The Model Atmospheric Greenhouse Effect

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Abstract:

We develop and describe the standard model of the atmospheric radiative greenhouse effect. This is a model whose boundary conditions are widely accepted in creating the paradigm, and setting the starting point, for increasing model complexity, and is almost universally utilized amongst various research and educational institutions. It will be shown that the boundary conditions of the standard radiative atmospheric greenhouse are unjustified, unphysical, and fictional, and it will also be demonstrated that physically real boundary conditions cannot even truly be described by such a model. A new starting-point model is introduced with physically accurate boundary conditions, and this will be understood to physically negate the requirement for a postulation of a radiative atmospheric greenhouse effect.

The Standard Model

Earth's Radiative Equilibrium

The standard, and generally only known approach, for determining Earth's radiative equilibrium with the Sun, begins with the application of the principle of conservation of energy via several applications of the Stefan-Boltzmann law. The total solar energy *absorbed* by the Earth must be equal to the energy *emitted* by the Earth, over the long-term average assuming radiative thermal equilibrium, and assuming there are no significant terrestrial sources of energy. Additional output energy from geothermal sources and the addition of energy into the atmosphere via Coriolis forces due to the rotation of the Earth are assumed to be small compared to the solar energy.

Beginning with the basic Stefan-Boltzmann equation, we have that the surface brightness (*s*) of an object radiating like a blackbody is proportional to the object's absolute temperature to the fourth power, as shown here:

$$s = \sigma T^4 \quad (W/m^2) \tag{1}$$

The proportionality factor 'σ' is called the 'Stefan-Boltzmann constant', and has a value of $5.67\text{x}10^{-8}$ ($W/m^2/K^4$).

In order to calculate the total power output, or luminosity, of the Sun, we multiply the solar surface brightness by the solar surface area:

$$\begin{aligned} L_\odot &= s \cdot A_{surf_\odot} \\ &= \sigma T_\odot^4 4\pi R_\odot^2 \quad (W) \end{aligned} \tag{2}$$

To determine the energy flux density of this power at the distance of the Earth, we map the spherical surface area of the Sun onto the surface area of a sphere with a radius equal to one astronomical unit:

$$\begin{aligned} F_\odot &= \frac{L_\odot}{4\pi d_\oplus^2} \\ &= \frac{\sigma T_\odot^4 \cancel{4}\cancel{\pi} R_\odot^2}{\cancel{4}\cancel{\pi} d_\oplus^2} \\ &= \sigma T_\odot^4 \frac{R_\odot^2}{d_\oplus^2} \quad (W/m^2) \end{aligned} \tag{3}$$

This is the energy flux density of solar power at the distance of the Earth, and has a value of about $F_{\odot} = 1370 \quad W/m^2$ (using the parameters listed in equation {9}), which is a temperature equivalent of 394K or 121^{0}C.

To calculate the total power intercepted by the Earth, we multiply the above equation by Earth's cross-sectional area:

$$\begin{aligned} L_{\odot_{\text{int.}}} &= F_{\odot} \cdot \pi R_{\oplus}^2 \\ &= \sigma T_{\odot}^4 \frac{R_{\odot}^2}{d_{\oplus}^2} \pi R_{\oplus}^2 \quad (W) \end{aligned} \tag{4}$$

Because some energy is reflected straight away due to Earth's albedo $(\alpha_{\oplus})$, and is never absorbed into the system, we have:

$$\begin{aligned} L_{\odot_{abs.}} &= L_{\odot_{\text{int.}}} \cdot (1-\alpha_{\oplus}) \\ &= F_{\odot} \cdot \pi R_{\oplus}^2 \cdot (1-\alpha_{\oplus}) \\ &= \sigma T_{\odot}^4 \frac{R_{\odot}^2}{d_{\oplus}^2} \pi R_{\oplus}^2 (1-\alpha_{\oplus}) \quad (W) \end{aligned} \tag{5}$$

and this is the total solar power absorbed into the surfaces and atmosphere of the Earth.

If we assume that the Earth is in long-term radiative thermal equilibrium with the solar radiative flux, we may equate the total power absorbed by the Earth from equation {5} to the total power it must emit. Applying the Stefan-Boltzmann law to the surface of the Earth, we thus have:

$$L_{\oplus_{emit.}} = \sigma T_{\oplus}^4 \cdot 4\pi R_{\oplus}^2 \quad (W) \tag{6}$$

and equating to equation {5}:

$$L_{\oplus_{emit.}} = L_{\odot_{abs.}}$$

$$\sigma T_{\oplus}^4 4\pi R_{\oplus}^2 = \sigma T_{\odot}^4 \frac{R_{\odot}^2}{d_{\oplus}^2} \pi R_{\oplus}^2 (1-\alpha_{\oplus})$$

$$T_{\oplus}^4 = \frac{\cancel{\sigma} T_{\odot}^4 \frac{R_{\odot}^2}{d_{\oplus}^2} \cancel{\pi} \cancel{R_{\oplus}^2} (1-\alpha_{\oplus})}{\cancel{\sigma} 4 \cancel{\pi} \cancel{R_{\oplus}^2}}$$

$$T_{\oplus} = T_{\odot} \sqrt[4]{\frac{R_{\odot}^2}{d_{\oplus}^2} \frac{(1-\alpha_{\oplus})}{4}} \tag{7}$$

In terms of surface flux, by substitution of equation {3} the derivation of equation {7} can alternatively be concluded as:

$$\sigma T_{\oplus}^{4} = F_{\odot}\left(1-\alpha_{\oplus}\right)/4 \qquad or \qquad T_{\oplus} = \sqrt[4]{\frac{F_{\odot}\left(1-\alpha_{\oplus}\right)}{4\sigma}} \tag{8}$$

Equations {7} or {8} present the standard solution for determining Earth's effective radiative equilibrium with the Sun.

Given the parameters values shown here:

$$\begin{aligned} T_{\odot} &= 5778 \quad (K) \\ R_{\odot} &= 6.96x10^{8} \quad (m) \\ d_{\oplus} &= 1.496x10^{11} \quad (m) \\ \alpha_{\oplus} &= 0.3 \end{aligned} \tag{9}$$

the radiative equilibrium temperature is calculated to be:

$$T_{\oplus} = 255K = -18^{o}C \tag{10}$$

which is said to be equivalent to the average solar input heating upon the surface of the Earth. This is more accurately known as the *effective* Blackbody temperature of the Earth.

