

Lecture 17 and 18

Global Warming, Climate Change & Bangladesh

Climate Change and Global Warming

-The Green House effect and global climate change have been subjects of scientific investigation for many decades, but these have received widespread attention first in 1990 through of the IPCC's publication on science, impacts & policy implications of climate change.

-IPCC's findings based on the extensive review by the world's experts in the respective fields reveal that atmospheric GH (carbon-di-oxide, methane, nitrous oxide and CFCs) could cause the world to warm and sea level to rise.

-In 1992 (UNCED conf, Rio de Janeiro), UNFCCC signed by the nations reflects both the concern about the effects of CC and urgent need for action to reduce its potential impacts particularly with respect to vulnerable developing countries.

Global Climate Change in the Past

- the global climate varies on all timescales (Warrick et al., 1994).
- The recent past cold glacial epochs (during Pleistocene, 2 mya) were separated by relatively warmer interglacial epochs.
- The last glacial maximum occurred 18,000 years ago when the global temperature was 4-5 degrees C colder than today.
- The world is currently enjoying warm, interglacial period.

-However, because of such cycles, the world is heading toward another cold period over the next several thousand years.

Causes of Global Climate Change

-Variations in Sun-Earth orbits/orbital forcing change, volcanic activity & ocean circulation in addition to naturally occurring GH gas concentrations.

- Climate changes (on the 10,000-100,000 years timescale), appear to be largely the result of orbital forcing changes.
- Factors (such as the shape of the earth's orbit around the Sun and the tilt of earth's axis in relation to the Sun) influence the seasonal & latitudinal distribution of energy received at the earth's surface from the Sun.
- The swings therefore from glacial to interglacial epochs during the Pleistocene can largely be explained by this mechanism.

-On shorter timescales (yrs to decades), factors like volcanic eruptions, variations in solar output, atmospheric/ocean circulation changes or atmospheric pollutants can influence climate.

-For example, the 1991 eruption of Mount Pinatubo in the Philippines slightly cooled the global surface temperature over several years.

What cause the temperature of the atmosphere to go up?

- There are many possible mechanisms that can cause the warming of the atmosphere, for example:
 - **Natural variation** – the climate becomes warmer by internal chaotic dynamics of the earth-atmosphere system (that is, no external influence).
 - **Solar activity** – either direct increase of solar energy output or indirect “trigger” mechanisms due to solar activity (though nobody knows how) may cause the surface temperature to go up.
 - **Greenhouse effect** – increasing “greenhouse” gases such as CO_2 , CH_4 , NO , CFC ,...etc. (actually H_2O is very efficient, too, but at present it is assumed to be in steady state).
- The last one is presently thought to be the most likely cause of the global warming and hence we will examine it here in this chapter..

