



GHGs, Rainfall and Climate Change

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Why in News?

A recent study has revealed that unprecedented **increase in greenhouse gases** can **decrease rainfall** in the **equatorial region**.

- This can further lead to replacement of [India's biodiversity hotspots](#) consisting of [evergreen forests](#) in the [Western Ghats](#), **northeast India** and the [Andamans](#) into **deciduous forests**.

What has the Recent Study Revealed?

- **About:**
 - The study pointed out the impacts of **increased greenhouse gases**, specifically high levels of atmospheric **carbon dioxide**, on rainfall patterns and vegetation in equatorial regions.
 - The study used **fossil pollen** (from **Lignite Mine** of Kutch) and **carbon isotope** data from the **Eocene era (54 million years ago, a period of global warming)**.
 - The study used data from **deep time hyperthermal events** that are considered potential analogs for future climate predictions.
 - **Extreme climate warmth (hyperthermal) events** through **deep-time (geological time)** offer insights into how the Earth may respond to present-day warming related to **greenhouse gas emissions**.
- **Impact on Rainfall and Vegetation Shifts:**
 - During the Eocene era, when atmospheric CO₂ concentrations exceeded 1000 parts per million by volume (ppmv) near the equator, there was a significant **decrease in rainfall** which led to increase in **deciduous forests**.
- **Relevance to Current Climate Change:**
 - The study draws parallels between past climatic conditions (Eocene era) and potential future scenarios under **increased greenhouse gas emissions**.
 - Insights from the study may contribute to **strategies for mitigating the impacts of climate change** on rainforests and other sensitive ecosystems.

What is Previous Evidence of Climate Change?

- Geological records document alternating periods of **glacial and warmer inter-glacial phases**.
- In the distant geological past, approximately **500-300 million years ago** during the **Cambrian, Ordovician, and Silurian periods**, Earth's climate was notably **warmer**.
- During the **Pleistocene epoch**, the Earth underwent cycles of glaciation and interglacial periods, with the last major glacial peak occurring around **18,000 years ago**. The current interglacial period began approximately **10,000 years ago**.
- The most recent glacial period spanned from about **120,000 to 11,500 years ago**. Since then, Earth has been in the interglacial period known as the [Holocene epoch](#).
- In regions with high **altitudes and latitudes**, geological features and sediment deposits bear evidence of the advance and retreat of glaciers indicating fluctuations between **warm and cold periods**.

- **Glacial periods** are characterised as **colder, dustier, and generally drier** compared to interglacial periods. These cycles of glaciation and inter-glacials are discernible in numerous paleoclimate records from both **marine and terrestrial environments** worldwide.
- **Interglacial periods** tend to occur during periods of peak solar radiation in the Northern Hemisphere summer.
- **Indian Context:**
 - India also witnessed alternate **wet and dry periods**.
 - Archaeological findings show that the Rajasthan desert experienced **wet and cool climate** around **8,000 B.C.**
 - In the period **3,000-1,700 B.C.** the region had higher rainfall after which the dry conditions prevailed.

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Geologic Time Scale

Eon	Era	Period	Epoch	MYA	Life Forms				
Phanerozoic	Cenozoic (CZ)	Quaternary (Q)	Holocene (H)	0.01	Age of Mammals	Extinction of large mammals and birds Modern humans			
			Pleistocene (PE)	2.6					
		Neogene (N)	Pliocene (PL)			5.3	Spread of grassy ecosystems		
			Miocene (MI)						
			Oligocene (OL)						
		Paleogene (PG)	Eocene (E)	33.9		Early primates			
			Paleocene (EP)						
							66.0	Mass extinction	
		Mesozoic (MZ)	Cretaceous (K)	145.0		Age of Reptiles	Placental mammals		
	Jurassic (J)		Early flowering plants						
	Triassic (TR)		Dinosaurs diverse and abundant						
			201.3	Age of Reptiles	Mass extinction First dinosaurs; first mammals Flying reptiles				
					251.9	Mass extinction			
	Paleozoic (PZ)	Permian (P)	298.9	Age of Amphibians			Coal-forming swamps Sharks abundant First reptiles		
		Pennsylvanian (PN)							
		Mississippian (M)							
		Devonian (D)							
				419.2	Fishes	Mass extinction First amphibians First forests (evergreens)			
				443.8	Fishes	First land plants Mass extinction			
		485.4	Marine Invertebrates	Primitive fish Trilobite maximum Rise of corals					
		485.4	Marine Invertebrates	Early shelled organisms					
		541.0			Complex multicelled organisms				
Proterozoic					Simple multicelled organisms				
		Precambrian (PC, W, X, Y, Z)	2500						
Archean			4000		Early bacteria and algae (stromatolites)				
Hadean			4600		Origin of life				
				4600	Formation of the Earth				



UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims:

Q. Human activities in the recent past have caused the increased concentration of carbon dioxide in the atmosphere, but a lot of it does not remain in the lower atmosphere because of ? (2011)

1. its escape into the outer stratosphere.
2. the photosynthesis by phytoplankton in the oceans.
3. the trapping of air in the polar ice caps.

Which of the statements given above is/are correct?

- (a) 1 and 2
(b) 2 only
(c) 2 and 3
(d) 3 only

Ans: (b)

Q. Which of the following phenomena might have influenced the evolution of organisms? (2014)

1. Continental drift
2. Glacial cycles

Select the correct answer using the code given below:

- (a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

Ans: (C)

Mains:

Q. How do the melting of the Arctic ice and glaciers of the Antarctic differently affect the weather patterns and human activities on the Earth? Explain. (2021)