Introduction to Climate Change

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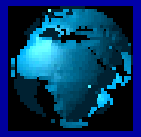


Our Earth and its Climate

A planet's climate is decided by

- Mass,
- Distance from the sun
- Composition of its atmosphere.

We are capable of changing it significantly.

Atmospheric Composition

- 78% nitrogen, 21% oxygen, and 1% other gases.
- Carbon dioxide accounts for just 0.03 - 0.04%.
- Water vapor 0 to 2%

Green House Gases

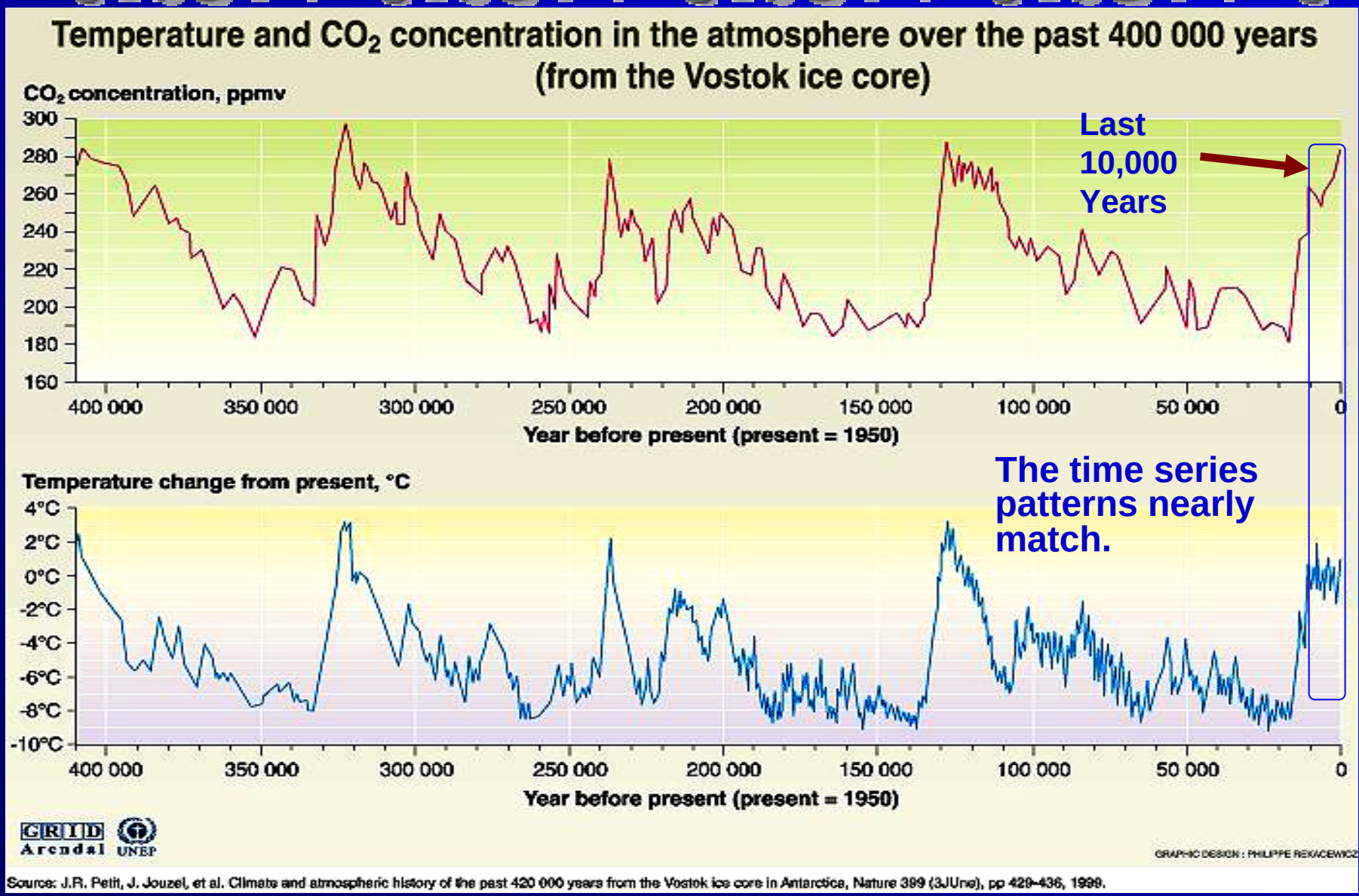
An essential enemy!!