Some of the evidence for Climate Change and Global Warming

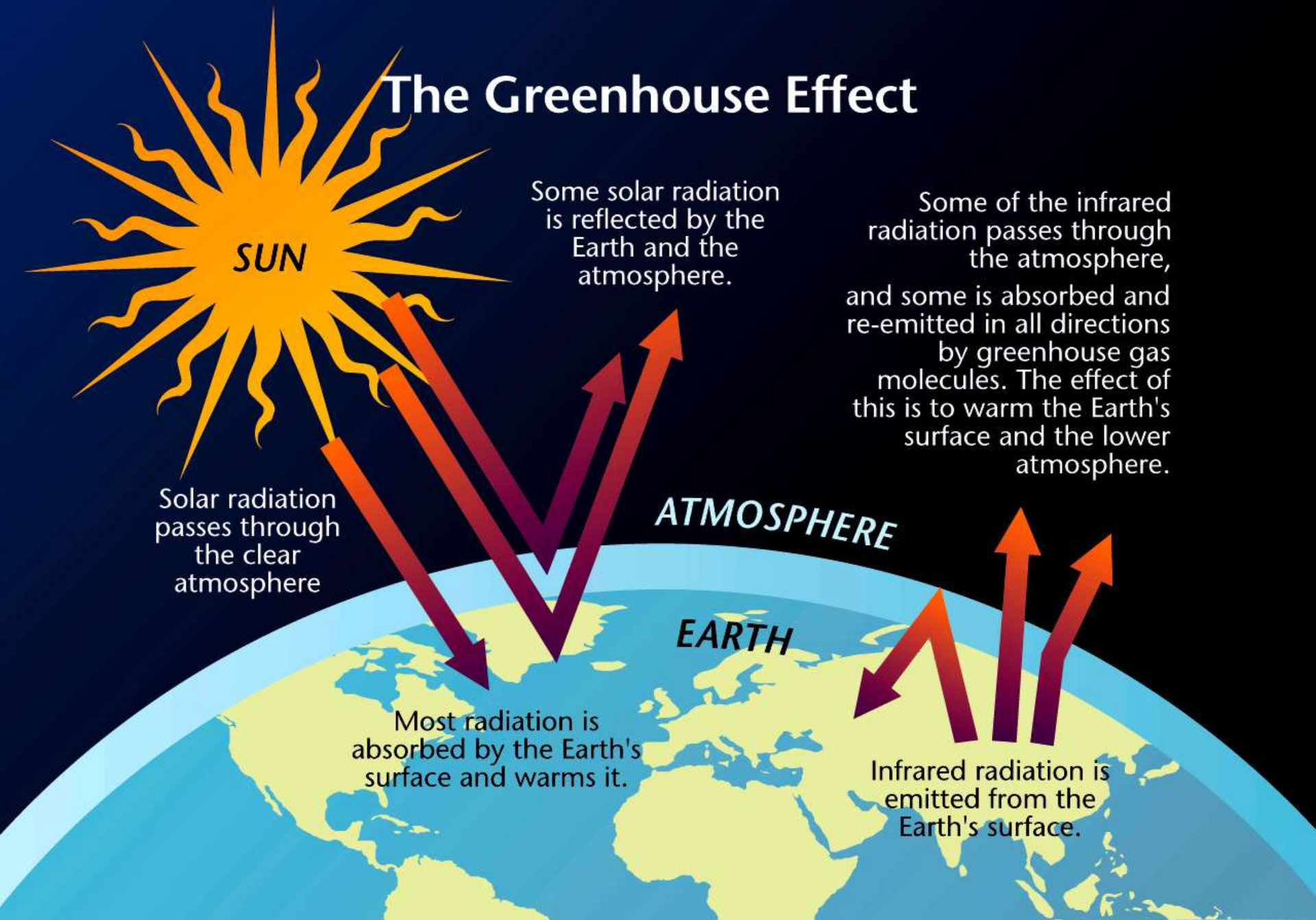
Increasing temperatures — Global temperature averages over the last 100 years by NASA and the Hadley Centre show the Earth has warmed by about 1°C, mostly in the last four decades. Oceans have also warmed by absorbing over 90% of the sun's heat.

Changes in rainfall — Rainfall patterns are changing across the globe with increasing floods and droughts. There are also changes between seasons in different regions.

Changes in nature — Growing seasons have lengthened with spring starting earlier and autumn/winter later. Many species are changing their behaviour and where they live.

Sea-level rise (SLR)— Sea-levels have risen about 17 cm (global average) since 1900 because of thermal expansion of ocean water and melting glacier ice. SLR has increased from ~1mm/year 100 years ago to 3 mm/year today.

The Greenhouse Effect



Greenhouse Effect

- Primary Greenhouse gas: water vapor, carbon di oxide, methane, Nitrus Oxide, Ozone
- The natural abundance of the above mentioned gases keep the earth's surface and lower atmosphere warm, which is known as natural greenhouse.
- Atmospheric concentrations of GHGs are determined by the balance between sources (emissions from anthropogenic activities and natural systems) and sinks (reduction of GHGs from the atmosphere by conversion to a different chemical compound).



Is the Greenhouse Effect Bad?

- Without the greenhouse effect the earth would be cold as Mars!
- But too much Greenhouse gas can heat up the Earth too fast
 - Rising seas
 - Polar ice melting
 - Unpredictable storms



The main greenhouse gases (GHGs)

The Convention concerns all greenhouse gases not covered by the 1987 Montreal Protocol to the United Nations Convention on Protection of the Ozone Layer. The focus of the Kyoto Protocol is on the following six:

- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous oxide (N₂O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF₆)

**NOTE: N₂ and O₂
are not GHGs**

The **first three** are estimated to account for **50, 18 and 6 per cent**, respectively. The HFCs and PFCs are used as replacements for ozone-depleting substances such as chlorofluorocarbons (CFCs) being phased out under the Montreal Protocol.

