Neue Studie: Verweildauer von CO_2 in der Atmosphäre 4 Jahre…Natürliche Quellen bewirken CO_2-Konzentrationsänderungen

geschrieben von Chris Frey | 3. September 2024

Kenneth Richard

„Die atmosphärischen CO_2-Beobachtungsdaten sind eindeutig nicht mit dem Klimanarrativ vereinbar. Im Gegenteil, sie widersprechen ihr.“ – Koutsoyiannis, 2024

In einer neuen Studie behauptet der IPCC, dass CO_2-Emissionen aus der Verbrennung fossiler Brennstoffe sich in der Atmosphäre „seltsam“ und ganz anders verhalten als CO_2-Moleküle aus natürlichen Emissionen (z. B. Pflanzenatmung, Ausgasung aus den Ozeanen), und bedient sich dabei „unangemessener Annahmen und Spekulationen“ sowie nicht realitätsnaher Modelle mit „imaginären Daten“.

„Die Unklarheit wird von unangemessenen Annahmen und Spekulationen begleitet, von denen die seltsamste ist, dass das Verhalten des CO_2 in der Atmosphäre von seiner Herkunft abhängt und dass das durch die anthropogene Verbrennung fossiler Brennstoffe freigesetzte CO_2 eine längere Verweildauer hat als natürlich freigesetztes.“

Während der IPCC einräumt, dass Emissionen aus natürlichen Quellen eine atmosphärische Verweildauer von nur 4 Jahren haben, hat er gleichzeitig Modelle des Inhalts erstellt, dass CO_2-Moleküle aus Emissionen fossiler Brennstoffe für Hunderte, Tausende, Zehntausende und sogar mehrere Hunderttausend Jahre in der Atmosphäre verbleiben.

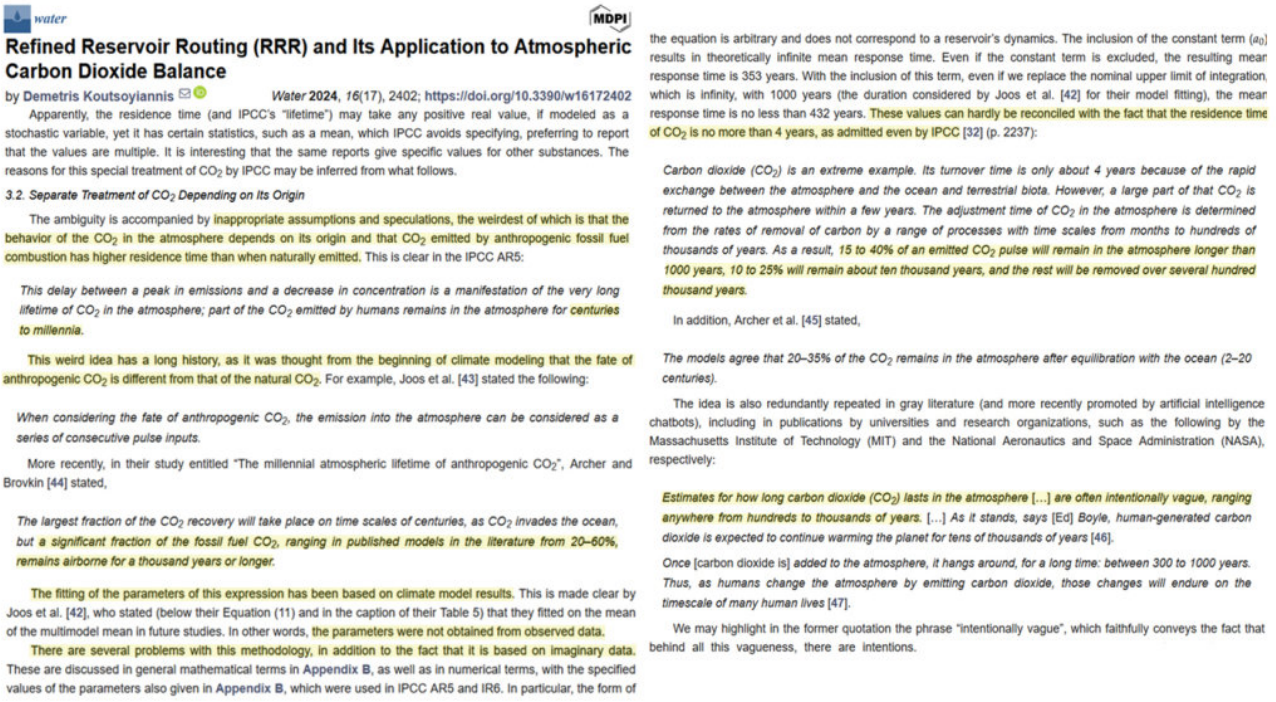
Laut IPCC:

„15 bis 40 % eines CO_2-Impulses [aus anthropogenen Emissionen] verbleiben länger als 1000 Jahre in der Atmosphäre, 10 bis 25 % verbleiben etwa zehntausend Jahre, und der Rest wird über mehrere hunderttausend Jahre abgebaut.“

„Kohlendioxid (CO_2) ist ein extremes Beispiel, seine Verweildauer beträgt aufgrund des schnellen Austauschs zwischen der Atmosphäre und dem Ozean nur etwa 4 Jahre.“

Auch hier gilt eine Verweilzeit von vier Jahren für natürliches CO_2, aber eine Verweilzeit von Hunderttausenden von Jahren für CO_2-Moleküle, die aus der Verbrennung fossiler Brennstoffe stammen. Es hat den Anschein, als könne man so ziemlich jedes Ergebnis aus imaginären Daten

ableiten.



water

MDPI

Refined Reservoir Routing (RRR) and Its Application to Atmospheric Carbon Dioxide Balance

by Demetris Koutsoyiannis

Water **2024**, *16*(17), 2402; https://doi.org/10.3390/w16172402

Apparently, the residence time (and IPCC's "lifetime") may take any positive real value, if modeled as a stochastic variable, yet it has certain statistics, such as a mean, which IPCC avoids specifying, preferring to report that the values are multiple. It is interesting that the same reports give specific values for other substances. The reasons for this special treatment of CO_2 by IPCC may be inferred from what follows.

3.2. Separate Treatment of CO_2 Depending on Its Origin

The ambiguity is accompanied by inappropriate assumptions and speculations, the weirdest of which is that the behavior of the CO_2 in the atmosphere depends on its origin and that CO_2 emitted by anthropogenic fossil fuel combustion has higher residence time than when naturally emitted. This is clear in the IPCC AR5:

> *This delay between a peak in emissions and a decrease in concentration is a manifestation of the very long lifetime of CO_2 in the atmosphere; part of the CO_2 emitted by humans remains in the atmosphere for centuries to millennia.*

This weird idea has a long history, as it was thought from the beginning of climate modeling that the fate of anthropogenic CO_2 is different from that of the natural CO_2. For example, Joos et al. [43] stated the following:

> *When considering the fate of anthropogenic CO_2, the emission into the atmosphere can be considered as a series of consecutive pulse inputs.*

More recently, in their study entitled "The millennial atmospheric lifetime of anthropogenic CO_2", Archer and Brovkin [44] stated,

> *The largest fraction of the CO_2 recovery will take place on time scales of centuries, as CO_2 invades the ocean, but a significant fraction of the fossil fuel CO_2, ranging in published models in the literature from 20–60%, remains airborne for a thousand years or longer.*

The fitting of the parameters of this expression has been based on climate model results. This is made clear by Joos et al. [42], who stated (below their Equation (11) and in the caption of their Table 5) that they fitted on the mean of the multimodel mean in future studies. In other words, the parameters were not obtained from observed data.

There are several problems with this methodology, in addition to the fact that it is based on imaginary data. These are discussed in general mathematical terms in Appendix B, as well as in numerical terms, with the specified values of the parameters also given in Appendix B, which were used in IPCC AR5 and IR6. In particular, the form of the equation is arbitrary and does not correspond to a reservoir's dynamics. The inclusion of the constant term (a_0) results in theoretically infinite mean response time. Even if the constant term is excluded, the resulting mean response time is 353 years. With the inclusion of this term, even if we replace the nominal upper limit of integration, which is infinity, with 1000 years (the duration considered by Joos et al. [42] for their model fitting), the mean response time is no less than 432 years. These values can hardly be reconciled with the fact that the residence time of CO_2 is no more than 4 years, as admitted even by IPCC [32] (p. 2237):

> *Carbon dioxide (CO_2) is an extreme example. Its turnover time is only about 4 years because of the rapid exchange between the atmosphere and the ocean and terrestrial biota. However, a large part of that CO_2 is returned to the atmosphere within a few years. The adjustment time of CO_2 in the atmosphere is determined from the rates of removal of carbon by a range of processes with time scales from months to hundreds of thousands of years. As a result, 15 to 40% of an emitted CO_2 pulse will remain in the atmosphere longer than 1000 years, 10 to 25% will remain about ten thousand years, and the rest will be removed over several hundred thousand years.*