The Standard Atmospheric Greenhouse Model

Let us further develop the standard model atmosphere which demonstrates the radiative atmospheric greenhouse effect. For this task, we utilize an ubiquitous model which is found and used across a very wide range of institutions and disciplines. This link:
http://www.tech-know.eu/uploads/CONSENSUS_SCIENCE.pdf
contains somewhere around *sixty* references to various scientific institutions, universities, and government facilities which demonstrate adherence to the standard model radiative greenhouse effect. Many of these references have web-links to diagrams which can be seen to agree with the diagram which will be presented below, but the links which are only descriptive are also descriptive of the same standard model. The standard model is shown below in Figure 1; it is a model which is well-adapted to introductory physics demonstrations in high-school & undergraduate university classrooms.

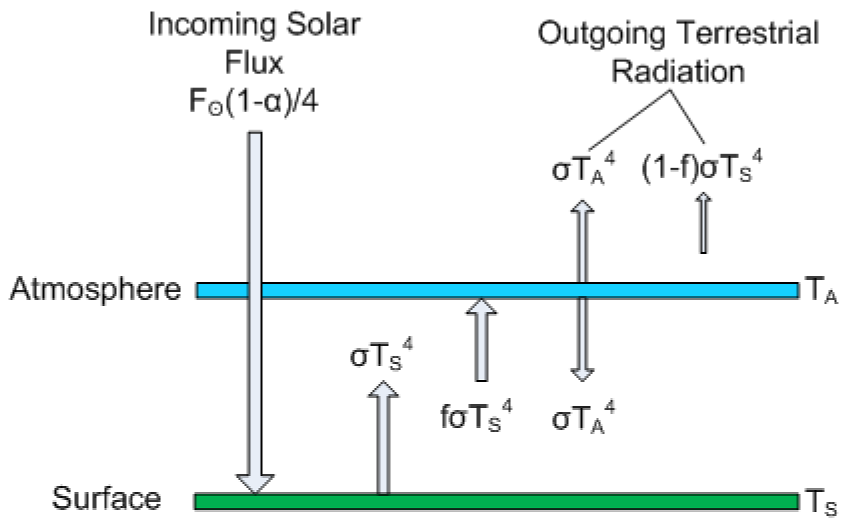


Figure 1: A simple standard atmospheric model demonstrating back-radiation and the greenhouse effect.

We can develop an understanding of the atmospheric radiative greenhouse effect by "reading" the diagram in Figure 1 from left, to right. The surface of the Earth (ground and oceans) is the lower surface and has an average temperature of "T_S", while the atmosphere is approximated by the upper surface and has a cooler temperature of "T_A". The average incoming solar flux which gets absorbed at the surface of the Earth is $F_{\odot}\left(1-\alpha\right)/4$, which includes the reflective losses due to albedo. The ground emits radiative energy equal to σT_S^4 as according with the Stefan-Boltzmann Law. Some fraction "*f*" of the energy emitted by the ground surface is absorbed in the atmosphere by greenhouse gases, and is specified by $f\sigma T_S^4$. Because the atmosphere also has an average temperature, it emits a radiative flux equal to σT_A^4, and it emits this radiation both upwards and downwards. Finally, the total outward radiation emitted by the surface and atmosphere is equal to the sum of those components, with the ground radiation reduced by the fraction absorbed into the atmosphere, or $\sigma T_A^4+\left(1-f\right)\sigma T_S^4$.

This model is described mathematically by satisfying the principle of conservation of energy, and so the incoming solar energy must be equal to the total energy emitted outward from the Earth. This results in the equation:

$$\frac{F_{\odot}\left(1-\alpha_{\oplus}\right)}{4}=\left(1-f\right)\sigma T_S^4+\sigma T_A^4 \qquad \{11\}$$

We can also apply conservation of energy to the atmospheric layer:

$$f\sigma T_S^4 = 2\sigma T_A^4 \tag{12}$$

We can substitute equation {12} into equation {11} to simplify the parameter space:

$$\frac{F_{\odot}\left(1-\alpha_{\oplus}\right)}{4} = \left(1-f\right)\sigma T_S^4 + \frac{f}{2}\sigma T_S^4 = \left(1-\frac{f}{2}\right)\sigma T_S^4 \tag{13}$$

which leads to a solution for the ground temperature of:

$$T_S = \sqrt[4]{\frac{F_{\odot}\left(1-\alpha_{\oplus}\right)}{4\sigma\left(1-f/2\right)}} \tag{14}$$

Because we already know what the average ground temperature is from measurement, and we also know the average albedo and solar input, we can solve for the fraction "*f*", which is the fraction of ground-radiated energy which the atmosphere absorbs:

$$f = 2\left[1-\frac{F_{\odot}\left(1-\alpha_{\oplus}\right)}{4\sigma T_S^4}\right] \tag{15}$$

or equivalently,

$$f = 2\left[1-\frac{T_{\oplus}^4}{T_S^4}\right] \tag{16}$$

Given that the average ground temperature is $+15^0$C or 288K, and using the parameter values from either equation {9} or {10}, it is calculated that the atmosphere absorbs 77% (*f = 0.77*) of the radiation emitted from the ground. This explains why the temperature of the surface is higher than the input solar heating, and explains the atmospheric radiative greenhouse effect. If it weren't for the radiation being absorbed into the atmosphere by greenhouse gases and slowing the rate of cooling of the ground, represented by $f\sigma T_A^4$, the ground would be much colder than it actually is. Thus, it can be seen that if greenhouse gases were to increase, resulting in an increase of the factor "*f*", then the ground temperature will become even warmer. Finally, applying '*f*' to equation {12} results in an atmospheric layer temperature of $T_A = \left(\sqrt[4]{f/2}\right)T_G = 227K = -46^0C$, which is very close to the temperature found at the top of the troposphere.

Faults of the Standard Atmospheric Greenhouse Model

Fictions in the Boundary Conditions

There exists a contradiction in the interpretation between equations {7} & {14}. Equation {7} is usually meant to infer that the radiative equilibrium temperature *should be* established at the ground, while equation {14} infers that the ground must actually be warmer than the radiative equilibrium of equation {7}. We resolve this contradiction by noting that the radiative equilibrium of equation {7} is merely the *system* equilibrium. The result of equation {7} (and equation {10}) does not identify where such a temperature can actually be found; it merely states that the *effective radiative system temperature* should be as such. *We identify the system as being the: surfaces of the ground & oceans + the atmosphere*. We hold that the effective radiative equilibrium output of equation {7} can only be identified with the *aggregate* ground & ocean + atmosphere system, which we call a thermodynamic ensemble. These, being the ones capable of radiative output towards space. Further, because this *ensemble* is bounded at the bottom and top by the Earth's surface and the top of the atmosphere, it becomes a forgone logical conclusion that the numerical *average of the system* should be physically found in between these two boundaries, which is therefore within the atmosphere at some altitude above the surface.

