The “Greenhouse Effect” Hypothesis’ Sleight of Hand

By Carl Brehmer, March 2016

ABSTRACT

In any meaningful thermodynamic discussion it is necessary at the outset to clearly define the parameters of the “system” under study. One of those parameters is whether or not the system is “closed”.

The typical explanation of the “greenhouse effect” hypothesis pulls a sleight of hand in this regard in that it starts out describing the thermodynamics of one “system” with an emphasis on the first law of TD, but then switches twice midstream to different “systems” altogether and asserts that the thermodynamics of the second and third systems mirror the thermodynamics of the first system.

If you are already confused you are not alone. The “greenhouse effect” hypothesis is itself very confused. Let's explore.

First system

The first system is the Earth/atmosphere ensemble, whose “boundary” is space and whose two thermal energy sources are 1) incoming sunlight and 2) internal nuclear decay.

This is, indeed, a “closed” system in that for all practical purposes there is no movement of matter into or out of the system that would carry thermal energy with it into or out of the system. (For the sake of this discussion we will neglect the energy added to the system by meteors and lost from the system by the outer atmosphere as it continually loses molecules blown out into space by the solar wind.)

In this system the thermal energy that crosses the “boundary” between the system and its surroundings is 100% electromagnetic. There is absorbed sunlight (insolation - albedo) in and long-waver IR radiation out.

According to the first law of thermodynamics for this entire Earth/atmosphere ensemble system to be in thermal equilibrium the total energy contained within the sunlight absorbed must equal the total energy contained within the outgoing long-wave radiation.

The “greenhouse effect” hypothesis asserts that an increase in the concentration of “greenhouse gases” inhibits the ability of the entire Earth/atmosphere ensemble “system” to emit long-wave IR radiation out into space. In the language of radiation thermodynamics, "greenhouse gases": make the entire Earth/atmosphere ensemble “system” less “emissive”.

This, in turn, forces the entire Earth/atmosphere ensemble system to retain enough thermal energy to raise its collective temperature high enough to again emit the requisite amount of long-wave IR radiation out into space to equal the absorbed incoming sunlight. (I am not saying that I agree that "greenhouse gases" make the Earth/atmosphere ensemble less emissive, rather I am simply attempting to state the claim of the "greenhouse effect" hypothesis.)

Note: This over-arching, big picture definition of the "greenhouse effect" hypothesis is not concerned with the distribution of thermal energy within the entire Earth/atmosphere ensemble system, only that the total amount of outgoing long-wave radiation equals the total amount of absorbed sunlight per the First Law of Thermodynamics. Now comes the sleight of hand.

Second system

The "greenhouse effect" hypothesis then switches mid-stream to a completely different thermodynamic system—a one-meter thick layer of air about 1.5 meters off of the ground. This is where weather stations are sited, whose temperatures are averaged along with sea surface temperatures to create the "global mean temperature".

This "global mean temperature" ignores the temperature of the entire solid Earth, the temperature of 99.98% of the oceans (the amount of ocean not contained within the thin layer of water whose temperature is being called the sea surface temperature) and the temperature of 99.9998% of the atmosphere (the amount of atmosphere not contained within the one meter thick layer of air whose temperature is being monitored.)

Thus, the "greenhouse effect" hypothesis assumes that the entire Earth/atmosphere ensemble system is retaining excess thermal energy based on the temperature of hottest 0.02% of the ocean combined with the hottest 0.0002% of the atmosphere.

Were they to base their calculations on the average temperature of the entire troposphere, which contains 85% of the atmosphere's mass, no retention of thermal energy would be suspected since the average temperature of the entire troposphere is well below zero °C.

What are the characteristics of this second thermodynamic system? Let's just look at the land based portion of this "second system". Its "boundaries" are imaginary dividing lines below and above a one-meter thick layer of air about 1.5 meters off of the ground.

1) Convection: This second system is completely "open" in that air is continually moving into and out of the system carrying thermal energy into and thermal energy out of the system.

2) Conduction: Because of the high R-factor of air very little thermal energy is moving into and out of the system via conduction (quite frankly the air within that limited layer does not stay in it long enough for significant conduction to occur.)

3) Radiation: Only a small amount of thermal energy enters this second system via IR radiation since most of the "net radiation heat loss" from the ground up-ward via up-going long-wave radiation passes straight through this system because of its "transmissivity".

4) Latent heat: There isn't any liquid water in this system (except when there is fog) so little or no thermal energy is lost due to evaporation, but this system does gain thermal energy at night when some of the water vapor present in this layer condenses into dew.

Let me elaborate on #3, the Radiation portion of this second system's thermodynamics. In a study that I did using surface radiation readings at a SURFRAD site in Desert Rock Nevada in the summer 2012, on cloudless days the up-going "net radiation heat loss rate" from the ground was 119 W/m^2.

