

Background – field of research

Several international policy measures have been taken over the last 10-15 years to reduce the global emissions of greenhouse gases into the atmosphere. Carbon dioxide (CO₂) is a greenhouse gas that receives a lot attention, as it has been emitted in large and increasing amounts by several anthropogenic activities over the last 150 years and has caused a significant increase of the CO₂ concentration in the atmosphere (see also figure 1 for the period 1960-2011).

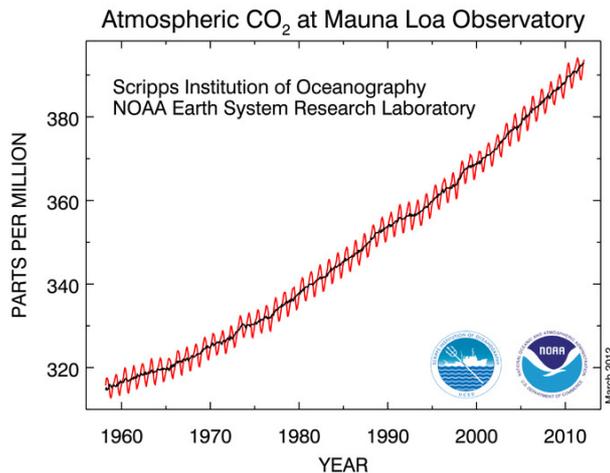
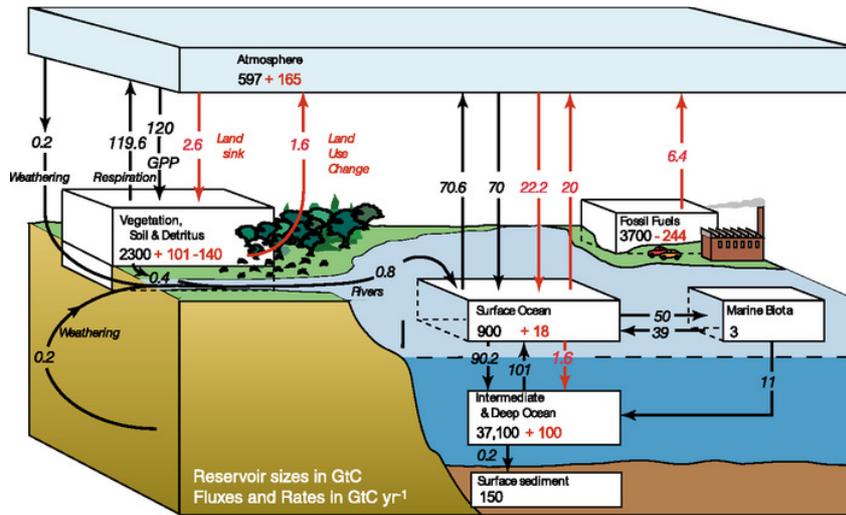


Fig. 1; Atmospheric CO₂ concentration (in ppm) measured at Mauna Loa Observatory, Hawaii (Source; 05-04-2012; <http://www.esrl.noaa.gov/gmd/obop/mlo/>)

All carbon on earth is part of the so-called carbon cycle, in which carbon is naturally exchanged between the biosphere, the atmosphere and the oceans in almost equal in- and outgoing carbon flows (figure 2). There are, however, different factors, both natural and anthropogenic that can change in- and/or outgoing flows and change the net flow during a certain time period. The combustion of fossil fuels is such an anthropogenic factor. The oceans and biosphere currently take up approximately half of the CO₂ that is released into the atmosphere by the combustion of fossil fuels. The other half stays in the atmosphere and therefore an annual increase of CO₂ in the atmosphere is currently measured.

The use of bio fuels instead of fossil fuels is encouraged to reduce or even stop a further increase of CO₂ in the atmosphere. Although the combustion of bio fuels also gives emissions of CO₂ into the atmosphere, this input can be counteracted by the uptake of CO₂ from the atmosphere by the plants that will be used as bio fuels. In principle, the bio fuel CO₂ emissions do therefore not cause a significant further increase of the atmospheric CO₂ concentration.



The global carbon cycle; carbon sources and sinks with carbon fluxes and rates. (IPCC 4AR 2007, section 7.3, source: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch7s7-3.html; 05-04-2012)

In several countries around the world, fossil fuel CO₂ emissions by large industrial plants and energy plants are financially discouraged (paying emission allowances) while the use of bio fuels is financially encouraged (no payment of emission allowances, fuel subsidies). In global treaties like the Kyoto Protocol, countries have agreed on achieving specific (fossil fuel) CO₂ emission reductions within a certain time period. If the agreements are not fulfilled countries risk financial penalties. Both companies and governments therefore have financial interests in reducing their fossil fuel CO₂ emissions, or at least report these reductions to the verification authorities. To independently quantify and verify the reported fossil fuel CO₂ emissions of an industrial/energy plant, to guarantee a specific biogenic or fossil composition of a produced fuel, or to verify the reduction trends in fossil fuel CO₂ emissions by countries, reliable verification methods are needed. These methods need to be developed and validated.