The “Missing Link” in the Greenhouse Effect

An Exposition in Six Parts

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What’s the Problem?

In his summary of a van Wijngaarden and Happer paper, Andy May begins his discussion as follows:

- “The phrase “greenhouse effect,” often abbreviated as “GHE,” is very ambiguous. It applies to Earth’s surface temperature, and has never been observed or measured, only modeled. To make matters worse, it has numerous possible components, and the relative contributions of the possible components are unknown.”

In an interview with Tom Nelson describing the issues with the IPCC Sixth Assessment Report and some of the issues with the climate models May says:

- “…they are clearly in that stage of their modeling effort that every time they try and fix a mismatch, they break something else. It’s a sign that their models are missing some vital component of climate.”

- The Greenhouse Effect, A Summary of Wijngaarden and Happer – Watts Up With That?
- Andy May: Is AR6 the worst and most biased IPCC report? | Tom Nelson Pod #105 (youtube.com)

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Definitions/Concepts

- **Thermal radiation** (Wikipedia) is electromagnetic radiation emitted by the thermal motion of particles in matter. Thermal radiation transmits as an electromagnetic wave through both matter and vacuum. When matter absorbs thermal radiation its temperature will tend to rise. All matter with a temperature greater than absolute zero emits thermal radiation. The emission of energy arises from a combination of electronic, molecular, and lattice oscillations in a material. Kinetic energy is converted to electromagnetism due to charge-acceleration or dipole oscillation. At room temperature, most of the emission is in the infrared (IR) spectrum. Thermal radiation is one of the fundamental mechanisms of heat transfer, along with conduction and convection.

- Thermal Radiation is a property of **condensed matter**, i.e., solids and liquids. Gases do **not** emit thermal radiation.

- **Absorption** is the process in which an atom/molecule interacts with a photon and absorbs its energy, producing an excited state.

- **Spontaneous Emission** is the process whereby an atom/molecule in an excited state loses energy by emitting a photon without any interaction with other particles, returning it to its ground (non-excited) state.

- **Stimulated Emission** is the process whereby a photon interacts with an atom/molecule in an excited state causing the excited atom/molecule to emit a photon and return to the ground state. This results in two photons.

Definitions/Concepts

- **Non-radiative Deactivation,** sometimes called **Thermalization** or **Quenching**, is the process whereby an atom/molecule in an excited states interacts via collision with another atom/molecule, transferring the excitation energy of the excited atom/molecule to the collision partner. This interaction returns the excited atom/molecule to its ground state and the energy is converted to kinetic energy of the collision partner. This increases the velocity of the collision partner which manifests itself as heat in the pool of gas molecules. There are **no photons** involved in this process.

- **Non-radiative Excitation** is the opposite process, whereby a collision partner can provide energy via collision to an atom/molecule creating an excited state. The collision results in lower kinetic energy for the collision partner which cools the pool of gas molecules. In some circumstances, the excited atom/molecule will then lose energy via **spontaneous emission**. In this case, the entire process is referred to as **Thermally Excited Emission** or alternatively **Reverse Thermalization.**

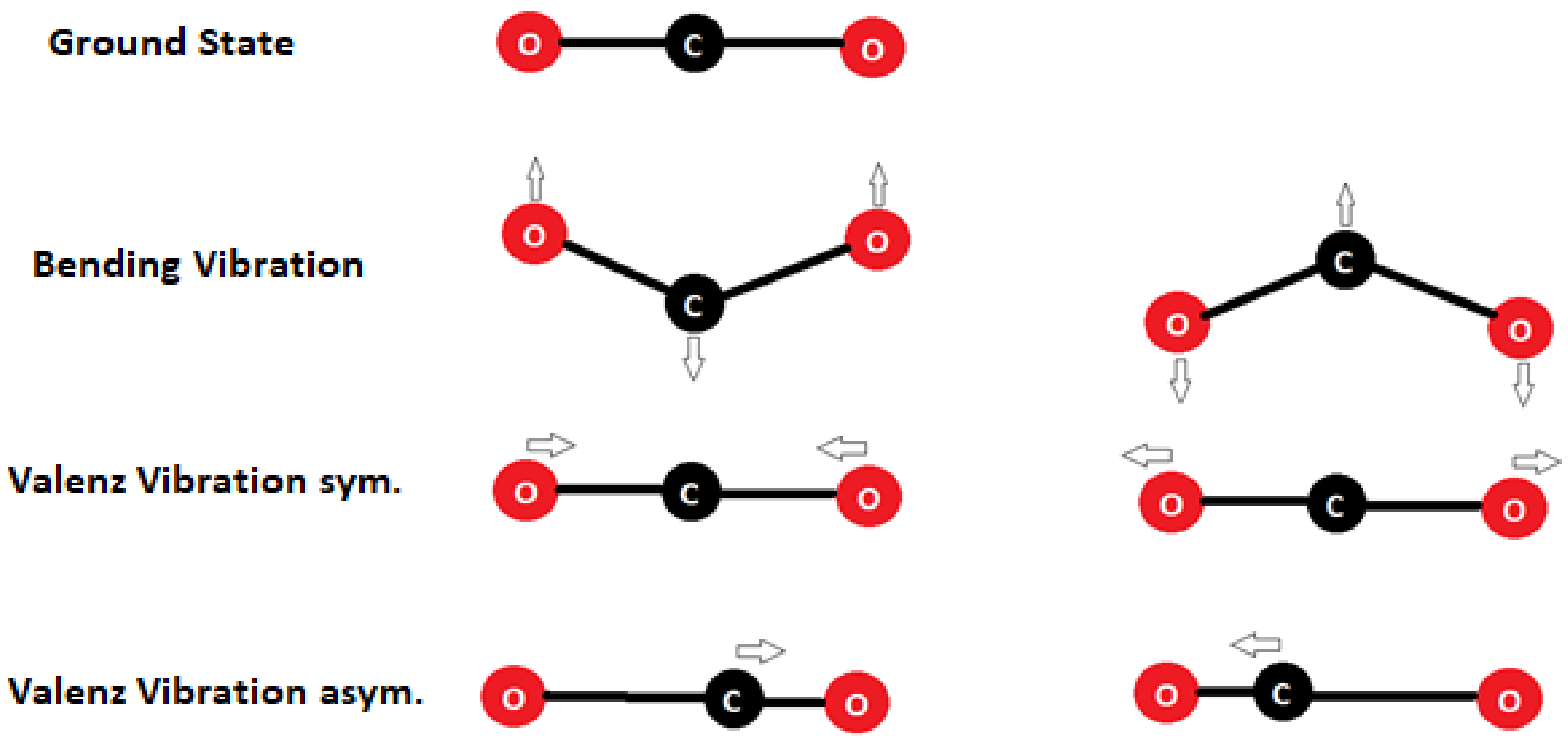
- **Radiative Transfer Theory** is the current "standard of practice" method for describing how the energy of **thermal emission** from the surface of the Earth is transported through the atmosphere to space. Radiative transfer is a mechanism whereby the energy is transported via interaction with photons, i.e., **Absorption, Spontaneous Emission,** and **Stimulated Emission.**

- **Radiative Forcing**, a phrase coined in the 1970s, is used to describe the postulated effect of (typically) an increase of "greenhouse gas" in the atmosphere on the efficiency of the transport of energy through the atmosphere.

Part 1

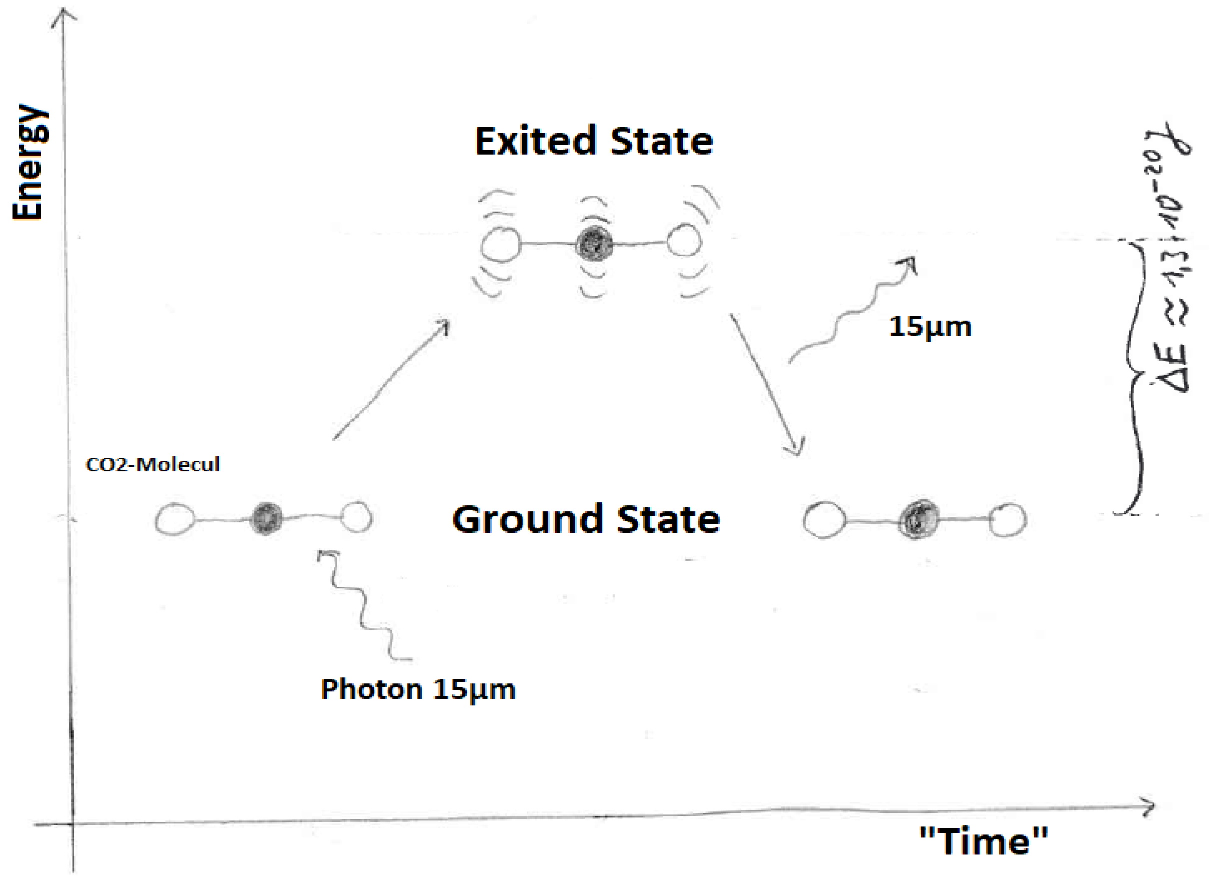
The Behavior of CO_2 Mixed with non-IR Active Gases

Vibrational States of the CO2 Molecule



Oscillation possibilities of the CO_2 molecule. Bending vibration: absorbs at 666cm^{-1}, the abbreviation (01^10) is often used as notation for this state of vibration; the symmetric valence vibration: is not IR active (Raman at 1366cm^{-1}), the asymmetric valence vibration: absorbs strongly at 2349cm^{-1}

Absorption and emission of a 15µm photon by CO_2



Only the ground state can absorb the 15µm radiation (photon)

Energy diagram, excitation of a CO_2 molecule

Decay of the Excited State Photon Emission

- Like the radioactive decay of unstable atomic nuclei, the excited state does not have a specific lifetime. The transition from the excited state to the ground state is random. This means that if you observe a single excited state, you cannot predict whether it will radiate immediately or continue to oscillate for a few seconds.
- Only if you observe many excited states, will you recognize a regularity in the decay rate of the excited states. The decay law can be formulated for the excited states with the decay constant from the HITRAN database.
- The half lifetime of the excited state can be calculated to be approximately 0.45 seconds. In the context of gas molecules that move around with the speed of sound, this transition from the excited state into the ground state is a very slow process.
- At standard temperature and pressure, each molecule will experience approximately *three Billion* (3,000,000,000 or 3×10^9) collisions in that time.