The physical proof of the above principle can be demonstrated as follows. The total energy the planet Earth intercepts is

$$\begin{aligned} E &= 1370\ W/m^2\ *\ \pi R_\oplus^2 \\ &= 1370\ W/m^2\ *\ \pi(6371000m)^2 \\ &= 1.747x10^{17}W \end{aligned} \tag{17}$$

and the total amount absorbed is

$$\begin{aligned} E_0 &= E*(1-\alpha) \\ &= E*(1-0.3) \\ &= 1.223x10^{17}W \end{aligned} \tag{18}$$

If the +15C surface-air temperature average was actually characteristic of the aggregate system, then it should be in agreement this value. However,

$$\sigma(273+15)^4*4\pi R_\oplus^2 = 1.99x10^{17}W \tag{19}$$

which is more energy than is even intercepted *before* albedo losses. Therefore, it is physically impossible that the +15^{0}C surface-air temperature could be characteristic of the entire thermodynamic radiative ensemble. This concept is analogous to that found in, say, the Sun's photosphere, where even though the bottom of the photosphere is around 9000K, the *effective* radiative system temperature of the photospheric ensemble is actually much less, at around 5778K. The fundamental reason why the +15^{0}C surface-air temperature can't be characteristic of the system, and neither 9000K in the solar photosphere, is simply because gases don't follow the Stefan-Boltzmann Law in terms of radiative output. If you have an ensemble of gases the most you can assign is an *effective* radiative equivalent of the entire ensemble, to that of a solid blackbody surface.

If we wished to equate the total absorbed energy of E_0 = 1.223x10^{17} W from equation {18} to an effective radiating temperature for the Earth (including atmosphere) aggregate spherical ensemble, we can use equation {2} as applied to the Earth:

$$L_\oplus = E_0 = \sigma T_\oplus^4 4\pi R_\oplus^2$$

$$T_\oplus = \sqrt[4]{\frac{E_0}{\sigma \pi R_\oplus^2}} \quad (K) \qquad \{20\}$$

It is by this method (with $L_\oplus$ = E_0 = 1.223x10^{17} W) where the effective Blackbody radiative temperature of -18^{0}C for the spherical ensemble actually originates. However, this has nothing to do with any *actual* temperature you might expect to find at any particular locality within the ensemble – it is only an *effective-average radiative* temperature, not an actual kinetically-average temperature, nor an isotropic temperature which the entire ensemble should be expected to emulate. That is, given the definition of an average and the physically real boundary conditions that exist, it should be expected to find both higher and lower temperatures than the average, and these temperatures can certainly be both spatially and temporally distributed, given any boundary conditions and any other requirements imposed via any other laws of physics or constraints of reality, as we will see below.

Continuing, we categorically assert that the result of equation {7} (and {20}) cannot be interpreted so as to be physically equivalent in temperature to the actual average solar heating input. What the Stefan-Boltzmann analysis states is, specifically, the instantaneous average effective spherical radiative *output* of the *system*, with the system-ensemble as defined above. It does not state *anything* further than this. There exists no logical or physical justification for reversing the interpretation of the result of equation {7}, and arbitrarily equating the effective instantaneous spherical *output* radiative flux with the instantaneous average radiative heating *input* over the same system geometry. The obvious physical justification for this reality is that, in actuality, only half of the Earth's surface physically accumulates radiative heating energy from the Sun in any moment. This is the *actual* and physically real average boundary condition that exists. The true, and physically accurate average of the system, is that half of the surface of the Earth absorbs twice as much energy as the entire surface of the Earth radiates. The incoming solar radiation is *not equal*, in energy flux density, and thus temperature, to the outgoing terrestrial radiation. Claiming otherwise forgets the reason for the difference in illumination between day and night, and is completely irrational within the frame of physics. Dividing the solar flux by a factor of four and thus spreading it instantaneously over the entire surface of the Earth as an input flux amounts to the denial of the existence of day-time and night-time, and violates the application on the Stefan-Boltzmann Law which deals only with instantaneous radiative flux.

If we wish to determine the physically instantaneous solar *input* energy density (Wattage per square meter) and corresponding heating temperature, via the Stefan-Boltzmann equation, we must use the correct actually-physical geometry. Thus, with a day-light hemisphere of half the surface area of an entire sphere, we must write the *hemispherical* equilibrium equation as:

$$L_{\oplus_{emit.}} = L_{\odot_{abs.}}$$

$$\sigma T_{\oplus}^4 \cdot 2\pi R_{\oplus}^2 = \sigma T_{\odot}^4 \cdot \frac{R_{\odot}^2}{d_{\oplus}^2} \pi R_{\oplus}^2 \left(1-\alpha_{\oplus}\right)$$

$$T_{\oplus}^4 = \frac{\cancel{\sigma} T_{\odot}^4 \frac{R_{\odot}^2}{d_{\oplus}^2} \cancel{\pi} \cancel{R_{\oplus}^2} \left(1-\alpha_{\oplus}\right)}{2\cancel{\pi} \cancel{R_{\oplus}^2} \cancel{\sigma}}$$

$$T_{\oplus} = T_{\odot} \sqrt[4]{\frac{R_{\odot}^2}{d_{\oplus}^2} \frac{\left(1-\alpha_{\oplus}\right)}{2}} \qquad \{21\}$$

for which we calculate a hemispherical surface heating input of

$$T_{\oplus} = 303K = +30^{o}C \qquad \{22\}$$

Following the logic developed previously, we understand that if the hemisphere were to achieve this temperature, it would strictly be an average temperature of the entire radiative thermodynamic ensemble, and so would necessarily be found kinetically at altitude. As the troposphere is generally warmer at the bottom than it is at the top, then we should expect a warmer ground-air temperature than this. However, the sun-lit hemisphere does not actually achieve this average temperature *even* at the surface, and must actually be much cooler. (There does not seem to be any readily-available data on separate day-time and night-time average temperatures for the Earth, which is very curious, while there is a wealth of data on *daily* average temperatures. The day-time and night-time averages are extremely important and would go far in helping to determine the heat-retention capacity and properties of the atmosphere.) We know that the sun-lit hemisphere ensemble cannot achieve +30^{0}C, because if it did, we would obviously have:

$$\sigma(273+30)^4 \cdot 2\pi R_\oplus^2 = 1.223x10^{17}\ W = E_0 \qquad \{23\}$$

which is equal to the total energy absorbed from equation {18}, and would mean that the night-side of the Earth would have no power left over to radiate and so should be at absolute zero.

