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**M.Sc. Semester II & IV
Core Course (CC-5): Environmental Science &
Elective Paper (EC-IC)**

Topic: Global Warming

GLOBAL WARMING

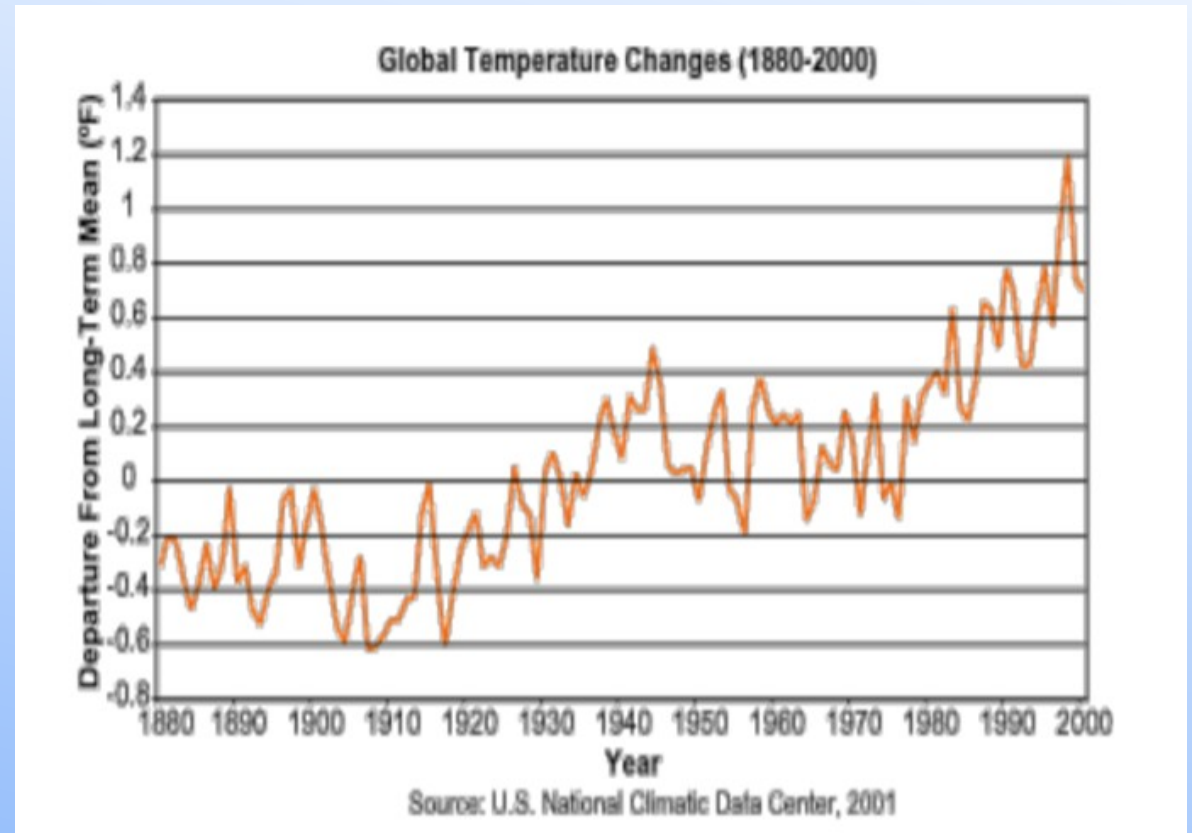


WHAT IS GLOBAL WARMING?

An increase in the average temperature of the Earth's atmosphere and oceans.

Global temperature on both land and sea increased by $0.6 \pm 0.2^{\circ}\text{C}$ over the past century.

Volume of atmospheric carbon dioxide increased from 280 parts per million in 1800 to 367 in 2000, a 31% increase over 200 years.



WHAT ARE THE CAUSES OF GLOBAL WARMING?

