Fast 160 wissenschaftliche Arbeiten beschreiben den winzigen Einfluss von CO_2 auf die Temperatur der Erde

geschrieben von Chris Frey | 27. Januar 2024

Kenneth Richard

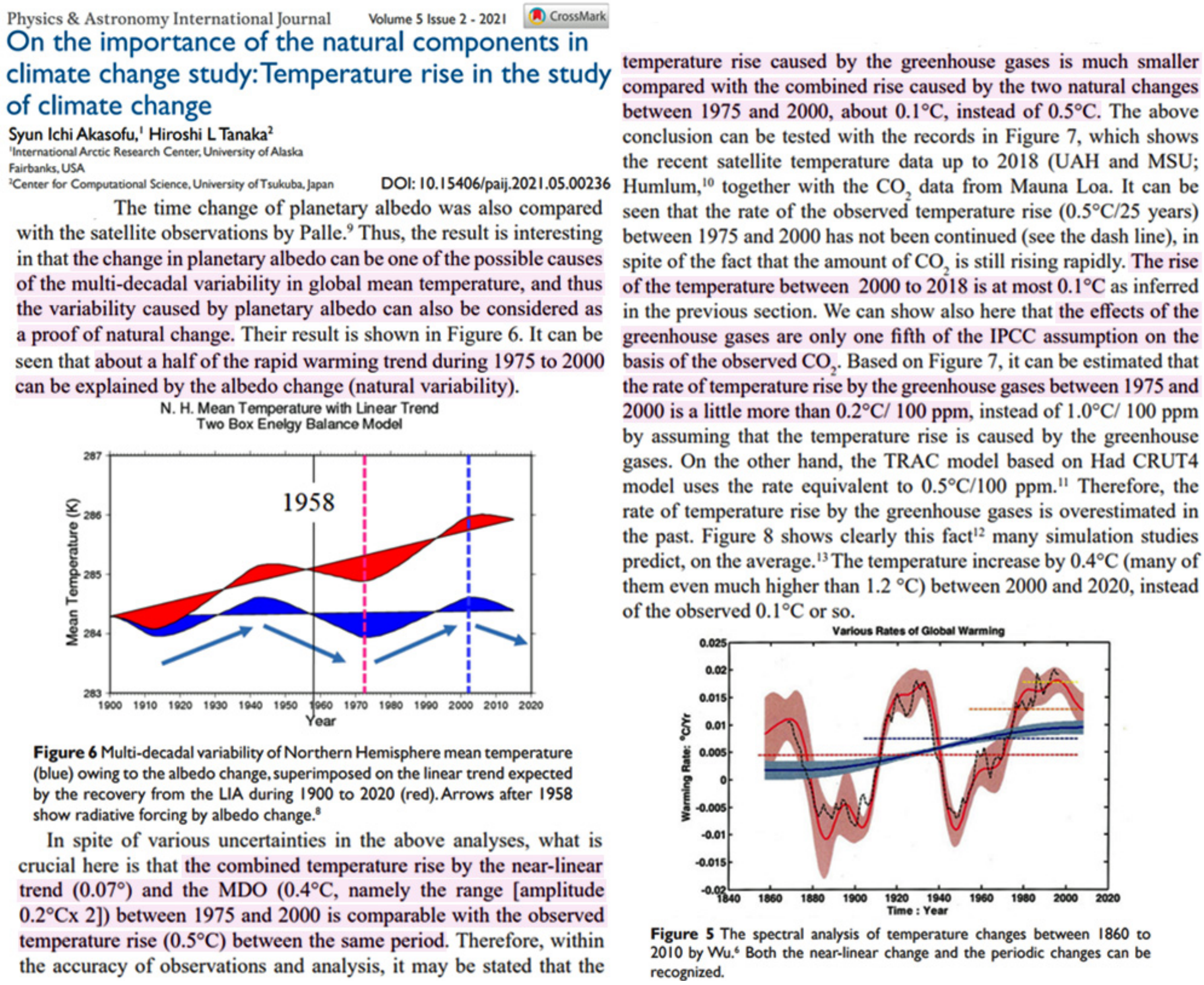
Wir haben unsere Liste der wissenschaftlichen Arbeiten zum Thema „Extrem niedrige CO_2-Klimasensitivität" aktualisiert und neue Arbeiten aus den Jahren 2022 und 2023 sowie einige neu entdeckte Arbeiten aus der Vergangenheit hinzugefügt.

Im Jahr 2016 enthielt diese Liste nur 50 Arbeiten (wie in der Webadresse angegeben). In weniger als 8 Jahren ist die Liste auf 159 (Stand heute) gestiegen.