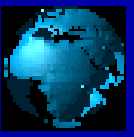
- CO_2 and some other minor gases
  1. Absorb some of the thermal radiation leaving the surface of the earth.
  2. Emit radiation from much higher and colder levels out to space.

- These radiatively active gases are known as greenhouse gases.
  - They act as a partial blanket for the thermal radiation from the surface which enables it to be substantially warmer than it would otherwise be, analogous to the effect of a greenhouse.

- Without the greenhouse gases, Earth's average temperature would be roughly –20°C.

Global Temperature and Greenhouse gases





Global Temperature..

Long Term Trends and Climate Sensitivity

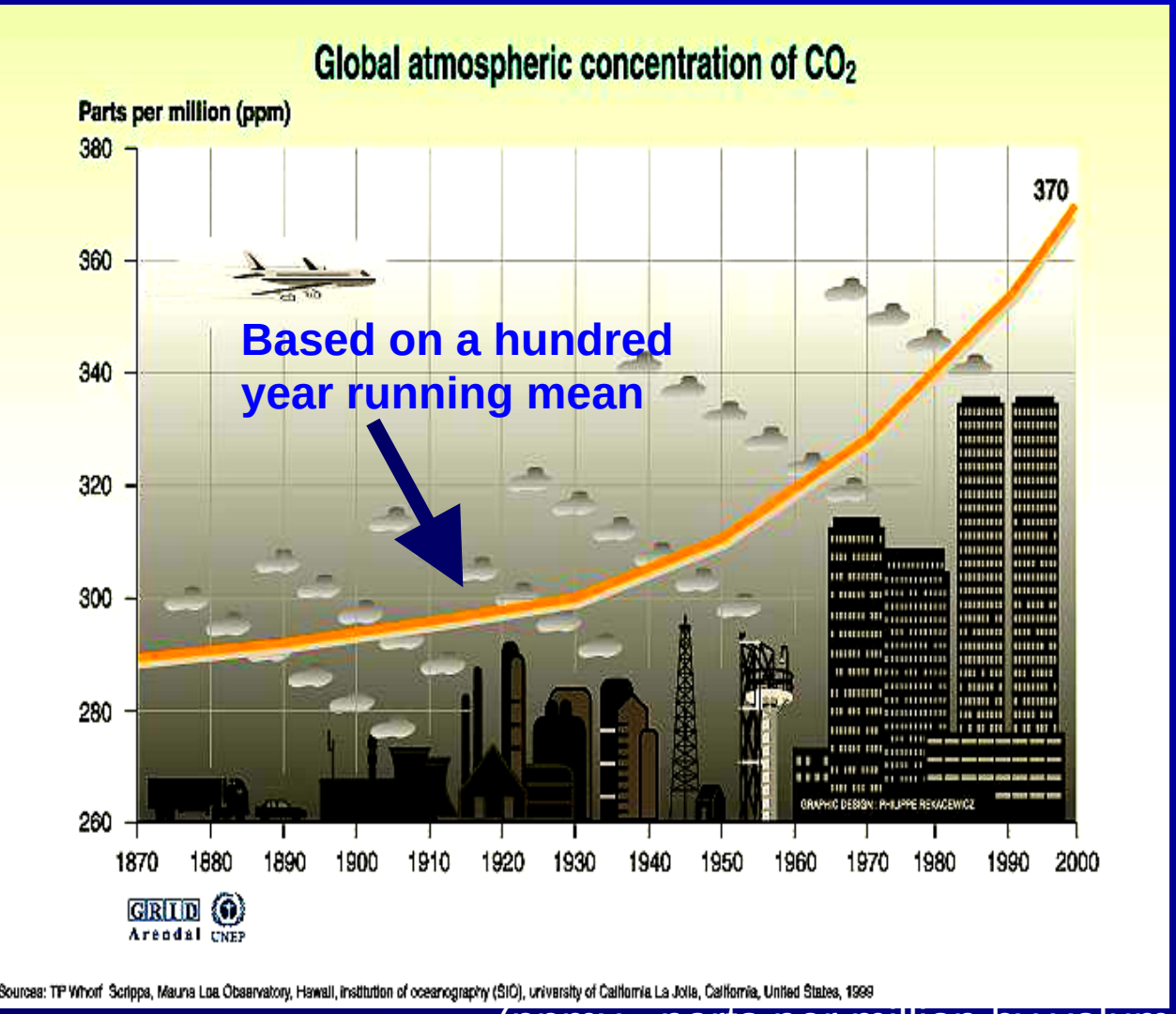
- There is a strong correlation between carbon dioxide content in the atmosphere and temperature.
- Over the last 400,000 years the Earth's climate has been unstable, with very significant temperature changes, going from a warm climate to an ice age in as rapidly as a few decades.
- The climate may be quite sensitive to internal or external climate forcing and feedbacks.