Man-made causes



Natural causes

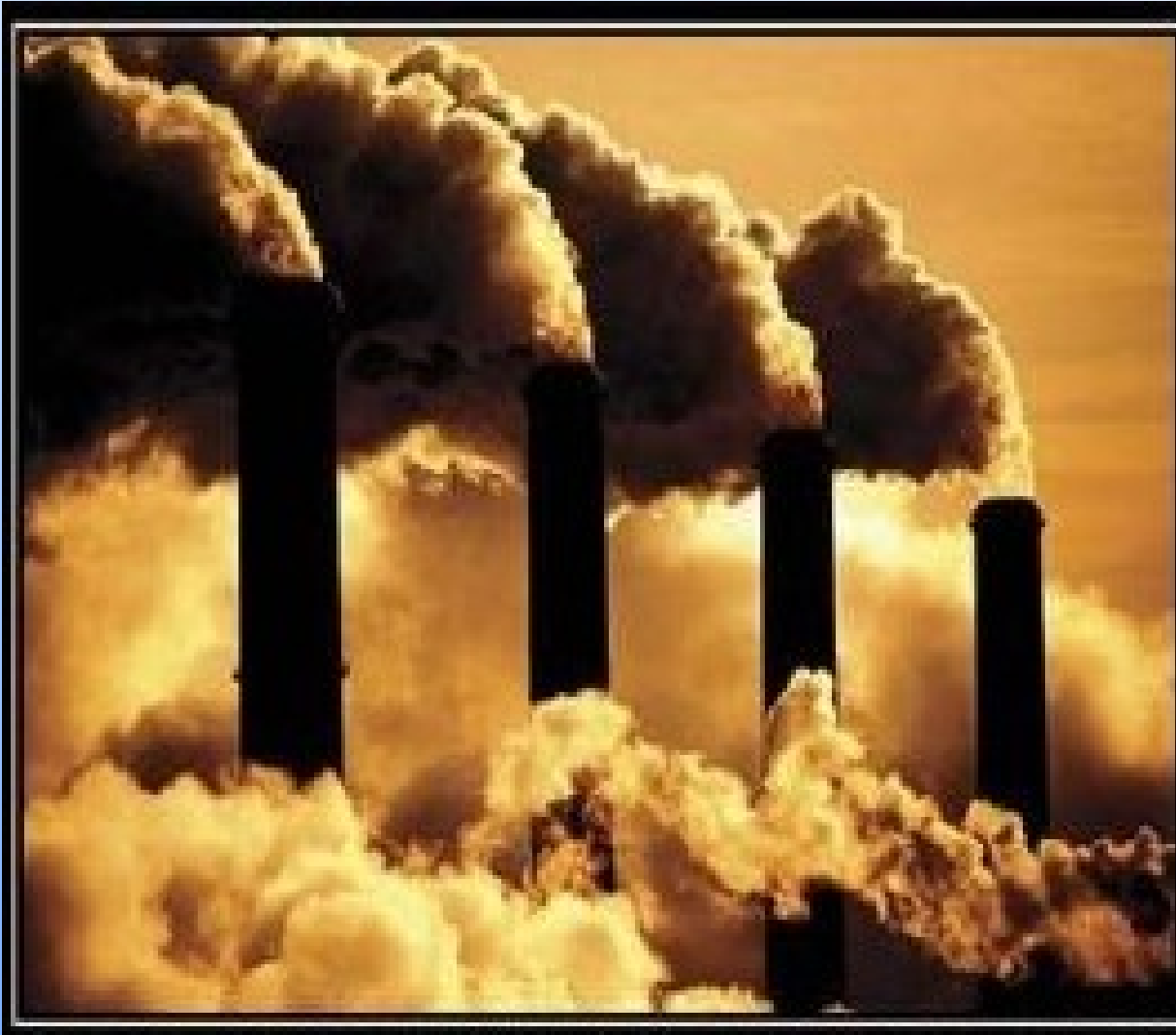


NATURAL CAUSES



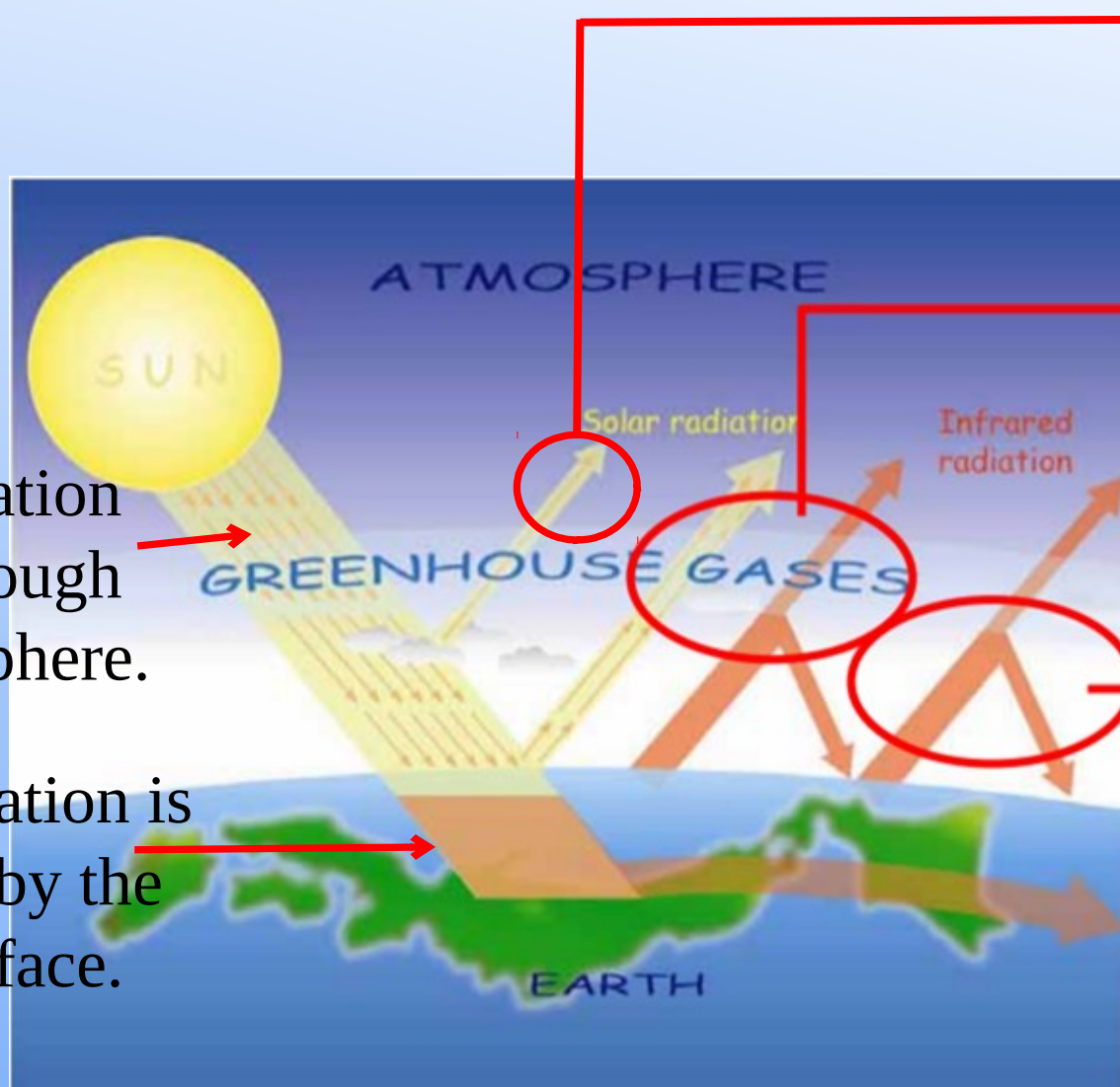
- Release of methane gas from arctic tundra and wet lands.
- Earth goes through a Cycle of climate change (40,000 years).

MAN-MADE CAUSES



Pollution: Burning of fossil fuels, coal burning power plants, automobile exhausts.

GREENHOUSE EFFECT



Solar radiation passes through the atmosphere.

