Fast 140 wissenschaftliche Studien weisen detailliert die minimale Auswirkung von CO2 auf die Temperatur der Erde nach

geschrieben von Chris Frey | 17. Januar 2022

Kenneth Richard

Vorbemerkung: Alle Hervorhebungen in den übersetzten Passagen im Original! Die Inhalte der hier abschnittsweise gezeigten Studien erwies sich als zu zeitaufwändig, außerdem hat Autor Richard die Ergebnisse gut zusammen gefasst. – Ende Vorbemerkung

Wir haben unsere Liste wissenschaftlicher Arbeiten zum Thema „Extrem niedrige CO_2-Klimasensitivität" mit neuen Arbeiten aus dem Jahr 2021 und einigen neu entdeckten Arbeiten aus der Vergangenheit aktualisiert.

Im Jahr 2016 enthielt diese Liste nur 50 Arbeiten (wie in der Webadresse angegeben). In weniger als 6 Jahren ist die Liste auf 137 (Stand heute) angewachsen.

Klicken Sie auf den Link, um die vollständige Liste der über 135 Studien zu sehen, welche die extrem geringe CO_2-Sensitivität nachweisen.

Einige Beispiele für die Arbeiten folgen hier:

Coe et al., 2021 (2XCO_2 [400 bis 800 ppm] = **0.5°C**)

Die HITRAN-Datenbank mit den Absorptionsspektren von Gasen ermöglicht es, die Absorption der Erdstrahlung bei der derzeitigen Temperatur von 288 K für jeden einzelnen Bestandteil der Atmosphäre und auch für die kombinierte Absorption der gesamten Atmosphäre genau zu bestimmen. Aus diesen Daten lässt sich schließen, **dass H_2O für 29,4 K der 3,3 K Erwärmung verantwortlich** ist, während CO_2 3,3 K und CH_4 und N_2O zusammen nur 0,3 K beitragen. **Die Empfindlichkeit des Klimas gegenüber einem künftigen Anstieg der CO_2-Konzentration wird auf 0,50 K berechnet, einschließlich der positiven Rückkopplungseffekte von H_2O**, während die Empfindlichkeit des Klimas gegenüber CH_4 und N_2O mit 0,06 K bzw. 0,08 K fast nicht nachweisbar ist. Dieses Ergebnis deutet stark darauf hin, dass ein Anstieg der CO_2-Konzentration nicht zu signifikanten Veränderungen der Erdtemperatur führen wird und dass ein Anstieg von CH_4 und N_2O kaum spürbare Auswirkungen haben wird.

International Journal of Atmospheric and Oceanic Sciences

2021; 5(2): 29-40

The Impact of CO_2, H_2O and Other "Greenhouse Gases" on Equilibrium Earth Temperatures

David Coe[1,*], Walter Fabinski[2], Gerhard Wiegleb[3]

5.2. Effect of Recently Increased Atmospheric CO_2

It is of some interest to calculate the increase in temperature that has occurred due to the increase in atmospheric CO_2 levels from the 280ppm prior at the start of the industrial revolution to the current 420ppm registered at the Mona Loa Observatory. (K. W. Thoning et. al. 2019) [17]. The HITRAN calculations show that atmospheric absorptivity has increased from 0.727 to 0.730 due to the increase of 140ppm CO_2, resulting in a temperature increase of 0.24Kelvin. This is, therefore, the full extent of anthropogenic global warming to date.

Table 6. *CO_2 Climate Sensitivity.*

CO_2 ppm doubling	50-100	100-200	200-400	400-800	800-1600
Climate sensitivity K	0.34	0.38	0.41	0.45	0.54
Sensitivity x feedback K	0.38	0.42	0.46	0.50	0.61

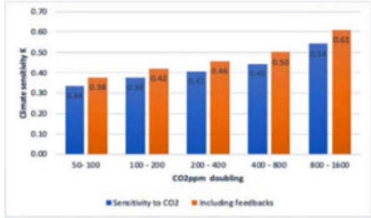

Figure 20. *Climate Sensitivity to CO_2.*

4.1. Climate Sensitivity to CO_2

From section 3.2 Table 2 shows the variation of equilibrium temperature for successive doublings of CO_2 concentration from 50ppm through to 1600ppm. The corresponding changes in temperature for each doubling are readily calculated in Table 6 and are shown in Figure 20. As can be seen "climate sensitivity" is not constant, but slowly increases with increasing CO_2 concentrations. Nevertheless, the values indicate that climate sensitivity at current CO_2 levels (400ppm) is of the order of 0.45 Kelvin. Applying the combined feedback H_2O and temperature multiplying factor of 1.124, increases the CO_2 climate sensitivity to 0.50 Kelvin, still significantly lower than most published values.