Global Temperature..

Greenhouse Gases : Why Worry?

- Temperatures have been less variable during the last 10,000 years.
  - It is unlikely that global mean temperatures have varied by more than 1°C in a century during this period.
  - *A possible scenario:* anthropogenic emissions of Green House Gases (GHGs) could bring the climate to a state where it reverts to the highly unstable climate of the pre-ice age period.
- Rather than a linear evolution, the climate follows a non-linear path with sudden and dramatic surprises when GHG levels reach an as-yet unknown trigger point.

Increasing trend of CO_2 the age of idustrialization

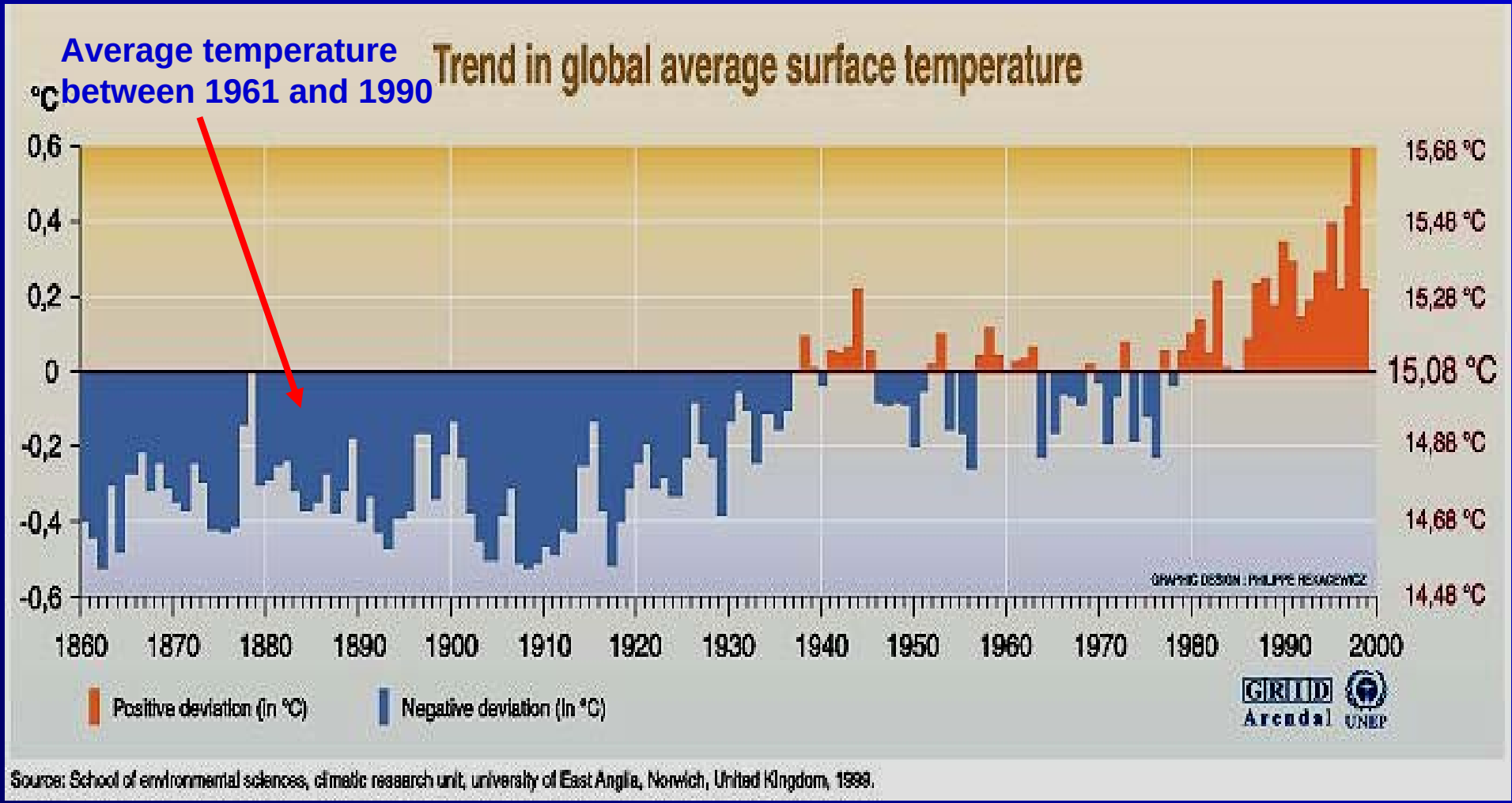


- Pre-industrial concentration 280ppmv
- Present concentration 367ppmv.
- The rapid increase in CO2 concentrations has been occurring since the onset of industrialization.
- Closely followed the increase in CO2 emissions from fossil fuels.

(ppmv= parts per million by volume).

Global SurfaceTemperature

Recent Trends



Combined land-surface air and sea surface temperatures (°C) 1861 to 1998, relative to the average temperature between 1961 and 1990.

Increasing Trend of Global Temperature

- The mean global surface temperature has increased by about 0.3 to 0.6°C since the late 19th century.
- By about 0.2 to 0.3°C over the last 40 years, which is the period with most reliable data.
- Recent years have been among the warmest since 1860 – the period for which instrumental records are available.
  - The four warmest years on record since 1860 have all occurred since 1990.