In addition, Archer et al. [45] stated,

> *The models agree that 20–35% of the CO_2 remains in the atmosphere after equilibration with the ocean (2–20 centuries).*

The idea is also redundantly repeated in gray literature (and more recently promoted by artificial intelligence chatbots), including in publications by universities and research organizations, such as the following by the Massachusetts Institute of Technology (MIT) and the National Aeronautics and Space Administration (NASA), respectively:

> *Estimates for how long carbon dioxide (CO_2) lasts in the atmosphere [...] are often intentionally vague, ranging anywhere from hundreds to thousands of years. [...] As it stands, says* [Ed] *Boyle, human-generated carbon dioxide is expected to continue warming the planet for tens of thousands of years* [46].
>
> *Once* [carbon dioxide is] *added to the atmosphere, it hangs around, for a long time: between 300 to 1000 years. Thus, as humans change the atmosphere by emitting carbon dioxide, those changes will endure on the timescale of many human lives* [47].

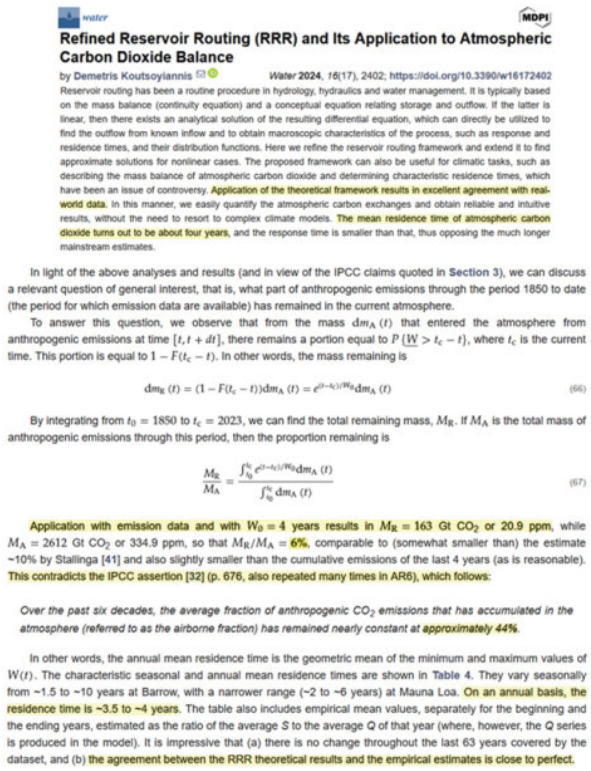
We may highlight in the former quotation the phrase "intentionally vague", which faithfully conveys the fact that behind all this vagueness, there are intentions.

Quelle: Koutsoyiannis, 2024

Anstatt sich auf Modelle zu verlassen, die auf Annahmen und Spekulationen beruhen, nutzt Dr. Koutsoyiannis einen gut etablierten, auf der Hydrologie basierenden theoretischen Rahmen (Refined Reservoir Routing oder RRR) in Kombination mit realen CO_2-Beobachtungen, um zu dem klaren Schluss zu kommen, dass die Verweilzeit für alle CO_2-Moleküle, unabhängig von ihrer Herkunft, zwischen 3,5 und 4 Jahren liegt.

Die angewandten theoretischen Ergebnisse stimmen so gut mit den empirischen Ergebnissen überein (z. B. ein empirischer Mittelwert von 3,91 Jahren gegenüber einem theoretischen Mittelwert von 3,94 Jahren in Barrow und ein identischer Wert von 3,68 Jahren für die empirischen und theoretischen Mittelwerte am Mauna Loa von 1958 bis 2023), dass der theoretische Rahmen als „nahezu perfekt“ bezeichnet werden kann. Mit anderen Worten: Die Übereinstimmung der angewandten Berechnungen mit den realen Beobachtungen liefert solide Belege dafür, dass die CO_2-Verweildauer wahrscheinlich nahe an diesem Bereich liegt.