In order to satisfy radiative equilibrium at the "top of the atmosphere" (TOA) at an average earth temperature of 288Kelvin, only 61.5% of the earth's radiated energy should be transmitted through to space, leaving 38.5% to be absorbed and retained by the atmosphere/earth. Use of the HITRAN data base of gaseous absorption spectra shows the current atmospheric absorption to be 73.0% of total radiative emissions of which 52.74% must be retained by the earth/atmosphere to satisfy the current TOA equilibrium. This is a simple expression of the current earth temperature equilibrium.

The 38.5% retained radiation absorption comprises 35.3% attributed to H_2O, 3.0% to CO_2 and a mere 0.2% to CH_4 and N_2O combined. From this it follows that the 33Kelvin warming of the earth from 255Kelvin, widely accepted as the zero-atmosphere earth temperature, to the current average temperature of 288Kelvin, is a 29.4K increase attributed to H_2O, 3.3K to CO_2 and 0.3K to CH_4 and N_2O combined. H_2O is by far the dominant greenhouse gas, and its atmospheric concentration is determined solely by atmospheric temperature. Furthermore, the strength of the H_2O infra-red absorption bands is such that the radiation within those bands is quickly absorbed in the lower atmosphere resulting in further increases in H_2O concentrations having little further effect upon atmospheric absorption and hence earth temperatures. An increase in average Relative Humidity of 1% will result in a temperature increase of 0.03Kelvin.

By comparison CO_2 is a bit player. It however does possess strong spectral absorption bands which, like H_2O, absorb most of the radiated energy, within those bands, in the lower atmosphere. It also suffers the big disadvantage that most of its absorption bands are overlapped by those of H_2O thus reducing greatly its effectiveness. In fact, the climate sensitivity to a doubling of CO_2 from 400ppm to 800ppm is calculated to be 0.45 Kelvin. This increases to 0.50 Kelvin when feedback effects are taken into account. This figure is significantly lower than the IPCC claims of 1.5 to 4.5 Kelvin.

The contribution of CH_4 and N_2O is miniscule. Not only have they contributed a mere 0.3Kelvin to current earth temperatures, their climate sensitivities to a doubling of their present atmospheric concentrations are 0.06 and 0.08 Kelvin respectively. As with CO_2 their absorption spectra are largely overlapped by the H_2O spectra again substantially reducing their impact.

It is often claimed that a major contributor to global warming is the positive feedback effect of H_2O. As the atmosphere warms, the atmospheric concentration of H_2O also increases, resulting in a further increase in temperature suggesting that a tipping point might eventually be reached where runaway temperatures are experienced. The calculations in this paper show that this is simply not the case. There is indeed a positive feedback effect due to the presence of H_2O, but this is limited to a multiplying effect of 1.183 to any temperature increase. For example, it increases the CO_2 climate sensitivity from 0.45K to 0.53K.

A further feedback, however, is caused by a reduction in atmospheric absorptivity as the spectral radiance of the earth's emitted energy increases with temperature, with peak emissions moving slightly towards lower radiation wavelengths. This causes a negative feedback with a temperature multiplier of 0.9894. This results in a total feedback multiplier of 1.124, reducing the effective CO_2 climate sensitivity from 0.53 to 0.50 Kelvin.

Feedback effects play a minor role in the warming of the earth. There is, and never can be, a tipping point. As the concentrations of greenhouse gases increase, the temperature sensitivity to those increases becomes smaller and smaller. The earth's atmosphere is a near perfect example of a stable system. It is also possible to attribute the impact of the increase in CO_2 concentrations from the pre-industrial levels of 280ppm to the current 420ppm to an increase in earth mean temperature of just 0.24Kelvin, a figure entirely consistent with the calculated climate sensitivity of 0.50 Kelvin.