THE GREENHOUSE GASES

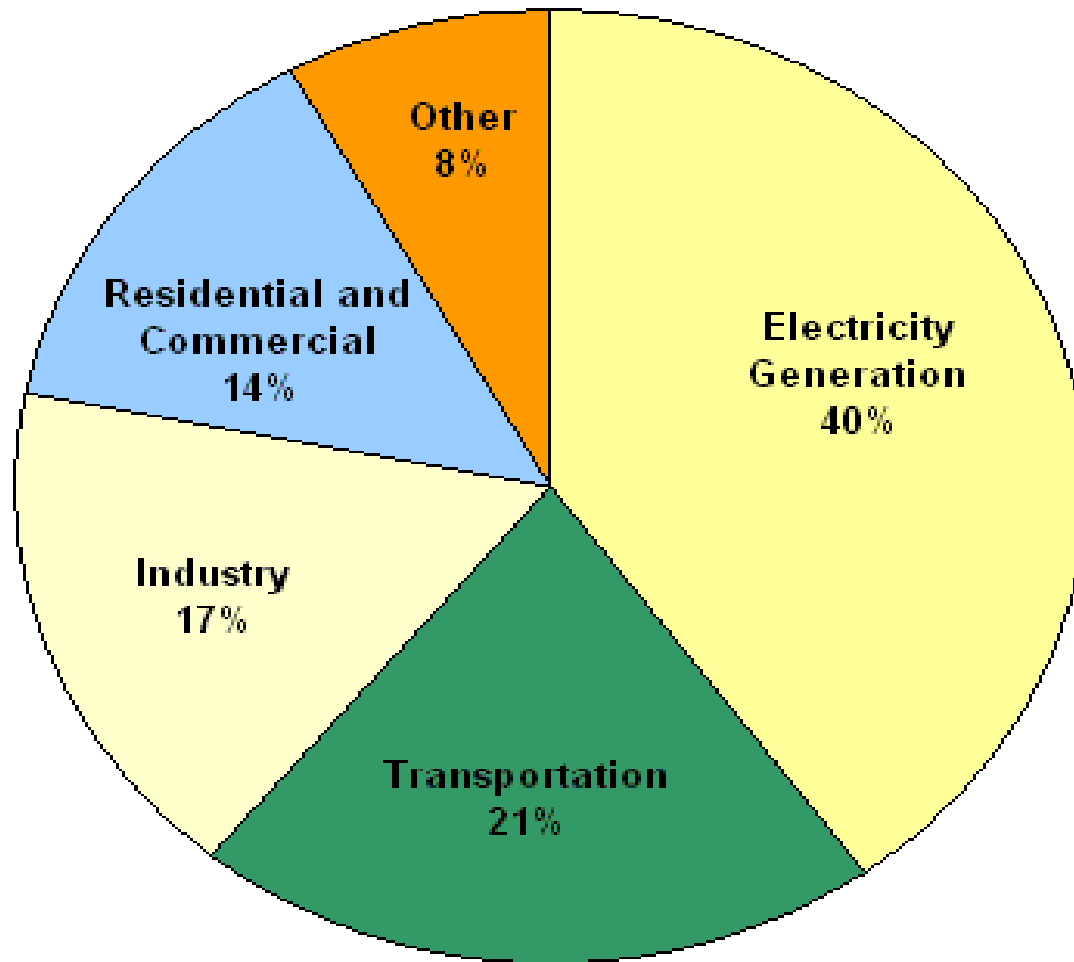
Carbon Dioxide or CO₂ is the most significant greenhouse gas released by human activities, mostly through the burning of fossil fuels. It is the main contributor to climate change.

Methane is produced when vegetation is burned, digested or rotted with no oxygen present. Garbage dumps, rice paddies, and grazing cows and other livestock release lots of methane.

You can find **nitrous oxide** naturally in the environment but human activities are increasing the amounts. Nitrous oxide is released when chemical fertilizers and manure are used in agriculture.

Halocarbons are a family of chemicals that include CFCs (which also damage the ozone layer), and other human-made chemicals that contain chlorine and fluorine