Up-going long-wave radiation - down-going long-wave radiation:

418 W/m^2 - 299 W/m^2 = 119 W/m^2

Since the calculated "transmissivity" of the air in this very arid climate was 0.26, 109 W/m^2 passed straight through the system in question (the one-meter thick layer of air about 1.5 meters off the ground) without thermally interacting with the system.

Total up-going IR radiation x transmissivity

418 W/m^2 x 0.26 = 109 W/m^2

Thus, the amount of "heat" that was being transferred from the ground into this second system on the hottest, cloud free days within this desert climate was only 10 W/m^2.

Up-going radiation heat loss rate – amount of radiation exiting through the "atmospheric window"

119 W/m^2 - 109 W/m^2 = 10 W/m^2

While 109 W/m^2 of up-going IR radiation was passing straight through this ground level layer of air leaving only 10 W/m^2 of "heat" to be absorbed this same ground level air was emitting 299 W/m^2. Since the air above this "second system" also had a transmissivity of at least 0.26 we can calculate that the up-going "radiation heat loss rate" from this "second system". It was 77.4 W/m^2.

Total up-going IR radiation from the "second system" x transmissivity

299 W/m^2 x 0.26 = 77.4 W/m^2

As you can see, from these simple calculations drawn from standard radiation thermodynamic using surface radiation readings being gathered by NOAA, this second system (whose temperatures are being averaged to create the "global mean temperature") loses over 7 times as much "heat" via IR radiation upwards as it gains via IR radiation from the ground! 10 W/m^2 of "heat" is transferred via IR radiation into this "second system" through the lower boundary of the system, while 77.4 W/ m^2 of "heat" is simultaneously being lost via IR radiation through the upper boundary of the system.

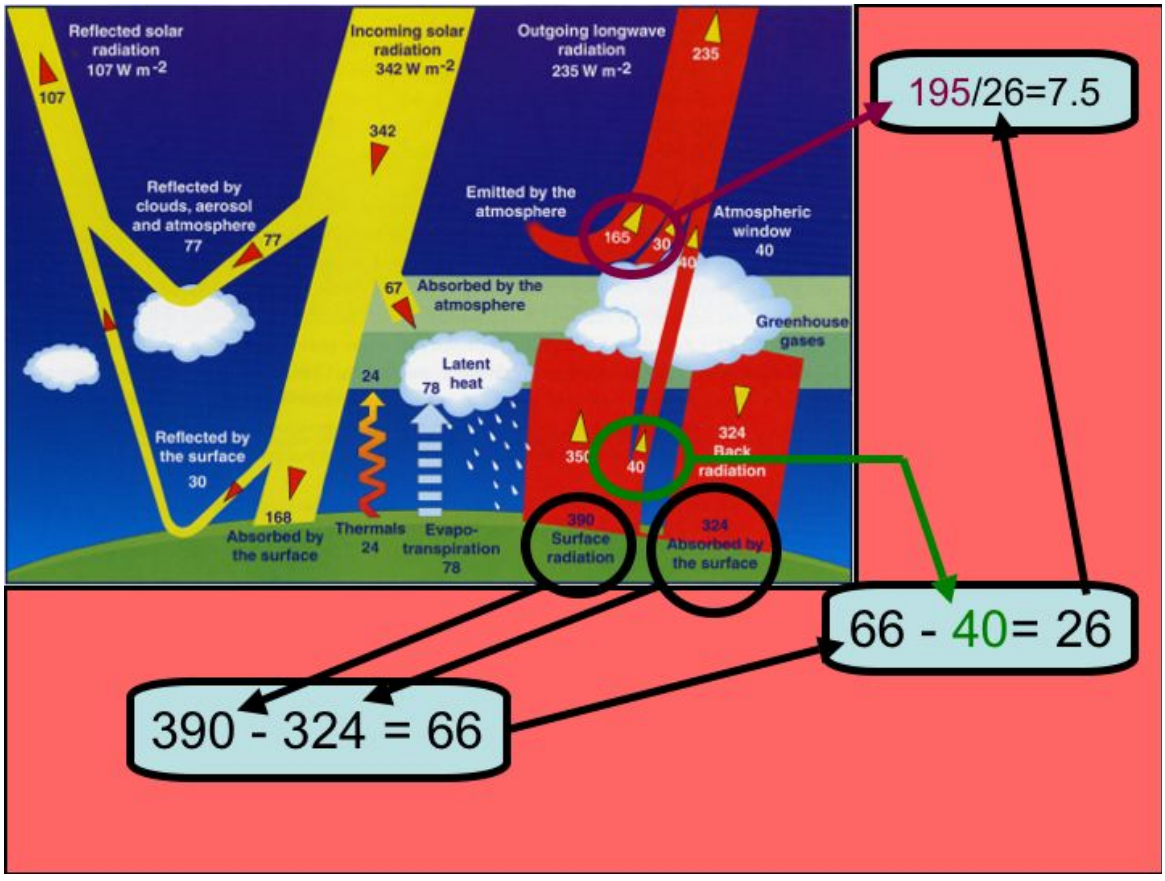
Contrary to this physical reality, the “greenhouse effect” hypothesis asserts that IR radiation is somehow causing "heat to be trapped” within the system under study, thus forcing its temperature to increase.

