GLOBAL WARMING

Global temperatures have been rising and are expected to continue at least into the near future. The Earth is heated by the Sun, and the Earth then heats the air. The Earth receives an enormous amount of solar radiation as the Sun's rays reach the Earth's atmosphere in the form of short-wave radiation. This radiation passes through the atmosphere where much of it is absorbed as it heats the Earth's surface. The Earth's surface, heated by the sun's energy, re-radiates this heat back into space as long-wave, or infrared radiation.

Some of this energy is absorbed by naturally-occurring trace gases in the atmosphere, including water-vapour, carbon dioxide, methane, nitrous oxide, and ozone, and –as a result– the temperature of the atmosphere increases. These energy-absorbing trace gases are known as the greenhouse gases, and this phenomenon in which the Earth's atmosphere absorbs solar energy re-radiated from the solid Earth is known as the greenhouse effect. The issue that we are now facing is that human activity – particularly in the burning of fossil fuels and in the clearing of land – is increasing the overall concentration of greenhouse gases. This additional increase is called the 'enhanced greenhouse effect,' but it is also referred to as 'global warming.'

The greenhouse effect of increasing level of greenhouse gases (GRG) in the atmosphere is popularly known as global warming. The causes of the global warming phenomenon have been traced to increased atmospheric levels of the so called greenhouse gases, namely, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) chlorofluorocarbon (CFCs), and the water vapour (H_2O) which is the largest contributor to greenhouse gases (below Table).

Greenhouse gases

Greenhouse Gas	*1**	*2**	*3**	*4**	*5*
CO_2	3,34,000	54.5	1	–	Fossil fuel combustion (80 percentage), deforestation Changes in land use, biomass burning etc.
CH_4	1,650	16.4	30	10	Biomass decomposition, wet land paddies, swamps, marshes, peat lands, enteric fermentation in cattle and insects.
N_2O	304	5.5	150	–	Fertilizer use, fossil fuel combustion, biomass burning.
O_3	Variable	10.9	2,000	–	Reactions involving pollutants such as, CH_4 NO_2, CFCs and sun shine.
CFCs	CFC 11 CFC 12	0.23 0.40	12.7	10,000	601-70 Aerosols, refrigerators air conditioners, solvents for the computer industry, etc.

The main greenhouse gases differ in the intensity of their heat trapping (or 'radiative foreign') and atmospheric lifetimes and thus, in their ability to affect the radioactive balance of the earth. CFCs and nitrous oxide are many times more potent than the same quantity of carbon dioxide or methane. Carbondioxide emission to the atmosphere is coming principally from the use of fossil fuels Change in landuse (deforestation) is also adding CO_2 to the atmosphere is coming principally from the use of fossil fuels. Change in landuse (deforestation) is also adding CO_2 to the atmosphere. Livestock, rice (paddies) and natural wet lands, coal mining, natural gas production, biomass burning etc., are main sources of methane.

Key greenhouse gases affected by human activity (per cent).

Effect	*Carbon Dioxide*	*Methane*	*CFC a*	*Nitrous oxide*
Increase in atmospheric concentrations Pre-industrial to 1990	26	115	*	8
1990-2025	23	51	–c	10
Contribution to the change in heat trapping Pre-industrial to 1990	61	23	12	4
1990-2025	68	17	10	5

Several studies indicate, that, direct effect of the heat trapping may double the concentration of CO_2 in the atmosphere, which can increase the global temperature by about 1-2°C. Over the past century the average global temperatures have increased between 0-3 to 0-6°C. CO_2 is steadily rising from a pre-industrial concentration of 260 to 270 PPM, to a current level of about 350 PPM. It is due to the great inertia of World's industrial system and their fossil fuel energy bias.

The US National Research Council (NRC) predicted that a nominally doubled CO_2 concentration of 600 PPM will likely to be reached by the year 2065.