Global Carbon Emissions from Fossil Fuel Burning by Sector



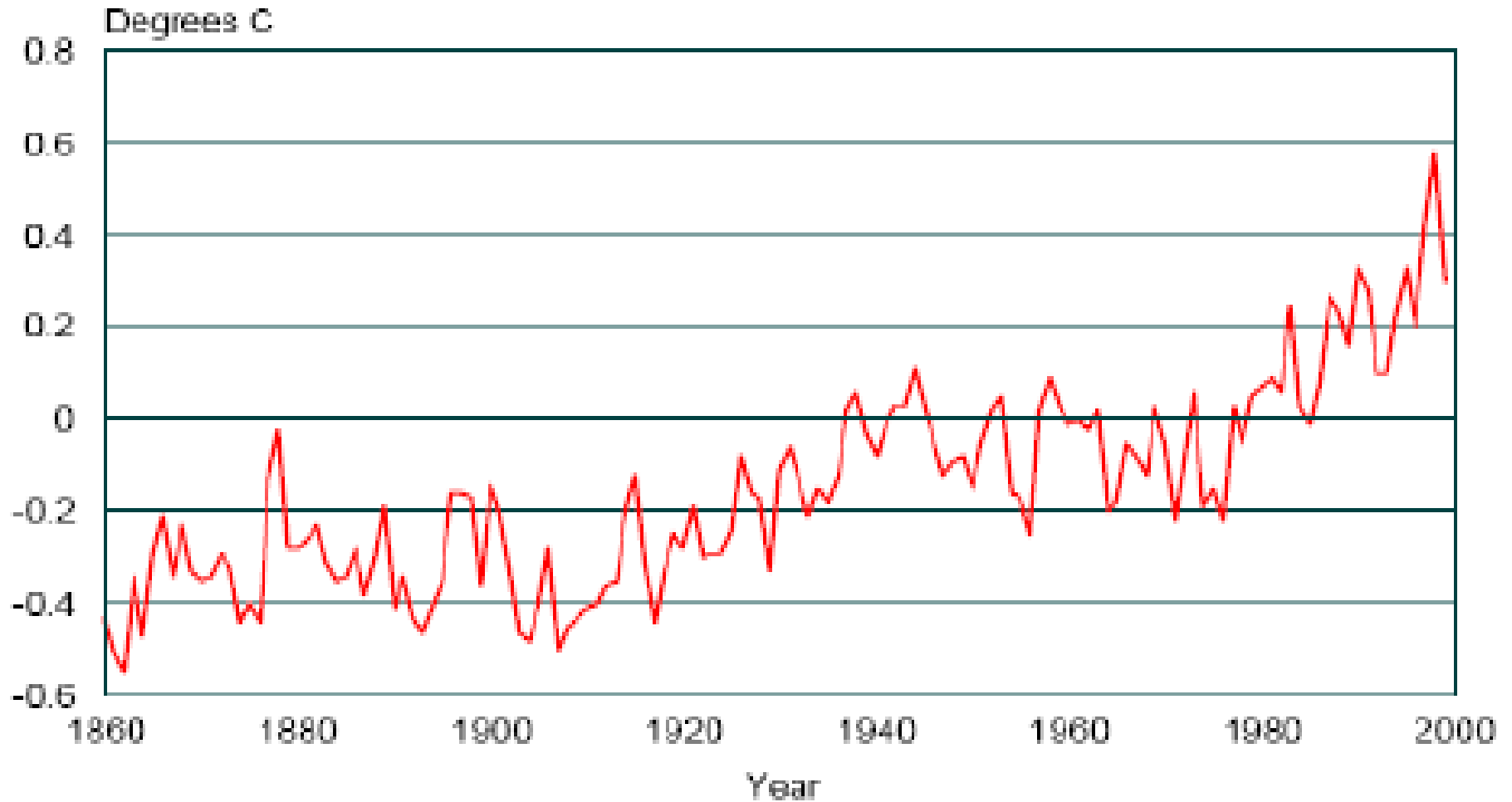
Source: IEA

CO2 Emissions per country and per capita 2008



CO₂-Ausstoß ausgewählter Staaten im Jahr 2008 (Gesamtemission und pro Kopf); Daten: International Energy Agency;

Global temperature change (1860-2000)