160 Studien finden extrem niedrige CO_2-Klimaempfindlichkeit. Hier einige Beispiele dazu aus den Jahren 2022 und 2023:

Akasofu und Tanaka, 2022 (100 ppm CO_2 = 0.2°C globale Temperaturänderung)

Trotz verschiedener Unsicherheiten in den obigen Analysen ist hier entscheidend, dass der kombinierte Temperaturanstieg durch den nahezu linearen Trend (0,07°) und die MDO (0,4°C, d.h. der Bereich [Amplitude 0,2°Cx 2]) zwischen 1975 und 2000 mit dem beobachteten Temperaturanstieg (0,5°C) im gleichen Zeitraum vergleichbar ist. Im Rahmen der Genauigkeit der Beobachtungen und Analysen kann daher festgestellt werden, **dass der durch die Treibhausgase verursachte Temperaturanstieg im Vergleich zu dem durch die beiden natürlichen Veränderungen zwischen 1975 und 2000 verursachten kombinierten Anstieg viel geringer ist, nämlich etwa 0,1°C statt 0,5°C.** Die obige Schlussfolgerung kann anhand der Aufzeichnungen in Abbildung 7 überprüft werden, welche die jüngsten Satellitentemperaturdaten bis 2018 (UAH und MSU; Humlum)10 zusammen mit den CO_2-Daten von Mauna Loa zeigt. Es ist zu erkennen, dass sich die Geschwindigkeit des beobachteten Temperaturanstiegs (0,5°C/25 Jahre) zwischen 1975 und 2000 nicht fortgesetzt hat (siehe gestrichelte Linie), obwohl die CO_2-Menge weiterhin schnell zunimmt. **Der Temperaturanstieg zwischen 2000 und 2018 beträgt höchstens 0,1 °C,** wie im vorigen Abschnitt dargelegt. Wir können auch hier zeigen, dass **die Auswirkungen der Treibhausgase nur ein Fünftel der IPCC-Annahme auf der Grundlage des beobachteten CO_2 betragen.** Anhand von Abbildung 7 lässt sich abschätzen, dass **die Rate des Temperaturanstiegs durch die Treibhausgase zwischen 1975 und 2000 etwas mehr als 0,2°C/100 ppm beträgt,** statt 1,0°C/100 ppm unter der Annahme, dass der Temperaturanstieg durch die Treibhausgase verursacht wird. Das TRAC-Modell, das auf dem CRUT4-Modell basiert, verwendet dagegen eine Rate, die 0,5°C/100 ppm entspricht. Daher wird die Geschwindigkeit des Temperaturanstiegs durch die Treibhausgase in der Vergangenheit überschätzt. Abbildung 8 zeigt deutlich diese Tatsache, die viele Simulationsstudien im Durchschnitt vorhersagen. Für den Zeitraum von 2000 bis 2020 wird ein Temperaturanstieg von 0,4 °C (in vielen Fällen sogar von mehr als 1,2 °C) vorhergesagt, anstatt der beobachteten 0,1 °C oder so.



Physics & Astronomy International Journal Volume 5 Issue 2 - 2021 CrossMark

On the importance of the natural components in climate change study: Temperature rise in the study of climate change

Syun Ichi Akasofu,[1] Hiroshi L Tanaka[2]
[1]International Arctic Research Center, University of Alaska Fairbanks, USA
[2]Center for Computational Science, University of Tsukuba, Japan

DOI: 10.15406/paij.2021.05.00236

The time change of planetary albedo was also compared with the satellite observations by Palle.[9] Thus, the result is interesting in that the change in planetary albedo can be one of the possible causes of the multi-decadal variability in global mean temperature, and thus the variability caused by planetary albedo can also be considered as a proof of natural change. Their result is shown in Figure 6. It can be seen that about a half of the rapid warming trend during 1975 to 2000 can be explained by the albedo change (natural variability).