Stability of the excited oscillation state (01^10) of the CO_2-Molecuel

$$N_i\,(t) = N_0\,e^{-K_d t}$$

With: $N_i\,(t)$: Number of CO_2 molecules in the excited state at time t.
N_0 : Number of CO_2 molecules in the excited state at time t = 0.
$K_d = 1.542 s^{-1}$: Decay constant (HITRAN database) https://www.spectralcalc.com/spectral_browser/db_data.php
t : Time [s]

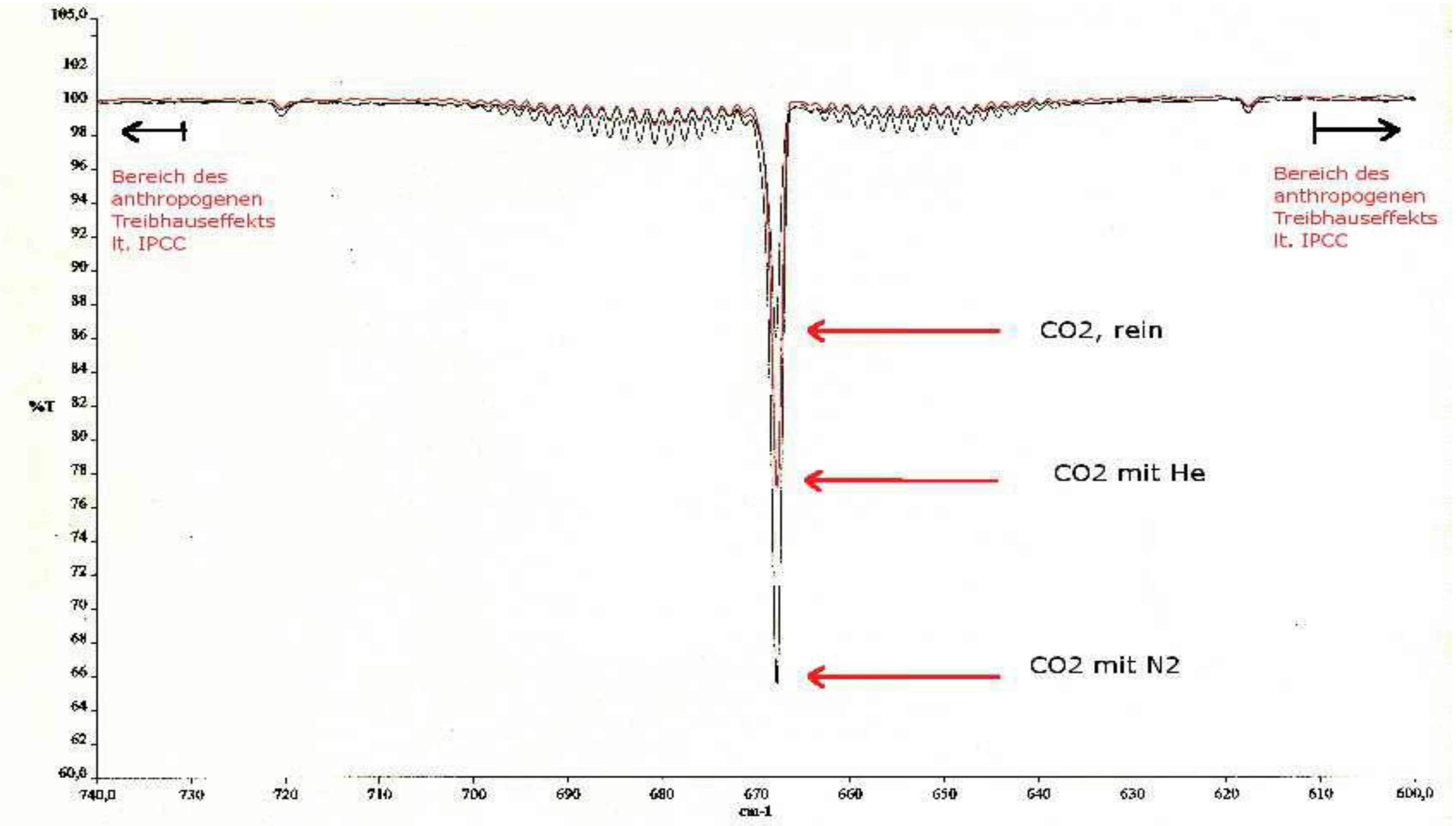
When the half-life has expired, the following applies: $$\frac{N_i(t)}{N_0} = \frac{1}{2} = e^{-K_d\,t_{1/2}}$$

Dissolve to $t_{1/2}$: $$\ln(1/2) = -K_d\,t_{1/2}$$

$$\boldsymbol{t_{1/2} = \frac{ln(2)}{K_d} = \frac{ln(2)}{1,542\,s^{-1}} \approx 0,45s}$$

Transition from the excited state to the ground state is a slow process and only the ground state can absorb the 15µm radiation!

CO_2 is not alone in the atmosphere!

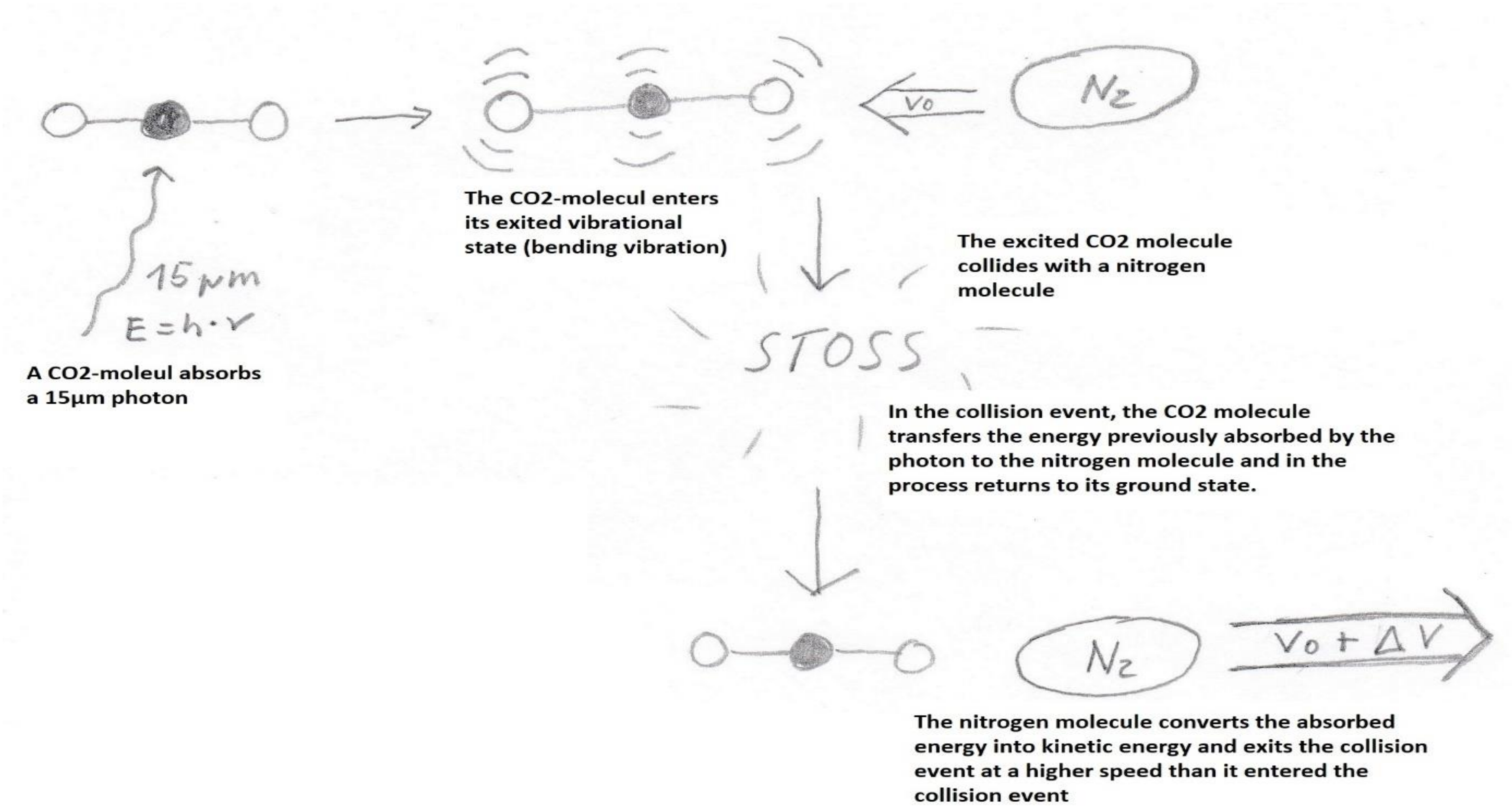


Source H.Hug: CO_2 absorption band at 666cm^{-1} measured in pure CO_2, in mixture with helium and in mixture with nitrogen. In all measurements, the same amount of CO_2 molecules is in the sample, https://www.eike-klima-energie.eu/wp-content/uploads/2016/12/Hug-pdf-12-Sept-2012.pdf

Interaction of CO_2 with other gases

- Figure 4 shows the wavenumber 666/cm absorption band in high resolution by Hug. To the left and right of the main 666/cm absorption, we can see several small absorptions that result from the fact that the bending vibration of the CO_2 molecule is superimposed by rotational movements of the CO_2 molecule. These are the so-called rotational bands.
- This diagram is a superposition of three spectra. All three samples contain the same amount of CO_2 in the beam path.
- The one with the lowest absorption is pure CO_2. The one with the highest absorption is CO_2 in mixture with nitrogen. Halfway between the pure CO_2 and the CO_2 in nitrogen we can see the absorption of the CO_2 in mixture with helium. It is a well-known effect that CO_2 in mixture with non-IR active gases absorbs much stronger than pure CO_2, but why?
- Since only CO_2 in its ground state can absorb 15-micrometer radiation the low absorption of the pure CO_2 sample must be caused by a low proportion of ground states in the pure CO_2 sample. The low proportion of the ground states in the pure CO_2 sample is caused by the long lifespan of the excited states and the constant bombardment with 15-micrometer photons. Since all three samples are exposed to the same stream of 15-micrometer photons, we must conclude that the presence of the other gases increases the proportion of ground states in the mixed samples. That means that non-IR active gases nitrogen and helium somehow help the excited states of the CO_2 molecules to return to their ground states more quickly and thus increase the proportion of the ground states.
- Hug-pdf-12-Sept-2012 (eike-klima-energie.eu)

Thermalisation of excited states (Quenching)



At 300K and 1 bar **approx. $7 * 10^9 \approx 10^{10}$ collisions per second**

German: Stoss = Collision

Explanation of Thermalization/Quenching

- The process is called thermalization or quenching of excited states. When a CO_2 molecule in its excited state collides with a gas molecule, its vibrational energy can be transferred to the colliding gas molecule. After this collision the CO_2 molecule has returned to its ground state. It now can absorb a 15-micrometer photon again. The molecule that collided with the excited CO_2 converts the energy transferred to it into kinetic energy. This means that the gas molecule involved in the collision with the excited CO_2 molecule picks up speed in the process. Thermal radiation is thus converted into molecular movement, sensible heat. At ambient temperature and pressure air molecules experience about 7×10^9 collisions per second. ***This process does not involve emission or absorption of a photon.***

- CO_2 is a popular laser medium. and this quenching process has been studied very thoroughly. To get a more realistic idea about how quick this process is we use quenching rates published by Siddles, Wilson, and Simpson to calculate the number of non-radiative deactivations per CO_2 molecule per second in air. At atmospheric pressure and 295 Kelvin it turns out that on average the CO_2 molecule experiences approximately 100,000 non-radiative deactivations per second. Siddles et al. also published quenching rates for CH_4 and NO_2 in separate publications. This phenomenon has been studied extensively by others. For example, fifty years ago in 1974 Cannemeijer and De Vries published CO_2 bending mode relaxation times in N_2 and O_2 of 12.8 and 8.8 microseconds, respectively. This is consistent with the work of Siddles et al.