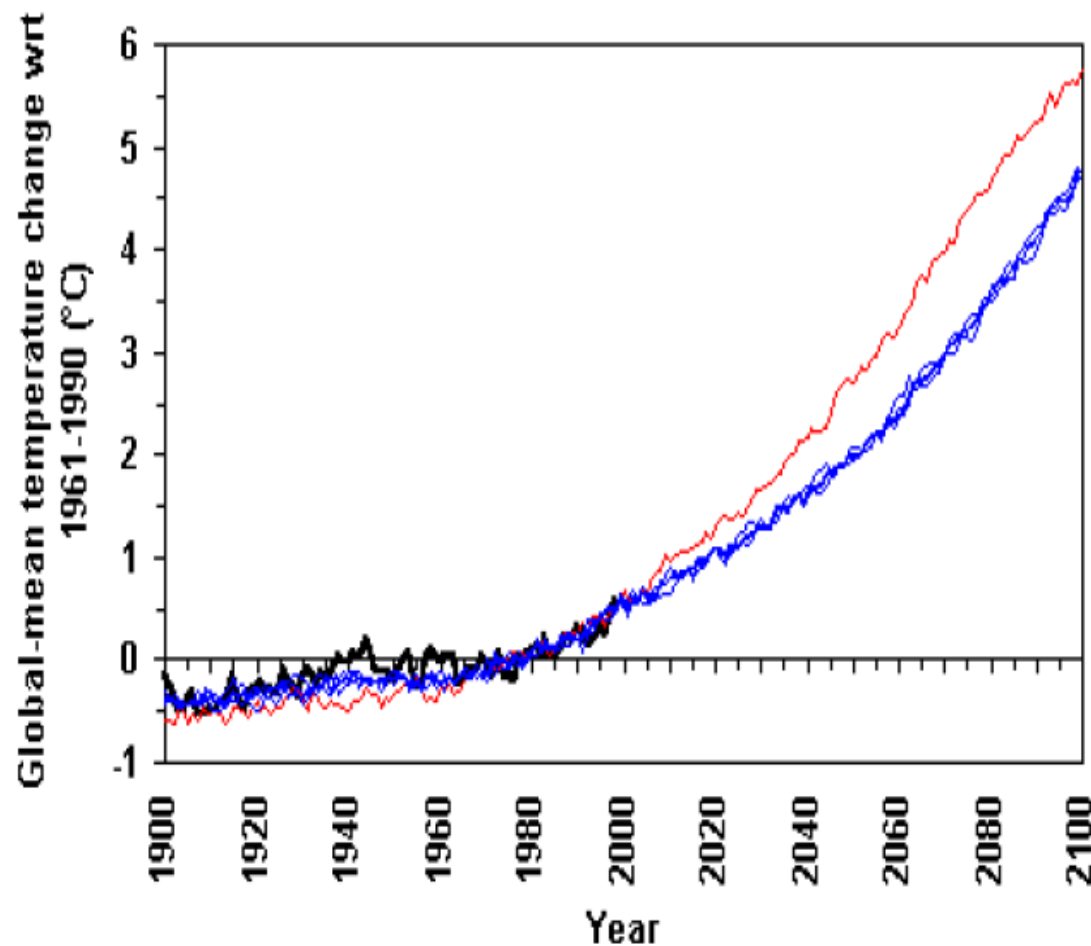
What is Global Warming?

- An increase in average global temperatures
- It is caused by an increase in **Greenhouse Gases** in the Atmosphere



Is Global Warming Happening?

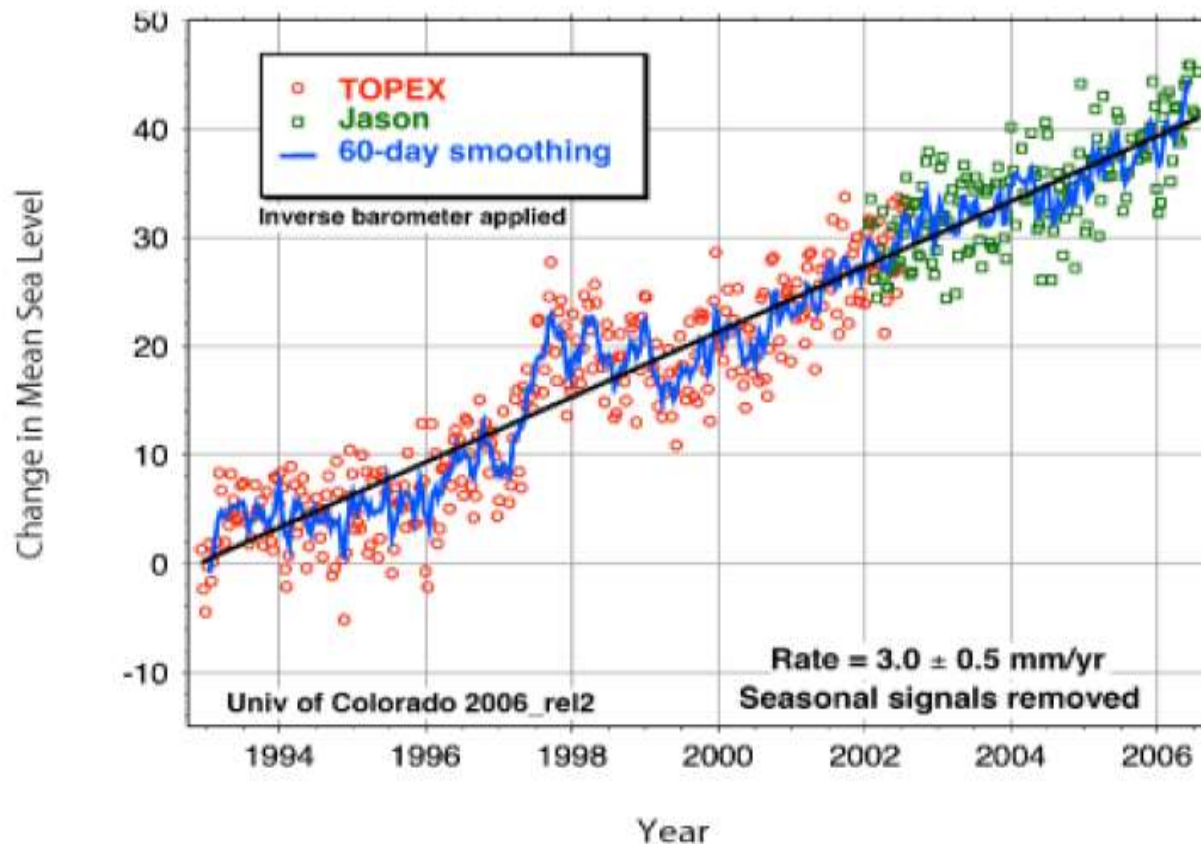
- 1. How much have global temperatures changed between 1980 and 2000?
- 2. How much are global temperatures expected to change between 2000 and 2100?