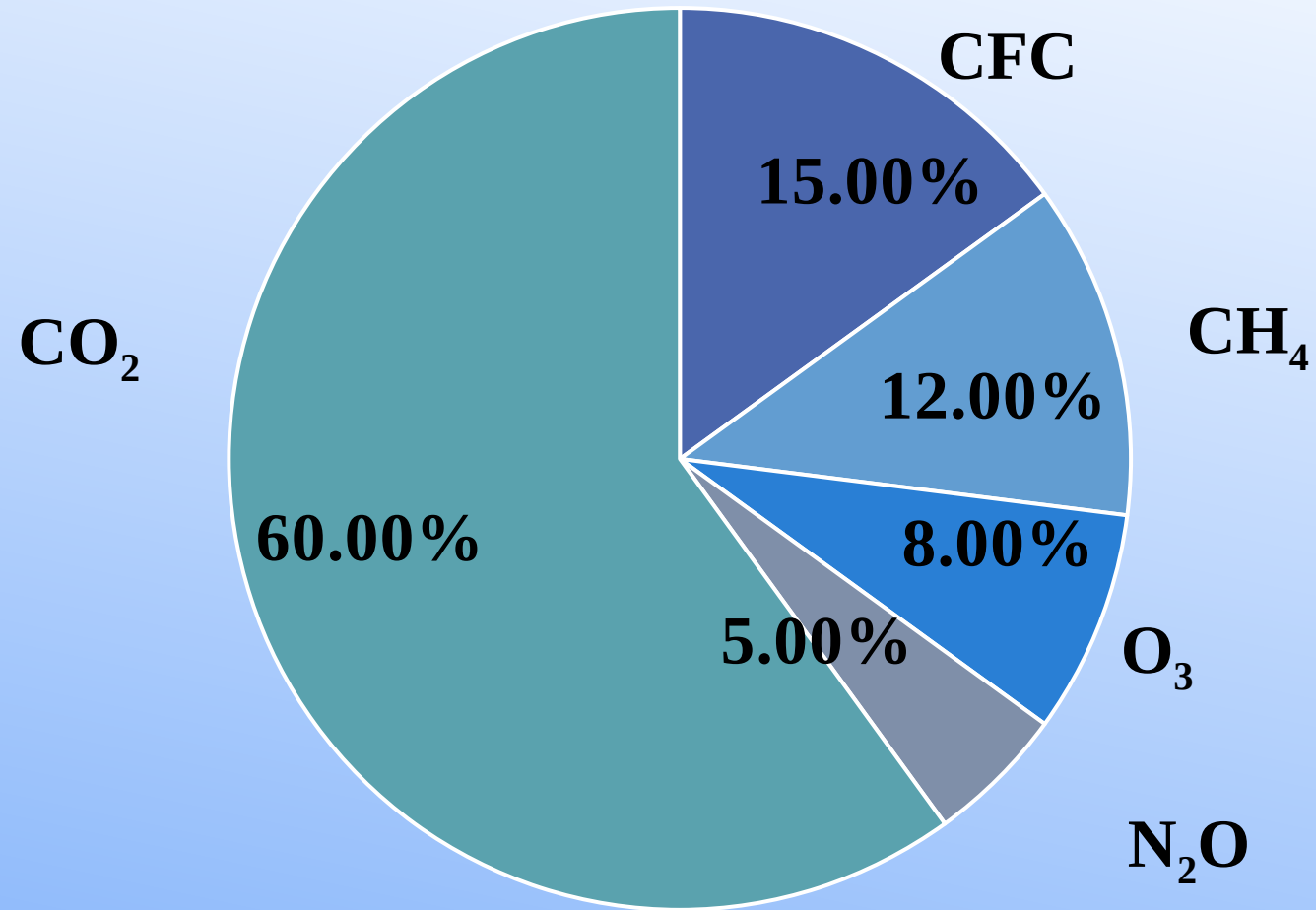
Most radiation is absorbed by the earth's surface.

Some solar radiation is reflected by the earth and the atmosphere.

Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted by green house gases.

Certain amounts of greenhouse gases (CO₂ etc) are necessary to keep the earth warm.