David Coe, Walter Fabinski, Gerhard Wiegleb. The Impact of CO_2, H_2O and Other "Greenhouse Gases" on Equilibrium Earth Temperatures.
International Journal of Atmospheric and Oceanic Sciences. Vol. 5, No. 2, 2021, pp. 29-40. doi: 10.11648/j.ijaos.20210502.12

Schildknecht, 2020 (2XCO_2 = **0.5°C**)

Auf der Grundlage neuer numerischer Strahlungstransferberechnungen überprüfen wir ein von Schack 1972 vorgelegtes Argument, wonach die Sättigung der Absorption von Infrarotstrahlung durch Kohlendioxid in der Atmosphäre eintritt, sobald die relative Kohlendioxidkonzentration eine Untergrenze von etwa 300 ppm überschreitet. Wir geben eine kurze und prägnante Darstellung des Treibhauseffekts der Erdatmosphäre. **Wir finden eine Gleichgewichts-Klimasensitivität (Temperaturanstieg ΔT aufgrund einer Verdoppelung der atmosphärischen CO_2-Konzentration) von ΔT ≈ 0,5°C.** Wir erläutern die Übereinstimmung dieser Ergebnisse zu ΔT mit Ergebnissen, die durch satellitengestützte Messungen von kurzfristigen Strahlungsfluss- und Änderungen der Oberflächentemperatur gewonnen wurden. … Die Absorption erreicht Werte nahe 100 % für einen realistischen CO_2-Gehalt von 0,03 %. Daraus wird gefolgert, dass ein **weiterer Anstieg des (anthropogenen) CO_2 nicht zu einer merklich stärkeren Absorption der Strahlung führen und folglich das Klima der Erde nicht beeinflussen kann. … Die Auswirkung einer anthropogenen CO_2-Erhöhung auf das Klima auf der Erde ist ziemlich vernachlässigbar.**

Anmerkung: Den Autor dieser Studie kann man ggf. vielleicht fragen, ob er sie auch in Deutsch hat. Seine E-Mail: schild@physik.uni-bielefeld.de

International Journal of Modern Physics B | Vol. 34, No. 30, 2050293 (2020)

SATURATION OF THE INFRARED ABSORPTION BY CARBON DIOXIDE IN THE ATMOSPHERE

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In the case of CO_2 in air, the wide band absorption constant κ for the infrared electromagnetic radiation depends on the concentration, or the partial pressure, of the CO_2, and a natural question concerns the magnitude of the CO_2 concentration that leads to approximate saturation within the troposphere of the earth.

In his 1972 article[1], Schack points out that for a concentration of 0.03 % carbon dioxide in air, approximate saturation is reached within a distance of approximately the magnitude of the height of the troposphere. The absorption reaches values close to 100 % for a realistic CO_2 content of 0.03 %, it is concluded[1] that any further increase of (anthropogenic) CO_2 cannot lead to an appreciably stronger absorption of radiation, and consequently cannot affect the earth's climate.

It will be useful to elaborate on the argument given by Schack in detail, in order to explicitly display the simplicity and generality of the underlying concepts that lead to a parameter-free prediction of the absorption of infrared radiation by CO_2.

Adopting Planck's radiation law for a temperature at the surface of the earth, chosen as $T = 293K$ by Schack, and taking into account the well-known absorption spectrum of the CO_2 molecule, one finds that the radiation of wave lengths λ_{CO_2} in the interval $13\ \mu m \leq \lambda_{CO_2} \leq 17.6\ \mu m$ is relevant for the absorption by CO_2. The total absorption due to CO_2 in the atmosphere is determined by the total mass of CO_2 that is transversed by a beam of infrared radiation on its path from the surface at $z = 0$ to the upper end of the atmosphere, or $z \to \infty$.

In the gravitational field of the earth, the pressure, p, of a gas decreases with increasing altitude, z, according to $dp = -\rho g\, dz$, where ρ denotes the density of the gas and g the acceleration due to gravity. For an ideal gas of temperature T, we have $p = \rho RT/M$, or $\rho = pM/RT$, with R being the gas constant, T denoting the absolute temperature and M the molecular weight of the gas. The total mass per unit area transversed by a beam of infrared radiation on its path through the atmosphere is determined by an integration over the density $\rho(p, T)$ from the surface to the upper end of the troposphere. The result of the integration may be represented in terms of an effective altitude z_0 of a fictitious atmosphere of homogeneous constant pressure p_0, constant temperature T and constant density ρ. The value of z_0 (obviously) depends on whether the atmosphere is treated isothermally, or rather more realistically, is described adiabatically.