Is Sea Level Rising?

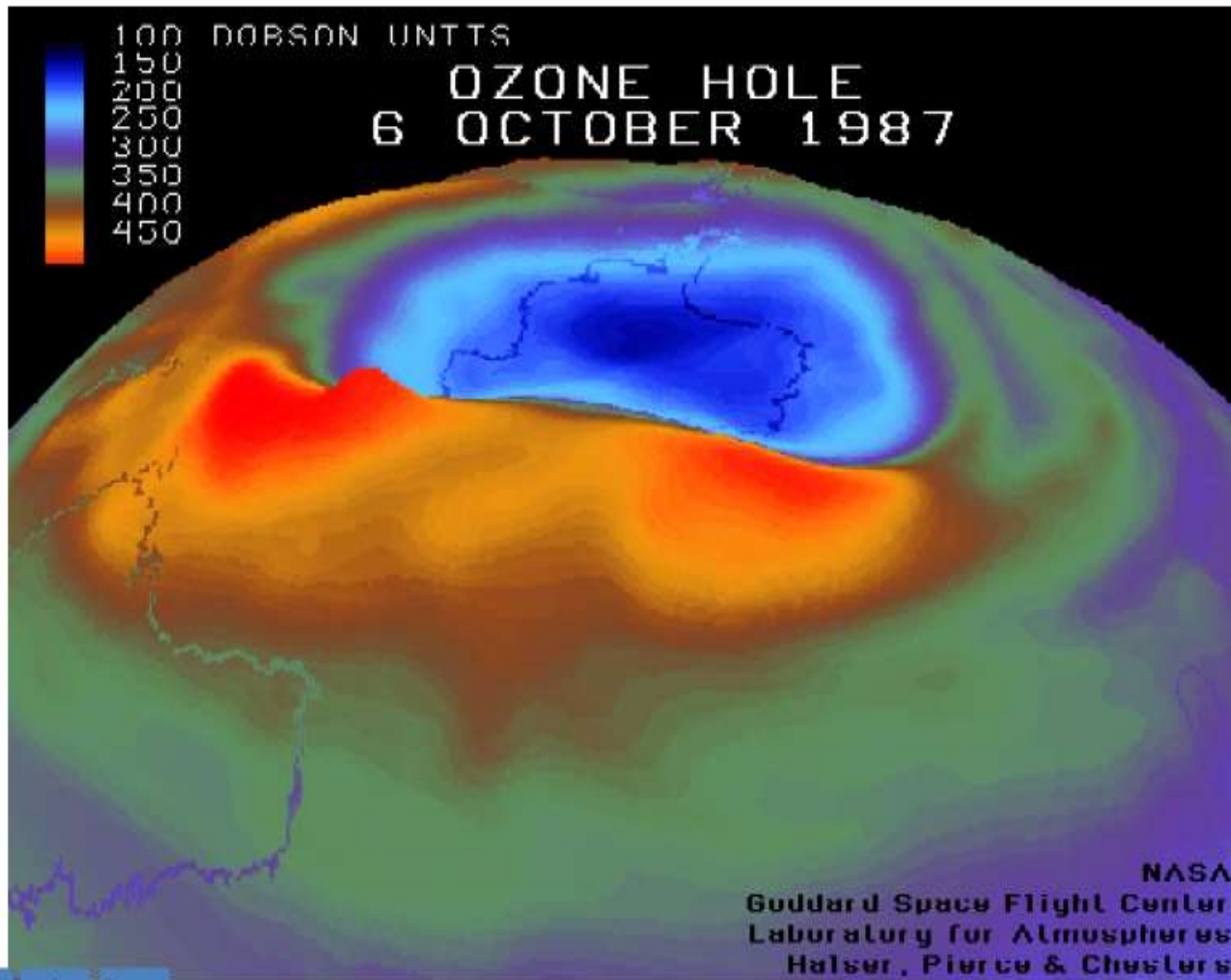
4. How much has sea level gone up since 1990?