RELATIVE CONTRIBUTION OF GREENHOUSE GASES TO THE ANTHROPOGENIC GREENHOUSE EFFECT

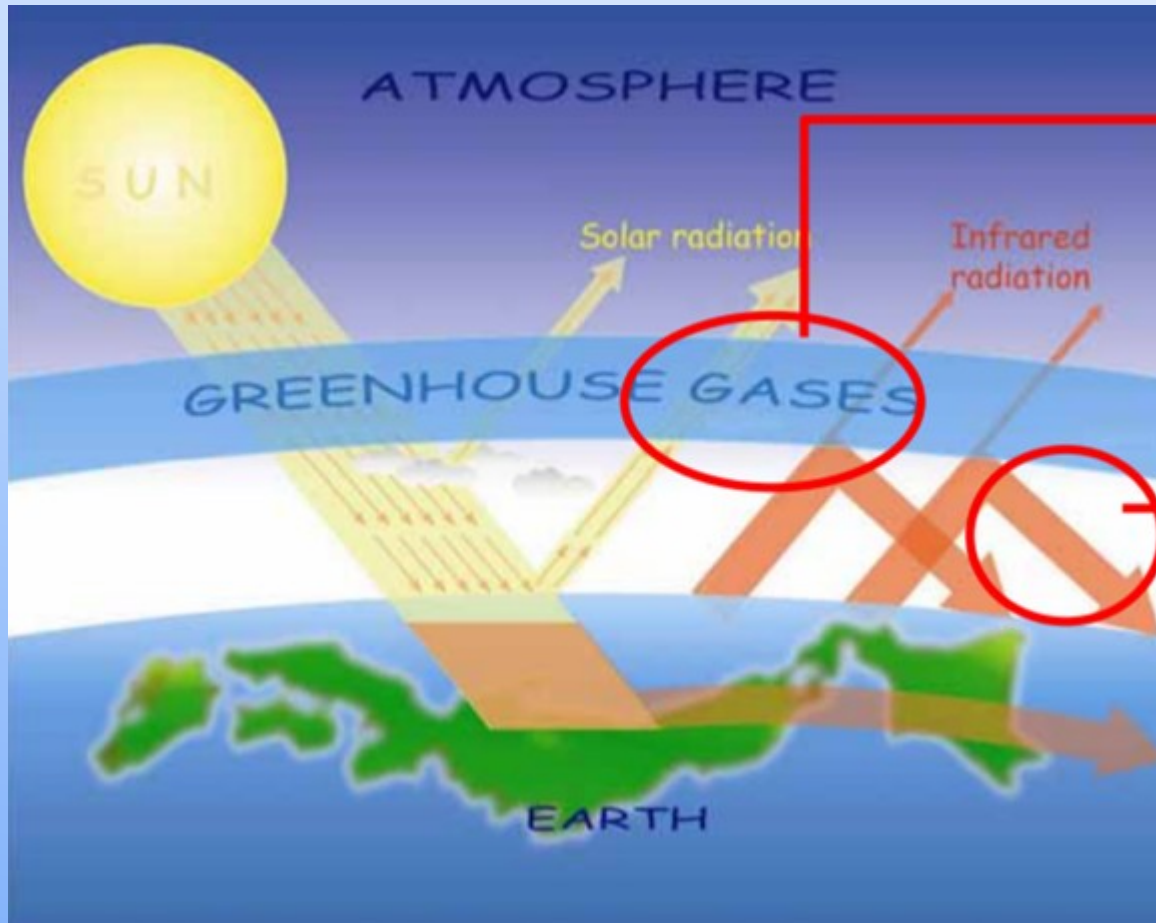


SOURCE OF GREENHOUSE GASES

- **Carbon dioxide:** Burning of fossil fuels, deforestation, coal burning power plants, automobile exhausts.
- **Methane:** Burning of biomass, production of coal and natural gas, cultivation of rice and raising of cattle.
- **Chloro-fluoro carbons:** Aerosol propellants, spray cans and refrigerators.
- **Nitrous oxide:** Agriculture activities and burning of fossil fuels.

GLOBAL WARMING

However, increase in concentration of greenhouse gases causes global warming.