Im Gegensatz dazu beträgt die berechnete Wahrscheinlichkeit für die modellierte, auf imaginären Daten basierende Behauptung, dass die Verweildauer eines CO_2-Moleküls mehr als 1000 Jahre beträgt, 10^{-68}, was bedeutet, dass sich der Wahrscheinlichkeitswert „nicht von einer Unmöglichkeit unterscheidet“.



water

MDPI

Refined Reservoir Routing (RRR) and Its Application to Atmospheric Carbon Dioxide Balance

by Demetris Koutsoyiannis

Water **2024**, *16*(17), 2402; https://doi.org/10.3390/w16172402

Reservoir routing has been a routine procedure in hydrology, hydraulics and water management. It is typically based on the mass balance (continuity equation) and a conceptual equation relating storage and outflow. If the latter is linear, then there exists an analytical solution of the resulting differential equation, which can directly be utilized to find the outflow from known inflow and to obtain macroscopic characteristics of the process, such as response and residence times, and their distribution functions. Here we refine the reservoir routing framework and extend it to find approximate solutions for nonlinear cases. The proposed framework can also be useful for climatic tasks, such as describing the mass balance of atmospheric carbon dioxide and determining characteristic residence times, which have been an issue of controversy. Application of the theoretical framework results in excellent agreement with real-world data. In this manner, we easily quantify the atmospheric carbon exchanges and obtain reliable and intuitive results, without the need to resort to complex climate models. The mean residence time of atmospheric carbon dioxide turns out to be about four years, and the response time is smaller than that, thus opposing the much longer mainstream estimates.

In light of the above analyses and results (and in view of the IPCC claims quoted in Section 3), we can discuss a relevant question of general interest, that is, what part of anthropogenic emissions through the period 1850 to date (the period for which emission data are available) has remained in the current atmosphere.

To answer this question, we observe that from the mass $\mathrm{d}m_\mathrm{A}(t)$ that entered the atmosphere from anthropogenic emissions at time $[t, t+\mathrm{d}t]$, there remains a portion equal to $P(W > t_c - t)$, where t_c is the current time. This portion is equal to $1 - F(t_c - t)$. In other words, the mass remaining is

$$\mathrm{d}m_\mathrm{R}(t) = (1 - F(t_c - t))\mathrm{d}m_\mathrm{A}(t) = e^{(t-t_c)/W_0}\mathrm{d}m_\mathrm{A}(t) \tag{66}$$

By integrating from $t_0 = 1850$ to $t_c = 2023$, we can find the total remaining mass, M_R. If M_A is the total mass of anthropogenic emissions through this period, then the proportion remaining is

$$\frac{M_\mathrm{R}}{M_\mathrm{A}} = \frac{\int_{t_0}^{t_c} e^{(t-t_c)/W_0}\mathrm{d}m_\mathrm{A}(t)}{\int_{t_0}^{t_c} \mathrm{d}m_\mathrm{A}(t)} \tag{67}$$

Application with emission data and with $W_0 = 4$ years results in $M_\mathrm{R} = 163$ Gt CO_2 or 20.9 ppm, while $M_\mathrm{A} = 2612$ Gt CO_2 or 334.9 ppm, so that $M_\mathrm{R}/M_\mathrm{A} = 6\%$, comparable to (somewhat smaller than) the estimate ~10% by Stallinga [41] and also slightly smaller than the cumulative emissions of the last 4 years (as is reasonable). This contradicts the IPCC assertion [32] (p. 676, also repeated many times in AR6), which follows:

> *Over the past six decades, the average fraction of anthropogenic CO_2 emissions that has accumulated in the atmosphere (referred to as the airborne fraction) has remained nearly constant at approximately 44%.*

In other words, the annual mean residence time is the geometric mean of the minimum and maximum values of $W(t)$. The characteristic seasonal and annual mean residence times are shown in Table 4. They vary seasonally from ~1.5 to ~10 years at Barrow, with a narrower range (~2 to ~6 years) at Mauna Loa. On an annual basis, the residence time is ~3.5 to ~4 years. The table also includes empirical mean values, separately for the beginning and the ending years, estimated as the ratio of the average *S* to the average *Q* of that year (where, however, the *Q* series is produced in the model). It is impressive that (a) there is no change throughout the last 63 years covered by the dataset, and (b) the agreement between the RRR theoretical results and the empirical estimates is close to perfect.

Table 4. Mean residence times, seasonal (W_min, W_max) and annual W_m (in years).