Thus, if some of these greenhouse gases continue to increase at the present rate the global temperature can rise alarming by 1.5°C to 4.5°C in the next 50 years and it will pose a new threat to human life. Industrial Revolution has released huge quantity of CO_2 to the atmosphere via burning of fossil fuels such as coal, gas and oil, Methane (CH_4) is another important greenhouse gas. Nearly 15 years have passed since the first evidence of an increase in concentration of atmospheric CH_4 was reported. Up to the present time, several time series measurements of the trend of atmospheric CH_4 had been carried in various locations of the world. The result indicates that the average temporal increase of CH_4during the last decade was about 1 per cent per year. Analysis of ancient air trapped in Polar ice cores revealed that the concentration of atmospheric CH_4 had remained almost constant at less than half of the present concentration until 300 years ago and that the accelerated increase in the concentration started in the 19th Century." The changes of its concentration exert a strong influence over the atmospheric chemistry, as well as on the global heat balance, causing a possible elevation of the global surface temperature.

Atmospheric CH_4 is produced by a wide variety of natural and anthropogenic processes. Several investigators have estimated atmospheric methane. They have considered major sources of CH_4 as enteric fermentation by ruminants, emission from natural wetlands, and cultivated wetland paddy fields, decomposition of Organic wastes in landfills and dumps, termites, biomass burning, coal mining operations, and leakage of natural gas. However, there are great degree of uncertainties in the estimated values of individual sources, and in the leading causes of the increasing

concentration of atmospheric CH_4, peat lands which occupy large areas in high latitudes are also a potential source of atmospheric CH_4, Chlorofluorocarbons (CFCS) are other potential greenhouse gases which significantly contribute to the global warming consequently causing modification in climate.

Possible Consequence of Global Warming

The potential effects of global warming listed here are just a handful of those discussed in the Intergovernmental Panel on Climate Change's (IPCC) 2007 report.

1. *Sea-Level Rise*

Rising sea levels are the most common concern among climate change experts; thermal expansion of the oceans – a result of water molecules expanding in warmer temperatures, increased precipitation, and the melting of mountain glaciers. Mountain glaciers have become much smaller during the past century, especially those in low latitude location like Mount Keyna in Africa and the Andes in South America.

Since the end of the last ice age, sea levels have risen over 200 meters, on average 0.1-20.2 millimeters (mm) each year. In recent years, however, that has accelerated to 1-2 mm each year. In the 20th century alone, sea levels rose 0.17 meters and predictions for the next century range anywhere from 0.18 to 0.59 meters.

2. *Melting Arctic Sea Ice*

Today, the Arctic summer sea ice is about half as thick as it was in 1950. Just like an ice cube melting in a glass of water, the melting Arctic sea ice does not contribute to sea-level rise, except for the expansion of seawater with increasing heat. However, melting Arctic sea ice may eventually lead to global changes in water circulation. The water from melted ice forms a layer at the sea surface that is less dense than the underlying water because it is less salty, potentially preventing the pattern of deep ocean currents from rising to the surface. Additionally, melting sea ice speeds up the warming of the Arctic since water absorbs 80 percentage of sunlight, about the same amount that the cover of sea ice used to reflect.

3. *Warmer Oceans*

Increasing ocean temperatures could cause serious ecological damage. In the past, warm sea-surface temperatures have been responsible for major destruction and can cause more damage if global temperatures continue to climb. Approximately one quarter of the world's coral reefs have died over the last few decades, many of them affected by coral bleaching – a process directly tied to warming waters, which weakens the coral animals.

4. *Severe Weather*

Scientists hypothesize that a warming atmosphere will lead to changes in ocean currents and in air circulation patterns that will significantly affect weather across the globe. Global warming appears to push many climates to their extremes – expanding deserts and making usually rainy areas much more so.

An increase in global temperature will likely to enhance the ability for severe weather, which could mean stronger and more frequent storms. Warmer temperatures cause more evaporation of

water, which as part of the water cycle eventually leads to increased precipitation. In fact, the world has been a 5-10 percentage increase in precipitation over the past century. Many computer models predict that the frequency of heavy rainfall events is also likely to rise with global warming, further increasing the potential for flooding.

While some parts of the world are projected to experience increased precipitation if global warming persists, other parts may experience higher levels of drought. This is because places that are typically dry – such as the centers of continents – will experience even more evaporation as global temperatures climb. However, scientists are still trying to decipher as to whether drought is increasing or whether we are merely experiencing a shift in areas of drought. Either way, hotter, driver temperatures in the American West – for example – are leading to extended wildfire seasons that threaten both national forests and private property, in addition to the population within these areas.