- The vibrational deactivation of the (00o1) and (0110): Modes of CO2 measured down to 140 K - ScienceDirect
- The vibrational deactivation of the bending modes of CD4 and CH4 measured down to 90 K - ScienceDirect
- The vibrational deactivation of the (0001) mode of N2O measured down to 150 K - ScienceDirect
- Vibrational relaxation of CO2 in CO2-N2 and CO2-O2 mixtures - ScienceDirect

Non-radiative deactivation of the excited state of the 15µm absorption of CO_2 in nitrogen and oxygen

At atmospheric pressure and 295K (approx. 22°C), the following thermalisation rates ("quenching rates") were determined for the non-radiative deactivation of the excited state of the 15µm absorption of CO_2 in nitrogen and oxygen.

$$K_{N_2} = 5{,}5 * 10^{-15} \frac{cm^3}{Molecules * sec}$$

$$K_{O_2} = 3{,}1 * 10^{-15} \frac{cm^3}{Molecules * sec}$$

For air, a mixture of approx. 20% oxygen and 80% nitrogen, we therefore estimate the thermalisation rate:

$$K_{Air} \approx (0{,}2 * 3{,}1 + 0{,}8 * 5{,}5) * 10^{-15} \frac{cm^3}{Molekules * sec}$$

$$K_{Air} \approx 5 * 10^{-15} \frac{cm^3}{Molekules * sec}$$

$$K_{Air} * N_{Lohschmitt} \approx 5 * 10^{-15} \frac{cm^3}{Molecules * sec} * 2{,}5 * 10^{19} \frac{Molecules}{cm^3} \approx 13{,}75 * 10^4 \frac{1}{sec}$$

$$\boldsymbol{K_{Air} * N_{Lohschmitt} \approx 10^5 \frac{1}{sec} \approx Number\ of\ non\ radiative\ deactivations\ per\ CO2\ molecule\ and\ sec}$$

Thevibrationaldeactivation ofthe(0001)and(0110)Modes ofCO2measureddown to140 K by Siddles, Wilson, Simpson, Chemical Physics 189 (1994) 779-91

Comparison of Thermalization vs Spontaneous Emission

Half life time of the excited state: $t_{1/2} \approx 0.45s$

Average lifespan of the excited state: $\tau = \frac{t_{1/2}}{ln\ 2} \approx \frac{0.45\ sec}{0.693} \approx 0.65\ sec$

Or

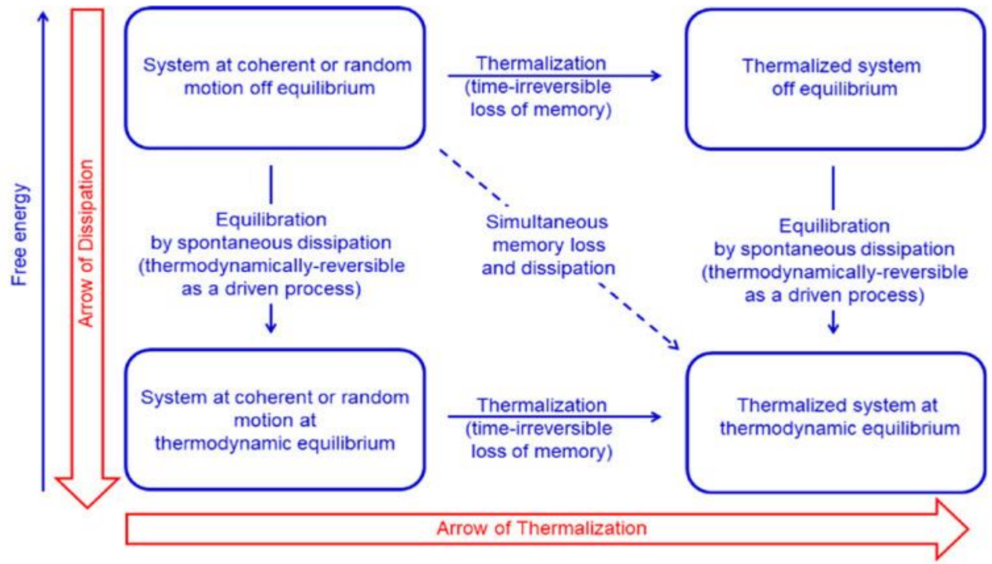
Number of radiative deactivations per molecule and second = $\frac{\mathbf{1}}{\mathbf{0.65\ sec}} \approx \mathbf{2}\ \frac{\mathbf{1}}{\mathbf{sec}}$

$$\textbf{Number of non radiative deactivations per molecule and second} \approx \mathbf{10^5}\ \frac{\mathbf{1}}{\mathbf{sec}}$$

In air under ambient conditions the thermalisation rate is by a factor of about 50,000 faster than the emission rate of the excited state.

=> Thermalisation kills the back radiation **and the greenhouse effect**

Thermalization of IR Absorbing gases in the Troposphere is Irreversible



The arrow of time splits into an arrow of dissipation that leads to thermodynamic equilibrium and an arrow of thermalization that leads to the loss of time-reversibility.

Figure 7 - "*The Origin of Irreversibility and Thermalization in Thermodynamic Processes*" by Roduner and Kruger[1], Figure 6

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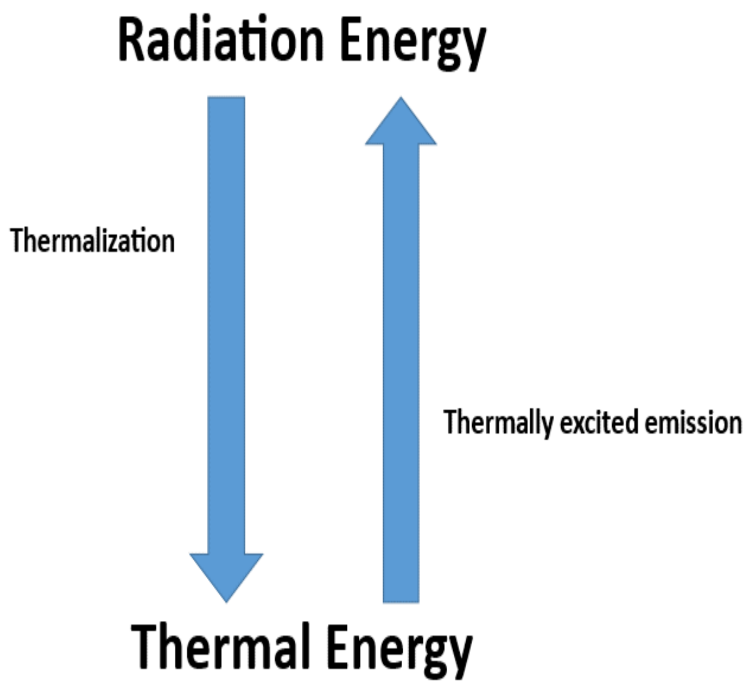
[1] The Origin of Irreversibility and Thermalization in Thermodynamic Processes

Implications of Thermalization

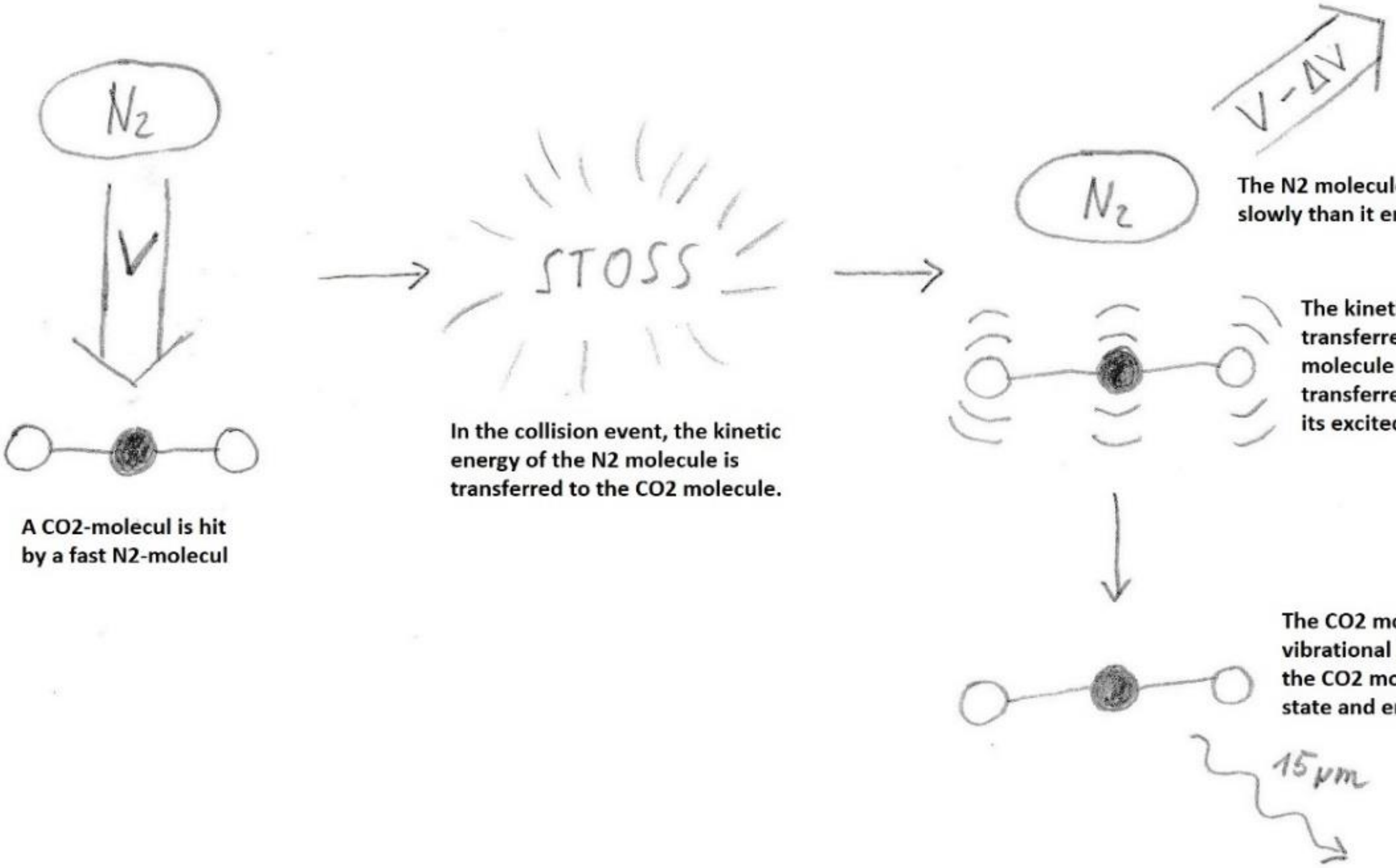
- The process of thermalization results in the near extinction of most radiation in the absorption/emission of the GHG bands a very short distance from emission at the surface. (50,000:1 ratio of thermalization:emission)
- The CO_2 molecule and other IR absorbing molecules serve as conduits to convert surface radiation to sensible heat, which enhances convection.
- Hug[3] calculated the attenuation of the 15 micrometer CO_2 band to be 99.94% over 10 meters at ~380 ppmv
- ***It is the process of thermalization, not saturation of absorption/emission, that results in the attenuation of the GHG emission bands in the atmosphere.***
- ***The conversion of radiation energy -> vibrational/rotational energy -> sensible heat results in the loss of memory of the original radiation field. The energy has been redistributed as sensible heat in the bath of air molecules. It is no longer quantized.***
- ***There is no radiation field to transport radiation through the atmosphere via a cascade of absorption and emission***
- While we have used CO_2 as an example here, the principles apply to all GHGs in the atmosphere, including H_2O

Thermally Excited Emission/Reverse Thermalization



- Thermalization results in a very efficient and quick conversion of radiation energy into sensible heat in gases or gas mixtures that contain infrared active gases.
- The opposite process is also possible. This process is called thermally excited emission.
- It converts the sensible heat of gases (the kinetic energy of gas molecules) into infrared radiation via the kinetic (collision) excitation of an IR active molecule to its vibrational state.
- It is sometimes also referred to as “reverse thermalization.”