Because both the night and day side of the Earth must radiate, they're necessarily at different temperatures, and they must share in the output of the expected *total* energy absorbed, we can write a mathematical formula to describe this:

$$\begin{aligned} L_{\oplus_{emit.}} &= L_{\odot_{abs.}} \\ (T_{\oplus_d}^4 + T_{\oplus_n}^4)\cdot\sigma 2\pi R_\oplus^2 &= 1.223x10^{17}\ W \\ T_{\oplus_d}^4 + T_{\oplus_n}^4 &= \frac{1.223x10^{17}}{\sigma 2\pi R_\oplus^2} \end{aligned} \qquad \{24\}$$

where the subscripts '*d*' and '*n*' denote "day" and "night" hemispheres. We can refine the equation by realizing that $T_{\oplus_d}^4$ & $T_{\oplus_n}^4$ denote only the effective radiative temperature of the ensemble, and that kinetically, this specific temperature is not expected to be found at the ground, but at altitude. Thus, neglecting the '$\oplus$' subscripts as it is implicitly understood we are referring to only terrestrial quantities:

$$\left(T_{d.g.} - \delta_d\right)^4 + \left(T_{n.g.} - \delta_n\right)^4 = \frac{1.223x10^{17}}{\sigma 2\pi R_\oplus^2} \qquad \{25\}$$

where the subscript '*g*' refers to the ground-air temperatures at, say, sea-level, and '$\delta_{d,n}$' denote the difference between the kinetic ground-air temperature and the ensemble radiative temperature on either hemisphere. That is:

$$\begin{aligned} T_{\oplus_d} &= \left(T_{d.g.} - \delta_d\right) \\ T_{\oplus_n} &= \left(T_{n.g.} - \delta_n\right) \end{aligned} \qquad \{26\}$$

If the two terms on the left of equation {26} were equal (or averaged), this would result in the same solution as we have seen, of -18^{0}C or 255K, via equation {24}, and with $\langle \delta \rangle = 33^0 C$ since $\langle T_g \rangle = 15^0 C.$ But obviously, day and night average temperatures are different, and we must still provide a physical explanation or description for the difference between the effective radiative ensemble temperature and the kinetic surface-air temperature.

We further establish that the maximum solar heating input is found underneath the solar zenith, where the local surface area can be approximated as a disk. Once again, in determining the physically instantaneous solar heating *input*, we must use the correct actually-physical geometry. Thus, with a disk-like geometric projection factor of unity, the solar zenith equilibrium situation is described as:

$$L_{\oplus_{emit.}} = L_{\odot_{abs.}}$$

$$\sigma T_\oplus^4 \cdot 1\pi R_\oplus^2 = \sigma T_\odot^4 \cdot \frac{R_\odot^2}{d_\oplus^2} \pi R_\oplus^2 \left(1-\alpha_\oplus\right)$$

$$T_\oplus^4 = \frac{\cancel{\sigma} T_\odot^4 \frac{R_\odot^2}{d_\oplus^2} \cancel{\pi} \cancel{R_\oplus^2} \left(1-\alpha_\oplus\right)}{1 \cancel{\pi} \cancel{R_\oplus^2} \cancel{\sigma}}$$

$$T_\oplus = T_\odot \sqrt[4]{\frac{R_\odot^2}{d_\oplus^2} \frac{\left(1-\alpha_\oplus\right)}{1}} \qquad \{27\}$$

for which we calculate a temperature equivalent input of

$$T_\oplus = 360.5K = +87.5^o C \qquad \{28\}$$

We hold that the average solar radiative input heating is only over one hemisphere of the Earth, has a temperature equivalent value of +30^{0}C, with a zenith maximum of +87.5^{0}C, and that this is not in any physically justifiable manner equivalent to an instantaneous average global heating input of -18^{0}C. What is equal, or conserved, is the *total energy* absorbed relative to that emitted; what *is not and does not* need to be conserved is the energy flux density and associated temperature between input and output.

Given that the average physical solar input on the day-lit hemisphere is equivalent to +30^{0}C, with a maximum input of +87.5^{0}C, and the day-lit hemisphere does not actually achieve this temperature, but we know it *must* absorb that equivalent amount energy, we must ask: to where does the energy go if it does not show up immediately in the kinetic temperature? Generally, it must obviously be said that the energy goes into other "non-thermal" degrees of freedom within the system, and these would be both macro and micro phenomena, such as latent heat, evaporation, and convection in the macro case, and intramolecular degrees of freedom in the micro case. Both of these phenomena will release heat back into the environment as the internal energy is released while the relevant physical ensemble cools, under less or zero solar insolation, and so the dark-side of the Earth is able to radiate the rest of the absorbed energy away such as to achieve a relatively stable long-term balance. Thus, day-time and night-time average temperatures are highly modulated or "smoothed out" as compared to a non-atmosphere planetary body, as can be confirmed by comparison of the Earth to the Moon. The effect of additional degrees of freedom in the system is to slow the rate of heating in the day time and thus lower the day-time temperature, while heat loss at night will be slowed and follow the standard expectation dependent upon the thermal capacity of the system, minus the residual heat input from condensation and other sources, etc. The difference in daily temperature extremes in comparing a desert to a rain-forest are a good example of the effect of the strongest so-called greenhouse gas, water vapour. With CO2 having a lower thermal capacity than even than that of air, *and* an intra-molecular radiative heat-loss mechanism (as opposed to merely an inter-molecular radiative loss mechanism, as found in non-greenhouse gases), and no latent heat or condensation abilities, it might very well act to *increase* the efficiency of cooling in the atmosphere compared to if it were not present at all. Certainly the proxy records indicate that the planet tends to re-enter ice-ages after the atmospheric CO_2 content is driven upwards by previous interglacial temperature increase (CO_2 concentration is driven upwards by oceanic outgassing).