5. Warmer Winters

Warmer winters mean that many deaths related to cold temperatures might be avoided and that the growing season will last longer, a possible upside to global warming. More people around the world die because of wintertime cold than because of summertime heat. Decreased wintertime deaths could offset some of the potential increase in summertime heat-related deaths, or even lead to more lives saved as a result of the changed temperature.

6. Agriculture

With drought affecting some regions and heat intensifying in the tropics, many areas are becoming unsuitable for agriculture. In tropical areas that are already dry and hot, the ability to harvest food will likely decrease even with small increases in warming. However, warmer temperatures and increased precipitation can also make previously marginal land more suitable for farming. Therefore, it is likely that – with a changing climate – global change in the agricultural pattern will occur.

7. Human Health Concerns

In addition to potential environmental changes, the human health implications of increased global warming are also very concerning. Extreme heat waves during the summers of 2003 and 2006 led to thousands of deaths in Europe, North America, and India. Unless steps are taken to avoid this heat waves are likely to increase–as will their intensity–leading to an even greater number of heat-related deaths.

8. Other Species Health Concerns

Animals and insects are also affected by global warming, most often related to changes in migration patterns, shorter hibernation time, relocation to new areas, and extinction due to lack of adaption. Many animals accustomed to living in the arctic regions, such as polar bears and penguins, have begun to be forced further out of their native habitat in search of more accommodating habitat closer to the poles. Animals that migrate, such as birds and butterflies, have begun arriving sooner and departing later from their normal patterns, and extending their migratory range closer to the poles.

Climate Change with Reference to Environment

Climate Change

1. **Introduction and Definition.** Climate refers the physical environmental factors of an areas. These physical factors include duration and quantity of light, temperature, humidity,

wind, gases, water, etc. Such conditions which average for about 30 years in called climate. These climatic conditions especially temperature may fluctuate from time to time but such fluctuations vary in different regions, *e.g.*, global warming during late autumn and winter takes place more in the areas of higher latitudes (*e.g.*, 2 to 3 times than the average change at the poles) than the areas in tropics.

These changes in the physical, environmental factors of an area over long period of time collectively called climatic change which may adversely affect the agriculture, migration of animals, hydrological cycle, thermal gradient between the poles and equator, wind pattern, distribution of rainfall, etc.

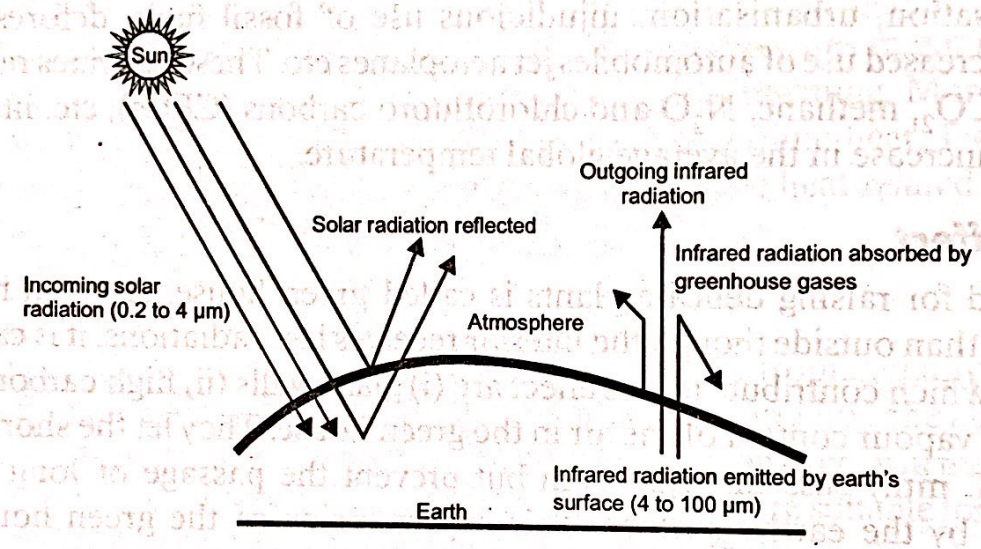
2. **Causes of climate change.** Main culprit of such climate is man himself. Anthropogenic (man-made) activities are mainly responsible for upsetting the delicate balance between the various components of the environment. These include: population explosion, rapid industrialisation, urbanisation, injudicious use of fossil fuels, deforestation, biomass burning, increased use of automobiles jet aeroplanes etc. These activities release greenhouse gases like CO_2, methane, N_2O and chlorofluoro carbons (CFCs), etc. in the atmosphere- and cause increase in the average global temperature.

