BENEVOLENT IAS ACADEMY

#1626-A,Sri Vinayaga Complex, Hope College,
Peelamedu (PO), Coimbatore – 641004.
Cell: +91-9787731607, 9787701067
Web: www.benevolentacademy.com. E-Mail: benevolentacademy@gmail.com

TODAY'S IMPORTANT CURRENT AFFAIRS UPSC

. Date: 27.09.2024

Global Warming and Its Impact on Forecasting

Source: The post is based on the article published in **"The Hindu"** on **27th Sep 2024**.

In News: The record warming of 2023-2024 is offering a clearer view of the impacts of global warming. The range of extreme events experienced globally has spanned from deadly heatwaves to devastating cyclones and floods, as well as droughts and wildfires.

Syllabus: _Mains – GS III (Environment &Ecology)_

Unexpected Trends in 2023-2024:

➢ Meteorologists predicted the **2023 El Niño** but were surprised by the extreme warming in 2023-2024.

➢ Factors such as the Hunga Tonga volcanic eruption and **CO_2 emissions** from wildfires intensified warming.

➢ The 2023 monsoon was erratic, with some regions experiencing droughts while others faced floods and landslides.

Global Warming and Temperature Rise:

❖ Global warming is driven by **greenhouse gases (GHGs)** like **CO2 and CH4**.

❖ GHGs trap heat, leading to higher global temperatures.

❖ Earth's average temperature has risen by **1°C** since the late **19th century.**

❖ 2023-2024 witnessed unprecedented temperature increases, with global temperatures 61°C above pre-industrial levels.

India's Warming:

- India's warming is below the global average.

- Indian temperatures increased by **7°C** since **1900,** while global land temperatures rose by **1.59°C.**

Impact of Warming on Predictability:

➢ Global warming has led to unpredictable weather patterns, making forecasts more difficult.

➢ Current models fail to reproduce monsoon trends over the last 50 years and are considered unreliable for the future.

➢ The record warming of 2023-2024 highlights the unpredictability of climate systems under **global warming**, complicating forecasts for natural phenomena like **El Niño, monsoons,** and **hurricanes**.

➢ Warming may extend the timescale of natural decadal variability, making it harder to distinguish between short-term fluctuations and long-term trends in climate behaviour.

➢ Despite advances, climate models are imperfect in capturing changes in dominant climate modes due to warming, leading to inconsistencies in predicting events like monsoon trends.

Types of Climate Models to forecast the weather:

General Circulation Models (GCMs): These models simulate the physics of the climate system by representing the interactions between the atmosphere, oceans, land, and ice. They divide the Earth into a three-dimensional grid and calculate climate variables like temperature and humidity in each grid cell.

Earth System Models (ESMs): An advanced subset of GCMs that includes biogeochemical cycles, allowing them to simulate interactions between climate and ecological processes, such as carbon and nitrogen cycles.

Regional Climate Models (RCMs): These focus on smaller geographic areas to provide more detailed climate projections by using outputs from GCMs as inputs for localized simulations.

Integrated Assessment Models (IAMs): These combine climate science with socioeconomic factors to analyze how human activities influence climate change and to project future emissions scenarios.

Challenges in Forecasting Extreme Weather:

Uncertainties:
Weather systems are chaotic, so small changes in initial conditions can lead to big differences in predictions. This is known as the butterfly effect.

Unforeseen factors:
New factors, like the impact of the Hunga Tonga volcano or wildfire-induced CO2 emissions, can make warming worse in ways that models can't predict.

Data scarcity:
A lack of data, especially for rare events, can make it difficult to develop accurate models.

Outdated infrastructure:
Outdated or insufficient observational infrastructure, like early warning systems, can make it harder to forecast extreme weather.

Hyper-locality:
The ability to forecast weather at a hyperlocal level is limited by the size of the grid used.

Rapid climate change:
Rapid climate change is having a significant impact on forecasting capabilities.

Future of Weather Prediction Models:

AI-powered models:
AI-powered models are expected to improve the accuracy of weather forecasts and help predict extreme weather events and long-term climate changes. Some models, like Google DeepMind's GraphCast, are already able to predict weather in seconds and outperform 90% of the world's best weather prediction systems.

Hybrid approaches:
Experts believe that the future of weather prediction will involve a combination of deep learning and physics-based approaches. This is because pure machine learning approaches have some limitations, such as the inability to account for rare but extreme weather events.

Integration with other technologies:
Future weather prediction models may integrate with IoT devices, satellite data, and quantum computing.

Fine-tuned models:
Some companies are developing ML models that are fine-tuned for specific use cases, such as energy trading and insurance

Way forward:

- ✓ Invest in improving climate models with cutting-edge technologies like AI, machine learning, and advanced sensors to increase the accuracy of short-term forecasts and better capture the impact of natural variability under warming.

- ✓ Develop robust, hyperlocal early warning systems to better prepare for extreme weather events, focusing on disaster management and reducing vulnerabilities in high-risk communities