Site	Minimum, $W_\mathrm{min} = A(\varphi - 1)$	Maximum, $W_\mathrm{max} = A(\varphi + 1)$	Arithmetic Average, $A\varphi$	Theoretical Mean, $W_\mathrm{m} = \sqrt{W_\mathrm{min} W_\mathrm{max}}$	Empirical Mean W_m, Beginning Year	Empirical Mean W_m, Ending Year
Calibration over the entire period						
Mauna Loa	2.20	6.15	4.17	3.68	3.68	3.70
Barrow	1.55	9.91	5.73	3.91	3.94	3.95
Calibration over period 1958–2002						
Mauna Loa	2.32	6.57	4.45	3.91	3.93	3.98
Barrow	1.53	9.88	5.70	3.89	3.92	3.98

- Hence, the probability that after 1000 years, at least one out of the $N = 10^{40.6}$ molecules remains in the atmosphere is $p_1 = pN = 10^{-108.6} \times 10^{40.6} = 10^{-68}$.
- A probability 10^{-68} is virtually no different from an impossibility. Hence, we can be certain that none of the molecules existing in the atmosphere now, whether due to an "emitted CO_2 pulse" or existing before it, will remain after 1000 years—let alone after "ten thousand years" or after "several hundred thousand years".
- To make this probability a reasonable rarity of 1% (10^{-2}) that a single molecule out of the $N = 10^{40.6}$ remains in the atmosphere, we need to make $p = p_1/N = 10^{-2}/10^{40.6} = 10^{-42.6}$. This would occur at time t such that $1 - F_W(t) = 1 - F_W(t/4) = e^{-t/4} = 10^{-42.6}$, which yields $t = 392$ years.

In other words, the IPCC's statement that "15 to 40% of an emitted CO_2 pulse will remain in the atmosphere longer than 1000 years, 10 to 25% will remain about ten thousand years, and the rest will be removed over several hundred thousand years" needs to be corrected to "not even one molecule from an emitted CO_2 pulse will remain in the atmosphere longer than 400 years, even if that emitted pulse amounts to the entire current atmospheric CO_2 content".

The application of the RRR framework to the atmospheric CO_2 gives useful insights in terms of residence and response times, which have been an issue of controversy. The theoretical framework results in excellent agreement with real-world data on carbon dioxide concentration. The atmosphere appears to behave as a linear reservoir in terms of the atmospheric CO_2, whose exchange is clearly dominated by the biosphere processes, with human emissions playing a minor role. The quantification of the atmospheric CO_2 exchange with the RRR framework yields reliable and intuitive results, complying with observations, in contrast to the results of complex climate models, which are shown to be inconsistent with reality. The mean residence time of atmospheric CO_2 is about four years, and the mean response time is smaller than that, thus contradicting the mainstream estimates, which suggest times of hundreds or thousands of years, or even longer.

Clearly, the atmospheric CO_2 observational data are not consistent with the climate narrative. They rather contradict it. In this, the present study complements earlier studies in that (a) causality direction between temperature and atmospheric CO_2 is opposite to that commonly assumed [11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34], (b) climate models misrepresent the causality direction that is identified by the data [11], (c) there are no discernible signs of anthropogenic CO_2 emissions on the greenhouse effect, which is dominated by water vapor and clouds [64], and (d) there are no discernible signs of change in the isotopic synthesis of atmospheric CO_2 sources and sinks, which is determined by the biosphere processes [65].

Quelle: Koutsoyiannis, 2024

Eine Verweildauer von nur 4 Jahren für alle CO_2-Moleküle, unabhängig von ihrer Herkunft, lässt den Schluss zu, dass die Natur bei der Veränderung der CO_2-Konzentration die Hauptrolle spielt. Die Emissionen aus fossilen Brennstoffen spielen nur eine untergeordnete Rolle.

Seit 1750 ist der Beitrag zur atmosphärischen CO_2-Konzentration, der aus natürlichen Emissionsquellen im Zusammenhang mit biologischen Prozessen stammt, etwa 4,5 Mal größer als der Beitrag der Emissionen fossiler Brennstoffe (z. B. 22,9 ppm pro Jahr aus der Natur, 5,2 ppm pro Jahr aus der Verbrennung fossiler Brennstoffe).