Thermally excited emission schematic



A CO2-molecul is hit by a fast N2-molecul

In the collision event, the kinetic energy of the N2 molecule is transferred to the CO2 molecule.

The N2 molecule exits the impact event more slowly than it entered the collision event.

The kinetic energy lost by the N2 molecule was transferred to the CO2 molecule. The CO2 molecule has converted the kinetic energy transferred to it into vibrational energy and is in its excited vibrational state after the collision.

The CO2 molecule remains in its excited vibrational state for a short time. Then the CO2 molecule returns to its ground state and emits a 15µm photon.

Temperature dependence of thermally excited emission

The proportion of gas molecules whose kinetic energy is greater than the excitation energy E_i is calculated as follows.

$$\frac{N_i}{N} = e^{-\frac{E_i}{k\,T}} = e^{-\frac{h\,\nu}{k\,T}}$$

For the excitation of the 15µm oscillation of the CO_2, this results at 220K (-53°C):

$$\nu = \frac{C}{\lambda} = \frac{3 * 10^8 \frac{m}{s}}{15 * 10^{-6} m} = 2 * 10^{13} \frac{1}{s}$$

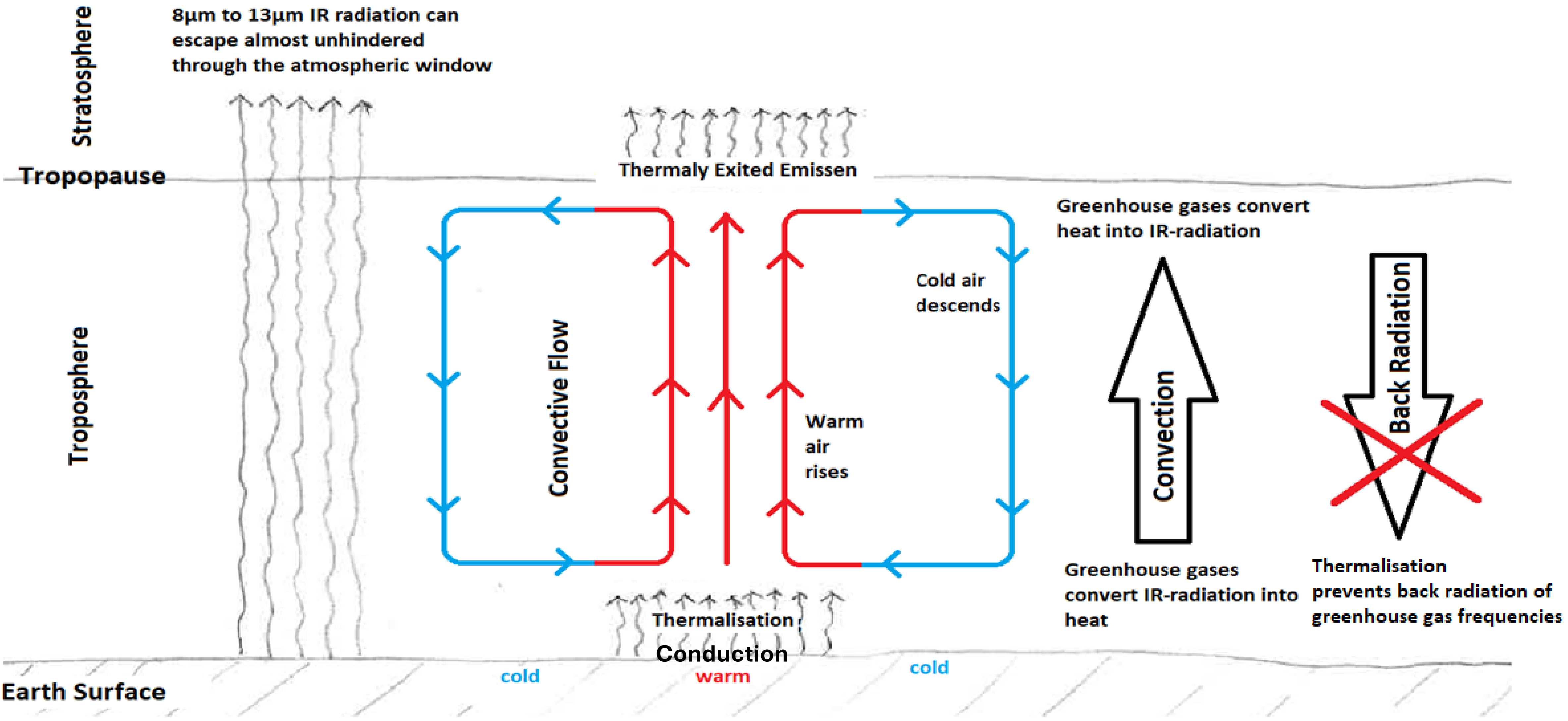
$$\frac{N_i}{N} = e^{-\frac{h\,\nu}{k\,T}} = e^{-\frac{6{,}626 * 10^{-34} Js * 2 * 10^{13} \frac{1}{s}}{1{,}38 * 10^{-23} \frac{J}{K} * 220K}} = 0{,}0127 \approx 1{,}3\%$$

- -53°C => 1.3%
- 15°C => 3%
- 30°C => 4%

Thermally Excited Emission Description

- In collision with another gas molecule, an IR-active molecule in the ground state can absorb sufficient energy from the kinetic energy of its collision partner that it goes into an excited vibrational state.
- It ***could*** then emit a photon and return to its ground state.
- In this process, kinetic energy from the gas molecule that collided with the CO2 molecule is converted into radiation. The gas cools down in this process since it loses thermal energy via infrared radiation.
- Note that these thermally excited gas molecules ***still have the same long half life for spontaneous emission***, and so ***in the lower atmosphere they will be thermalized very quickly***. The cooling of the atmosphere happens at altitudes where the thermalization rate is lower and the photons from spontaneous emission can escape to space.
- The kinetic energy of gas molecules follows the Maxwell-Boltzmann distribution. Therefore, the proportion of gas molecules whose kinetic energy is greater than the excitation energy E_i can be calculated. Even at low temperatures like -53 Celsius about 1.3% of the gas molecules have sufficient kinetic energy to excite the CO2 bending vibration.

Heat transport through the atmosphere



Heat transport in the troposphere by convection currents and thermally excited emission at the boundary of the troposphere

Heat Transport through the Atmosphere

- In the range of 8- to 13-micrometers infrared radiation emitted by the Earth's surface can escape almost unhindered through the so-called atmospheric windows.
- The IR radiation that is absorbed in the lower atmosphere by greenhouse gas molecules is thermalized due to the frequent collisions with other gas molecules under the high pressure of the lower atmosphere. The sensible heat liberated in this process joins the sensible heat transferred into the air via direct collisions of air molecules with the Earth's surface (conduction) and initiates convection flows.
- These convection flows transport the heat up to the boundary layer of the troposphere.
- Under the low pressure of high altitudes thermally excited emission becomes the dominant process since thermalization becomes less frequent.
- In the upper atmosphere, the thermally excited emission converts the convectively transported heat energy into infrared radiation that can escape into space. The details of this process for the primary GHGs will be presented in Part 3
- While this diagram only represents the vertical flows, the overall transport is far more complex.
- Thermalization decouples the surface radiation from the radiation at the TOA
- The radiation at the TOA is a function of atmospheric composition and temperature, independent of the surface thermal radiation.

Part 2

The Application of the Concept of Radiative Transfer in Climate Science

Some History of the Theory of Radiative Transfer – Part 1

- The first calculations to estimate the global warming produced by increasing CO2 in the atmosphere were attributed to Arrhenius in 1896.
- Karl Schwarzschild and his paper *"Ueber Gleichgewict in der Sonnenatmosphare"* (1906) is oft cited as the seminal work in the concept of radiative transfer theory.
- Schwarzschild presented this concept as a conjecture, not a conclusion. He proposed that an energy transport via radiation transfer might better explain the observed brightness distribution of the sun than an energy transport via convection (adiabatic equilibrium). It is more a substitution from a material flow (convection) to a radiation flow (with the physical matter of the atmosphere static, i.e., no convection.)
- At the end of the introductory paragraph of the paper Schwarzschild states, "**The whole consideration can therefore by no means be considered conclusive or compelling, but it may provide a starting point for further speculation, by expressing a simple thought initially in the simplest form.**"

- On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground (rsc.org)
- Ueber das Gleichgewicht der Sonnenatmosphäre (digizeitschriften.de)

Some History of the Theory of Radiative Transfer – Part 2

- Upon completing the calculations in his work, they did not fit the data as well as he had hoped, but the "radiative equilibrium model" data fit much better than the "adiabatic equilibrium model" data.
- His closing statement in the paper was, ***"It can be seen, that the radiative equilibrium depicts the distribution of brightness on the solar disk as well as can be expected under the simplified assumptions, under which the calculations have been made here, that the adiabatic equilibrium would result in a completely different appearance of the solar disk. The introduction of the radiative equilibrium has thus found a certain empirical justification."***
- The process in Schwarzschild's model was based on energy transport via photon absorption/emission in an atmosphere without convection. The model was never actually validated by observation and we know now that the atmosphere of our sun is highly convective.
- The atmosphere of Earth is dominated by strong convection, and the excitation and de-excitation of IR active molecules is driven by particle collisions, not photon interactions, as explained in Part 1.
- Despite this apparent incongruity of application, use of this model has become a "standard of practice"
- Perhaps this is because the method was amenable to calculation by early digital computers, saving much time compared to hand calculations prior to that time.

