakes, river and other water bodies to evaporate.

2. **Condensation**: As the warm, moist air rises into the atmosphere, it start cool down.

3. **Cloud formation**: The condensed water droplets and ice crystals gather around microscopic particles in the atmosphere.

4. Coalescence: Within the clouds, water drops collide and merge together through a process called coalescence.

5. Precipitation: Once the water drops or ice crystal become too heavy for the cloud to support, they fall from the cloud as the precipitation

6.Collection: The precipitation reaches the earth's surface, where it Collects in the rivers, lakes or oceans, or it absorbed into the ground.

Different types of rainfall

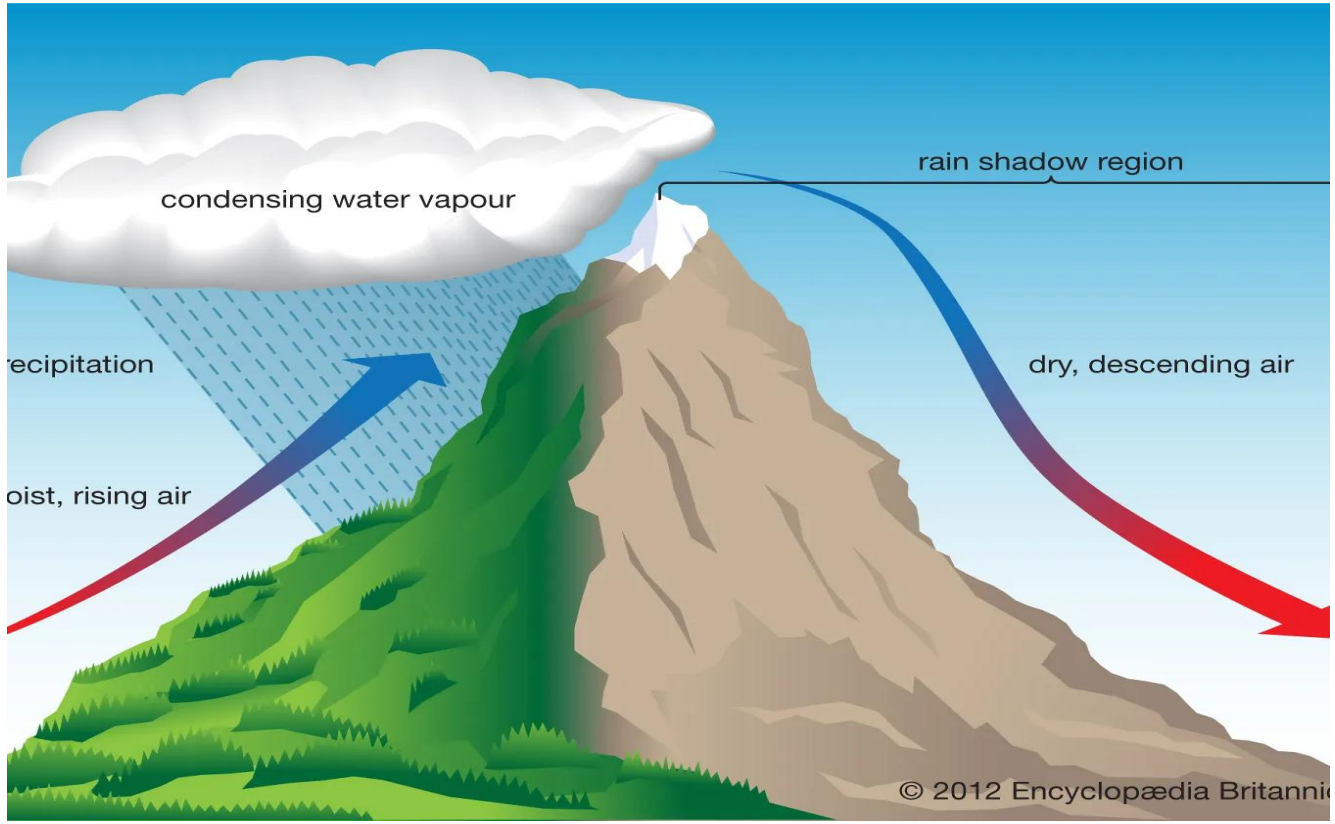
A Rainfall can take different forms depending on the temperature and other conditions in the atmosphere.

1.Convectional rainfall

It occurs when warm, moist air rises and cools, causing water droplets to condense and fall as rain.

