What Can the Mauna Loa CO_2 Record Tell Us?

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The record of atmospheric carbon dioxide measurements at NOAA's Mauna Loa Observatory, started by Dave Keeling, now spans 49 years. It is dominated by the steady rise of the observed CO_2 mole fraction. The rate of rise has accelerated significantly since the beginning of the record, and there is also clear evidence of substantial year to year variations, although there is not a single year in which the annual average CO_2 mole fraction decreased. When the observed increase of dissolved inorganic carbon in the oceans, due to the absorption of industrial CO_2, is taken into account, two features can be quantified. The first is that large emissions of CO_2 due to land use change took place before 1958, and the second is that the terrestrial biosphere has been a net sink of CO_2 in more recent decades. A closer look at the year to year variations of the CO_2 growth rate shows that the terrestrial biosphere responds with a time lag to variations of both temperature and precipitation. The response functions are quantified and can explain, when applied to the observed global temperature and precipitation records, 65% of the short term (interannual) variations of the growth rate of carbon dioxide.

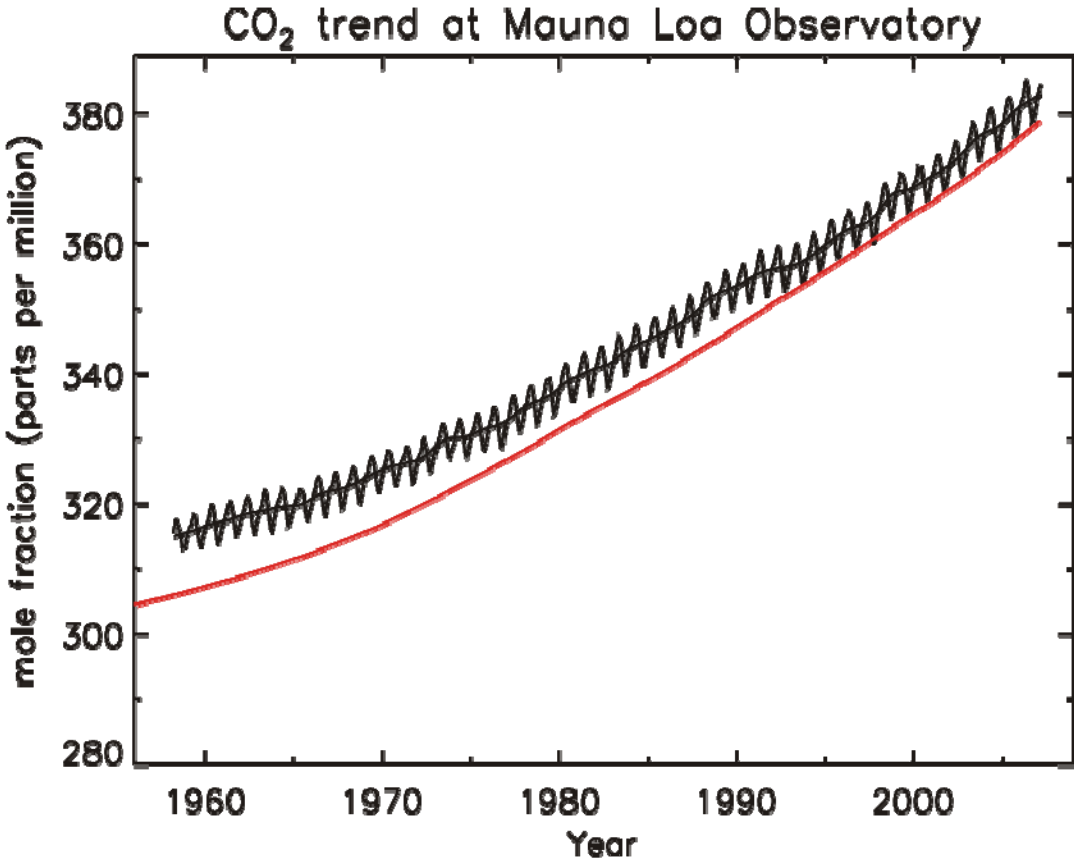

Figure 1. Monthly mean mole fraction of carbon dioxide at Mauna Loa. The de-seasonalized trend is obtained by applying a smoothing filter with a full width at half-maximum of 1 year (thick black line). The expected atmospheric increase since 1850 in response to fossil fuel burning when only absorption of the excess CO_2 by the oceans is taken into account is given by the Hamburg Ocean Carbon Cycle model (red curve).