A Contemporary Example from van Wijngaarden and Happer

- “Dependence of Earth’s Thermal Radiation on Five Most Abundant Greenhouse Gases”, published in December, 2020 WThermal-Radiationf.pdf (yorku.ca)
- The assumptions and methodologies of the radiative transfer model as presented in this work are consistent with common interpretations of the GHE. One might consider these a “standard of practice.”
- The following is not directed exclusively at the authors van Wijngaarden and Happer, but to serve as a vehicle to question/challenge some of the assumptions and conclusions in the various models attempting to validate the GHE.
- As a reminder, all calculations of this type are *models*, based on certain *assumptions*. They are one-dimensional, static, and seek to calculate the “equilibrium” or “radiative balance” of the scenario.

Some Invalid Assumptions in the Radiative Transfer Model

- Section 1 of the paper states "Greenhouse warming of the Earth's surface and lower atmosphere is driven by *radiative forcing*, …", as though it is a matter of fact. The GHE has yet to be demonstrated. It has only been modeled.
- In section 3, equation (9), vWH use the Planck intensity to calculate the emission of the IR components of the GHGs. Implicit in this is the assumption that individual molecular species will spontaneously radiate according to a Planck distribution as though they were part of a blackbody, which is invalid though commonly assumed. This is conflating Kirchhoff's Law for condensed matter bodies with individual molecules which does not apply.
- In section 3, equation (14) vWH invokes the Einstein coefficient for the rate of spontaneous emission. We know from the work of Siddles et al. that non-radiative deactivation occurs at a rate that makes spontaneous emission insignificant, (~50,000:1 for CO2 at STP). The Einstein coefficients are valid for atoms in a radiation field where both excitation and de-excitation are driven by interactions with photons. After thermalization near the surface the excitation and de-excitation in the troposphere are dominated by collisions with other gas molecules, thermalization and thermal excitation. There no longer exists a radiation field for radiative transfer to occur.
- In section 4, equation (23) vWH invoke the "Schwarzschild equation" which is common practice in climate radiative transfer models. It is not valid in the Earth's atmosphere.

What do these Models Say?

- Because the model assumes that all the GHGs are absorbing and emitting radiation in random directions throughout the atmosphere, it posits that much of that emitted radiation is directed down and is re-absorbed by the Earth's surface, because the atmosphere is densest near the surface (hence, more radiation from the GHGs near the surface). This modeled downwelling radiation (so-called "back radiation") purportedly makes the temperature of the surface higher than it would be in the absence of the "back radiation."
- This "back radiation" cannot exist in the presence of thermalization at a ratio of 50,000:1 relative to spontaneous emission.
- The IR spectrum at the top of atmosphere predicted by this model is in good qualitative agreement with the observed satellite spectrum in varying climatic conditions.
- This should not be surprising because the radiation detected in space is the result of spontaneous emission, so it is the one place in the model where the assumptions generally are consistent with the actual conditions.
- Unfortunately, some features of the spectrum have been consistently misinterpreted and the "back radiation" is considered a real phenomenon. The details of this will be discussed in Part 3.
- ***The outgoing radiation spectrum is fully decoupled from the surface radiation by thermalization. The spectrum is a function of the atmospheric composition and temperature where it is measured.***

The CO_2 Absorption "Notch"

- The "notch" around the CO_2 absorption band is commonly interpreted as CO_2 "trapping heat in the atmosphere." ***This is a serious misinterpretation of the OLR spectrum that has led science astray.***
- The emission at wave numbers below the atmospheric window is from water vapor. The "notch" occurs because water vapor emissions begin to overlap with the CO_2 absorption band, and the *water emission* is being *absorbed* by CO_2.
- What the emission curve does not reveal is that the CO_2 is then *thermalized* via collisions and that sensible heat energy drives additional thermally excited emission by water vapor.
- The reason there is such a tiny emission peak for CO_2 at the bottom of the "notch" is that almost all the excess radiation has been released to space by water vapor and there is little work remaining for CO_2 to do.
- ***The failure to recognize that the behavior of IR active gas molecules changes radically in the presence of non-IR active species due to thermalization has led to the perpetuation of the radiative transfer model, despite evidence showing that it is invalid.***
- ***There is no law of conservation of radiation***

Part 3

How Heat from the Surface of the Earth is Transported to Space from the Ground Up

Start at the Surface

- In the first few millimeters above the surface, chaotic atomic activity results in conduction which transfers sensible heat from the surface to the atmosphere. Over 100 lbs. of molecules/sq-m/sec strike the surface.
- Conduction is continuous wherever the ground temperature is higher than air temperature which is the case on most of the planet most of the time, inversion layers being the notable exception.
- The magnitude of conduction accelerates during periods of insolation when incoming radiation adds heat to surface.
- It is highly variable in magnitude over short distances due to surface variations (asphalt vs grass, for example.)
- Heat from conduction drives convection beyond the transition layer.

Surface Radiation and Thermalization

- In the first few meters above the surface, upwelling longwave radiation (ULR) that does not pass through the atmospheric window is absorbed by GHGs which are thermalized almost immediately as described in Part 1 of this essay.
- The radiation from the surface is gone, converted into sensible heat (kinetic energy) which further drives convection.
- There is no radiation field of significance to drive energy transport via radiative transfer.
- Some thermalized GHG molecules will be raised to excited states through collision, but these will be overwhelmingly thermalized before they can emit a photon. The GHGs have acted as a conduit to convert radiative energy into sensible heat.
- Thermalization decouples the surface radiation from radiation that is emitted into space.
- *Convection creates an "atmospheric speed limit" for the sensible heat to reach the upper atmosphere.*
- ***The heat is not "trapped." Its transport is simply slowed to a tiny fraction of the speed of light.***

Water, Water Everywhere

- Water vapor will typically account for 90% or more of the GHGs in most of the atmosphere.
- As a result of equipartition, this means that water vapor will carry 90%+ of the heat energy carried by all the GHG molecules.
- Some of this is sensible heat, and some is latent heat.
- Water is a condensing GHG that is not uniformly distributed in the atmosphere.
- How will this energy be transferred to space?

Latent Heat

- Latent Heat in water vapor, which is transported by convection, will be released as sensible heat when the water vapor condenses.
- This heat will first be absorbed by the nucleating site.
- Some of this heat may be transferred by conduction to molecules colliding with the condensed droplet, increasing their kinetic energy.
- This added energy further drives convection and thermal excitation of IR active molecules.

Water does (almost) all the Work

- At higher altitudes in the troposphere, the reduced pressure from condensation results in a lower frequency of collisions, and a proportionally reduced thermalization rate.
- Because the emission rate is not dependent on pressure/density, the probability of emission increases with increasing altitude.
- As the thermalization rate decreases, the rate of thermally induced emission increases.
- Water vapor emits over a wide range of frequencies at relatively low energies. There is a high fraction of air molecules with sufficient kinetic energy to induce thermally excited emission in H2O.
- The condensation of water results in a lower density of water vapor molecules in the atmosphere. This results in an increased mean free path for a photon emitted by H2O. At an adequately long mean free path, the photon will escape to space.
- Because the altitude of the troposphere varies with latitude, the effective emission altitude will vary as well. Emission of the broad H2O band in the OLR spectrum would indicate a typical emission altitude ~ 2-6 km.
- ***All but a small fraction of OLR energy comes from water vapor***.

Ozone

- Ozone is a non-condensing gas that is not uniformly distributed.
- The concentration is maximum in the stratosphere.
- Emission from O3 begins at a higher altitude where the lower rate of thermalization and higher mean free path of emitted photons allows the energy to escape to space.
- This occurs in the mid to upper stratosphere.

CO_2

- CO_2 is both non-condensing and uniformly distributed.
- The conditions for CO_2 emission to both avoid thermalization and absorption (allowing the energy to escape to space) occur near the mesopause.
- With a thermalization rate of 50,000:1 relative to spontaneous emission at STP, we would expect this to occur in the neighborhood where atmospheric pressure is around STP/50,000
- Not coincidentally, this occurs near the mesopause where the pressure is about 1-20 millitorr/0.1-2.5 Pa.

Koll and Cronin – OLR Linear with Temperature

- In a 2018 paper, Koll and Cronin published data showing that for typical terrestrial temperatures the magnitude of total OLR is a linear function of near surface temperature.
- This apparently surprised the authors who had expected that the OLR would be a function of T^4, consistent with the Stefan Boltzmann equation.
- Koll and Cronin did not consider that because thermalization converts the surface radiation into sensible heat in the atmosphere, the resulting convection follows Newton’s law of cooling which is a linear function.
- This is also consistent with water vapor as the primary radiator of IR energy into space
- ***Higher temperature -> higher water vapor concentration -> more radiation from water vapor (cooling)***
- In summary, the radiation emitted by the surface and the radiation observed by satellite at the TOA are decoupled by thermalization near the surface in the first few meters of the troposphere. Most of the energy loss to space comes from water vapor emission. Emission by the other GHGs is insignificant. Again, this does not mean that the non-condensing GHGs “trap” heat in the atmosphere, but that the radiated energy they absorb from the surface is mostly transferred via thermalization and equipartition to water vapor and radiated to space by water vapor.
- Earth’s outgoing longwave radiation linear due to H2O greenhouse effect | PNAS

Koll and Cronin – OLR Linear with Temperature

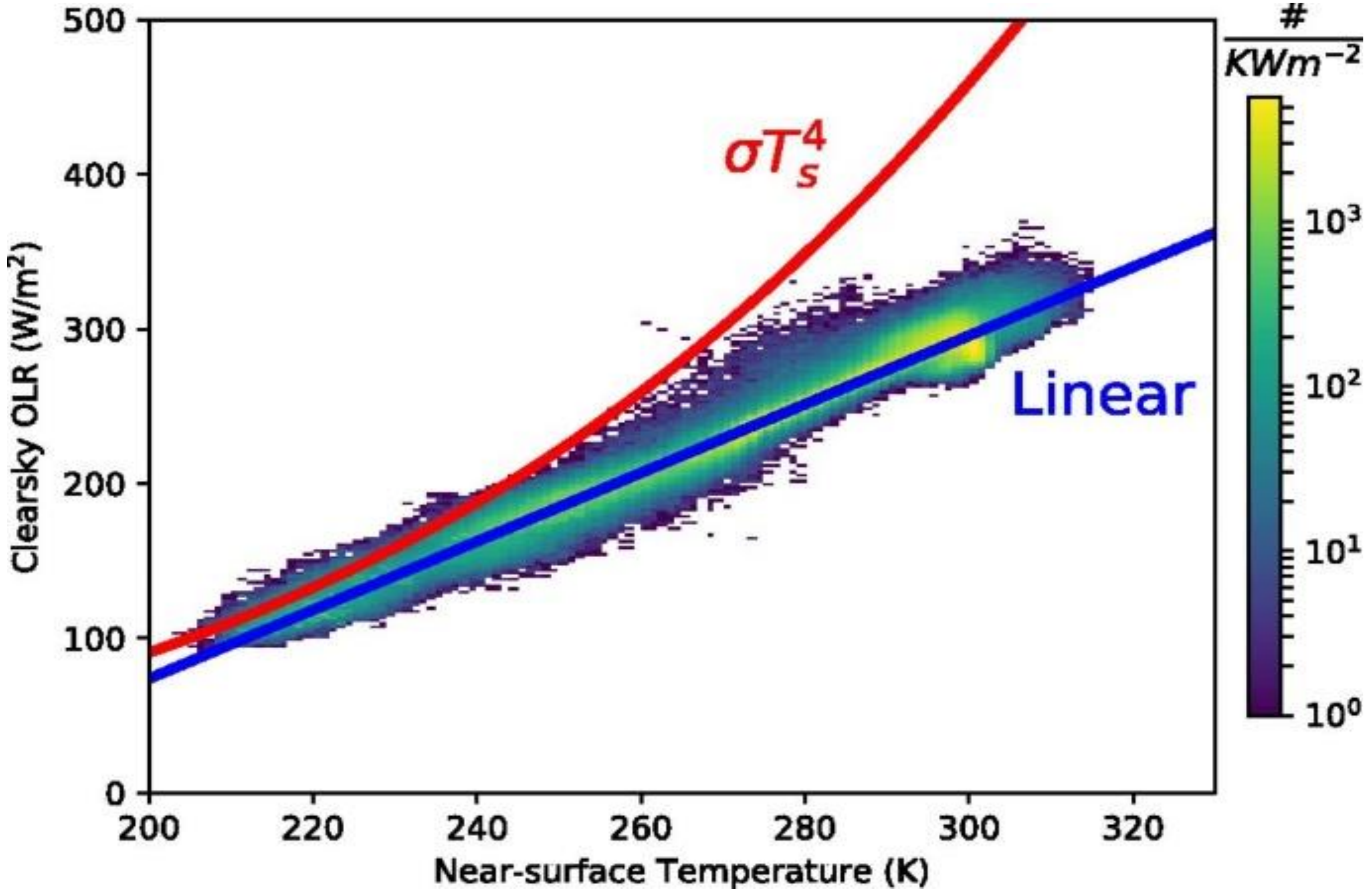


Figure 10 - From Koll and Cronin (2018) – The color indicates the density of the data points measured in this histogram. The blue line is a linear regression with reported R2 of ~0.97.