Out of curiosity I applied these same mathematical formulae to the very humid air in Mississippi during the same time period. The results are as follows:

1) Transmissivity of the air = 0.12
2) Net radiation heat loss rate from the ground = 53W/m^2
3) Amount of "heat" transferred from the ground to the air via IR radiation = 4.6W/m^2
4) Amount of "heat" transferred upwards from the “second system” via IR radiation = 42W/m^2

As you can see, the increased humidity in Mississippi increased the ratio of radiative heat loss to radiative heat gain in this second system from ~1:7.7 and in Nevada to ~1:10. This is not inconsistent with radiation thermodynamics since increasing the emissivity of matter enhances its ability to cool via IR radiation and, indeed, water vapor increases the emissivity of air.

Before we move on do not think that these findings conflict with the Kiehl and Trenberth’s generally accepted Earth Energy Budget.



Applying the same mathematical formulae as above to the KT Earth Energy Budget we see that globally the ongoing average amount of “heat” (net radiation heat loss rate) that is being transferred from the ground to the atmosphere via IR radiation is only 26 W/m^2, while simultaneously the ongoing average amount of “heat” that is being transferred out into space by the atmosphere via IR radiation is 195 W/m^2.

This is a 1:7.5 ratio of atmospheric “heat” gain via IR radiation from the ground to atmospheric “heat” loss via IR radiation out into space. In other words, for every 1 W/m^2 of heat gained via IR radiation from the ground the atmosphere disgorges 7.5 W/m^2 via IR radiation out into space. From where does this extra energy come? From “thermals”, from “latent heat transfer” and from sunlight absorbed directly by the atmosphere on it’s way in.

The idea therefore that “greenhouse gases” are somehow causing the atmosphere to “trap heat” simply doesn’t jibe with the actual thermodynamics of the atmosphere. Stated directly, the “greenhouse effect” hypothesis is false. Thus the believers in the “greenhouse effect” hypothesis had to create a third imaginary system.

3) Third system

In the third system the entire atmosphere is replaced by a single thin pane of magic material that is 100% transparent to down-going sunlight while simultaneously being 100% opaque to up-going longwave radiation. In other words at some wavelength the pane of material magically changes from being a "white" body to being a "black" body.

Beyond that, this pane of magic material is, unlike the atmosphere, separated from the ground by a layer of vacuum thus making the thermodynamic relationship between the ground and the atmosphere 100% electromagnetic. Gone are convection, i.e., the movement of thermal energy into and out of the system via mass transfer, conduction and latent heat transfer.

The majority of the mathematical formulas being taught within institutions of "higher learning" that presume to explain and quantify the “greenhouse effect” hypothesis apply to this third imaginary — non-existent — system and thus have no connection whatever to the real world thermodynamics of the atmosphere, which is what science is suppose to study.

Scientific Realities Do Not Require Analogies

Within the realm of rhetoric (*"the art of effective or persuasive speaking or writing"*) the "analogy" is used to convey an abstract idea using a concrete or tangible reality.

For example one might say, "You are as annoying as nails on a chalkboard." Being annoyed is an intangible, emotional feeling whereas "nails on a chalkboard" actually generate a physical sound that is very unpleasant to listen to.

Scientific truths are tangible realities and as such are in no need of an analogy to be understood. They are simply observed and/or experienced. Charles Law, for example, is a scientific truth. If you keep the pressure of a gas the same the temperature of the gas will be directly proportional to its volume—as the temperature increases so does its volume.

One does not need to use an analogy to understand Charles Law; one simply states what is observed in the real world. Ergo, if the "greenhouse effect" were a tangible—a scientific —reality it wouldn't need to be explained vis-à-vis an analogy. One could simply observe and describe its operation in the real world.

Even the name "greenhouse effect" is itself an analogy used to give an intangible thought or idea the appearance of being a scientific reality. The intangible idea, *"the presence of carbon dioxide in the air causes the air to be warmer than it would be without it,"* not only has never been observed in the real world [1], historical observations that compare CO_2 levels and temperatures contradict the belief. In order, therefore, to make the "greenhouse effect" appear to be real they attach an analogy to it drawn from the tangible world.

Carbon dioxide makes the atmosphere behave like . . .

a greenhouse
insulation
a jacket
a heat trap
a heater
etc.

Scientific truths have a singular name, a singular definition and are quantified by a singular mathematical formula. All three of these singularities are absent when it comes to the "greenhouse effect" hypothesis.

References

[1] Ångström, Knut, 1900, "Ueber die Bedeutung des Wasserdampfes und der Kohlensäure bei der Absorption der Erdatmosphäre", which describes an experiment by one of Svante Arrhenius' contemporaries who falsified Arrhenius's hypothesis that an increase in atmospheric carbon dioxide would cause global warming.
Available in English: https://ozonedepletiontheory.info/Papers/Angstrom1900-English.pdf