The standard greenhouse model can be shown to formally break down by applying it to another planetary body, and subsequently by inspection of its mathematical limits and boundary conditions. First, Venus is roughly the square-root-of-two times closer to the Sun than the Earth, and so it experiences about twice the Solar flux. Venus' albedo is $\alpha_{♀} = 0.7$, and its ground temperature is approximately 730K. Then by equation {15}:

$$f = 2\left[1 - \frac{(2*1370)*(1-0.7)}{4\sigma 730^4}\right] \tag{29}$$

$$f = 1.97 \text{ or } 197\%$$

which ostensibly implies that Venus' atmosphere absorbs more energy than the surface flux even produces; i.e. this is a basic violation of conservation of energy. Second, if the presumed effect of a thicker and thicker atmosphere with more and more GHG's (greenhouse gases) is to increase the strength of the GHE (greenhouse effect), and thus increase the surface temperature, then the limit of the GHG absorption factor '*f*' from equations {15} or {16} is an asymptote of 2. The ground temperature is actually seemingly independent of the Solar insolation, and, the linearly closer the '*f*' factor gets to 200%, the exponentially higher the surface temperature is; this is nonsensical. See Figure 2.

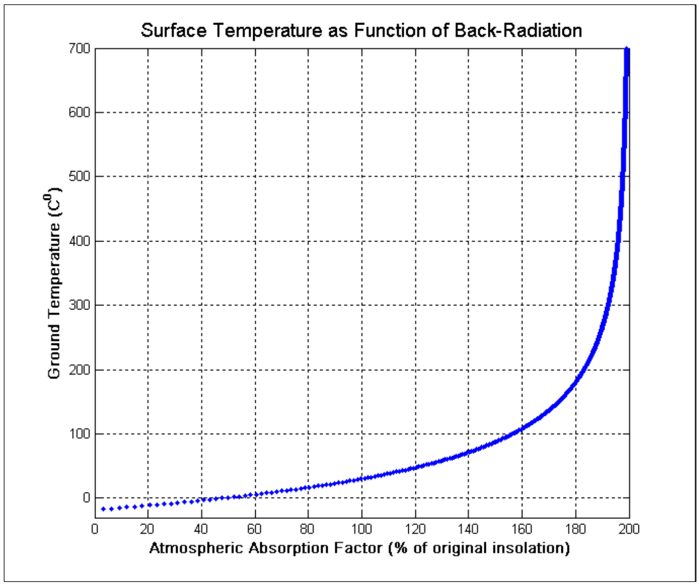
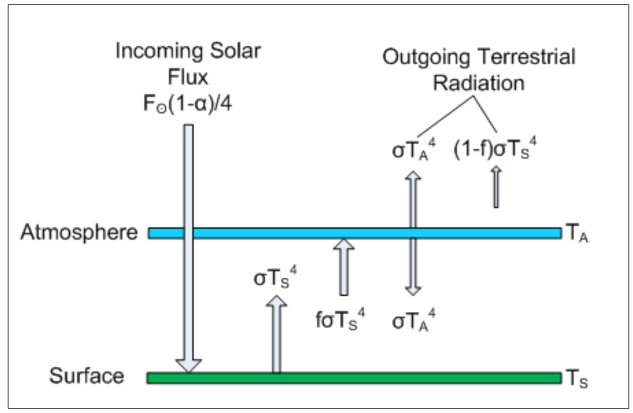


Figure 2: The equation for atmospheric absorption in the standard greenhouse model is nonsensical.

The standard model greenhouse seems to only coincidentally give a rational result for the case of the Earth; however, since it is not capable of representing a rational model in general, the case of the Earth must only be by happenstance. The philosophical paradigm occurring here is very similar to teaching students the Rayleigh-Jeans Law approximation of spectral radiance, while never continuing to mention that the R-J Law breaks down in general and is not a physically correct description. Why *leading* academic institutions would teach such a model to students does not seem to have ever been explained in the literature. One could ask *why* we in academia would do such a thing, when the model is so simply and obviously wrong? An even stronger paradigmatic inquiry can be made in that, given well over thirty-years of institutional academic dogma, instruction, and research into the GH Theory, there has not yet been developed a correct and simplified model based on readily accessible undergraduate physics and made widely available that actually does describe the GHE. The model which is presented, as we have presented here, is obviously incorrect with a minimum of analysis and application of logic, so we must ask: Why do we not have a *valid* simplified model of the GHE?

Perhaps we can correct the model by simply limiting the '*f*' factor to 1. If we do this, perhaps it is more similar to Venus as the surface of Venus likely doesn't emit any radiation directly to space at all, given its extremely thick & opaque atmosphere. All of the absorbed solar insolation is then re-emitted by the atmosphere, which would be a completely logical assertion. In that case, inspection of the conservation of energy equation {11} $\frac{F_{\odot}\left(1-\alpha_{\oplus}\right)}{4}=\left(1-f\right)\sigma T_S^4+\sigma T_A^4$ yields that the temperature of the atmosphere is entirely determined by the known quantities of the Solar input, which simply results in the Blackbody temperature, and leaves no way of actually determining what the ground temperature should be. If the argument is made that the Solar insolation *similarly* doesn't make it all the way down to the ground (the corollary of the previous logic), then one is *immediately* confronted with the problem of explaining the ground temperature, a-priori. In fact, this is where the worst and primary violation of logic occurs in the standard GH model: a ground temperature which is *higher* than the spherically-averaged Solar insolation is observed, but a then-invented scheme of radiative physics within the atmosphere, *dependent upon this already-higher temperature*, is used to justify the existence of this higher-than-solar-insolation ground temperature in the first place. In addition to being obviously tautologous, this paradigm *has* to be a violation of various laws of physics and thermodynamics, with no further qualification even necessary. That main-stream academia, at some of our most prestigious universities, are teaching this model without also teaching the violation of basic physics and logic here as a value-added educational exercise, speaks greatly to the problem of institutional dogmatic inertia.



The back-radiative GH model is boot-strapped into existence (i.e., pulling oneself out of quick-sand by pulling up on your own bootstraps...a basic violation of mechanics) via paradigmatic illogic, which must obviously be congruent and inherently systemic. The secondary conservation of energy equality within the model, from equation {12}, where $f\sigma T_S^4=2\sigma T_A^4$, is actually completely unjustifiable physically as the atmosphere *must* radiate its energy isotropically, and one cannot arbitrarily constrain it to just "up-and-down", and the factor of 2. Furthermore, if '*f*' was nearly or equal to 2, then this equation dictates that that atmospheric temperature be equal to the surface temperature, and then the entire right-side of equation {11} becomes equal to zero, which is plainly a violation of the primary boundary condition. The entire setup of these supposed physics formulas are inherently self-contradictory! All of this is in addition to, and indeed caused by, having already made the completely unphysical approximation that the Solar insolation impinges the entire surface area of the Earth-globe at once, with a heating strength equal to -18^{0}C, thus denying the existence of day and night, rather than its physically-actual insolation average of +30^{0}C and maximum of +87.5^{0}C (or much higher depending on local albedo).