It has been the aim of this paper to estimate the increase in temperature ΔT ("climate sensitivity") of the surface of the earth due to a doubling of the CO_2 concentration in the atmosphere. The estimate is obtained in a concise and transparent manner without oversimplification. All necessary steps are explicitly elaborated upon.

The basic assumption of associating a uniform constant temperature T with the surface of the earth, and a black-body long-wave infrared radiation $S(T)$, is by no means trivial, implicitly or explicitly, however, common to main-stream investigations on this matter. Our results are based on a new radiative-transfer evaluation, the details being presented in Appendix A. The absorption of the atmosphere in the CO_2 spectral range can be, and is reliably determined, and leads to an approximately constant value beyond an altitude of about 5 km, or a length of the horizontal CO_2-air pipe of about 3 km at surface temperature and pressure.

Assuming restoration of equilibrium upon doubling of the CO_2 concentration by an associated increase of the temperature then implies a definite estimate of the increase of the surface temperature ΔT, given by $\Delta T \cong 0.5\ ^0C$ (compare Sections 3 and 4).

In terms of the widely employed feedback parameter f, the result of $\Delta T \cong 0.5^0C$ corresponds to a negative feedback of $f < 0$. This result is empirically supported by satellite-based measurements of short-time fluctuations of the outgoing radiation flux at the TOA as a function of (sea-)surface temperature. A consistent picture emerges by combining theoretical radiation-transfer results with radiation-flux measurements (compare Section 5). This picture disagrees with an abundant number of predictions from climate models that imply positive feedbacks, $f > 0$.

The quantitative result of $\Delta T \simeq 0.5$ to $0.6\ ^0C$ valid for the drastic increase of doubling of the CO_2 content in air from 380 ppm to 760 ppm to be related to one century, confirms that the effect of an anthropogenic CO_2 increase on the climate on earth is fairly negligible. This conclusion is in strong contrast to the values of $\Delta T \sim 1.5 - 4.5\ ^0C$ quoted in the 2013 IPCC report[11]. The published results on ΔT fill an even larger interval between $\Delta T \simeq 0.4^0C$ to $\Delta T \simeq 8^0C$. There is a systematic tendency of the results on ΔT published between the years 2000 to 2018 to decrease[12] with increasing publication date, the results coming closer to our result of $\Delta T \simeq 0.5\ ^0C$.

Easterbrook, 2016

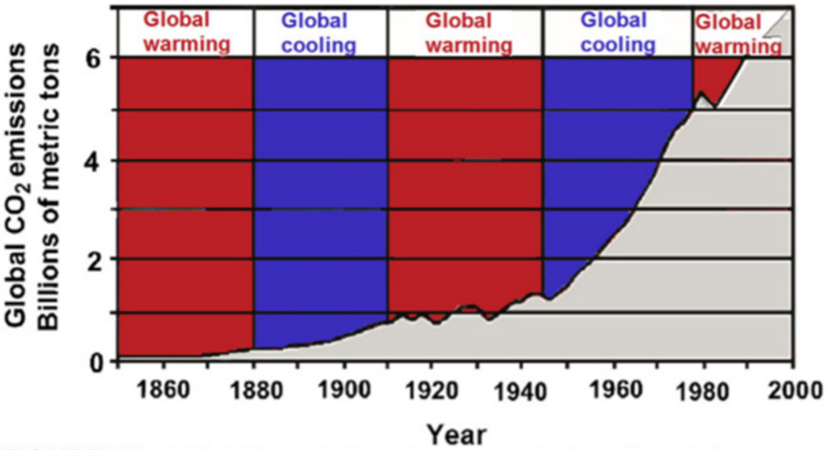
CO2 macht nur einen winzigen Teil der Atmosphäre aus (0,04%) und trägt nur zu 3,6 % zum Treibhauseffekt bei. Der CO2-Gehalt in der Atmosphäre hat sich seit dem Anstieg der Emissionen nach 1945 nur um 0,008 % erhöht. Ein solch winziger Anstieg des CO2-Gehalts kann nicht den von den CO2-Befürwortern vorhergesagten Temperaturanstieg von 10°F verursachen. Die Klimamodellierer bauen in ihre Modelle eine hohe Wasserdampfkomponente ein, die sie auf den erhöhten atmosphärischen Wasserdampf zurückführen, der durch die sehr geringe Erwärmung durch CO2 verursacht wird, und da Wasserdampf 90-95 % des Treibhauseffekts ausmacht, behaupten sie, dass das Ergebnis eine Erwärmung sein wird. Das Problem ist, dass der atmosphärische Wasserdampf seit 1948 tatsächlich zurückgegangen ist und nicht zugenommen hat, wie es die Klimamodelle behaupten. **Falls CO2 die globale Erwärmung verursacht, dann sollte CO2 immer der Erwärmung vorausgehen, wenn sich das Klima der Erde nach einer Eiszeit erwärmt. Doch in allen Fällen hinkt CO2 der Erwärmung um ~800 Jahre hinterher. Kürzere Zeiträume zeigen dasselbe – die Erwärmung geht immer einem Anstieg des CO2 voraus und kann daher nicht die Ursache der Erwärmung sein.**