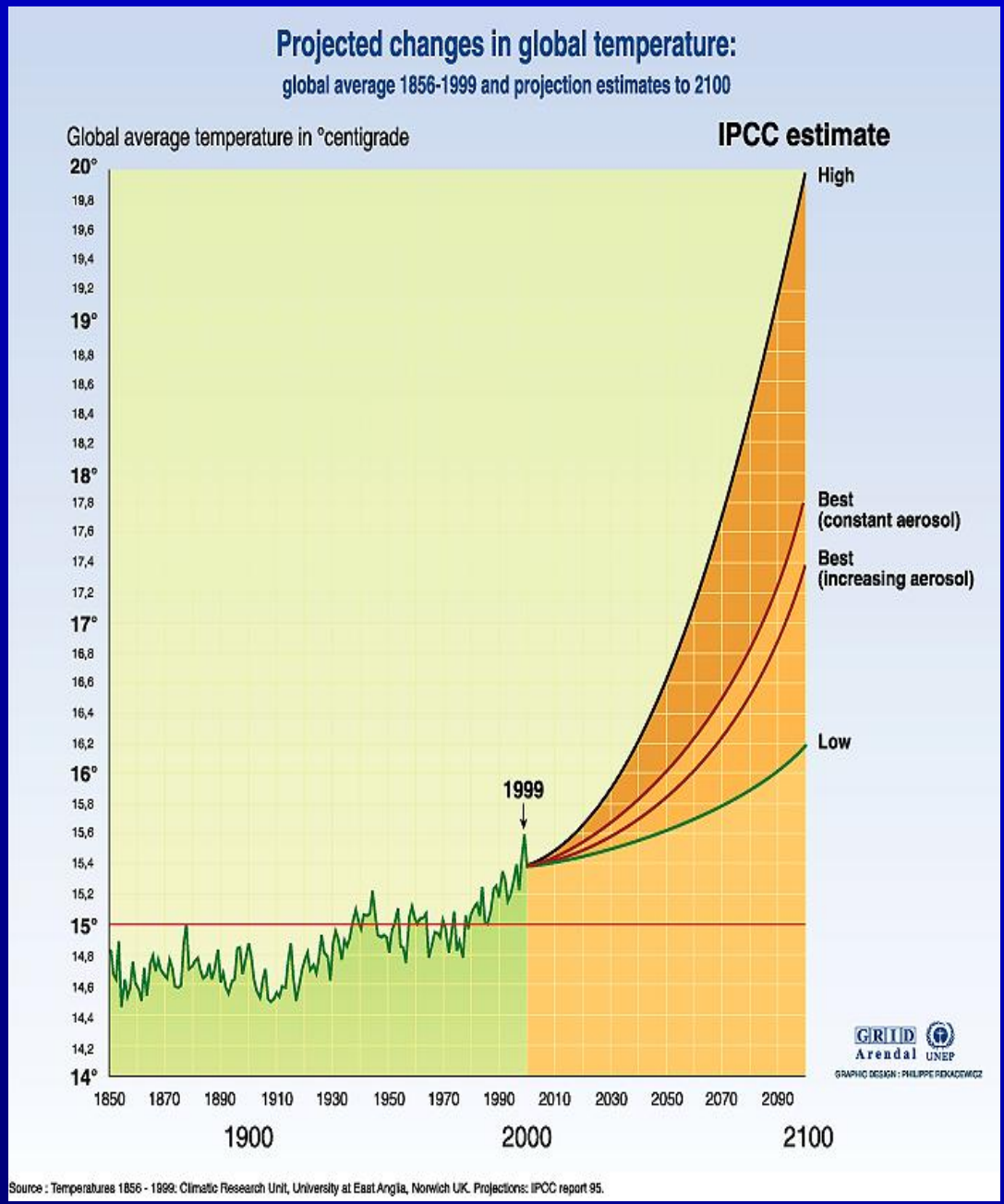
Global Warming→ Recent observations

- The warming has been greatest at night over land in the mid-to-high latitudes of the northern hemisphere.
- The warming during the northern winter and spring has been stronger than at other seasons.
- In some areas, primarily over continents, the warming has been several times greater than the global average.