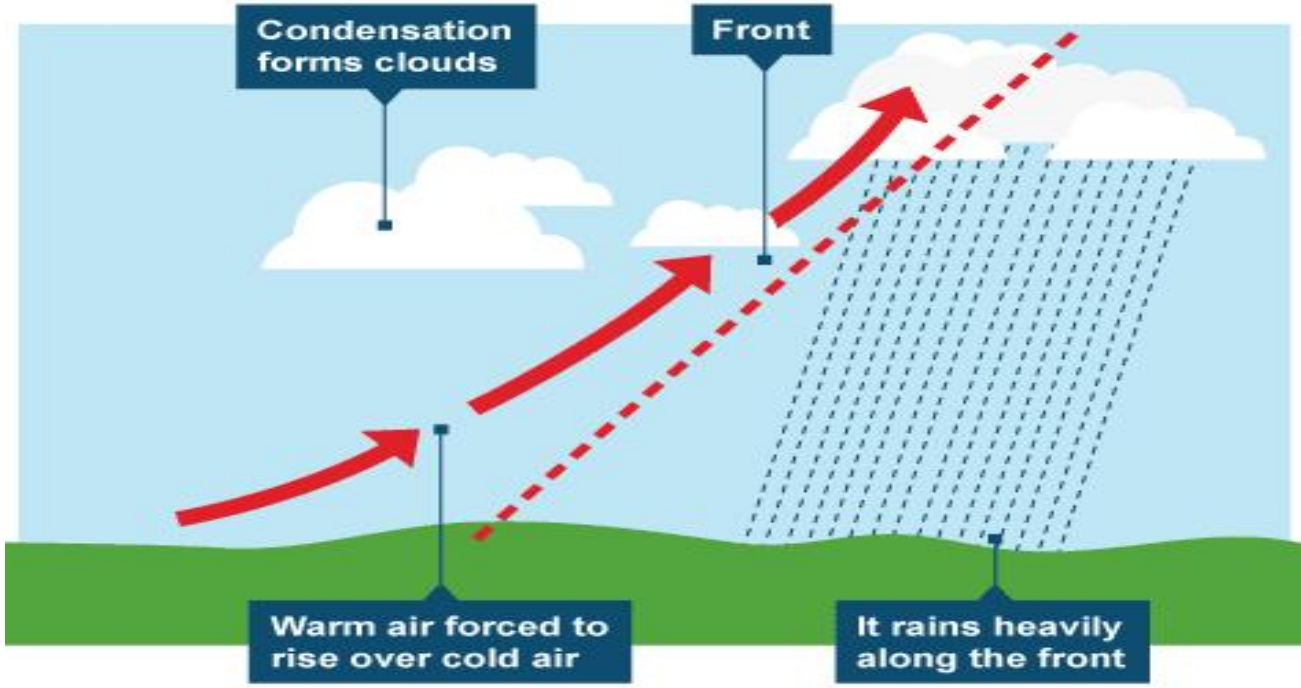
2.Orographic rainfall

It is also known as relief rainfall. It occurs when air is forced to rise over a mountain or hills, causing it to cool and condense into rain and the condensed water droplets became large enough fall as rain



3. Frontal rainfall

It is also known as cyclonic rainfall. It occurs when two air masses with different temperature and moisture content collides. Fronts are boundaries between air masses and they can be either warm or cold fronts.



Form of rainfall

Rainfall can take different forms depend on the temperature.

- Liquid form: Rain, drizzle and shower
- Solid form: Snow and hail
- Mixed form: Sleet and glaze

Liquid form

1. Rain

It is defined as precipitation of solid of drops of liquid water. The cloud consists of minute droplets of water and when these droplets combine and form large drops and can’t remain suspended in the air they fall down as rain.

2. Drizzle: It is more or less uniform precipitation of very small and minute rain drops. These drops can be carried away even by light winds.

https://commons.wikimedia.org/w/index.php?title=File:Mist_falls_into_Kumealon_Inlet.webp&oldid=690335647

3. Shower: It is the precipitation lasting for a short time with relatively clear intervals.

Solid form

1. **Snow**: It occurs when only condense medium has a temperature were below freezing temperature.

https://commons.wikimedia.org/w/index.php?title=File:Snow_Scene_at_Shipka_Pass_1.JPG&oldid=862591913

1. **Hail**: Is a precipitation of solid ice falls from cumulonimbus clouds and is often associated with thunder and storm.

https://commons.wikimedia.org/w/index.php?title=File:August_5_2017_Warwickshire_hail_02.jpg&oldid=807384576

Mixed form

1. **Sleet:** It is simultaneous precipitation of the mixed of rain and snow. Occasionally, half frozen drops also fall as sleet forms when drops are frozen as the fall through a layer of cold air.

1. **Glaze**: This is formed at sub-freezing temperature when rainfall on object or ground. It looks like sheets or coat.

Positive impacts on environments and human society

- Rainfall provides water for agriculture, which is essential for the production of the food crop.
- Rainfall also replenishes ground water which is used for drinking water and irrigation.
- Rainfall can help to control air pollution by washing away particle from the atmosphere.

- Forest which are some of the most biodiverse ecosystems on the earth depend on rainfall for the survival.

- The amount of rainfall in an area can affect the types of plant and animals that can survive there. For examples plants that require a lot of water such as tropical rain forest plants can not survive in areas with low rainfall.

- Some animals, such as amphibians and fish, rely on rainfall to create habitats in the ponds and stream.

- Rainfall can also have culture and social impacts. In many cultures, rainfall is associated with fertility and abundance, and is often cerebrated in ritual and ceremonies. For example, Indian, the monsoon season is cerebrated with festival such as Raksha Bandhan.

Negative impacts of rainfall on environments and human society

- Flooding can cause significant damage of infrastructure, homes and crops. It can also result in the loss of lives, displacement of people and spread of waterborne diseases.

- Intense rainfall can cause soil erosion. When rain falls at high rates, it can wash away the soil, which is rich in nutrients necessary for plant growth.

- Heavy rainfall can trigger landslides, especially in hilly or mountainous areas with unstable slopes

- Heavy rainfall can disrupt daily life by causing transportation delays, road closures, and power outages.

- Rainfall can contribute to water pollution by carrying pollutant from atmosphere, such as chemicals, fertilizer and pesticides into water bodies.
- Excessive or poorly timed rainfall can damage crops.
- Excessive rainfall can lead to flooding, especially in an area with poor drainage systems or in regions prone to heavy rainfall.

Management and conservation of rainfall

Rainwater harvesting: This involves capturing and storing rainfall
For later use. They use techniques such as rooftop collecting system
rain barrels, large-scale storage tanks.

Watershed management: This focus on preserving and restoring the health of
entire rivers basins or watersheds

Soil conservation: health soils with good water holding can maximize rainfall retention.
techniques such as plowing, terracing, and mulching help prevent soil erosion.

Conclusion

Rainfall is an essential component of our environment, affecting everything from agriculture and water resources to human society and culture. Understanding rainfall patterns, influences and impacts is important for managing our water resources and preparing for future changes in our climate.

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