https://www.sciencedirect.com/science/article/pii/B9780128045886000094
Evidence-Based Climate Science (Second Edition)
D.J. Easterbrook
2016, Pages 163-173
https://doi.org/10.1016/B978-0-12-804588-6.00009-4

During the 1915 to 1945 warm period, temperatures rose without significant increase in CO_2, showing that global warming occurs without any possibility of CO_2 as a cause because it occurred before CO_2 had risen significantly. CO_2 began to rise sharply after the end of World War II (1945) and continued for 30 years. But instead of causing global warming, as would be the case if CO_2 caused atmospheric warming, global cooling occurred for 30 years (1945–1977) during soaring CO_2. In 1977, the northeastern Pacific switched from its cool mode (where it had been since ~1945) to its warm mode, and global warming occurred from 1978 to about 2000. CO_2 continued to rise as it had since 1958, so the warm period corresponded to increased CO_2 as a matter of coincidence (Fig. 9.13).

At the abrupt 1977 "Great Climate Shift," when the global climate shifted from cooling to warming, no significant change occurred in the rate of increase of CO_2 (Fig. 9.12), suggesting that CO_2 had nothing to do with the shifting of the climate.

CO_2, which makes up only 0.040% of the atmosphere and constitutes only 3.6% of the greenhouse effect, has increased only 0.008% since emissions began to soar after 1945. How can such a tiny increment of CO_2 cause the 10°F increase in temperature predicted by CO_2 advocates? The obvious answer is that it can't.



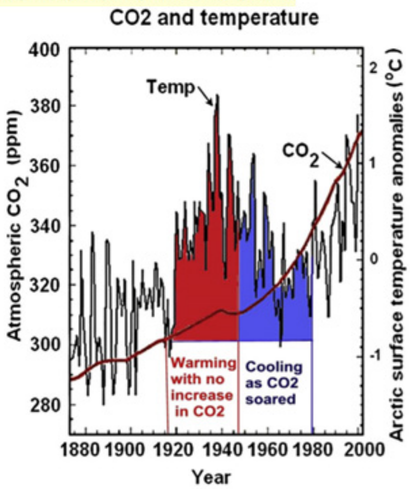


FIGURE 9.8 Global CO_2 emissions show no correlation with global warming.

https://www.sciencedirect.com/science/article/pii/B9780128045886000094
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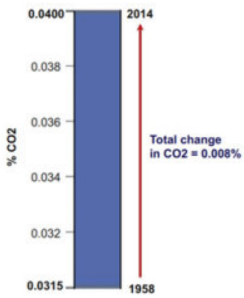

Water vapor accounts for up to 95% of greenhouse gases, with CO_2, methane, and a few other gases making up the remaining 5%. The greenhouse effect from CO_2 is only about 3.6%. Most of the greenhouse warming effect takes place early (Fig. 9.7). After that, the effect decreases exponentially (Fig. 9.6), so the rise in atmospheric CO_2 from 0.030% to 0.038% from 1950 to 2016 could have caused warming of only about 0.01°C. The total change in CO_2 of the atmosphere amounted to an addition of only one molecule of CO_2 per 10,000 molecules of air.