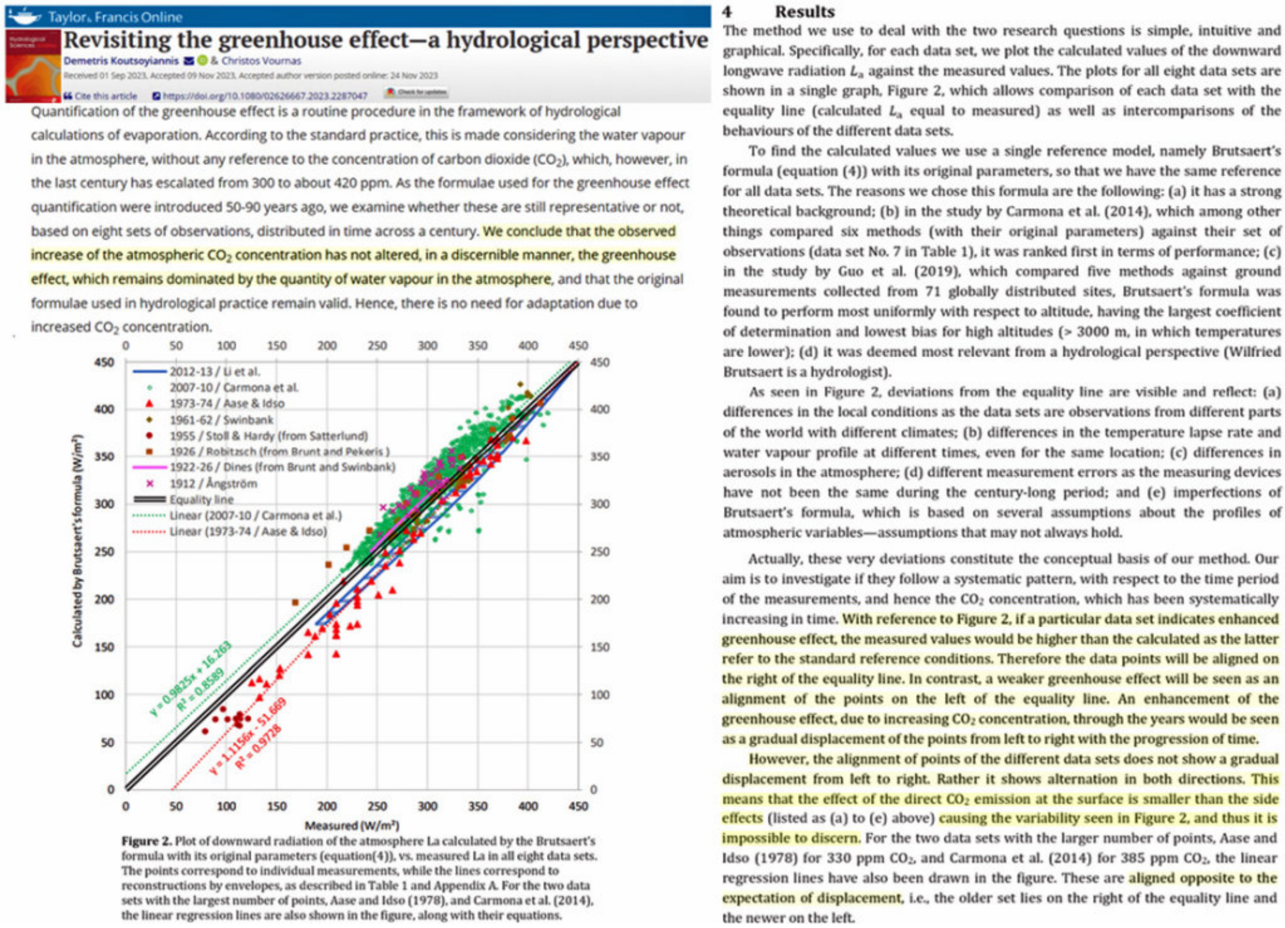
Figure 6 Multi-decadal variability of Northern Hemisphere mean temperature (blue) owing to the albedo change, superimposed on the linear trend expected by the recovery from the LIA during 1900 to 2020 (red). Arrows after 1958 show radiative forcing by albedo change.[8]

In spite of various uncertainties in the above analyses, what is crucial here is that the combined temperature rise by the near-linear trend (0.07°) and the MDO (0.4°C, namely the range [amplitude 0.2°Cx 2]) between 1975 and 2000 is comparable with the observed temperature rise (0.5°C) between the same period. Therefore, within the accuracy of observations and analysis, it may be stated that the temperature rise caused by the greenhouse gases is much smaller compared with the combined rise caused by the two natural changes between 1975 and 2000, about 0.1°C, instead of 0.5°C. The above conclusion can be tested with the records in Figure 7, which shows the recent satellite temperature data up to 2018 (UAH and MSU; Humlum,[10] together with the CO_2 data from Mauna Loa. It can be seen that the rate of the observed temperature rise (0.5°C/25 years) between 1975 and 2000 has not been continued (see the dash line), in spite of the fact that the amount of CO_2 is still rising rapidly. The rise of the temperature between 2000 to 2018 is at most 0.1°C as inferred in the previous section. We can show also here that the effects of the greenhouse gases are only one fifth of the IPCC assumption on the basis of the observed CO_2. Based on Figure 7, it can be estimated that the rate of temperature rise by the greenhouse gases between 1975 and 2000 is a little more than 0.2°C/ 100 ppm, instead of 1.0°C/ 100 ppm by assuming that the temperature rise is caused by the greenhouse gases. On the other hand, the TRAC model based on Had CRUT4 model uses the rate equivalent to 0.5°C/100 ppm.[11] Therefore, the rate of temperature rise by the greenhouse gases is overestimated in the past. Figure 8 shows clearly this fact[12] many simulation studies predict, on the average.[13] The temperature increase by 0.4°C (many of them even much higher than 1.2 °C) between 2000 and 2020, instead of the observed 0.1°C or so.

Figure 5 The spectral analysis of temperature changes between 1860 to 2010 by Wu.[6] Both the near-linear change and the periodic changes can be recognized.

[Koutsoyiannis und Vournas, 2023](#)