Once this paradigmatic illogic is exposed it becomes all the easier to question various qualitative and quantitative aspects of the standard model GH. One of the first is the implicit, and as we have seen systemically tautologous conjecture, that "back-radiation" from GHG's increase the surface temperature of the Earth or slow its rate of cooling. If this behaviour (a source raising its own temperature by having its own radiation fall back upon it) is the result of a fundamental physics property of GHG's and atmospheres which contain them, then a higher concentration of GHG *and* a higher flux of radiation which interacts with it, should result in higher temperatures. Such a physically real scenario is found in the comparison of day-time desert and tropical conditions at similar latitude: the desert which is nearly devoid of the strongest GHG, water vapour, easily reaches 50^{0}C - 60^{0}C, whereas the tropical region saturated with water vapour only reaches into the 30's ^{0}C. This is in direct contradiction to an expected universal physics of a GHG back-radiation phenomenon. Additional insight may be found in comparison of a desert with an atmosphere to a desert without one at all, such as is found on the Moon. Clearly the role of any atmosphere at all, independent of GHG's, is that it modulates and smoothes-out the variation of Solar insolation-induced surface temperature, and when a GHG is present, does this even more efficiently due to the additional heat-transporting abilities within the gas. A universal physics-based back-radiation GHE postulate seems to be crowded out against real-world atmospheric behaviour, and this can be experimentally proven one way or the other, as we will see later.

An example of a quantitative logical test of the standard GH postulate comes with analysis of the expected temperature distribution of a compressible gas in a gravitational field. The internal energy of a parcel of gas in a column of air is easily expressed as a sum of its thermal and gravitational potential energies, as shown here:

$$U = C_p T + gh \qquad \{30\}$$

where 'U' is the internal energy, 'C_p' the thermal capacity of the gas, 'T' its temperature, 'g' the gravitational field strength and 'h' the height of the parcel above the ground surface. Differentiation of this equation results in:

$$dU = 0 = C_p \cdot dT + g \cdot dh \qquad \{31\}$$

so that

$$\frac{dT}{dh} = -\frac{g}{C_p} \qquad \{32\}$$

This basic equation of fundamental physics describes the distribution of energy and temperature of a compressible gas in a gravitational field. It is sometimes called the 'adiabatic lapse rate' because it matches, for dry-air, the same value as derived in meteorology for an adiabatic rising or falling parcel of air in the atmosphere. However, equation {32} is actually much more fundamental and would be true independent of any bulk-motions of gas in the air column. It describes what the distribution of temperature *has* to be, at least qualitatively, a-priori. We note that the sign of the equation indicates a decreasing temperature with altitude, as we would expect based on the physically logical grounds discussed previously. With g = 9.8m/s^2 and C_p = 1.0 J/g/K, the theoretical temperature distribution is approximately -10K/km. This value is obviously independent of any effect of GHG's as no consideration of those were made in the derivation. Now, it is expected that an increase in GHG's will increase the temperature of the bottom of the atmosphere, while decreasing that at the top, and because the atmosphere is essentially fixed in depth, this would require the 'lapse rate' distribution of temperature to be larger, as there would be a larger temperature differential over the same atmospheric height. However, this is obviously the effect the postulated back-radiation GHE must have in the first place with the existing, presumed already quite significant, effect from already-existing GHG's in the atmosphere, no matter what the thickness the atmosphere is. That is, the lapse rate should *already* be faster than -10K/km because there is (ostensibly) *already* a GHE in operation *in* the atmosphere. Yet this is clearly not the case, and the fastest lapse rate derived in meteorology is still that value as can be derived from equation {32}, independent of any pre-existing GHE. Additionally, if we examine the effect of the strongest GHG on the lapse rate, which is water vapour, we find that it acts to *reduce* the rate of temperature change, *not* increase it, which is again in direct opposition to the requirements of the GH postulate. The observed average lapse-rate of the atmosphere, called its environmental lapse rate, is actually far smaller in magnitude at -6.5K/km. Once again, there does not seem to be any *room* for the postulate of a back-radiation heating GHE because observations from the real world seem to disallow it.

In the end, all we can do with a solely radiative-averaging approach is state the broad physical requirements of a descriptive theory. That is, the surface + atmosphere represent a thermodynamic ensemble complex. The parts of this ensemble directly at and above the ground & sea surface represent the component of the ensemble capable of radiative energy output to space, should loosely be in thermodynamic equilibrium with the Solar insolation, while the below-surface component of the ensemble is assumed to contribute very little additional energy to the output balance. The tropospheric part of the atmosphere should have a distribution approximately following the solution of equation {32}, which is

$$T = \frac{-g}{C_p}\left(h-h_0\right)+T_0 \tag{33}$$

where 'h_0' and 'T_0' are corresponding reference points of the altitude and temperature, and with downward modulation of the lapse rate due to cooling effects from GHG's. It is every component of the surface and above-surface ensemble which participates in radiative output to space, including non-GHG's, as is popularly and incorrectly counter-claimed. All parts of an ensemble radiate thermal energy as molecules bounce against each-other and lose energy to radiation via the inelastic collisions and congruent changes in velocity of the atomic/molecular electron-cloud. The distribution of temperature in the atmosphere does not seem to be affected by a back-radiative GHE or else it would already show up as an increase in the lapse rate above what a fundamental physics analysis predicts, and the real-world rate is actually smaller. If we maintain that the sea-level average air temperature is T = +15^{0}C and the effective Blackbody temperature is T_0 = -18^{0}C, and utilizing the observed average environmental lapse rate of 6.5K/km, then

$$\begin{gathered} T_0 - T = \frac{g}{C_p}\left(h-h_0\right) \\ -18-15 = 6.5\left(0-h_0\right) \\ h_0 = 5km \end{gathered} \tag{34}$$

Because we utilized only the *effective* average Blackbody radiating temperature for the temperature reference point, there is not a strict reason to assume the kinetic temperature at 5km will be equal to it, given possible emissivity effects; however, the average temperature at 5km in altitude is indeed around -18^{0}C. Utilizing daily average values and referring back to equation {25}, we can then write

$$\left(T_g - \delta\right)^4 = \frac{1.223x10^{17}}{\sigma 4\pi R_\oplus^2} \tag{35}$$

with 'T_g' being the average surface-air temperature, and 'δ' the difference between the effective Blackbody temperature and the previous, which is 33^0C.