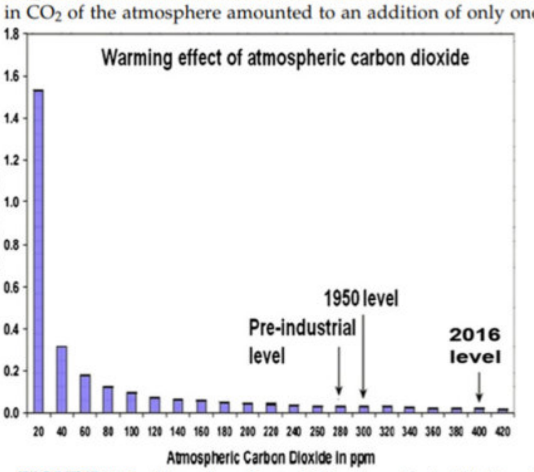

FIGURE 9.7 Warming effect of CO_2 *From D. Archibald.*

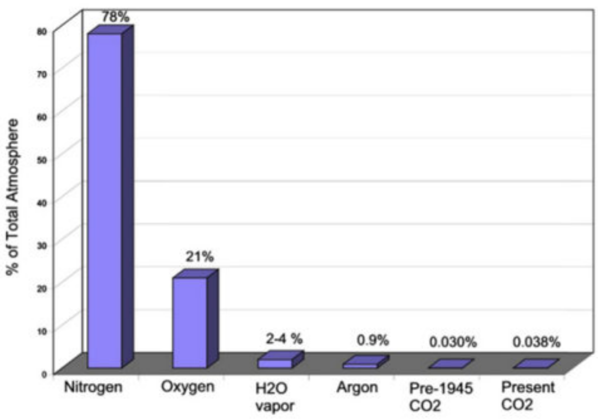

FIGURE 9.5 Composition of the atmosphere. CO_2 makes up only 0.04% of the atmosphere.

https://www.sciencedirect.com/science/article/pii/B9780128045886000094

Evidence-Based Climate Science (Second Edition)

D.J. Easterbrook

2016, Pages 163-173

https://doi.org/10.1016/B978-0-12-804588-6.00009-4

For several decades, the IPCC has forcefully asserted that increased atmospheric causes global warming that will result in catastrophic consequences for the world. We can test this contention by looking at the timing of increased CO_2 and global warming during alternating Ice Ages and interglaciations. At the end of each Ice Age over the past 420,000 years, the global climate warmed during the following interglaciation and CO_2 rose. All we need to do is to see which came first, global warming or increased CO_2. If CO_2 caused the global warming, then the rise in CO_2 must precede global warming. If it lags global warming, it cannot possibly be the cause of the warming.

Measurements of CO_2 in air bubbles in ice of the Vostock core in Antarctica have been published by Petit et al. (1999), Fischer et al. (1999), Monnin et al. (2001), Mudelsee (2001), Caillon et al. (2003). Petit at al. (1999) measured CO_2 for 420,000 years of the Vostock ice core and found that as the climate cooled into an Ice Age, the decrease in atmospheric CO_2 lagged temperature by several thousand years. Fischer et al. (1999) found that in going from an Ice Age into a warm interglacial, rise in CO_2 lagged warming by 600 ± 400 years. Monnin et al. (2001) showed that rise in CO_2 lagged warming by 800 ± 600 years in the Dome Concordia ice core in Antarctica. Mudelsee (2001) found that over the full 420,000 years of the Vostock core, CO_2 lagged warming by 1300 ± 1000 years. Caillon et al. (2003) analyzed the Vostock core data and found that CO_2 lagged warming by 800 ± 200 years. All five studies of the Antarctic ice cores showed that CO_2 always lagged warming and thus could not be the cause of the warming.

Vostok Ice Cores 250,000 - 200,000 years ago

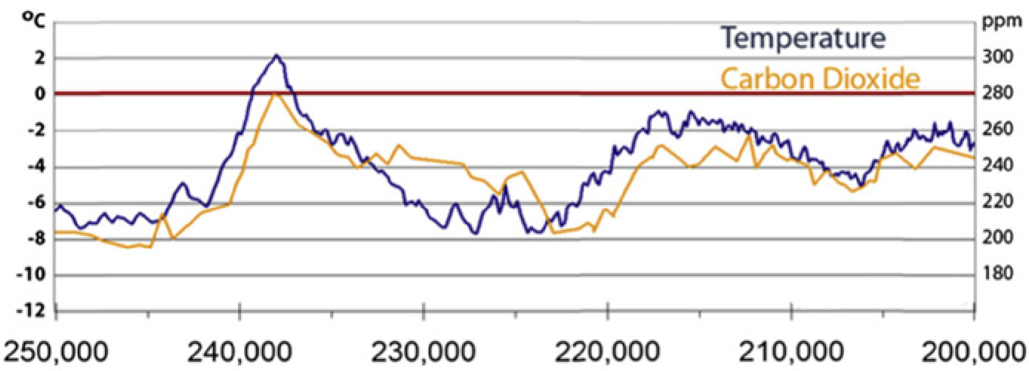

FIGURE 9.14 CO_2 lags warming for the entire 420,000 years of the Antarctic ice cores.