Green House Effect

A glass house used for raising delicate plants is called green house. A green house has higher temperature inside than outside though the interior receives less radiations, it is called green house effect. The factors which contribute to this effect are (i) glass walls (ii) high carbon dioxide content and (iii) high water vapour content of the air in the green house. They let the short wave radiations (wavelength 0.15-4. mm) pass through them but prevent the passage of long wave (infra red) radiations emitted by the earth's surface. This makes inside of the green house warmer than outside.

In the context of environment, green house effect refers to selective energy absorption by some atmospheric gases, which allow short wave length energy to pass through but absorbs longer wave lengths and reflect heat back to earth'. The atmospheric gases which are permeable to short wave solar radiations, but are strong absorber of long wave radiations emitted from the surface of earth are called green house gases. These include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), ozone (O_3) and water vapour (H_2O). Though carbon dioxide contributes maximum to the green house effect on the earth, methane (CH_4) and chlorofluoro carbons (CFCs) are potent green house gases even though their contributions in the atmosphere are much less than that of carbon dioxide. The mean annual temperature of the earth is about 15°C, however, in the absence of green house gases in the atmosphere, earth's mean temperature would drop sharply to about –20°C. This capacity of the atmosphere to keep the earth warm depends upon the concentration of green house gases. The excessive increase in concentration of these gases in the atmosphere would retain more and more of the infrared radiation, resulting in enhanced greenhouse effect. The consequent increase in the global mean temperature is referred to as global warming. The Inter governmental Panel on Climatic change (IPCC) periodically makes an assessment of the atmospheric abundance of green house gases and its possible impact on climate and related issues. The trends in the increase in concentrations of green house gases since pre-industrial times are briefly described below.

1. **Carbon dioxide (CO_2).** Carbone dioxide is the most abundant greenhouse gas in the atmosphere. It is chiefly produced by the burning of fuels. It is also released by plants and animals during the process of respiration. The level of CO_2 in the atmosphere has increased from the pre-industrial level of 280 ppm to 368 ppm in 2000. This has been largely due to fossil fuel burning, deforestation and change in land use.
2. **Methane (CH_4).** Methane is a product of incomplete decomposition caused by a group of bacteria called methanogens, under anaerobic conditions. It is produced from garbage dumps, fresh water wet lands (swamps), flooded rice fields and enteric fermentation in cattle. It is also produced by biomass burning. The concentration of methane in atmosphere has become more than double in 2000 (1750 ppb) than its concentration during the pre-industrial times (700 ppb).



The Green House Effect

The atmosphere is transparent to the incoming short-wave radiations; it is translucent to the-long-wave infrared radiations which are absorbed by the greenhouse gases to make the earth warm.

3. **Chlorofluorocarbons (CFCs).** CFCs are synthetic gaseous compounds of carbon and halogens. They are non-toxic, non-flammable and highly stable compounds. These compounds were synthesised during the 20th century and are extensively used as refrigerants, aerosol propellants, insulators and fire extinguishers. The main sources of CFCs in the atmosphere are leaking air conditioners and refrigeration units, evaporation of industrial solvents, production of plastic foams and propellants in aerosol spray cans. CFCs can persist for 45 to 260 years or more in the atmosphere. The concentration of CFC-11 HFC-23 has become about 282 ppt in recent times.
4. **Nitrous oxide (N_2O).** The main source of N_2O are agriculture, biomass burning and industrial processes. It is produced by the breakdown of nitrogen rich fertilizers in the soil and nitrate contaminated ground water, burning of nitrogen rich fuels, livestock waste and during nylon production. The concentration of N_2O in the atmosphere has increased from about 270 ppb in pre-industrial time to about 316 ppb in 2000.