- However, in a few areas, temperatures have actually cooled, e.g., over the southern Mississippi Valley in North America.

Global temperature increase predictions

IPCC estimates 1 to 5°C increase

- *IPCC stands for Intergovernmental Panel on climate change.*



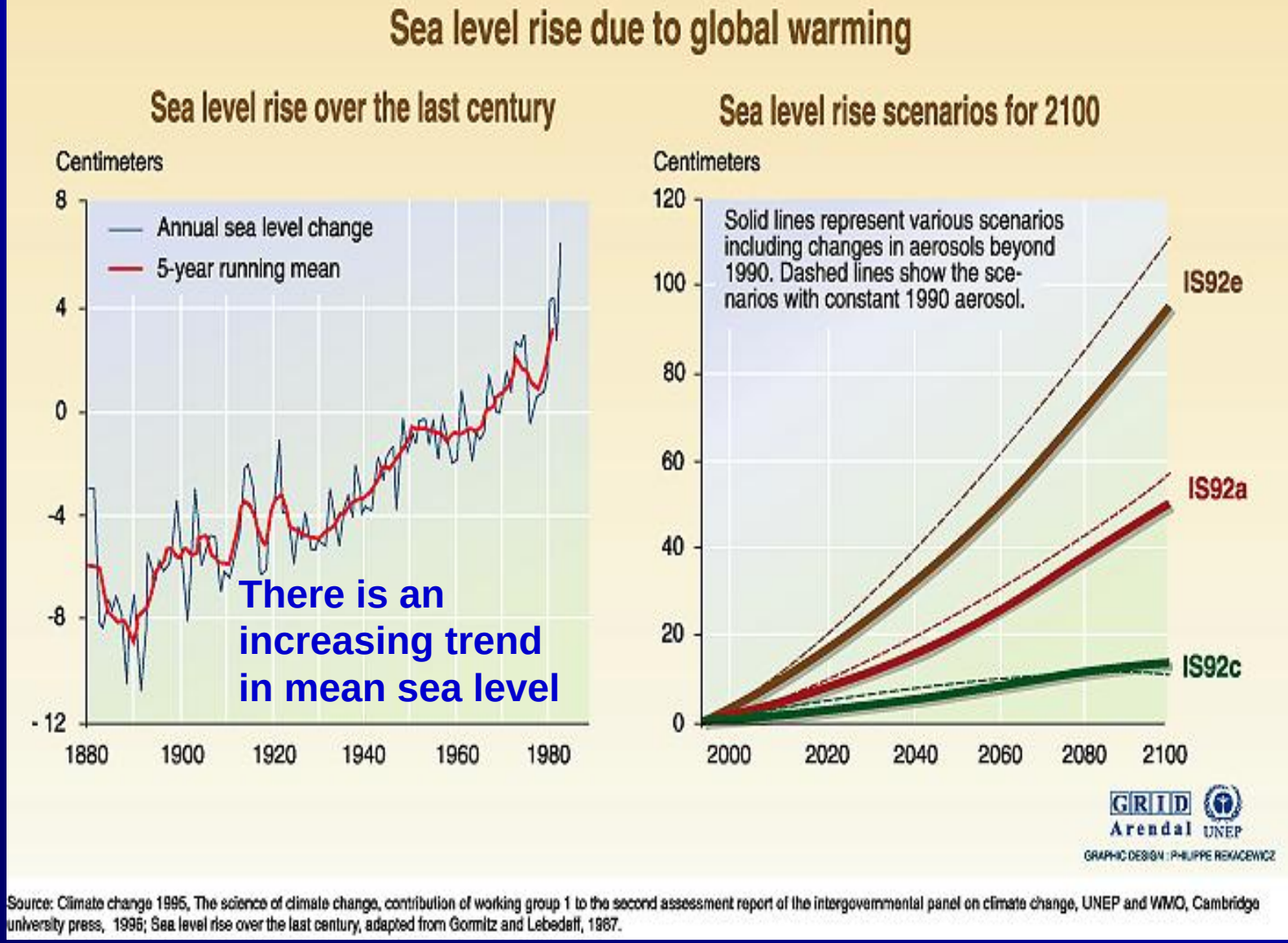
How global warming influences climatic processes