Eine Verstärkung des Treibhauseffekts durch die zunehmende CO_2-Konzentration im Laufe der Jahre würde sich in einer allmählichen Verschiebung der Punkte von links nach rechts mit dem Fortschreiten der Zeit zeigen. Die Ausrichtung der Punkte der verschiedenen Datensätze zeigt jedoch keine allmähliche Verschiebung von links nach rechts. **Das bedeutet, dass der Effekt der direkten CO_2-Emission an der Oberfläche kleiner ist als die Nebeneffekte, die die Schwankungen in Abbildung 2 verursachen, und daher nicht zu erkennen sind. …** Die Quantifizierung des Treibhauseffekts ist ein Routineverfahren im Rahmen der hydrologischen Berechnungen der Verdunstung. Nach gängiger Praxis wird dabei der Wasserdampf in der Atmosphäre berücksichtigt, ohne Bezug auf die Konzentration von Kohlendioxid (CO_2), die jedoch im letzten Jahrhundert von 300 auf etwa 420 ppm gestiegen ist. Da die für die Quantifizierung des Treibhauseffekts verwendeten Formeln vor 50-90 Jahren eingeführt wurden, untersuchen wir anhand von acht über ein Jahrhundert verteilten Beobachtungsreihen, ob sie immer noch repräsentativ sind oder nicht. **Wir kommen zu dem Schluss, dass der beobachtete Anstieg der atmosphärischen CO_2-Konzentration den Treibhauseffekt, der nach wie vor von der Wasserdampfmenge in der Atmosphäre dominiert wird, nicht nennenswert verändert hat** und dass die ursprünglichen, in der hydrologischen Praxis verwendeten Formeln weiterhin gültig sind. **Es besteht also kein Anpassungsbedarf aufgrund einer erhöhten CO_2-Konzentration.**


Taylor & Francis Online

Revisiting the greenhouse effect—a hydrological perspective

Demetris Koutsoyiannis & Christos Vournas

Received 01 Sep 2023, Accepted 09 Nov 2023, Accepted author version posted online: 24 Nov 2023

Cite this article https://doi.org/10.1080/02626667.2023.2287047

Quantification of the greenhouse effect is a routine procedure in the framework of hydrological calculations of evaporation. According to the standard practice, this is made considering the water vapour in the atmosphere, without any reference to the concentration of carbon dioxide (CO_2), which, however, in the last century has escalated from 300 to about 420 ppm. As the formulae used for the greenhouse effect quantification were introduced 50-90 years ago, we examine whether these are still representative or not, based on eight sets of observations, distributed in time across a century. We conclude that the observed increase of the atmospheric CO_2 concentration has not altered, in a discernible manner, the greenhouse effect, which remains dominated by the quantity of water vapour in the atmosphere, and that the original formulae used in hydrological practice remain valid. Hence, there is no need for adaptation due to increased CO_2 concentration.

Figure 2. Plot of downward radiation of the atmosphere La calculated by the Brutsaert's formula with its original parameters (equation(4)), vs. measured La in all eight data sets. The points correspond to individual measurements, while the lines correspond to reconstructions by envelopes, as described in Table 1 and Appendix A. For the two data sets with the largest number of points, Aase and Idso (1978), and Carmona et al. (2014), the linear regression lines are also shown in the figure, along with their equations.

4 Results

The method we use to deal with the two research questions is simple, intuitive and graphical. Specifically, for each data set, we plot the calculated values of the downward longwave radiation L_a against the measured values. The plots for all eight data sets are shown in a single graph, Figure 2, which allows comparison of each data set with the equality line (calculated L_a equal to measured) as well as intercomparisons of the behaviours of the different data sets.

To find the calculated values we use a single reference model, namely Brutsaert's formula (equation (4)) with its original parameters, so that we have the same reference for all data sets. The reasons we chose this formula are the following: (a) it has a strong theoretical background; (b) in the study by Carmona et al. (2014), which among other things compared six methods (with their original parameters) against their set of observations (data set No. 7 in Table 1), it was ranked first in terms of performance; (c) in the study by Guo et al. (2019), which compared five methods against ground measurements collected from 71 globally distributed sites, Brutsaert's formula was found to perform most uniformly with respect to altitude, having the largest coefficient of determination and lowest bias for high altitudes (> 3000 m, in which temperatures are lower); (d) it was deemed most relevant from a hydrological perspective (Wilfried Brutsaert is a hydrologist).

As seen in Figure 2, deviations from the equality line are visible and reflect: (a) differences in the local conditions as the data sets are observations from different parts of the world with different climates; (b) differences in the temperature lapse rate and water vapour profile at different times, even for the same location; (c) differences in aerosols in the atmosphere; (d) different measurement errors as the measuring devices have not been the same during the century-long period; and (e) imperfections of Brutsaert's formula, which is based on several assumptions about the profiles of atmospheric variables—assumptions that may not always hold.