Davis, 2017

Die Korrelation zwischen ΔRF_{CO_2} und linear-detrendiertem T über das Phanerozoikum ist positiv und erkennbar, aber nur 2,6 % der Varianz in T ist auf die Varianz in ΔRF_{CO_2} zurückzuführen. Von 68 Korrelationskoeffizienten (die Hälfte davon nichtparametrisch) zwischen ΔRF_{CO_2} und T-Proxies, die alle bekannten großen phanerozoischen Klimaübergänge umfassen, sind 75,0 % nicht erkennbar und 41,2 % der erkennbaren Korrelationen sind negativ. Spektralanalyse, Auto- und Kreuzkorrelation zeigen, dass Proxies für T, die atmosphärische CO_2-Konzentration und ΔRF_{CO_2} über das Phanerozoikum hinweg oszillieren und die **Zyklen von CO_2 und ΔRF_{CO_2} antiphasisch sind**. Ein auffälliger 15-Millionen-Jahre-CO_2-Zyklus fällt eng mit festgestellten Massenaussterben der Vergangenheit zusammen, was darauf hindeutet, dass die Beziehung zwischen CO_2, dem Aussterben der biologischen Vielfalt und der damit verbundenen Kohlenstoffpolitik dringend erforscht werden muss. **Diese Studie zeigt, dass Veränderungen der atmosphärischen CO_2-Konzentration keine Temperaturveränderungen im antiken Klima verursacht haben.**

climate

Climate **2017**, *5*(4), 76; https://doi.org/10.3390/cli5040076

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Article

The Relationship between Atmospheric Carbon Dioxide Concentration and Global Temperature for the Last 425 Million Years

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Abstract: Assessing human impacts on climate and biodiversity requires an understanding of the relationship between the concentration of carbon dioxide (CO_2) in the Earth's atmosphere and global temperature (T). Here I explore this relationship empirically using comprehensive, recently-compiled databases of stable-isotope proxies from the Phanerozoic Eon (~540 to 0 years before the present) and through complementary modeling using the atmospheric absorption/transmittance code MODTRAN. Atmospheric CO_2 concentration is correlated weakly but *negatively* with linearly-detrended T proxies over the last 425 million years. Of 68 correlation coefficients (half non-parametric) between CO_2 and T proxies encompassing all known major Phanerozoic climate transitions, 77.9% are non-discernible ($p > 0.05$) and 60.0% of discernible correlations are negative. Marginal radiative forcing (ΔRF_{CO2}), the change in forcing at the top of the troposphere associated with a unit increase in atmospheric CO_2 concentration, was computed using MODTRAN. The correlation between ΔRF_{CO2} and linearly-detrended T across the Phanerozoic Eon is positive and discernible, but only 2.6% of variance in T is attributable to variance in ΔRF_{CO2}. Of 68 correlation coefficients (half non-parametric) between ΔRF_{CO2} and T proxies encompassing all known major Phanerozoic climate transitions, 75.0% are non-discernible and 41.2% of discernible correlations are negative. Spectral analysis, auto- and cross-correlation show that proxies for T, atmospheric CO_2 concentration and ΔRF_{CO2} oscillate across the Phanerozoic, and cycles of CO_2 and ΔRF_{CO2} are antiphasic. A prominent 15 million-year CO_2 cycle coincides closely with identified mass extinctions of the past, suggesting a pressing need for research on the relationship between CO_2, biodiversity extinction, and related carbon policies. This study demonstrates that changes in atmospheric CO_2 concentration did not cause temperature change in the ancient climate.

