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Scrutinizing the Carbon Cycle and CO_2 Residence Time in the Atmosphere

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Climate scientists presume that the carbon cycle has come out of balance due to the increasing anthropogenic emissions from fossil fuel combustion and land use change. This is made responsible for the rapidly increasing atmospheric CO_2 concentrations over recent years, and it is estimated that the removal of the additional emissions from the atmosphere will take a few hundred thousand years. Since this goes along with an increasing greenhouse effect and a further global warming, a better understanding of the carbon cycle is of great importance for all future climate change predictions. We have critically scrutinized this cycle and present an alternative concept, for which the uptake of CO_2 by natural sinks scales proportional with the CO_2 concentration. In addition, we consider temperature dependent natural emission and absorption rates, by which the paleoclimatic CO_2 variations and the actual CO_2 growth rate can well be explained. The anthropogenic contribution to the actual CO_2 concentration is found to be *4.3%*, its fraction to the CO_2 increase over the Industrial Era is *15 %* and the average residence time *4 years*.

Key-words: Carbon cycle, atmospheric CO_2 concentration, CO_2 residence time, anthropogenic emissions, fossil fuel combustion, land use change, climate change

1. Introduction

The carbon cycle can be understood as a series of carbon reservoirs in the Earth-Atmosphere-System (*EASy*), which are connected to each other by exchange fluxes of carbon and its main bio-chemical compounds. For climate considerations especially atmospheric CO_2 as the main atmospheric phase of the global carbon cycle is of great importance due to its infrared active properties and its classification as the most dangerous greenhouse gas. Therefore, particularly the increase of CO_2 in the atmosphere, which climate scientists mainly trace back to growing anthropogenic emissions as well as a reduced uptake of CO_2 by oceans and land vegetation, are in the focus of many investigations.

In the *5th Assessment Report* (*AR5*, 2013) of the *Intergovernmental Panel on Climate Change* (*IPCC*) we can read (*AR5-Chap.12-FAQ 12.3*, p. 1107): "*Global temperature would not respond quickly to the greenhouse gas concentration changes... Eliminating CO_2 emissions only would lead to near constant temperature for many centuries (commitment from past emissions)... As a consequence of the large inertia in the climate and carbon cycle, the long-term global temperature is largely controlled by total CO_2 emissions that have accumulated over time, irrespective of the time when they were emitted*."

So, the *IPCC* assumes that not only the Earth as a large heat storage but also the atmosphere as a big storage for CO_2, cumulating this greenhouse gas over many centuries, is responsible for a slow response of the global temperature. But obviously this response is assumed to work only in one direction. While the CO_2 increase of *100 ppm* over the last century is made liable for a relatively fast increase of the temperature of about *0.8 °C* over this period, eliminating further emissions are expected to lead to near constant temperatures for many centuries. The *IPCC* explains this with '*extremely long*