Mean Sea Level Rise



Graph Source: Cazenave, A., and R. S. Nerem (2004), Present-day sea level change: Observations and causes, Rev. Geophys., 42, RG3001, doi:10.1029/2003RG000139.

3-D Image of the Ozone Hole



The melting glaciers in the Himalayas

- Glaciers in the Himalayas are receding faster than in any other parts of the world.
- In **Northwest China**, 27% of the glacier area will decline by 2050 (equivalent to an ice volume of 16,184 km³).
- IPCC made a forecast that if **current trends continue**, **80% of Himalayan glaciers** will be gone in **30 years**; recent estimates suggest this loss in 50 years.
- The **current trends of glacial melt** suggest that the Ganges, Indus, Brahmaputra and other rivers across the northern Indian plain could likely become **seasonal rivers** in the near future.

Snow-cover change in the Himalayas



Landsat MSS image 15 Oct 1975

Snow-cover change in the Himalayas



ASTER image of Feb 2006

Austrian glacier Krimmler Kees 1982 and 1997 (15 years)



Scenarios of Vernagt-Glacier in Austria



© KfG 2002

Our climate is already changing!



Rising tides. Some scientists predict that a warmer climate will trigger more violent storms, which will cause increased rates of coastal erosion. Cape Hatteras in North Carolina in the USA.

Our climate is already changing!



Low-lying Bangladesh is prone to coastal flooding caused by storm surges, which have killed thousands of people in recent years. Experts say if the sea level goes up by 1 metre, Bangladesh will lose 17.5% of its land.

Our climate is already changing!

UK
October
2004



Experts predict that fierce storms and floods are likely to become more frequent in the future. If homes and factories continue to be built on floodplains, the cost of severe flooding will soar.

Climate Change Scenarios: Bangladesh

Year	Sea Level Rise (cm)	Temperature Increase (°C)	Precipitation Fluctuation Compared to 1990 (%)
2030	30	+0.7 in monsoon; +1.3 in winter	-3 in winter; + 11 in monsoon
2050	50	+1.1 in monsoon; +1.8 in winter	-37 in winter; + 28 in monsoon

Affects of global warming in Bangladesh

- SLR will directly affect vast coastal area and flood plains of Bangladesh;
- In case of static altitude of the coastal areas with stagnant delta development process:
 - 10 cm SLR - 2020 inundate 2% of the country
 - 25 cm SLR - 2050 inundate 4 % of the country
 - 1m SLR - 2100 about 17 % of the country
- **Twenty million people**, engaged in salt/ shrimp production, fishery/ agriculture, and other businesses will be directly affected.

Impacts on the Sundarbans

- 10 cm SLR will **inundate 15%** of the Sundarbans
- 25 cm SLR will **inundate 40%** of the Sundarbans
- 45 cm SLR will **inundate 75%** of the Sundarbans
- 60 cm SLR will **inundate 100%** of the Sundarbans
- 1 - M SLR will **destroy Whole** Sundarbans

Species like Sundari, main economic species in the Sundarbans, would be replaced by less valuable Goran and Gewa.

Loss of the Sundarbans and other coastal wetlands would reduce breeding ground for many estuarine fish, which could reduce their population.