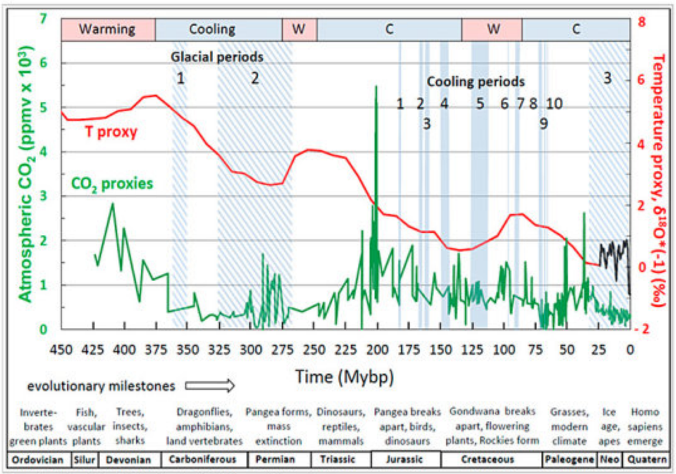

Figure 5. Temperature (T) and atmospheric carbon dioxide (CO_2) concentration proxies during the Phanerozoic Eon. Time series of the global temperature proxy ($\delta^{18}O^*(-1)$, red curve, $n = 6680$) are from Prokoph et al. [28] while concurrent atmospheric CO_2 concentration proxies (green curve, $n = 831$) are from Royer [40]. The red curve plots moving averages of the non-detrended T proxy averaged in 50 My windows incremented in ten-My steps (the 10–50 My moving average in Figure 3b). The green curve shows mean CO_2 concentration values in one-My bins averaged over high-resolution portions of the CO_2 record (the most recent Phanerozoic) and linearly interpolated over low-resolution portions (the older Phanerozoic). Glaciations based on independent sedimentary evidence are designated by vertical blue cross-hatched areas, while putative cool periods are designated by vertical solid blue bars. Major cooling and warming cycles are shown by the colored bars across the top while geological periods and evolutionary milestones are shown across the bottom. Abbreviations: CO_2, atmospheric concentration of carbon dioxide based on various proxies (Methods); ppmv, parts per million by volume; Silu, Silurian; Neo, Neogene; Quatern, Quaternary. The three major glacial periods and ten cooling periods identified by blue cross-hatches and solid lines, respectively, are (after [21]): *Glacial periods*. 1. late Devonian/early Carboniferous; 2. Permo-Carboniferous; 3. late Cenozoic. *Cooling periods*. 1. late Pliensbachian; 2. Bathonian; 3. late Callovian to mid-Oxfordian; 4. Tithonian to early Berriasian; 5. Aptian; 6. mid-Cenomanian; 7. mid-Turonian; 8. Campanian-Maastrichtian boundary; 9. mid-Maastrichtian; 10. late-Maastrichtian.

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Regression of linearly-detrended temperature proxies (Figure 3b, lower red curve) against atmospheric CO_2 concentration proxy data reveals a weak but discernible *negative* correlation between CO_2 concentration and T (Figure 6). Contrary to the conventional expectation, therefore, as the concentration of atmospheric CO_2 increased during the Phanerozoic climate, T decreased. This finding is consistent with the apparent weak antiphasic relation between atmospheric CO_2 concentration proxies and T suggested by visual examination of empirical data (Figure 5). The percent of variance in T that can be explained by variance in atmospheric CO_2 concentration, or conversely, $R^2 \times 100$, is 3.6% (Figure 6). Therefore, more than 95% of the variance in T is explained by unidentified variables other than the atmospheric concentration of CO_2. Regression of non-detrended temperature (Figure 3b, upper red curve) against atmospheric CO_2 concentration shows a weak but discernible positive correlation between CO_2 concentration and T. This weak positive association may result from the general decline in temperature accompanied by a weak overall decline in CO_2 concentration (trendline in Figure 4).

If ΔRF_{CO2} is a more direct indicator of the impact of CO_2 on temperature than atmospheric concentration as hypothesized, then the correlation between ΔRF_{CO2} and T over the Phanerozoic Eon might be expected to be positive and statistically discernible. This hypothesis is confirmed (Figure 9). This analysis entailed averaging atmospheric CO_2 concentration in one-My bins over the recent Phanerozoic and either averaging or interpolating CO_2 values over the older Phanerozoic (Methods). Owing to the relatively large sample size, the Pearson correlation coefficient is statistically discernible despite its small value ($R = 0.16$, $n = 199$), with the consequence that only a small fraction (2.56%) of the variance in T can be explained by variance in ΔRF_{CO2} (Figure 9). Even though the correlation coefficient between ΔRF_{CO2} and T is positive and discernible as hypothesized, therefore, the correlation coefficient can be considered negligible and the maximum effect of ΔRF_{CO2} on T is for practical purposes insignificant (<95%).

Link:
https://notrickszone.com/2022/01/13/nearly-140-scientific-papers-detail-the-minuscule-effect-co2-has-on-earths-temperature/

Übersetzt von Christian Freuer für das EIKE