Environment Class 10

7th March, 2024 at 9:00 AM

IMPACT OF CLOUDS (09:09 AM)

- Clouds can have both warming and cooling effects on the climate.
- Climate change can lead to changes in the coverage altitude and reflectivity of the cloud.
- These changes can either **amplify or dampen** the original change.

IMPACT OF AEROSOLS

- Aerosols are microscopic solid or liquid particles that are so small they **remain suspended** in the air from days to weeks.
- The effect of aerosols varies, most of the aerosols can have a cooling effect as they reflect more sunlight.
- But some aerosols such as **black carbon (soot).**

RADIATIVE FORCING

- It is defined as changing the earth's heat balance due to some external change.
- It is measured in **watts/m^2.**
- E.g. The increased amount of **CO_2/CH_4 has positive radiative forcing** which means more heat is incoming than outgoing.
- Some factors are negative radiative forcing aerosols in the atmosphere.

CAUSES OF CLIMATE CHANGE (09:31 AM)

- In past also climate change has occurred.
- Many natural processes can contribute to climate change.
- **i. Variation in solar activity:** The measurements shown from the last few decades do not point to any net increase in solar activities.
- **ii. Milankovitch Cycle:** Earth's orbit and its axis of rotation are not fixed. This cycle includes:
- a. The shape of the earth's orbit is determined by eccentricity. This changes in about 100,000-400,000 years.
- The axial tilt changes from **21.5 degrees to 24.5 degrees.**
- These cycles cannot explain the rapid warming.
- **Volcanic activity:** They can release large CO_2, but they also release SO_2, aerosols which can contribute to global cooling.
- This is why Scientists can say with high certainty that the current increase in temperature is mostly anthropogenic.
- **Global Warming Potential**
- GWP of a gas refers to the **total contribution to global warming** resulting from the emission of one unit of that gas relative to one unit of reference gas which is taken as CO_2 for a duration of time.
- **The GWP of carbon dioxide is defined as 1.**
- **Baseline Year:**
- Researchers calculate the average increase in temperature based on a baseline year which is taken as 1850-1900.
- This represents **pre-industrial temperature.**
- Compared to pre-industrial temperature the average temperature increase has been about 1.2 Degrees Celsius.

- **Key Greenhouse Gases:**
- **CO_2 Sources:**
- Burning of Coal, Natural Gas, and Diesel.
- Industry: Many industrial processes emit CO_2 for fossil fuel consumption. E.g. Cement, Iron and Steel industry, etc.
- **Mitigation:**
- Renewable Energy Sources
- Afforestation
- Decarbonisation of the transportation sector.
- Behavioural Changes: Use of Public Transport
- Energy Efficient equipment
- Carbon Tax
- Carbon offset
- **Carbon Capture, Utilization, and Storage (CCUS)**
- The atmospheric CO_2 concentration has increased from 280 parts per million (pre-industrial level) to 421 PPM in 2022.
- **Methane (CH_4) Sources**
- The average concentration of methane has increased from 720 ppm to 1900 ppm.
- It is emitted by natural sources also such as **natural wetlands, termites, volcanoes, and wildfires.**
- About 60 percent of emissions are anthropogenic.
- Out of total anthropogenic emissions, 60 percent is because of agriculture and livestock farming, 20 percent is because of waste and the remaining is mostly because of the energy sector.
- Certain types of crops such as rice, are a large source of methane emission.
- **Domestic livestock** produce methane as part of the digestive process. These are called **ruminant animals.**
- They have a large stomach within which microbial fermentation in anaerobic conditions releases methane.
- The animal manure stored in holding tanks also released methane.
- Methane is generated in **landfills** as waste decomposes.
- Energy and Industry: These are a major source and it is emitted during production, processing, storage and transmission of natural gas.
- **Coal mining** is another source of methane emission
- **MItigation (10:38 AM)**
- Change in cropping pattern.
- Modification to animal feeding practices.
- Upgrading the equipment to prevent leakages from the energy sector and industrial emissions.
- Better manure management and waste management practices.
- Methane has a relatively smaller life and within a decade or two it oxidizes to CO2.