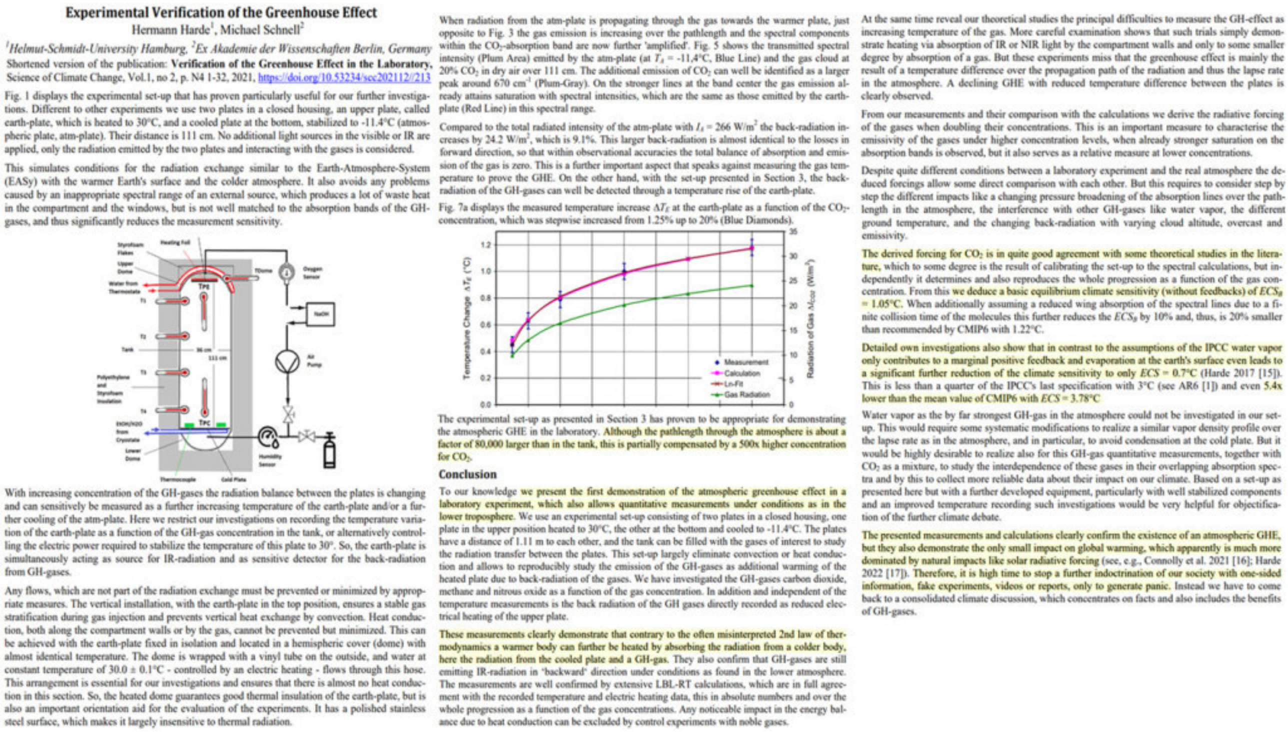
Actually, these very deviations constitute the conceptual basis of our method. Our aim is to investigate if they follow a systematic pattern, with respect to the time period of the measurements, and hence the CO_2 concentration, which has been systematically increasing in time. With reference to Figure 2, if a particular data set indicates enhanced greenhouse effect, the measured values would be higher than the calculated as the latter refer to the standard reference conditions. Therefore the data points will be aligned on the right of the equality line. In contrast, a weaker greenhouse effect will be seen as an alignment of the points on the left of the equality line. An enhancement of the greenhouse effect, due to increasing CO_2 concentration, through the years would be seen as a gradual displacement of the points from left to right with the progression of time.

However, the alignment of points of the different data sets does not show a gradual displacement from left to right. Rather it shows alternation in both directions. This means that the effect of the direct CO_2 emission at the surface is smaller than the side effects (listed as (a) to (e) above) causing the variability seen in Figure 2, and thus it is impossible to discern. For the two data sets with the larger number of points, Aase and Idso (1978) for 330 ppm CO_2, and Carmona et al. (2014) for 385 ppm CO_2, the linear regression lines have also been drawn in the figure. These are aligned opposite to the expectation of displacement, i.e., the older set lies on the right of the equality line and the newer on the left.

[Harde and Schnell, 2022](#) (2XCO_2 = 0.7°C)

Das abgeleitete Antrieb durch CO_2 stimmt recht gut mit einigen theoretischen Studien in der Literatur überein, was bis zu einem gewissen Grad das Ergebnis der Kalibrierung des Aufbaus auf die Spektralberechnungen ist, aber unabhängig davon bestimmt und reproduziert es auch den gesamten Verlauf in Abhängigkeit von der Gaskonzentration. Daraus leiten wir **eine grundlegende Gleichgewichts-Klimasensitivität (ohne Rückkopplungen) von ECSB = 1,05°C ab.** Nimmt man zusätzlich eine reduzierte Flügelabsorption der Spektrallinien aufgrund einer endlichen Kollisionszeit der Moleküle an, so reduziert sich die ECSB um weitere 10% und ist damit 20% kleiner als von CMIP6 mit 1,22°C empfohlen. … **Detaillierte eigene Untersuchungen zeigen auch, dass im Gegensatz zu den Annahmen des IPCC der Wasserdampf nur zu einer**

marginalen positiven Rückkopplung beiträgt und die Verdunstung an der Erdoberfläche sogar zu einer deutlichen weiteren Reduktion der Klimasensitivität auf nur ECS = 0,7°C führt (Harde 2017 [15]). Das ist weniger als ein Viertel der letzten Vorgabe des IPCC mit 3°C (siehe AR6 [1]) und sogar 5,4x niedriger als der Mittelwert von CMIP6 mit ECS = 3,78°C. Die vorgestellten Messungen und Berechnungen bestätigen eindeutig die Existenz eines atmosphärischen GHE, zeigen aber auch den nur geringen Einfluss auf die globale Erwärmung, die offenbar viel stärker von natürlichen Einflüssen wie dem solaren Strahlungsantrieb dominiert wird (siehe z.B. Connolly et al. 2021 [16]; Harde 2022 [17]).



