

VLEEM II: Sustainability and climate change



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VLEEM II: Short History of Climate Change (Science)



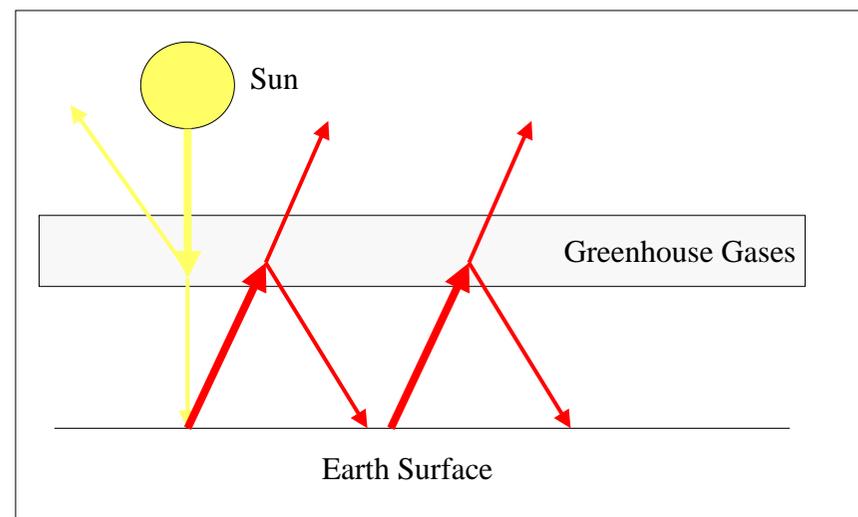
- * 1896 Arrhenius postulates the enhancement of the greenhouse effect due to anthropogenic emissions
- * 1955 Plass showed that additional carbondioxyde in the atmosphere leads to enhanced absorption of long wave radiation.
- * 1955 Suess showed that carbon from fossil fuels stayed in the atmosphere (keyword: ^{14}C)
- * 1955 Revelle started to look in the up-take of carbon by sea-water
- * 1960 Keeling could proof a rise in carbon content of the atmosphere by direct measurements

VLEEM II: Short History of Climate Change (Politics)

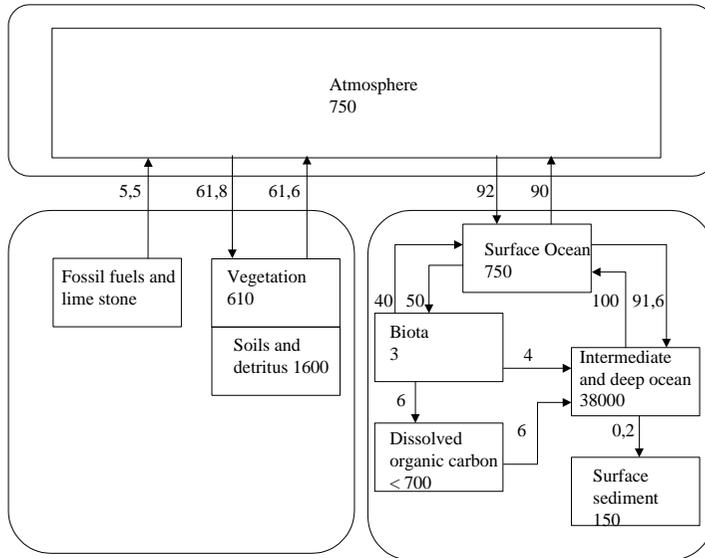


- * 1972 Environmental summit Stockholm
- * 1987 Brundtland report
- * 1992 Rio summit
- * 1997 Kyoto-conference
- * 2002 Johannesburg summit

