4.2 The Greenhouse Effect





• Plus, **methane** can be oxidized to carbon dioxide and water in the atmosphere

Process	Flux / gigatonnes / year
Photosynthesis	- 120
Cell respiration	+ 119.6
Ocean uptake	- 92.2
Ocean loss	+ 90.6
Deforestation and land use changes	+ 1.6
Combustion of fossil fuels	+ 6.4

Carbon fluxes in the carbon cycle

Table 1: Records of CO2 increase since 1958. Data is obtained from MaunaLoa monitoring station, Hawaii.

Years	Average CO ₂ concentration (ppm)	Years	Average CO ₂ concentration (ppm)
1958	315,17	1981	339,76
1959	315,83	1982	340,96
1960	316,75	1983	342,6
1961	317,49	1984	344,25
1962	318,3	1985	345,73
1963	318,83	1986	346,98
1964	318,93	1987	348,75
1965	319,87	1988	351,31
1966	321,21	1989	352,77
1967	322,02	1990	354,03
1968	322,89	1991	355,48
1969	324,46	1992	356,29
1970	325,52	1993	356,99
1971	326,16	1994	358,88
1972	327,29	1995	360,9
1973	329,51	1996	362,57
1974	330,08	1997	363,76
1975	330,99	1998	366,62
1976	331,99	1999	368,31
1977	333,73	2000	369,48
1978	335,34	2001	371,02
1979	336,68	2002	373,1
1980	338,51	2003	375,64
		2004	377,38

Annual fluctuation does exist. There is a drop from May to October due to increased photosynthesis and vise versa from November to April.



Figure 1: Contributions of sectors to global CO₂ emissions in 2004







Figure 3: Carbon emissions from fossil fuel burning per person in 2006

Country	
Country	Emissions per person
	Tonnes of carbon
Qatar	22.4
United Arab Emirates	13.3
Kuwait	10.4
Singapore	9.2
USA	5.5
Canada	• 5.4
Norway	5.3
Australia	4.5
Kazakhstan	4.1
Saudi Arabia	3.9
World average	1.3

Burning of fossil fuels (Cause) \rightarrow Greenhouse Effect (CO₂ increase)

The layer of air which, supports life is the troposphere (8 Km above the earth surface). Its composition in gases remains constant and any change causes a problem.

- **CO**₂ is formed naturally during the respiration of organisms, but is taken up by plants. Hence, no accumulation, but recycling
- It is the burning of fossil fuels that causes a rise in atmospheric CO₂ concentration.

 \rightarrow This change in the composition of air, prevents more of the suns heat to escape from the Earth.

 \rightarrow Acts as the glass in a greenhouse

- \rightarrow Rise in temperature \rightarrow melting of polar ice \rightarrow sea level rise \rightarrow floodings
 - Most of the warming is attributed to CO₂

Why?

- 1) It has the highest concentration among other gases (63.4 %)
- 2) The impact of a gas depends on its ability to absorb long wave radiation
- 3) It remains in the atmosphere longer (approx. 100 years) compared to other greenhouse gases like:

Methane (18.3 %), nitrous oxides (6.1 %), CFC's (12.2 %) and Water vapour

!!! It is the Greenhouse Effect that maintains the earth's surface at an average temperature of 15 C and not –18 **!!!**

Measures to reduce the impact:

- Reduce energy consumption
- Use alternative sources of energy (Solar, wind power)
- Reforest areas to encourage growth of photosynthesizing plants

CONSEQUENCES OF GLOBAL TEMPERATURE RISE ON ARCTIC ECOSYSTEMS

- Increased rates of decomposition of detritus previously trapped in permafrost that will melt during summer times
- Expansion of the range of habitats available to temperate species
- Loss of ice habitat for polar bears
- Changes in distribution of prey species affecting higher trophic levels
- Increased success of pest species including pathogens
- The Arctic ice cap may completely disappear
- Marine species sensitive to temperature changes might not adapt and eventually become extinct (eg corals and coral reef areas)

Go to the site below to use a model that simulates climate change:

http://climate.nasa.gov/ClimateTimeMachine/climateTimeMachine.cfm

Viewpoints on climate change are presented by Al Gore and George Monbiot, an author, journalist of the Guardian Newspaper and environmental campaigner based in Wales. Just click on the link below!!!

http://www.monbiot.com/archives/category/climate-change/

http://www.takepart.com/an-inconvenient-truth

THE PRECAUTIONARY PRINCIPLE (not assessed)

This principle holds that, if the effects of a human – induced change would be very large, perhaps catastrophic, those responsible for the change must prove that it will **not do harm** before proceeding. This is the reverse of the normal situation, where those who are concerned about the change would have to prove that it will **do harm** in order to prevent such changes going ahead.

For example, if the possible consequences of rapid global warming are devastating enough, preventive measures are justified even if it is far from certain that rapid global warming will result from current human activities.

Please discuss the following:

- Consider whether the economic harm of measures taken now to limit global warming could be balanced against the potentially much greater harm for future generations of taking no action now.
- 2) There are also ethical questions about whether the health and wealth of future human generations should be jeopardized, and whether it is right to knowingly damage the habitat of, and possibly drive to extinction, species other than humans.
- 3) Think that only through international cooperation will a solution be found. There is an inequality between those in the world who are contributing most to the problem and those who will be most harmed.

 Table 2: A timeline of agreements and commitments for action (not assessed)

Year	Events the second state and the second s
1979	First World Climate Conference. Climate change officially recognized as a serious problem needing an international response when evidence of increasing carbon dioxide levels established.
1988	Intergovernmental Panel on Climate Change (IPCC) established by United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO). The IPCC is a collaborative activity comprising over 2000 climate scientists worldwide. Its main activity is to provide at regular intervals an assessment of the state of knowledge on climate change
1990	First IPCC Report on Climate Change. The Report confirms that climate change is a reality and is supported by scientific data.
1992	UN Earth Summit, Rio de Janeiro (United Nations Conference on Environment and Development). United Nations Framework Convention on Climate Change (UNFCCC) signed by 154 governments.
1995	First UNFCCC conference. Governments recognized that voluntary commitments were inadequate and work started to draft a protocol for adoption at the third Conference of Parties in 1997. Second IPCC Report concludes that the balance of evidence suggests a discernible human influence on the global climate.
1997	Kyoto Protocol signed by some 160 nations at third UNFCCC conference. The Protocol calls for the first ever legally binding commitments to reduce carbon dioxide and five other greenhouse gas emissions to 5.2% below 1990 levels before 2012. The US signed but has not ratified the protocol.
2001	Third IPCC Report states that anthropogenic emissions will raise global mean temperature by 5.8°C by 2050.
2004	Kyoto Protocol is still ineffective . For the Kyoto Protocol to be effective at least 55 countries have to ratify (fully adopt the commitments) and there must be enough annex I (developed) countries who together are accountable for more than 55% of the emissions according to the 1990 levels. However the percentage of annex I countries is only 37.5%.
2005	Kyoto Protocol goes into effect , signed by major industrial nations except US. Work to retard emissions accelerates in Japan, Western Europe, US regional governments and corporations.
2007	Fourth IPCC Report warns that serious effects of warming have become evident; cost of reducing emissions would be far less than the damage they will cause. In December 2007 UN climate conference in Bali agreed on the Bali road map which set the framework for negotiations on a long-term agreement on emissions cuts and recognized the urgency. However, it did not specify emission reduction levels.
2008	Bangkok Climate Change talks in April and Poznan, Poland, Climate Change conference in December, negotiations continued towards an international agreement to be concluded in Copenhagen at the end of 2009 to take effect in 2012.