A Comparison of Interpretations

- It is interesting to consider the difference in perspective of the mechanism presented here versus the radiative transfer model.
- For this we will refer to another work of vWH, “Atmosphere and Greenhouse Gas Primer”. For reference, we will use the model flux distributions (vWH Figure 6) and spectrum (vWH Figure 7) below which were presented in that work.

- GreenhousePrimerArxiv.pdf (yorku.ca)

Outgoing OLR vs Altitude by Wave Number

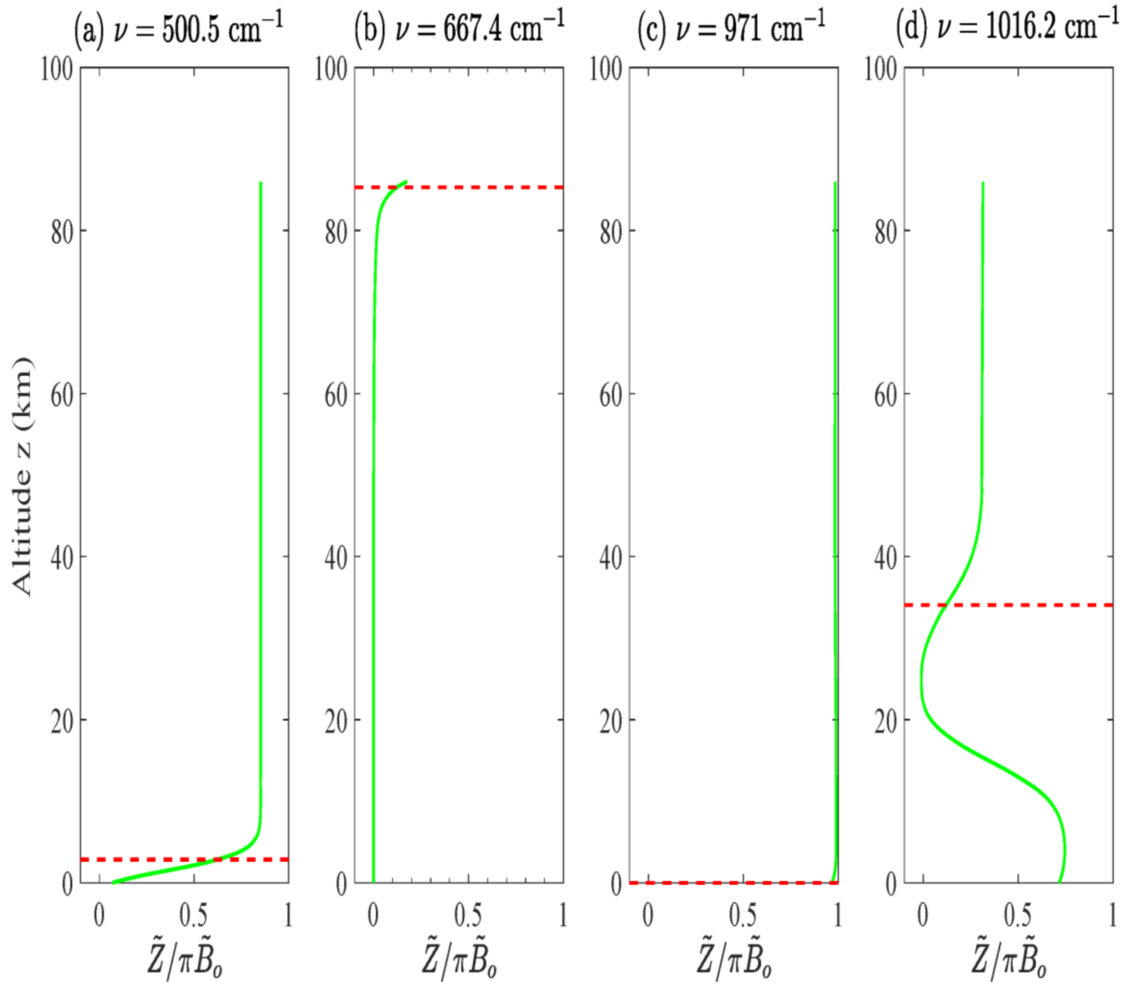


Figure 6: Relative magnitude of OLR vs Altitude at wavenumbers for H20, CO2, atm window, Ozone

Modeled Outgoing OLR Spectrum

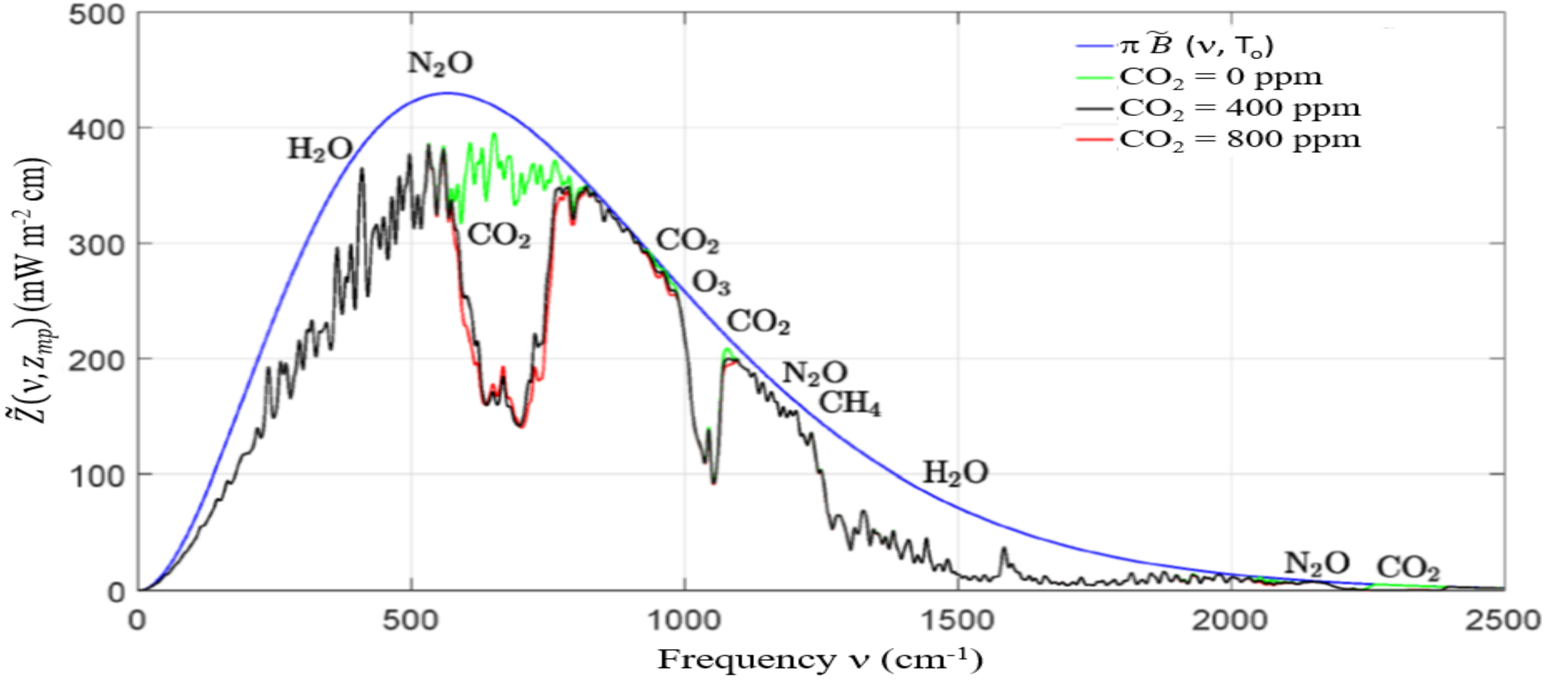


Figure 7: Effects of changing concentrations of carbon dioxide, CO2 on the thermal radiative flux to space from the top of a midlatitude standard atmosphere at altitude zmp = 86 km, with the temperature profile of Fig. 5. The smooth blue line is the spectral flux from a surface at the temperature T0 = 288.7 K for a transparent atmosphere with no greenhouse gases. The green line is the flux if all CO2 were removed but with all the other greenhouse gases at their standard concentrations. The black line is for all greenhouse gases at their standard concentrations. The red line is for twice the standard concentration of CO2 but with all the other greenhouse gases at their standard concentrations. Doubling the standard concentration of CO2 from 400 to 800 ppm increases the forcing (the area between the black and red lines) by 3.0 W m^2.

Van Wijngaarden and Happer on Water Vapor

- "*Fig. 6a shows that for a frequency v = 500.5 cm^{-1}, in the pure rotational band of water vapor, the spectral flux Z˜ , "breaks out" near the emission altitude ze = 2.9 km, in the lower troposphere. The energy for the flux is radiated by H2O molecules,* ***which extract heat from convecting air parcels****. The atmosphere is cooler at an altitude of 2.9 km than at the surface, so the spectral flux Z˜ that is radiated to space, the value of the green line at the top of the atmosphere, is only about 80% of the surface Planck value."*
- We find the phrase, "…which extract heat from convecting air parcels" to be odd. Molecules do not "extract" heat in a gas. They absorb energy either via collision or absorption of a photon. At lower altitudes thermalization and equipartition lead to H2O molecules carrying most of the energy carried by all GHG species because H2O typically represents 90+% of the GHG molecules in the lower troposphere. The H2O molecules emit radiation as a result of thermally excited emission. Rather than saying "which extract heat from convecting air parcels," it would be more accurate to say, "which are excited by molecular collisions," the actual process.
- As can be seen in Figure 7 from vWH, the H2O emission band overlaps the CO2 emission band as shown in the green spectrum representing the absence of CO2. Water vapor dominates the emission of IR energy into space. This will be discussed in more detail in the "Engineering Perspective" section, Part 4.