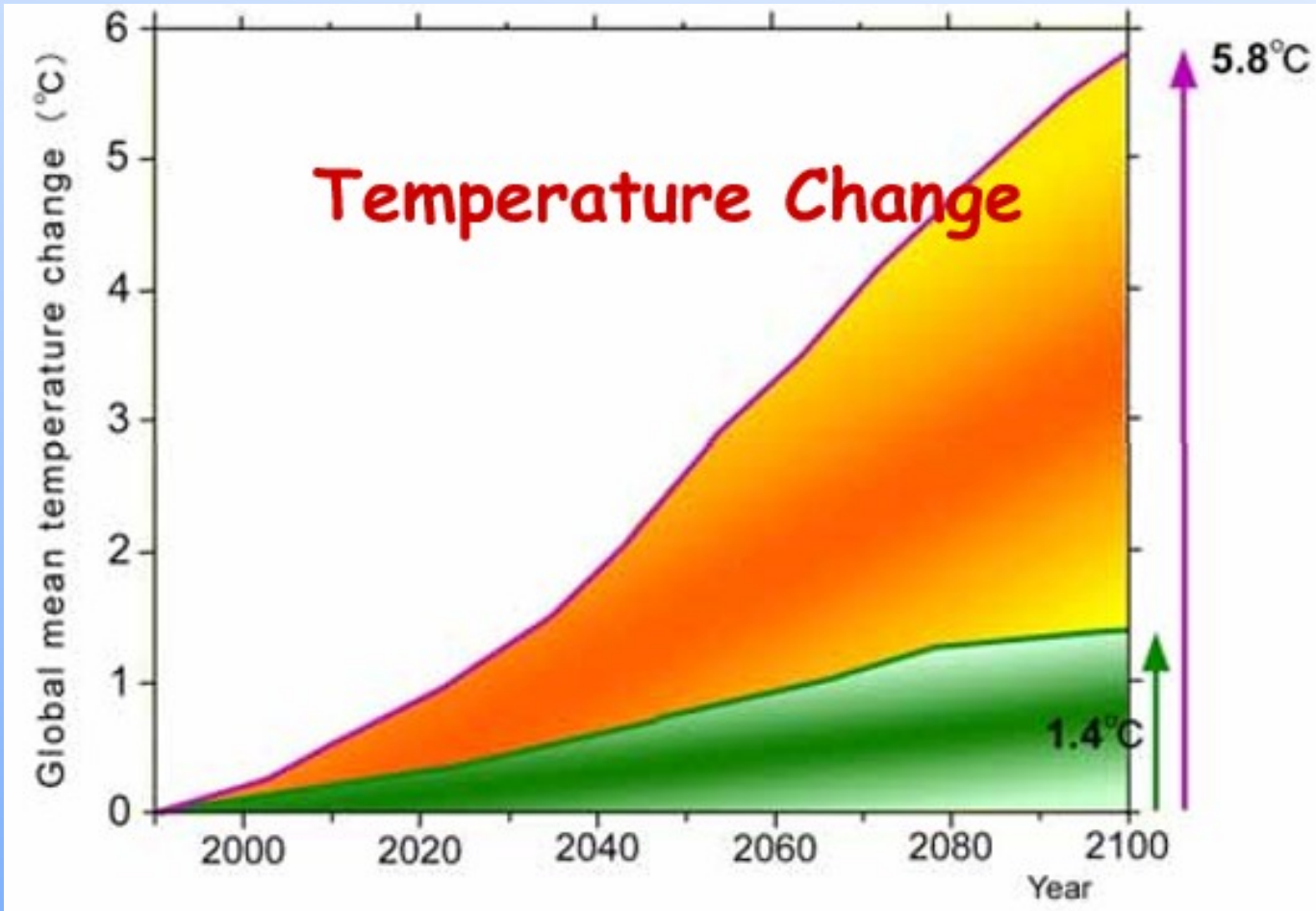


Increase in greenhouse gases in the atmosphere “thickens” the infrared radiation absorption layer.

The “thicker” absorption layer keeps the earth warmer.

EFFECTS OF GLOBAL WARMING

RISING TEMPERATURE



Temperature rise of 1.4°C at the lowest and 5.8°C at the highest is projected in case of no CO₂ emission reduction.

GLOBAL SURFACE TEMPERATURES

- Increased about 0.6°C/ century since the late 19th century.
- Increased to 2°C/ century over the past 25 years.
- Troposphere temperatures (the lowest 8 km of the Earth's atmosphere) collected since 1979 also indicate warming.
- Cooling effect in higher parts of the atmosphere: stratospheric temperatures have been decreasing.
- Regions that have temperatures (1-3°C) warmer than the average:
 - United States
 - Most of the Europe
- Regions that have temperatures (1-3°C) cooler than the average:
 - Australia

- Global rise in temperature changes pattern of rainfall and soil moisture.
- At global level, in Central North America and Southern Europe increase in winter precipitation and a decrease in summer rains was noticed.
- As a result, soil moisture is expected to decrease in summer and significant effect on the grain growing regions of USA.
- With change in climate, Canada and Russia may become productive.
- However, the Canadian soils are thin and less fertile and thus, have little effect on food production.
- In Southern Asia & Australia, precipitation will change little in winter but a increase in summer precipitation by 5 to 15%.