- The air temperature difference drives the atmospheric circulation.
- The temperature of ocean water drives the ocean currents.
- Once the temperature is increased the energy input driving these processes increases.
  - This results speeding up of the processes.
- The moisture holding capacity of air increases
  - Temperature increase results in higher rate of evaporation and transpiration.

Change in Precipitation patterns

- Change in global temperature will have a definite effect on the distribution of precipitation.
- Precipitation has increased over land at high latitudes of the Northern Hemisphere, especially during the cold season.
- Decrease in precipitation occurred in steps after the 1960s over the subtropics and the tropics from Africa to Indonesia.
- Precipitation averaged over the Earth's land surface increased from the start of the century up to about 1960, but has decreased since about 1980.

Global Warming→ Mean Sea Level rise



Source: Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996; Sea level rise over the last century, adapted from Gornitz and Lebedeff, 1987.

Global Warming→ Mean Sea Level rise

- Over the last 100 years, the global sea level has risen by about 10 to 25 cm.
- It is likely that much of the rise in sea level has been related to the concurrent rise in global temperature over the last 100 years.
- On this time scale, the warming and the consequent thermal expansion of the oceans may account for about 2-7 cm of the observed sea level rise, while the observed retreat of glaciers and ice caps may account for about 2-5 cm.
- The rate of observed sea level rise suggests that there has been a net positive contribution from the huge ice sheets of Greenland and Antarctica,
- The ice sheets remain a major source of uncertainty in accounting for past changes in sea level because of insufficient data.

Climate Change and Bangladesh Scenario

- The country is located in the Bengal Basin, a low-lying very flat delta.