Experimental Verification of the Greenhouse Effect

Hermann Harde[1], Michael Schnell[2]

[1]*Helmut-Schmidt-University Hamburg*, [2]*Ex Akademie der Wissenschaften Berlin, Germany*

Shortened version of the publication: **Verification of the Greenhouse Effect in the Laboratory,** Science of Climate Change, Vol.1, no 2, p. N4 1-32, 2021, https://doi.org/10.53234/scc202112//213

Fig. 1 displays the experimental set-up that has proven particularly useful for our further investigations. Different to other experiments we use two plates in a closed housing, an upper plate, called earth-plate, which is heated to 30°C, and a cooled plate at the bottom, stabilized to -11.4°C (atmospheric plate, atm-plate). Their distance is 111 cm. No additional light sources in the visible or IR are applied, only the radiation emitted by the two plates and interacting with the gases is considered.

This simulates conditions for the radiation exchange similar to the Earth-Atmosphere-System (EASy) with the warmer Earth's surface and the colder atmosphere. It also avoids any problems caused by an inappropriate spectral range of an external source, which produces a lot of waste heat in the compartment and the windows, but is not well matched to the absorption bands of the GH-gases, and thus significantly reduces the measurement sensitivity.

With increasing concentration of the GH-gases the radiation balance between the plates is changing and can sensitively be measured as a further increasing temperature of the earth-plate and/or a further cooling of the atm-plate. Here we restrict our investigations on recording the temperature variation of the earth-plate as a function of the GH-gas concentration in the tank, or alternatively controlling the electric power required to stabilize the temperature of this plate to 30°. So, the earth-plate is simultaneously acting as source for IR-radiation and as sensitive detector for the back-radiation from GH-gases.

Any flows, which are not part of the radiation exchange must be prevented or minimized by appropriate measures. The vertical installation, with the earth-plate in the top position, ensures a stable gas stratification during gas injection and prevents vertical heat exchange by convection. Heat conduction, both along the compartment walls or by the gas, cannot be prevented but minimized. This can be achieved with the earth-plate fixed in isolation and located in a hemispheric cover (dome) with almost identical temperature. The dome is wrapped with a vinyl tube on the outside, and water at constant temperature of 30.0 ± 0.1°C - controlled by an electric heating - flows through this hose. This arrangement is essential for our investigations and ensures that there is almost no heat conduction in this section. So, the heated dome guarantees good thermal insulation of the earth-plate, but is also an important orientation aid for the evaluation of the experiments. It has a polished stainless steel surface, which makes it largely insensitive to thermal radiation.

When radiation from the atm-plate is propagating through the gas towards the warmer plate, just opposite to Fig. 3 the gas emission is increasing over the pathlength and the spectral components within the CO_2-absorption band are now further 'amplified'. Fig. 5 shows the transmitted spectral intensity (Plum Area) emitted by the atm-plate (at T_A = -11,4°C, Blue Line) and the gas cloud at 20% CO_2 in dry air over 111 cm. The additional emission of CO_2 can well be identified as a larger peak around 670 cm^{-1} (Plum-Gray). On the stronger lines at the band center the gas emission already attains saturation with spectral intensities, which are the same as those emitted by the earth-plate (Red Line) in this spectral range.

Compared to the total radiated intensity of the atm-plate with I_A = 266 W/m^2 the back-radiation increases by 24.2 W/m^2, which is 9.1%. This larger back-radiation is almost identical to the losses in forward direction, so that within observational accuracies the total balance of absorption and emission of the gas is zero. This is a further important aspect that speaks against measuring the gas temperature to prove the GHE. On the other hand, with the set-up presented in Section 3, the back-radiation of the GH-gases can well be detected through a temperature rise of the earth-plate.

Fig. 7a displays the measured temperature increase ΔT_E at the earth-plate as a function of the CO_2-concentration, which was stepwise increased from 1.25% up to 20% (Blue Diamonds).

The experimental set-up as presented in Section 3 has proven to be appropriate for demonstrating the atmospheric GHE in the laboratory. Although the pathlength through the atmosphere is about a factor of 80,000 larger than in the tank, this is partially compensated by a 500x higher concentration for CO_2.

Conclusion

To our knowledge we present the first demonstration of the atmospheric greenhouse effect in a laboratory experiment, which also allows quantitative measurements under conditions as in the lower troposphere. We use an experimental set-up consisting of two plates in a closed housing, one plate in the upper position heated to 30°C, the other at the bottom and cooled to -11.4°C. The plates have a distance of 1.11 m to each other, and the tank can be filled with the gases of interest to study the radiation transfer between the plates. This set-up largely eliminate convection or heat conduction and allows to reproducibly study the emission of the GH-gases as additional warming of the heated plate due to back-radiation of the gases. We have investigated the GH-gases carbon dioxide, methane and nitrous oxide as a function of the gas concentration. In addition and independent of the temperature measurements is the back radiation of the GH gases directly recorded as reduced electrical heating of the upper plate.