Van Wijngaarden and Happer on CO_2

- "*Fig. 6b shows that for a frequency v = 667.4 cm−1, in the middle of the strong Q branch of the CO_2 bending-mode band, the emission altitude is near the top of the atmosphere, ze = 85.3 km. Here the energy for the emission is not from convecting air parcels. Most of the emitted energy is supplied by the absorption of solar ultraviolet radiation. Heavily absorbed frequencies, like v = 667.4 cm−1, make a negligible contribution to radiative heat transport in the troposphere*."
- The authors would agree with the last sentence of this statement since there is no radiative heat transport in the troposphere by CO_2. But how does the absorption of solar ultraviolet radiation provide emission in the 667.4/cm IR band of CO_2? CO_2 can only emit a photon at 667/cm if it has absorbed a photon at that frequency or if it has been thermally excited via collision into a vibrational state that results in the emission of a photon. The statement in vWH's work makes no sense.
- The thermalization rate is a function of atmospheric pressure while the spontaneous emission rate is constant, so we need to know where the atmospheric density is reduced by a factor of about 50,000. It should be no surprise that happens in the upper mesosphere/mesopause. The emission spike we see for CO_2 is the result of thermally excited emission.
- This tiny spike represents the only net contribution of CO_2 in the energy dynamics of the atmosphere. It should also be noted that the "notch" in the spectrum from CO_2 absorption is not from absorption of radiation emitted by the surface, but from partial absorption of radiation emitted by water vapor that overlaps the CO_2 band. That CO_2, as at the surface, is thermalized and the energy is redistributed through equipartition.

Van Wijngaarden and Happer on Ozone

- "*Fig. 6d shows that for a frequency of v = 1016.2 cm−1, in the middle of the O3 absorption band, the emission altitude ze = 34.0 km is at the same altitude where the O3 concentration is a maximum as is shown in Fig. 5. There is little ozone in the troposphere, so the spectral flux Z˜ in the troposphere is not much smaller than the surface Planck flux. Most of the flux from the surface and troposphere is absorbed by O3 in the lower stratosphere, to be replaced by emission from the warmer, upper parts of the stratosphere, where the temperature maximizes because of absorption of solar ultraviolet light by ozone. The absorbed ultraviolet light provides the energy that is radiated back to space at the frequency v = 1016.2 cm−1.*"
- The statement from vWH here is similar to their statement regarding CO2. The difference is that the concentration of ozone is lower and it is stratified in the atmosphere, and so emission breaks out at about 34 km altitude. As with CO2, the emission from ozone is the result of thermally excited emission/reverse thermalization at an altitude where the emitted photons can escape to space. As with CO2, there is a tiny spike of emission at 1016/cm.
- For both CO2 and Ozone, the connection to ultraviolet is unclear and is not explained in the paper.

Part 4

An Engineering Perspective on Climate – “Average”, “Balance”, and “Equilibrium”

The Root of Some Misconceptions

- The arguments that are the basis of the GHE and “climate science” as practiced today are based on one-dimensional steady state concepts and the use of values such as “average temperature”, “average solar irradiance”, “energy balance”, and “radiative equilibrium” to name a few.
- There is nothing about atmospheric dynamics, weather, and climate that is “average”, and the system is never in “equilibrium” or “balance.”

The Basics

- The Earth is a dynamic system that goes through diurnal and seasonal cycles with significant changes in temperature.
- The diurnal cycle is a high frequency cycle with almost constant (over a short number of days) energy input from insolation for (on average) 50% of the cycle and energy loss for 100% of the cycle.
- The seasonal cycle is superposed on the diurnal cycle and is a lower frequency cycle in which the energy input is varied by approximately 7 percent from the peak to the valley of the cycle (based on an approximately 3.5 % difference in distance from the sun between perihelion and aphelion.)
- From an engineering perspective, it is a periodically driven system with an adaptive response that is proportional to the energy input. In such a system, the response of the system will change only if the input to the system changes.
- Because the input changes regularly and cyclically, the Earth's energy is never in "balance" or in "equilibrium."
- ***There is a natural response by the atmosphere attempting to attain a balance/equilibrium that can never be achieved. The manifestation of this is what we call weather on short time scales and climate on long time scales.***

Why the Current Perspective is Incorrect

- The GHE conjecture posits that the difference in the energy radiated from the surface integrated over all wavelengths and the similar integral of energy over the measured spectrum at TOA is an indication that a certain quantity of heat is being "trapped" in the atmosphere.
- It further posits that *the atmosphere then radiates downward to increase the surface temperature*.
- If the system had a constant input and radiative transfer was the mechanism this might be true, and the one-dimensional model would reach an equilibrium.
- The model is perturbed by changing parameters to create what is called "radiative forcing" (a term that was invented circa 1970 to accommodate this imagined phenomenon) which results in a different equilibrium temperature.
- This cannot simply be carried over to a three-dimensional system where the energy input varies widely over both space and time for both high and low temporal frequencies
- Just as the OLR spectrum tells us nothing about heat transport in the atmosphere, one-dimensional radiative forcing models tell us virtually nothing about climate, as illustrated by the following "thought experiments."

What if…….#1

- First, suppose that the Earth's diurnal period is halved, to 12 hours. The results of the radiative transfer equations would remain the same.
- The diurnal temperature variation would be greatly reduced.
- The peak temperatures of the days would be cooler, and the minimum temperatures of the night would be warmer.
- There would be less evaporation during the day, and less condensation at night. The hydrologic cycle would likely be different.
- The Coriolis effect would be much greater, and the effects on both atmospheric and ocean circulations would likely be drastic.
- The spectrum of OLR into would likely not change, but the world would be a much different place.
- Would it be better or worse for life?

What if…#2

- In the opposite sense, suppose the diurnal period is doubled, and the day was 48 hours instead of 24.
- The Coriolis effect would be greatly reduced.
- If one was living in what is now a warm climate, imagine what would happen at the peak heat of the day with 24 hours of insolation rather than 12.
- Would a current high temperature of 100F peak at 120? 140?
- Likewise at night, would the comfortable low at 75F now become 40? 25? Daytime evaporation and nighttime condensation would be greatly increased.
- What happens to the weather and habitability under these conditions?
- The transitions between hot and cold sides of the planet could become violent places indeed, and adaptation to extremes would be necessary on a daily basis.
- There are many other effects that could be enumerated. The purpose is not to model these scenarios n detail but to illustrate the folly of using "average" values to make a statement about what is happening in the climate.

The Relationship of Earth and Energy

- With respect to energy, the Earth is an open system. It is embedded in the vacuum of space.
- The atmosphere is the medium that regulates energy transport between the surface and space.
- The ONLY source of input energy comes from space in the form of radiation from the Sun.
- The energy input per unit time is finite and relatively constant, but variable on multiple time scales.
- The energy as received at the surface varies continuously over both space and time.
- Excess energy is output to space in the form of OLR. The vacuum of space is *effectively an infinite sink* for the OLR.

The View form 500,000 Feet

- During each diurnal cycle the earth accumulates energy from solar radiation during the day.
- Energy is being released to space simultaneously during daylight hours.
- At night, the energy release to space continues via the same process.
- Energy input varies instantaneously and continuously as the Earth rotates.
- As we approach a warmer season in the annual cycle, a bit of excess energy remains at the end of each day and the hemisphere warms.
- The opposite occurs as we approach a cooler season.
- The Earth accommodates these temperature variations on daily and seasonal cycles.
- ***With a finite energy input and an effectively infinite sink for the excess energy to leave, it is difficult to rationalize a scenario that results in "runaway warming" without a substantial change in input energy.***

No Hand-Waving Required

- The atmospheric energy flows as described in this work demonstrate a more plausible mechanism for energy transport in the atmosphere that naturally maintains climate stability.
- As explained in Part 3, the flow of energy from the surface to space is dominated by water vapor as reflected in the OLR spectrum.
- This should not be surprising as the surface of the earth is predominantly water, and it is often referred to as a “water planet.”
- Water vapor as the primary conduit for shedding energy to space comes with a benefit.
- The concentration of water vapor rises with temperature, so as the earth warms the capacity to radiate heat to space increases.
- This means that water vapor provides a negative feedback mechanism for moderating the temperature of the planet.
- ***Given that the Earth has managed itself without man’s intervention over the epochs, it should not surprise us that Le Chatelier’s principle is at work. Climate change is natural. (And out of mankind’s control)***

It's Where Weather is Created

- The Earth receives energy from the Sun at the speed of light, but it sheds the energy at the speed of convection.
- Convection creates a "speed limit" for the rate at which energy can leave the Earth. That is a "slowing" of heat transport in the atmosphere of sorts, but not "trapping" via "radiative forcing."
- The so-called GHGs convert radiation energy to sensible heat via thermalization.
- The resulting convection is not purely vertical and includes advection due to the various forces at work in the atmosphere.
- This creates imbalances in barometric pressure, water vapor concentration, and temperature. The manifestation of these imbalances is weather.
- Clouds are a part of weather and are a result of the system.
- ***Water, the hydrologic cycle, is the primary driver***

Part 5

Observations/Comments on Global Climate Models

Why Models are Important

- Most, if not all the alarmism being stirred regarding climate is based on “predictions” of the global (GCM) models.
- Despite the failure of any dire predictions from these models to come to fruition in the past several decades, alarmists continue to use their “results” to drive massive policy change in energy, economics, and environment.
- “Results” appears in quotes because the modelers refer to their various runs with different parameter sets as “experiments.”
- The results of these “experiments” are published and discussed at various meetings and conferences and are always presented as *realistic scenarios* of what *could happen*.
- This often becomes conflated by politicians, activists, and media pundits into what is *happening right now,* ***even though it’s not***.
- Unfortunately, it is an illusion that the GCMs provide any insight into future climate. This has been demonstrated through generations of these models

CMIP

- The Coupled Model Intercomparison Project (CMIP) is “a collaborative framework designed to improve knowledge of climate change” [Wikipedia].
- The most recent Phase 6 (CMIP6) included more than 30 models from more than a dozen countries.
- Papers concerning the results of these “experiments” are typically used as inputs in the IPCC assessment reports, and ultimately carry impact into public policy.
- One can begin to gain some insight into the methodology in these models through a summary document from NASA GISS, “GISS-E2.1: Configurations and Climatology” (47 listed authors).
- GISS-E2.1: Configurations and Climatology - Kelley - 2020 - Journal of Advances in Modeling Earth Systems - Wiley Online Library

An Example

- "The total solar irradiance has been updated based on new satellite calibrations (Kopp & Lean, 2011) to have a base value of 1,361 W/m^2 (compared to 1,366 W/m^2 in GISS-E2) **though this is not expected to have any impact on the climatology or sensitivity once the models have been retuned [sic] for radiative balance** (Rind et al., 2014)." (Emphasis added.)
- This would correspond in their model parameterization to a change of -1.25 W/m^2 in the solar irradiance.
- In their Table 2 *"Global Annual Ensemble Mean Model Features Over the Period 1979–2014 (1980–2004 for the E2 Models) and Key Diagnostics Compared to Observations or Best Estimates"* later in the paper, the change to the "TOA Net Radiative Imbalance" in the model is only -0.24 W/m^2.
- How does -1.25 translate to -0.24?
- The number they use for "observed" TOA Net Radiative Imbalance is 0.41+/-0.03 W/m^2, and that number is derived from *NOAA NODC ocean heat content data*.
- We are curious how TOA imbalance at that level of precision can be derived from ocean heat content data. Perhaps they should say "divined" rather than "derived."