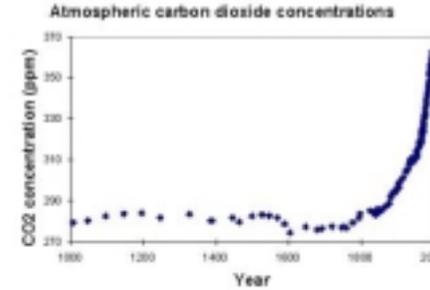
VLEEM II: The greenhouse gas effect



VLEEM II: The carbon cycle



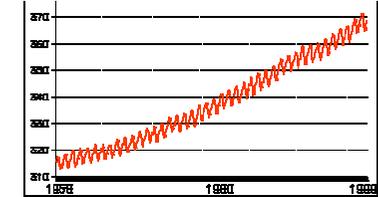
VLEEM II: The carbon cycle



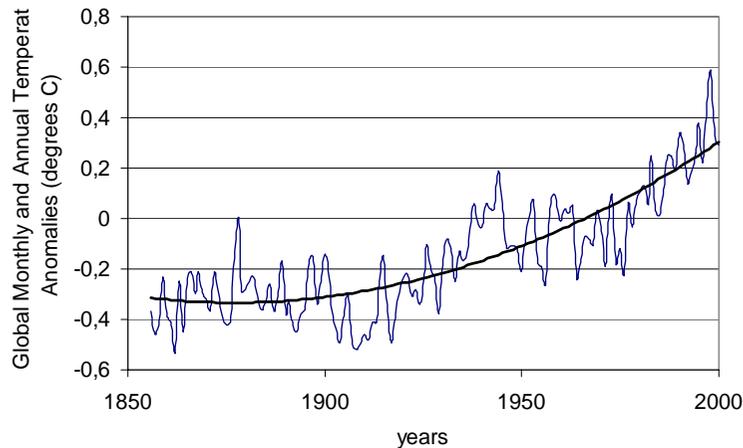
Analysis of air in ice-cores proofs that the carbon content in the atmosphere rises sharply after beginning of the industrialisation.

Direct measurements of CO₂-proof a steady increase

Carbon dioxide concentration (in parts per million, ppm) of the air at the summit of Mauna Loa, Hawaii, from 1958 to 2008.



VLEEM II: Increase of Global Temperature



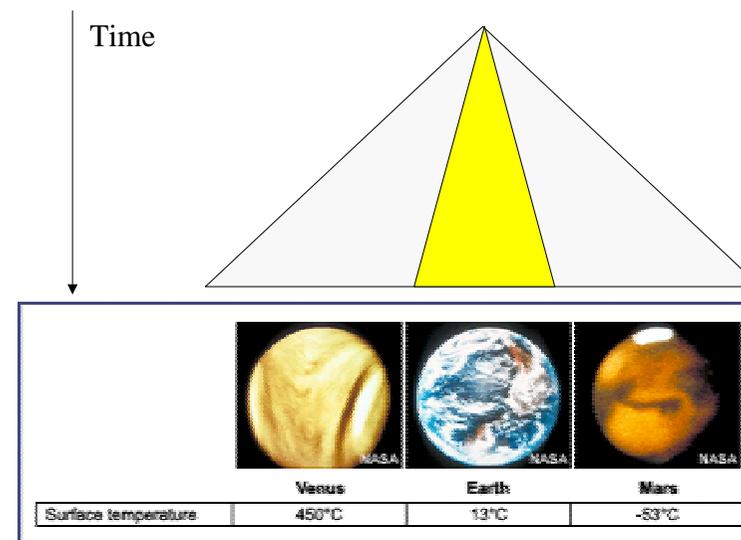
VLEEM II: Geo-Engineering



The idea of geo-engineering is to actively change major parameters of the system earth, like the overall albedo or the take up of carbon by the ocean.

These ideas are mainly discussed in the US, but the might become very relevant, if climate change becomes extremely obvious, but measures to reduce greenhouse gas emissions fail.

$$\min \int_1^{2200} (c_{Damage}(yr, l)(1-\delta)^{(yr-2000)} + c_{Mitigation}(yr, l)(1-\delta)^{(yr-2000)}) dyr$$



The debate on climate change can be phrased in two ways:

- * the danger of climate change force us to change the energy system completely.
- * progress in energy technologies make it possible to supply even arising demand of energy, with less and less carbon emissions.

The potential to reach “zero”-emission:

A technological cluster can only be considered sustainable, if - in the most extended application of the cluster - a state could be reached with “zero”-CO2-emission from the energy sector.

- * the potential of each technology to achieve “zero”-emission will be analysed.
- * the flexibility of the technological mix will be used to judge the sustainability of the development, 1.) has the mix the potential to reduce emissions, 2.) are enough back-stop options available in case some of the technologies fail to fulfil their potentials

- * only a cost-benefit analysis - if it would be possible - could be the basis for a sound concentration level
- * the guard-rail approach is close to VLEEM, but too much based on Malthusian pessimism
- * VLEEM tries first to develop ideas of a “zero”-emission future.
- * The analysis will then precise lines on how these futures can be reached.
- * This is an optimistic approach.