These measurements clearly demonstrate that contrary to the often misinterpreted 2nd law of thermodynamics a warmer body can further be heated by absorbing the radiation from a colder body, here the radiation from the cooled plate and a GH-gas. They also confirm that GH-gases are still emitting IR-radiation in "backward" direction under conditions as found in the lower atmosphere. The measurements are well confirmed by extensive LBL-RT calculations, which are in full agreement with the recorded temperature and electric heating data, this in absolute numbers and over the whole progression as a function of the gas concentrations. Any noticeable impact in the energy balance due to heat conduction can be excluded by control experiments with noble gases.

At the same time reveal our theoretical studies the principal difficulties to measure the GH-effect as increasing temperature of the gas. More careful examination shows that such trials simply demonstrate heating via absorption of IR or NIR light by the compartment walls and only to some smaller degree by absorption of a gas. But these experiments miss that the greenhouse effect is mainly the result of a temperature difference over the propagation path of the radiation and thus the lapse rate in the atmosphere. A declining GHE with reduced temperature difference between the plates is clearly observed.

From our measurements and their comparison with the calculations we derive the radiative forcing of the gases when doubling their concentrations. This is an important measure to characterise the emissivity of the gases under higher concentration levels, when already stronger saturation on the absorption bands is observed, but it also serves as a relative measure at lower concentrations.

Despite quite different conditions between a laboratory experiment and the real atmosphere the deduced forcings allow some direct comparison with each other. But this requires to consider step by step the different impacts like a changing pressure broadening of the absorption lines over the pathlength in the atmosphere, the interference with other GH-gases like water vapor, the different ground temperature, and the changing back-radiation with varying cloud altitude, overcast and emissivity.

The derived forcing for CO_2 is in quite good agreement with some theoretical studies in the literature, which to some degree is the result of calibrating the set-up to the spectral calculations, but independently it determines and also reproduces the whole progression as a function of the gas concentration. From this we deduce a basic equilibrium climate sensitivity (without feedbacks) of ECS_B = 1.05°C. When additionally assuming a reduced wing absorption of the spectral lines due to a finite collision time of the molecules this further reduces the ECS_B by 10% and, thus, is 20% smaller than recommended by CMIP6 with 1.22°C.

Detailed own investigations also show that in contrast to the assumptions of the IPCC water vapor only contributes to a marginal positive feedback and evaporation at the earth's surface even leads to a significant further reduction of the climate sensitivity to only ECS = 0.7°C (Harde 2017 [15]). This is less than a quarter of the IPCC's last specification with 3°C (see AR6 [1]) and even 5.4x lower than the mean value of CMIP6 with ECS = 3.78°C

Water vapor as the by far strongest GH-gas in the atmosphere could not be investigated in our set-up. This would require some systematic modifications to realize a similar vapor density profile over the lapse rate as in the atmosphere, and in particular, to avoid condensation at the cold plate. But it would be highly desirable to realize also for this GH-gas quantitative measurements, together with CO_2 as a mixture, to study the interdependence of these gases in their overlapping absorption spectra and by this to collect more reliable data about their impact on our climate. Based on a set-up as presented here but with a further developed equipment, particularly with well stabilized components and an improved temperature recording such investigations would be very helpful for objectification of the further climate debate.

The presented measurements and calculations clearly confirm the existence of an atmospheric GHE, but they also demonstrate the only small impact on global warming, which apparently is much more dominated by natural impacts like solar radiative forcing (see, e.g., Connolly et al. 2021 [16]; Harde 2022 [17]). Therefore, it is high time to stop a further indoctrination of our society with one-sided information, fake experiments, videos or reports, only to generate panic. Instead we have to come back to a consolidated climate discussion, which concentrates on facts and also includes the benefits of GH-gases.

Siem and Olsen, 2023 (Ein CO_2-Anstieg von 400 auf 1.000.000 ppm ergibt eine Abkühlung um 0,22°C)

Diese Studie befasst sich mit den Wechselwirkungen zwischen Wärme- und Strahlungsenergiefluss in experimentellen Situationen von unterschiedlicher Komplexität. **Von besonderem Interesse ist, wie sich IR-Energie, die von CO_2-Gas re-emittiert wird, in einer Erde/Atmosphäre simulierten Anordnung verhält.** Ein solches Experiment wurde von Hermann Harde und Michael Schnell durchgeführt, wo sie zeigten, dass die von CO_2 emittierte IR-Strahlung eine kleine Metallplatte mit schwarzem Körper erwärmen kann. In einem Kontrollexperiment haben wir dieses Ergebnis bestätigt. In ihrem Experiment wurde jedoch die IR-Strahlung des Heizelements stark abgeschwächt. **In einem modifizierten Experiment, bei dem die IR-Strahlung des Heizelements vorhanden ist, wurde keine Erwärmung, sondern eine leichte Abkühlung [die durchschnittliche Abkühlung betrug -0,22°C±0,03°C] eines schwarzen Objekts festgestellt, wenn Luft [0,04%] durch CO_2 [100%] ersetzt wird.** Die veränderte experimentelle Situation entspricht auch eher der Situation auf der Erde und in der Atmosphäre.