FOOD PRODUCTION

- Increase in basal rate of respiration of plants, plant diseases and pests leads to decrease in production of crops.
- With every 1°C rise in temperature there will be a reduction of 5% in the yield of rice crops in South-East Asia.

MELTING ICE



- From 1979- 2007, the average per decade decline in entire ice coverage was a 10.2% decline in ice extent and 11.4% decline in ice area.

ARCTIC AMPLIFICATION

- Poles of the Earth are warming faster than the lower latitudes.
- The period of 1995-2005 was the warmest decade in the Arctic region, with temperature 2°C above the 1951-1999.
- Primary cause of this phenomenon is ice-albedo feedback.

IMPACT ON ARCTIC ECOSYSTEM

- The ecosystem which sustains the life of Arctic residents is degrading due to melting of ice with rise in temperature.
- The layer of permafrost is melting, causing an inland lake to drain into the ocean and killing freshwater fish.



- Melting of permafrost could release large amount of Carbon in the form of CO_2 and CH_4 into the atmosphere.

**MELTING POLAR ICECAPS WILL RAISE OCEAN LEVELS;
THE ARCTIC OCEAN COULD BE ICE FREE IN SUMMER BY
2050**

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- A polar bear is shown walking across a large, broken piece of sea ice. The bear is in the center of the frame, moving from left to right. The ice is white and blue, with some shadows cast by the bear. The background shows more ice and a dark blue sea.
- **Consequently wiping out much of the polar bear habitat.**
 - **The bear would disappear from Alaska but would continue to exist in the Canadian Arctic region and Northern Greenland Coast.**

RISE OF SEA LEVEL



Melting of ice and thermal expansion of oceans and seas increases the sea level.

SEA LEVEL RISING

A photograph of a coastal city with high-rise buildings and waves crashing on a beach, illustrating the impact of sea level rise. The sky is blue with some clouds, and the water is a mix of green and white foam.

- Rising at an average rate of 1-2 mm/year over the past 100 years.
- One estimate is that sea level will rise 15 cm by the year 2050 and 34cm by the year 2100.

DIRECT TEMPERATURE EFFECTS

Increase in average temperature.



More extreme heat waves during summers and less extreme cold spells during winters.



Harmful to those with heart problems, asthma, the elderly, the very young and the homeless.

CLIMATE-SENSITIVE DISEASES

- Increases the risk of some infectious diseases.
 - Particularly that appear in warm areas; are spread by mosquitoes and other insects.
 - E.g. Malaria, dengue fever, yellow fever, encephalitis.
- Algal blooms occur more frequently as temperatures rises (particularly in areas with polluted waters).

Diseases (e.g. cholera) accompanying algal blooms become more frequent.

AIR QUALITY

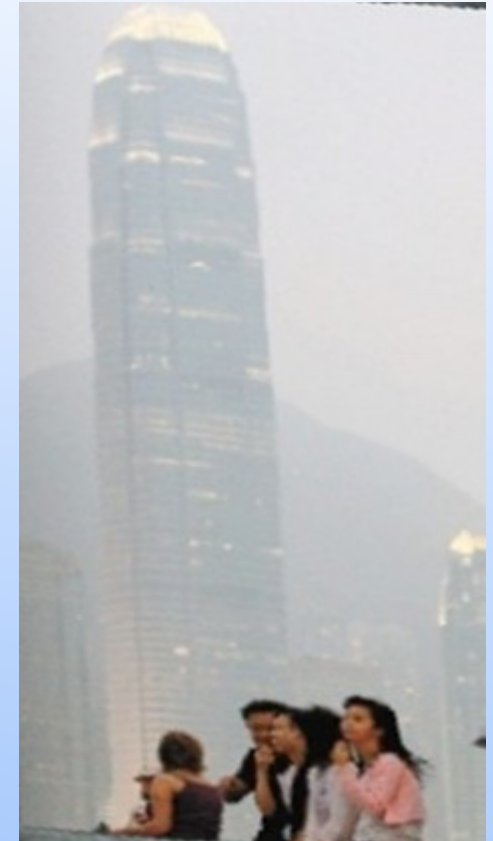
An increase in the concentration of ground-level ozone.