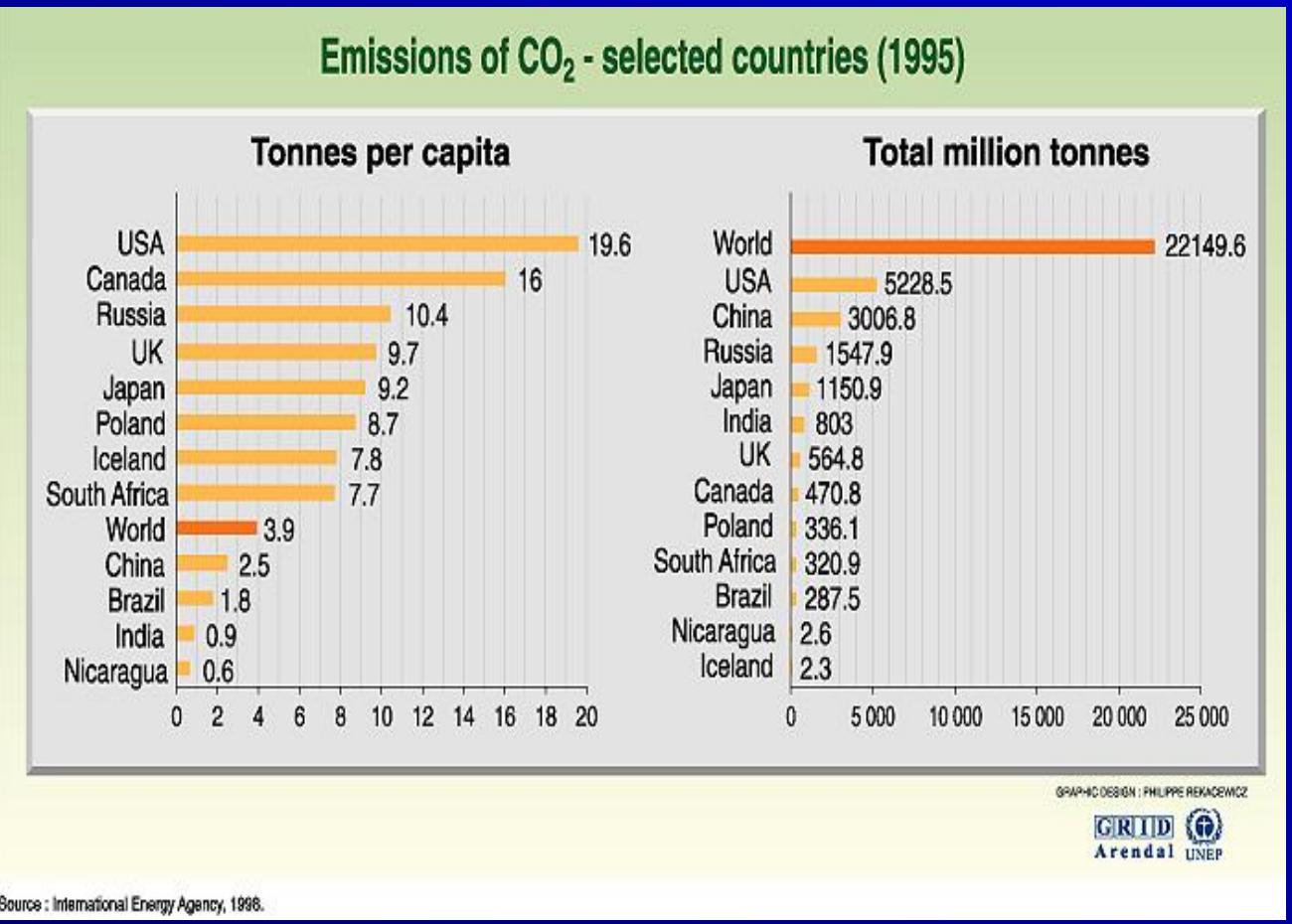
- About 80 per cent of Bangladesh is floodplains with very low mean elevation above the sea level.

- Differences in the elevation between adjoining ridge tops and depression centers range from
  - less than 1 meter on tidal floodplains,
  - 1 to 3 meters on the main river and estuarine floodplains, and
  - up to 5 to 6 meters in the Sylhet Basin in the north-east.
  - Only in the extreme north-west land elevations exceed 30 meters above the mean sea level.

Climate change and Bangladesh

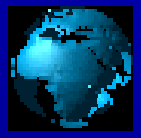
- The flat topography makes a significant part of Bangladesh vulnerable to sea level change.
  - The active delta and dynamic morphology complicates the reliable estimation of vulnerability of tidal floodplains to sea level rise.
- The net sea level rise would result in
  - Inundation of coastal land
  - Reduced drainage and hence prolonged flooding due to high backwater.
- Higher precipitation within GBM basin would result in greater flood magnitude and frequency.

How much of it do we deserve?



- Per capita emissions of CO2 is less than 0.2 ton annually in Bangladesh, compared to 1.6 tons in the developing countries
- The global average being 4.0 tons annually in the world as a whole.

Before the signing of the Kyoto Protocol



Thank You

Questions and Answer Time