Scientific Research Publishing
Atmospheric and Climate Sciences, 2023, 13, 240-254

The Influence of Heat Source IR Radiation on Black-Body Heating/Cooling with Increased CO_2 Concentration

Thorstein O. Seim[1], Borgar T. Olsen[2,3]
[1]Nycomed Pharma, Oslo, Norway
[2]Max-Planck-Institute for Physiological and Clinical Research, Munich, Germany
[3]Telenor (Televerkets) Research Department, Fornebu, Norway

DOI: 10.4236/acs.2023.132014

. The Harde/Schnell Experiment

Harde and Schnell [10] have presented an experiment that should explain how added amounts of greenhouse gases (like CO_2) heat the surface of the Earth. Their experimental setup is shown in Figure 1, consisting of a cylinder-shaped tank, which on the inside consists of polished aluminum. Internal height/diameter is 111 cm/36cm. The dome shaped top part is heated to 30˚C while a cooled (−11.4˚C), black plate is placed at the bottom. Compared to the earth/atmosphere situation this setup is mounted upside-down. Close to the top of the tank is a small black-painted aluminum plate placed, representing the Earth's surface (the Earth Plate EP). This setup leads to a vertically stable temperature gradient, similar to the lapse rate gradient of the troposphere. The cold plate represents the top of the troposphere.

The cylinder was first filled with dry air and left to stabilize thermally. When CO_2 was added to the air in the tank the temperature of the Earth Plate increases. This is seen in their Figure 10(a). The highest concentration of CO_2 used was 20%, leading to an increase of the Earth Plate temperature of 1.18˚C.

It is of interest to find how much the temperature of the Earth Plate will increase with CO_2 concentration close to 100%. If we compute the temperature increment ΔT in their Figure 10(a) as function of $\text{Log}(c)$, where c is the concentration of CO_2 in %, we get:

$$\Delta T = 0.6075 \times \text{Log}(c) + 0.3853. \quad (1)$$

We can now calculate the temperature increment for CO_2 concentrations above 20%. For $c = 100\%$ we expect to get a temperature increment of 1.60 degrees.

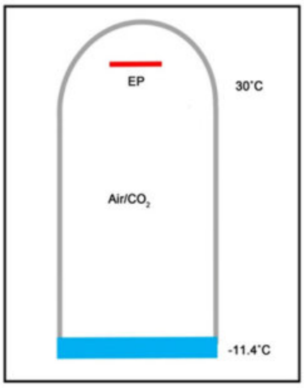


Figure 1. The experimental setup used by Harde and Schnell [10].

5. Removing the Al-Foil from the Black Heating Plate

With the Al-foil removed from the heating plate the experiment was repeated. Now the result changed markedly from the previous one. See Figure 7. In this setup, with added IR energy from the black heating plate, the black envelope becomes warmer, not colder than the surrounding air. After 150 minutes of heating of the air in the box the temperature increment stabilizes at 1.1˚C. After filling CO_2 it stabilizes at 0.8˚C ± 0.025˚C, that is, at a slightly lower value than for air alone. So, in this case, adding CO_2 cools the black envelope slightly. The experiment was repeated and the average cooling was found to be −0.22˚C ± 0.03˚C. (Note: During filling the box with cold CO_2 the temperature of the Al-foil envelope drops about 4 degrees, while the temperature of the black envelope drops less than one degree).

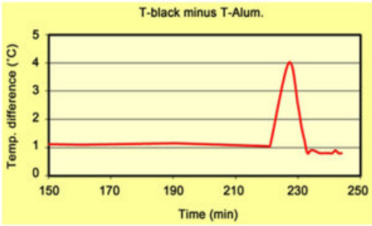


Figure 7. Adding IR radiation from the black heating plate makes the black envelope warmer than the air. CO_2 is filled after 220 minutes.

6. Discussion

In the Harde/Schnell experiment (and our modified version) the IR energy radiation from the heating source is strongly attenuated, as shown in Figure 9. In the Earth-Atmosphere-System no such attenuation takes place of the IR energy radiation from the Earth's heated surface.

When CO_2 is filled and heated the IR quanta density increases in the box. This should lead to higher number of absorbed quanta in the black envelope and increase its temperature, but the opposite happen. Lack of increased heating when CO_2 is added has been shown earlier [14] [15], but not cooling. Since filling CO_2 is slightly cooling the black envelope then some energy must be removed from it. This can be explained as follows:

1) The black envelope will absorb a part of the IR radiation emitted by the heating plate.

2) When CO_2 replaces air in the box, it will absorb some of the IR quanta that otherwise would be absorbed by the black envelope.

3) The IR quanta, which is absorbed by CO_2, will then be emitted in all directions. Most of them will not hit the black envelope but will hit the Al-covered walls, be reflected, and leave the box through the window. This cools the black envelope slightly.

7. Conclusions

That the presence of CO_2 in the box, with the heating plate present, lead to cooling of a black body (the black envelope) was an unexpected surprise.

The presence of IR radiation from a heated black-body suppresses the heating ability of IR radiation from CO_2. This result is also unexpected. From the Stefan-Boltzmanns law and the climate models used by IPCC, we expected to get heating from IR quanta emitted by increased concentration of CO_2 gas.

Link:
https://notrickszone.com/2024/01/18/nearly-160-scientific-papers-detail-the-minuscule-effect-CO₂-has-on-earths-temperature/

Übersetzt von Christian Freuer für das EIKE