Impacts on Human Life

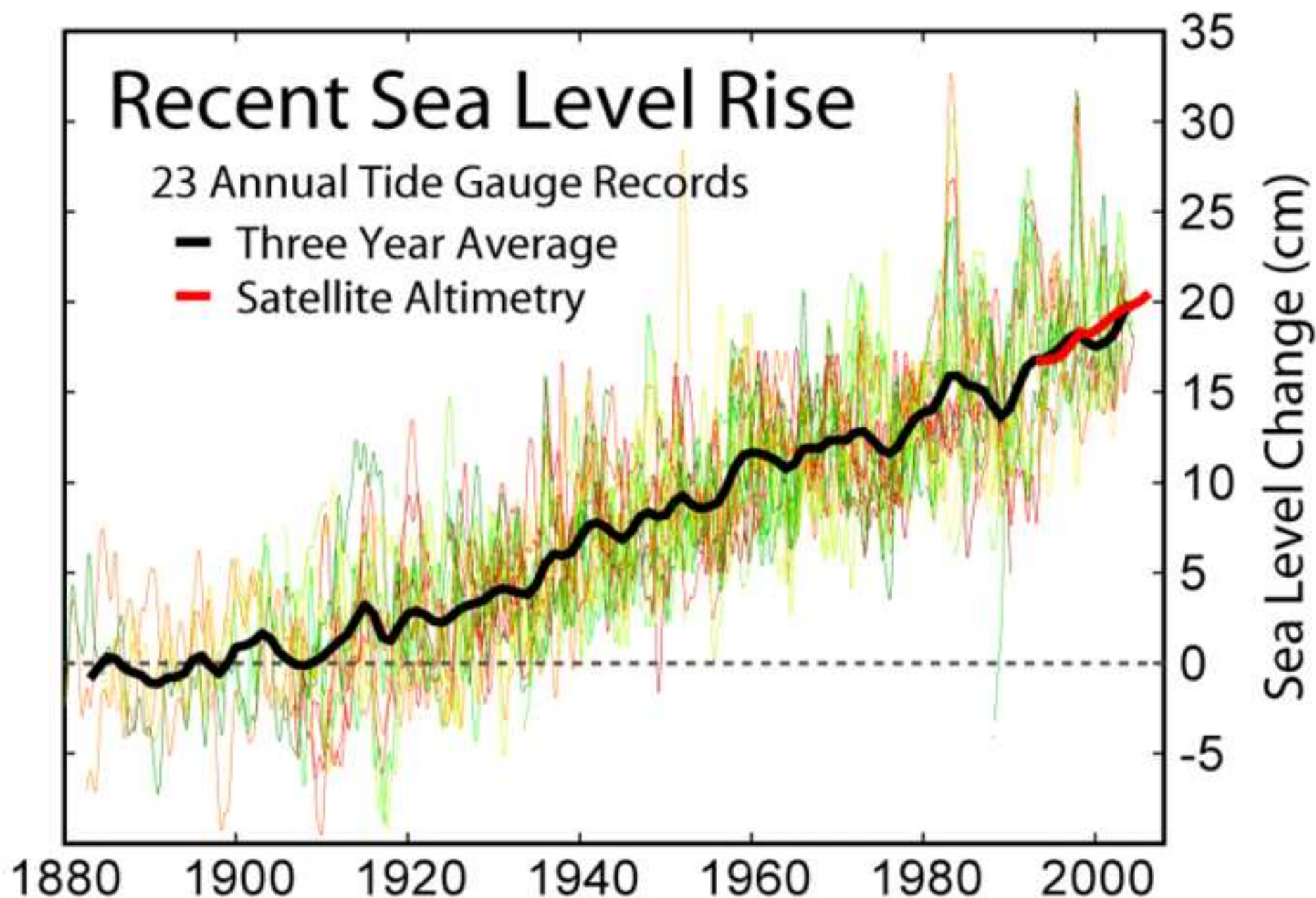
- The **most marginalized** (mountain communities and ethnic minorities, etc.) and **vulnerable groups** will suffer the most from impact on biodiversity and affect on people's diet, nutritional status and nutrition related health problems.
- **Infectious diseases**, particularly the insect vector-borne diseases such as malaria, dengue fever are sensitive to the impact of climate change.
- **Agriculture**, particularly rain-fed agriculture is highly sensitive to climate change and therefore cause food shortage.

Recent Sea Level Rise

23 Annual Tide Gauge Records

— Three Year Average

— Satellite Altimetry



Adaptation: Capacity building

- Disaster preparedness activities
- Special weather forecasting
 - Local language
- Participatory community fund
- A participatory approach to coastal resource planning, inventory and zoning
- Insurance
 - Agriculture
 - Crop
 - Fisheries
 - Boat

Adaptation: Land Accretion and Reclamation Potential

- About 2 billion tons of sediments per annum from the upper catchments areas;
- Scope to accelerate and consolidation of accretion process;
- Land reclamation potential.