Damages lung tissue.



Harmful for those with asthma and other chronic lung diseases.



FOOD SUPPLY

Rising temperatures and variable precipitation.



Decrease the production of staple foods in many of the poorest regions.



Increasing risks of malnutrition.

UV EXPOSURE (AUSTRALIA)

➤ Skin Cancer

- An abnormal growth of skin tissues.

➤ Premature aging

- Makes the skin thick, wrinkled and leathery.



➤ Cataracts

- No longer have transparent lenses in their eyes.

UV EXPOSURE (AUSTRALIA)

➤ Other Eye Damages

- Skin cancer around the eyes.
- Degeneration of the yellow spot.

➤ Suppression of Immunity

- Overexposure to UV radiation → suppress proper functioning of the body immune system and natural defenses of skin.
- UV-B radiation weakens the immune system → increases the chance of infection and disease.

DESTRUCTION OF CORAL REEFS



EFFECT ON CORALS AND SHELLFISH

- Corals and Shellfish rely on the carbonate ion as a major building block of the shell.
- As atmospheric CO_2 increases, ocean CO_2 also increases.
- CO_2 reacts with water to form carbonic acid which in turn disassociates into hydrogen and bicarbonate ions which ultimately increases the acidity of water and decreases the concentration of CO_3^{2-} .
- It also increases the solubility of calcium, main component of corals.
- Due to that ,difficult for species to fix calcium carbonate and build shell.
- Coral reefs also experiencing bleaching due to increased temperature of ocean.

FORCED MIGRATION AND DISEASES

- As ocean temperature increases, temperature dependent species are forced to migrate.
- This affects fisheries throughout the world and ultimately disrupt ecosystem functions.
- Warmer water allows certain pathogens to grow and breed and spread different types of disease.

MEASURES ON CONTROLLING THE PROBLEM

- **Government**

- * Set some **laws** to limit the amount of pollutants produced by factories.

- * Develop the **skills of using renewable fuels**, e.g. solar energy, wind energy.



MEASURES ON CONTROLLING THE PROBLEM

* Encourage the factories to replace fossil fuels by renewable fuels, which would not cause environmental pollution.

* Carry out **energy saving scheme** → reduce the pollution produced by burning fossil fuels.

* Build more **plants** → reduce the pollutants e.g. CO₂.

MEASURES ON CONTROLLING THE PROBLEM

•Citizens

* Reduce the use of plastic bag → as burning plastic emit CO_2

* Recycle the resources, e.g. plastic.

* Reduce the use of sprays → as CFCs would be emitted out.

* Reduce the use of air-conditioner, which will emit CFCs.

* Use public transportation instead of private cars



WHAT CAN BE DONE: ALTERNATIVES

Renewable Energy Sources



DTE solar array in Southfield, MI

Solar Energies



Wind Power

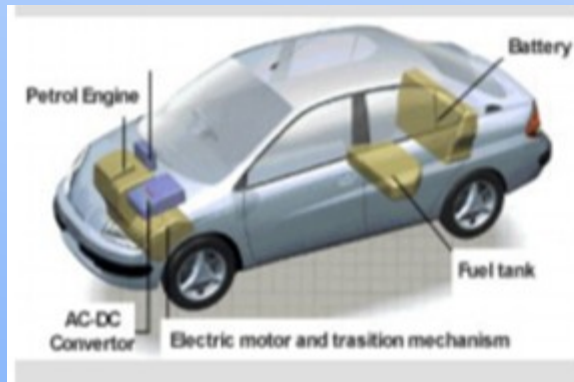


Biomass



Geothermal

Changes in Vehicle Systems



Hybrid



Fuel Cell



Battery-Electric

KYOTO PROTOCOL

- 1997, Kyoto, Japan developed countries agreed to specific targets for cutting their emission of greenhouse gases.
- Industrialized countries committed to an overall reduction of emissions of greenhouse gases to 5.2% below 1990 levels for the period 2008-2012.
- Objective is the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.