The 'δ' term, which is generally labelled the GHE, then arises as a meaningful juxtaposition of physically unique metrics with a concurrent physical justification found in fundamental physical equations and including the bare logical necessity that the thermal average of the ensemble be found at altitude, in-between its two boundaries. This, as opposed to the illogical *direct* comparison of said physically unique (i.e., different) metrics without qualification and the consequent arrangement of tautologies built up to superficially sustain and promote that original deception. Thus, there is absolutely no allowance nor justification for a back-radiative GHE whatsoever, in the reference frame of logic and Natural Philosophy. We will return to this ahead.

Comparison to Successful Model Atmospheres

The field of Astronomy and Astrophysics has long been involved with the problem of atmospheric modelling, as it pertains to stellar atmospheres and in particular, stellar photospheres. The modelling techniques and boundary conditions employed in astronomy, in relation to stellar photospheres, can easily be seen to have laid the groundwork for similar modelling of the terrestrial atmosphere.

Let us examine the assumptions and boundary conditions of a typical model photosphere. In "*The Observation and Analysis of Stellar Photospheres*" (Gray 1992), pg. 147, we find several basic assumptions, approximations, and related boundary conditions from which we initiate the creation of a model. These are, quoting:

1. *Plane parallel geometry, making all physical variables a function of only one space coordinate.*
2. *Hydrostatic equilibrium, meaning that the photosphere is not undergoing large-scale accelerations comparable to the surface gravity; there is no dynamically significant mass loss.*
3. *Fine structures, such as granulation, starspots, and prominences, are negligible. (...)*
4. *Magnetic fields are excluded (...).*

And further down the page we read: *"The photosphere may then be characterized by one physical temperature at each depth. The excitation, ionization, source function, and thermal velocity distributions in the vicinity of one point are all described by this unique temperature. Progressing outward through the photosphere, each successive volume is assigned a lesser temperature so that in the [local thermodynamic equilibrium] situation it is customary to replace the tabulation of the source function as it varies with depth by a tabulation of the temperature. The essential model then consists of temperature and pressure given as a function of optical depth."*

The last two of the above requirements obviously only pertain to stellar photospheres, but the second one can apply to the terrestrial atmosphere as well. The first condition is the most important and has direct application to the terrestrial case. A typical stellar model schematic is shown on the left side of Figure 3, below; on the right side of the same figure is an alternative attempt at a model, which we will discuss in relation to the terrestrial radiative model greenhouse.

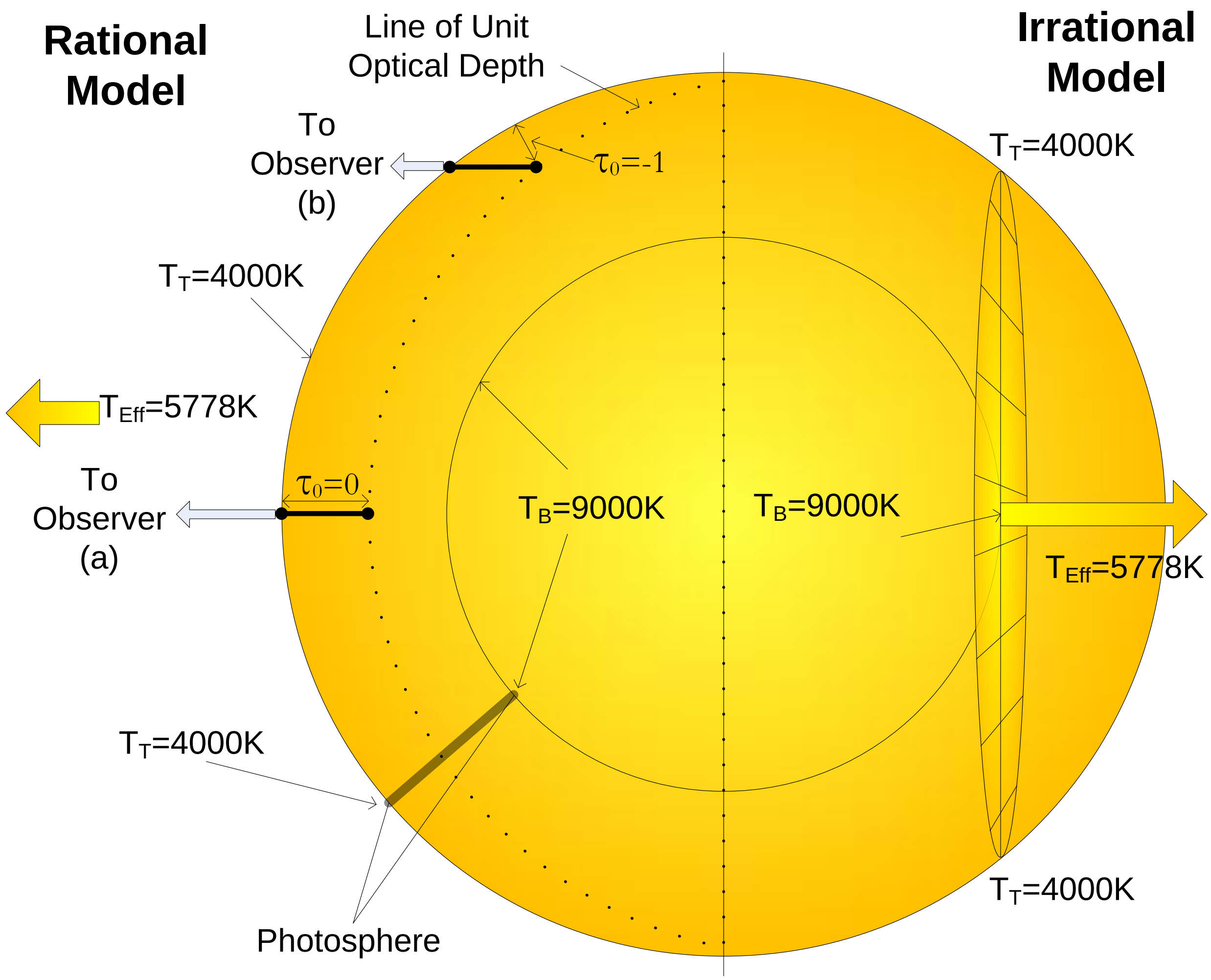


Figure 3: Schematic of a simple model stellar atmosphere on the left, and an alternative simple model on the right. "T_T" means temperature at the top of the photosphere; "T_B" means temperature at the bottom. "T_{Eff}" refers to the effective blackbody temperature of the aggregate radiative output. "τ" denotes optical depth.