Complexity

- Diving a bit deeper, we discover the hundreds of variables and parameters that that go into each "experiment." The models are exceedingly complex and require scores of individuals to manage them. Consider some variable names such as:
- **"subsurface_litter_mass_content_of_carbon"**
- **"minus_tendency_of_atmosphere_mass_content_of_ammonium_dry_aerosol_particles_due_to_dry_deposition"**
- **"tendency_of_sea_water_conservative_temperature_expressed_as_heat_content_due_to_parameterized_submesoscale_eddy_advection"**
-
- Why is such extreme detail used in a system that has yet to demonstrate any ability to simulate the climate?
- Also in this document, there are comparisons of model outputs relative to measured values for many of the output parameters. Despite using the "everything but the kitchen sink" approach to include a myriad of variables, the models are unable to simulate the real world. If one wants to explore how complex this has become, the *CIMP6 Forcing Datasets Summary* is linked in the references. In a recent video on the YouTube channel "Climate Chat" at timestamp 25:20 in the video, Gavin Schmidt discusses the complexity of these models and asserts that it takes **one year** to complete a "run" of the models. A link to the video is in the references. It is worth watching at least part of the video to see how the world expert in climate modeling responds in an interview.
- CMIP6_Forcing_Datasets_Summary - Google Docs
- (125) Much Ado About Accelerating Warming with Climate Scientist Gavin Schmidt - YouTube

Implicit Assumptions

- Radiative transfer through the atmosphere is the critical mechanism for the transport of heat energy from the surface of the Earth to space.
- CO_2 is the primary "driver" of increasing temperature.
- The authors have explained in the prior parts of this essay that the physics of heat transfer in the atmosphere is very different from the radiative transfer model which is a mathematical abstraction with no connection to reality in Earth's atmosphere.
- Perhaps the radiative transfer route was chosen because it makes the problem mathematically tractable albeit still extremely complex.
- ***Unfortunately, the use of imaginary physics in the name of convenience cannot provide correct results.***
- ***The models do not test the GHE hypothesis. They assume it is fact and then simulate it under varying conditions. The result will always be some degree of warming.***

It’s a Fool’s Errand

- The Earth Ocean/Atmospheric system is extremely complex and chaotic.
- The current oversimplified and inappropriate radiative transfer code already taxes the best and fastest computer systems, and an appropriate model may not even be possible.
- ***If the bureaucrats who continue to fund these efforts had any curiosity and integrity in addition to some concept of the overwhelming complexity and futility of the effort, they would cut off funding.***
- The climate modeling leadership refuses to allow their community to debate a competent skeptic.
- The situation evokes the scene in “The Wizard of Oz” when Dorothy encounters the “Great and Powerful OZ” only to find when she pulls the curtain back it’s all an illusion.
- Climate modeling is not science. Science is based on observation and investigation.
- Climate model runs are not experiments. The inability to perform physical experiments on the climate does not justify this reference. Models are not reality.
- Climate model outputs are not evidence, The outputs of the models are predictable results based on the model inputs.

Part 6

Summary and Conclusions

From Richard Lindzen

- ***"What historians will definitely wonder about in future centuries is how deeply flawed logic, obscured by shrewd and unrelenting propaganda, actually enabled a coalition of powerful special interests to convince nearly everyone in the world that CO2 from human industry was a dangerous, planet-destroying toxin. It will be remembered as the greatest mass delusion in the history of the world – that CO2, the life of plants, was considered for a time to be a deadly poison."***
- Quotations of the Day on Climate Alarmism.... | American Enterprise Institute - AEI

Heat Transport Summary

- We have presented an alternative paradigm to explain how heat absorbed by the Earth's surface is returned to space.
- The "***missing link***" in the GHE is the *assumed* spontaneous emission by GHGs in the lower atmosphere which is required for the radiative transfer mechanism to apply.
- Thermalization kills the upwelling radiation field from the surface, and the work of heat transport from the atmosphere to space is performed by convection until radiation from thermally excited emission (reverse thermalization) can escape to space at higher altitudes.
- So-called GHGs are a conduit that converts surface radiation to sensible heat in the atmosphere. This decouples the surface radiation from the atmosphere and outside of the atmospheric window there is no direct radiative energy transport from the surface into space.
- ***The heat is not "trapped", it is simply slowed by the atmospheric "speed limit" of convection.***
- The Outgoing Longwave Radiation (OLR) outside the atmospheric window is determined by the atmospheric composition and thermally excited emission as a function of altitude of the GHG species therein.
- ***Perhaps the greatest irony in all of this is that the so-called "Greenhouse Gases" facilitate heat transfer at the surface AND the top of the atmosphere, rather than hindering it.***

It’s All About Water

- Almost all the OLR outside of the atmospheric window is emitted by water vapor. The contribution of other so-called GHGs is insignificant.
- This is apparent from the predominance of water vapor emission at low frequencies in the OLR spectrum.
- Water vapor is the most abundant GHG, generally making up 90% or more of all GHG in the lower atmosphere.
- Because water begins condensing at a relatively low altitude, the low density of water vapor molecules enables the escape of photons from thermally excited emission at a much lower altitude than other GHGs.
- As shown in Koll and Cronin[11], there is an approximately linear relationship between OLR and surface temperature over a wide range of terrestrial surface temperatures.
- While their “radiation-centric” analysis attributed this to other more complicated factors, it is more easily explained by recognizing that the convection generally follows Newton’s law of cooling which is a linear function of temperature.
- ***This also provides a natural negative feedback mechanism preventing “runaway” warming or cooling***

How Climate Models went in the Wrong Direction

- We posit that radiative transfer models were chosen for treatment of these phenomena because they mirrored the conjectures of Arrhenius and Schwarzschild, and that they were tractable from a computational perspective.
- As indicated earlier in this work, they have become a ***de facto "standard of practice"*** in climate modeling.
- What those who chose this modeling approach failed to consider was that the works of Kirchoff, Schwarzschild, and Arrhenius were conjectures without experimental support and preceded the modern understanding of the quantum behavior of IR active gas molecules.
- The early scientists (Kirchhoff, Stefan, Boltzmann, Planck)assumed that there was a 1:1 relationship between absorption and emission by "bodies." This is true under a limited set of conditions and was intended to apply to condensed matter in thermodynamic equilibrium.
- Climate modelers conflated this into a 1:1 relationship between absorption and emission at the atomic/molecular level. This is stated explicitly by Syukuro Manabe in his 2021 Nobel Prize acceptance speech, and this is a misapplication of Kirchhoff's law that is deeply rooted in radiative transfer models.
- Syukuro 'Suki' Manabe's Nobel Prize lecture in physics (youtube.com)

Why the Model TOA is Pretty Good but the "Back Radiation" is Wrong

- One might argue that because these models can reproduce measured OLR spectra with reasonable accuracy, they should be useful to provide some information regarding the behavior of the climate system.
- The work of vWH shows that spectra measured from various points on the globe with both moderate and extreme climate conditions can be reproduced qualitatively.
- This was explained in Part 2. For outgoing radiation, emission breaks out when the mean free path of the photon allows it.
- There is a catch, however. These models require the presence of a "*back radiation*" component of the atmosphere radiating energy back to the surface.
- Because thermalization converts the radiation field from the surface to sensible heat, the energy for a downwelling radiation field is no longer available.

Takeaways

- The dominance of the thermalization of IR active gases in the atmosphere renders energy transport via radiative transfer in the troposphere a physical impossibility.
- This phenomenon has been studied and measured for many decades and is a natural outcome of quantum physics, thermodynamics, and statistical mechanics. It is irrefutable but has been ignored in “mainstream” climate models.
- We have discussed why concepts such as “balance” and “equilibrium” cannot be used to represent dynamics of heat transport in the atmosphere. It is cyclic and chaotic, constantly changing.
- We have also attempted to explain, within the limits of maintaining some brevity in the exposition, how the misapplication of the concept of radiative transfer theory invalidates the models upon which the “climate crisis” is based.
- Our alternative paradigm does not require any “hand waving” and is based on well understood principles of physics and engineering. We do not have to create new concepts like “radiative forcing” to understand it.

What We Cannot Know

- Because this is a convection-based model, a global circulation model based on the real mechanisms of heat transfer would likely require orders of magnitude more computing power than the current radiative transfer based GCM models.
- This further supports our belief that the attempt to model and predict global climate is an expensive and worthless pursuit.
- The only feature of energy transfer from the surface to space that the models get right is that within the "atmospheric window" most of the surface radiation escapes directly to space without interaction.
- Everything else in the output of models is based on processes that do not exist in the atmosphere.
- Good science requires epistemological grounding.
- There must be an awareness and acceptance of what is NOT known and what CANNOT be known. "Climate science" is but one discipline where this principle has been abandoned.

Why There Has Been No Meaningful Progress

- Will Happer, in the closing section of his presentation "CO2 the Gas of Life", eloquently describes five reasons why the campaign to demonize CO2 has been so successful. They are ***Noble Lies, Political Lies, Ignorance, Stupidity, and Greed***. It is worth listening to his presentation. He elaborates on each of these at closing.
- Why has the skeptic community been so *INEFFECTIVE* in countering the narrative? Certainly, the deck is stacked against us. The IPCC is chartered to investigate only human influence on climate. The media and cancel culture love to foment fear in the populace. The alarmists abstain from scientific debate because according to them, it would lend credibility to "misinformation." They have fanatics demonstrating in the street and disrupting normal life. While there has been some shift in popular perception, the damaging policies continue. The skeptic community for the most part has not only acquiesced to the existence of the GHE, but in some cases developed mathematical models to "demonstrate" it. We play defense while they play offense.
- ***In the meantime, our primary geopolitical rivals with scientists who understand the principles presented here are watching gleefully as Western Governments take down our energy infrastructure and industrial base without having to fire a single shot.***
- Will Happer: CO2, the Gas of Life | Tom Nelson Pod #158 (youtube.com)

Why We are Presenting This Work

- The authors of this essay come from quite different backgrounds, but share training in the hard sciences, an insatiable curiosity, decades of solving complex engineering problems, and pursuit of the truth.
- Perhaps most concerning regarding the “skeptic” community is the absence of curiosity or critical thinking regarding the core principle at the root of this false “crisis.”
- One would think that the debunking/falsification of the GHE would be considered a good thing.
- It would mean that the madness of dismantling the energy economy of the western world could stop and we could get back to business.
- The EPA Endangerment Finding on CO2 would be shown to be invalid.
- The benefits of abundant energy could be spread to less developed populations throughout the world.
- More CO2 would continue to “green” the planet. ***There can be NO GREEN WITHOUT CO2!***
- If only it were that simple…

Impacts/Potential Roadblocks

- To the dismay of many, the need for the IPCC and climate related NGOs would no longer exist.
- Those who are making billions from government subsidized solar, wind, “carbon capture”, batteries and EVs would see their gravy trains dry up.
- Many “climate scientists” would have to transition to another field if there is no “crisis.”
- At an individual level, it will be difficult for many to cope. Human nature tends to prefer comfortable ignorance to cognitive dissonance.
- Discovering that the narrative pushed over almost three generations is false will be more than some can bear.
- And what of trust in the scientific community? One could argue that it no longer deserves trust. Richard Lindzen called this “…the greatest mass delusion in human history…”
- ***This may be the greatest scientific debacle in history driven by those five reasons enumerated by Dr. Happer.***

What Next?

- ***If the Earth could speak, it would say, "You don't need to save me. I've got this!"***
- There is no faster way to end this madness than by disemboweling the GHE with data.
- The blueprint for that is in this essay.
- The GHE is a false concept, a 125-year-old conjecture based on incorrect assumptions that have not died.
- The question is, will there be anyone in the scientific community with sufficient influence as well as the humility and courage to admit how wrong this has all been? We shall see.

It's easier to fool people than to convince them they have been fooled.

(Often attributed to Mark Twain, though unverified.)