NITROGEN DIOXIDE (11:03 AM)

- The average concentration of N_20 has increased from 270 ppm to 330 ppm.
- It can be released naturally as part of the nitrogen cycle.
- About 50 percent is anthropogenic and major sources are:
- **Use of Synthetic and Organic fertilisers**
- Burning of agricultural residue.
- A byproduct of nitric acid and adipic acid production.
- Nitric acid is used to make synthetic fertilisers and adipic acid is used to make fibres such as nylon.
- Fuel combustion can release nitrous oxide.
- Treatment of domestic wastewater.
- **Mitigation**
- Efficient use of Nitrogen-based fertilisers.
- Technological upgrades to prevent leakages from the industry.
- Selective Catalytic Reduction in Vehicles to reduce nitrogen oxide into nitrogen.
- **N_2O has a lifetime of more than 100 years.**

CHLORINATED GASES (11:16 AM)

- a. CFCs - Chlorofluorocarbons
- b. HCFC - Hydrochlorofluorocarbons
- c. HFCs - Hydrofluorocarbons
- d. Sulphur hexafluoride (SF6)
- e. Nitrogen trifluoride (NF3)
- **HFCs - Hydrofluorocarbons:**
- GWP can be 14800 and atmospheric life could be 270 years. They are used as refrigerants.
- They are used as aerosol proponent, solvents, and fire retardants.
- Perfluorocarbons
- They are produced as a byproduct in aluminium production and they are also used in semiconductors.
- It has an atmospheric life of up to 50,000 years.
- **Sulphur hexafluoride (SF_6)**
- GWP of 22800 and atmospheric lifetime of 3200 years.
- It is used in magnesium manufacturing, semiconductor manufacturing, insulating gas, and circuit breakers.
- **Nitrogen trifluoride (NF_3)**
- GWP of 17200, and atmospheric life of 740 years.
- This is used in semiconductor manufacturing.
- All of these are 100 percent anthropogenic in nature.
- **Mitigation:**
- Recycling
- Destruction of the gases
- Finding suitable alternatives
- In terms of emissions by country, china is the largest emitter followed by the US.
- In terms of per capita emission India's contribution is much less.

IMPACT OF CLIMATE CHANGE (11:45 AM)

- The **cryosphere** comprises parts of the earth which is **frozen**. E.g. **Snow, Ice Glaciers, Ice sheets, Permafrost.**
- The cryosphere is affected in many ways due to climate change.
- Because of accelerated melting, we are witnessing sea level rise and altered water supply among others.
- **Reduced Sea Ice:** Both the extent and thickness of the Arctic Sea have decreased river recent decades.
- Regulating planet's temperature because of high albedo.
- Because of Ice-albedo feedback, the Arctic is witnessing accelerated warming.
- **Permafrost Thawing:**
- Rising temperatures can cause permafrost to thaw releasing CO2, Methane which can further accelerate global warming.
- The impact of global warming on the Arctic and the Antarctic is not the same.
- The Arctic has witnessed rapid warming and the western Antarctica ice sheet is dintegrating because of global warming.
- Eastern Antarctica has shown resilience, the **difference in the impact on the Arctic and the Antarctic is because of the following:**
- - The Arctic is an ocean surrounded by the continents.
- - The Antarctic is a continent surrounded by the Southern Ocean.
- -Thus the **differential heating of land and water** plays an important role.
- - The Antarctica central plateau is at a high altitude which means colder temperature.
- While arctic sea level nature makes it more susceptible to warming.
- The antarctic **circum-polar current,** a cold current, flows around Antarctica and somewhat **isolates it from other ocean basins** which limits the exchange of heat.
- The **polar vortex** at Antarctica is much stronger.

The topic for the next class: Impact on the Himalayas, Steps to tackle climate change