Mit anderen Worten: Die beobachteten CO_2-Daten widersprechen dem Klimanarrativ, dem zufolge die anthropogene Verbrennung fossiler Brennstoffe die CO_2-Änderungen verursacht.

water

MDPI

Refined Reservoir Routing (RRR) and Its Application to Atmospheric Carbon Dioxide Balance

by Demetris Koutsoyiannis

Water **2024**, *16*(17), 2402; https://doi.org/10.3390/w16172402

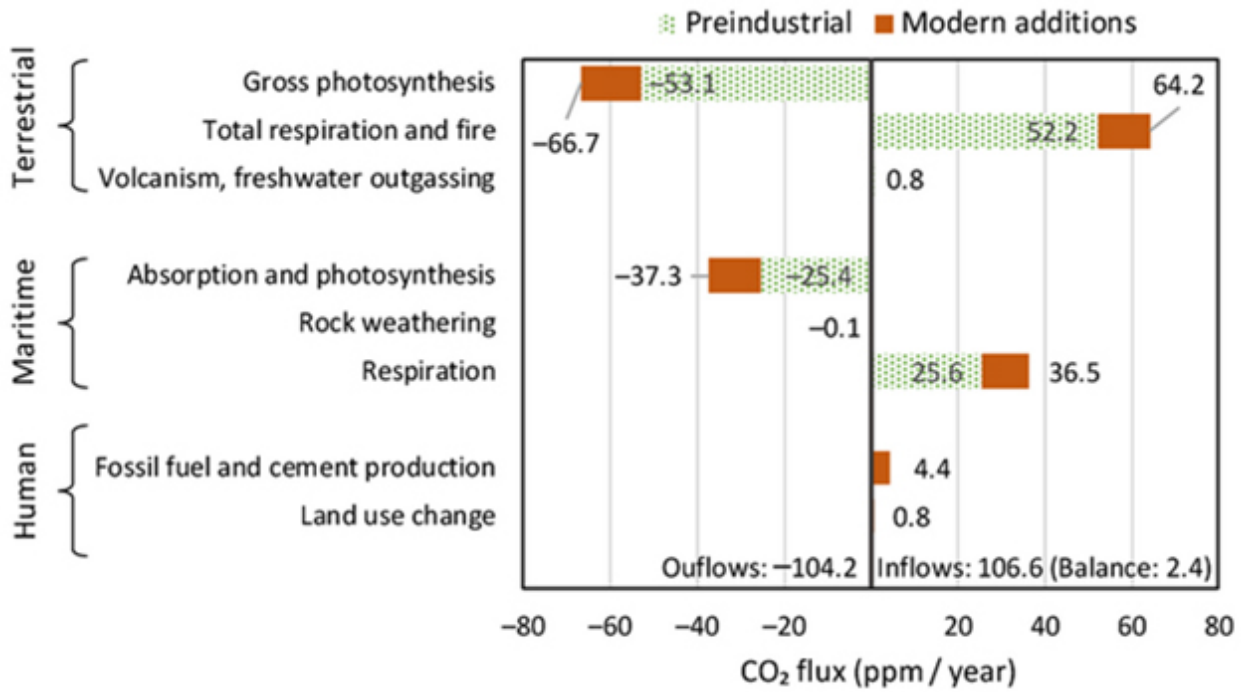


Figure 9. Annual carbon balance in the Earth's atmosphere, in ppm CO_2/year, based on the IPCC estimates [32] (Figure 5.12). The balance of 2.4 ppm CO_2/year is the annual CO_2 accumulation in the atmosphere. The total of the modern natural additions (64.2 + 36.5 − (52.2 + 25.6)) = 22.9 ppm is 4.4 times larger than the human emissions (4.4 + 0.8 = 5.2 ppm). (Adapted from [11]).

Based on this graph, we make the following observations, which are important for the modeling of the CO_2 exchanges that follow:

1. Human activities are responsible for only 4% of carbon emissions.
2. The vast majority of changes in the atmosphere since 1750 (red bars in the graph) are due to natural processes, respiration and photosynthesis.
3. The increases in both CO_2 emissions and sinks are due to the temperature increase, which expands the biosphere and makes it more productive.
4. The terrestrial biosphere processes are much stronger than the maritime ones in terms of both production and absorption of CO_2.
5. The CO_2 emissions by merely the ocean biosphere are much larger than human emissions.
6. The modern (post 1750) CO_2 additions to pre-industrial quantities (red bars in the right half of the graph, corresponding to positive values) exceed the human emissions by a factor of ~4.5. In the most recent 65 years, covered by measurements, the rate of natural emissions is ~3.5 times greater than the CO_2 emissions from fossil fuels.

Quelle: Koutsoyiannis, 2024

Link: https://notrickszone.com/2024/08/30/new-study-co%e2%82%82s-atmospheric-residence-time-4-years-natural-sources-drive-co%e2%82%82-concentration-changes/

Übersetzt von Christian Freuer für das EIKE