Let us go through a brief exercise describing a simple model stellar atmosphere. Ignoring all the labels, lines, and arrows, in the above figure, one can draw the attention to the employment of radial shading on the image – that is, the center of the star is brightest, and the brightness decreases out towards the surface, or the "limbs". This denotes two things: 1) that the center of the star is hottest, and the temperature decreases monotonically outward to the top of the photosphere; and 2) that this is *actually* what is observed by instruments looking directly at the Sun. But if the star has a constant surface temperature, then how is it possible that the "center" portion of the star image appears to be more bright than the starlight which comes from the limbs? This phenomenon is called "limb darkening", and it exists because light rays originating from the limbs are emitted from shallower optical depths within the photosphere. The line of unit optical depth is denoted by the dashed curve, and one can see that although the optical depth might penetrate to the same atmospheric depth relative to the observer, it does not penetrate to the same depth relative to the actual surface of the star. Essentially, light emitted from the limbs toward the distant observer comes from higher and cooler layers within the photosphere, while light emitted from the center of the disk includes that from deeper, and hotter layers, in the photosphere. We learn in "*Photospheres*" that this phenomenon can be used to probe the actual temperature profile of the stellar photosphere, and that the temperature profile physically is actually one which increases monotonically with photospheric depth.

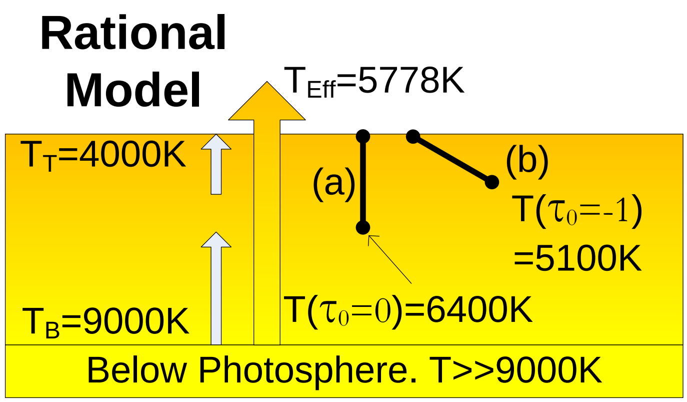


Figure 4: An example of physically accurate modelling with non-fictional boundary conditions. The effective radiative temperature is 5778K, even though the bottom of the atmosphere is 9000K.

The model of the left side of Figure 3 can be simplified somewhat to the diagram shown above in Figure 4. Because the temperature distribution in a star really physically is azimuthally isotropic and radially decreasing, we can employ the approximation of a plane-parallel atmosphere, and make the physical characteristics in the photosphere a monotonic function of temperature and pressure vs. depth. And finally, the net, or aggregate, radiative flux, which is a sum of all radiative components escaping from the bottom to the top of the photosphere, is denoted as "T_{Eff}", which is the effective blackbody emission temperature of the photospheric ensemble. All of the features of this model represent the actually-physical reality of the true photosphere, in its boundary conditions and related properties, and provides a valid starting point for increasing model complexity. *This model works, because it represents what is real.*

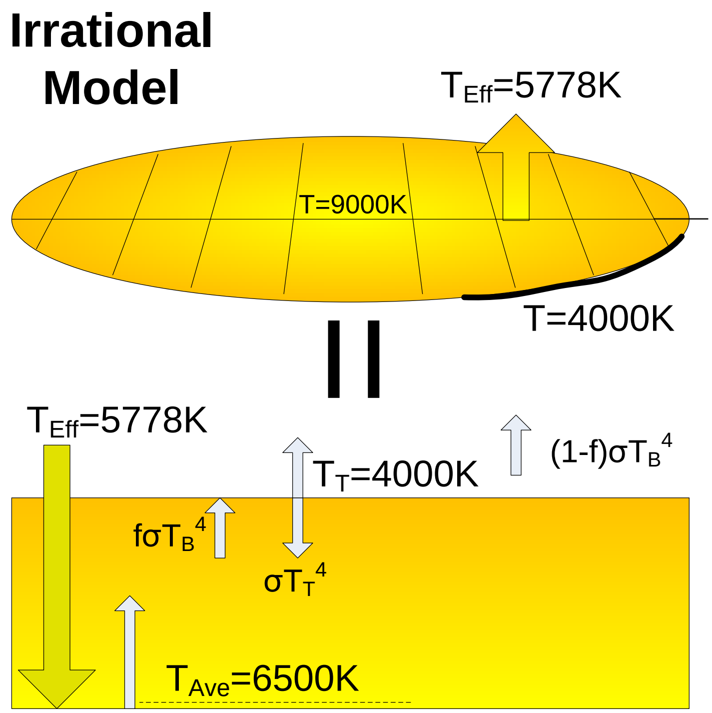


Figure 5: An example of how to invent fiction by assuming fictional & unphysical boundary conditions and switching system output conditions in place of input initial conditions.

Now let us develop an alternative model photosphere using an identical ideology as that with the terrestrial model radiative greenhouse. We take a plane cut-out which intersects the bottom of the photosphere, and who's periphery is the top of the photosphere. The temperature profile across this disk is radial, with 9000K at the center, 4000K around the circumference, and with an effective radiative output equivalent to 5778K. The reason why we choose a physically convoluted geometry for our model is to match the same being done for the approximation of the Earth & atmosphere in the standard GH model.

First, even though there is a real physical temperature variation across the disk, let us model it with the average temperature of 6500K. By never indicating that the real temperature at the bottom of the photosphere is 9000K, we never have to explain that it is from the *real* source of heat from below – all of that information can be simply lost from the model and the physics.

Second, instead of specifying that the effective temperature of 5778K is the aggregate ensemble *output*, let us instead *reverse* the situation and model it as the system *input*. What is the physical justification for this? There is none, and we further categorically declare that we do not have to explain it, other than in-so-far as simply stating that this is the theoretical system output, and therefore "should" be the same as the system input.

Third, because the average temperature of the photosphere is 6500K, but the heating input is modeled as only 5778K, we need to invent a method by which the average photospheric temperature can be risen to the required level. How can this be achieved? Let us correctly observe that the atmosphere above the "6500K surface" reflects or reemits some radiative energy *back towards* the 6500K average source, but invent a tautological postulate that this can therefore be used to explain why it is warmer than 5778K in the first place. Never mind explaining why there isn't a run-away heating effect. Given the fictional boundary conditions we've already allotted ourselves, we invent another fiction where a cool atmosphere at only 4000K can raise the temperature of a warmer photosphere at 5778K to 6500K. We explain that this is not a violation of thermodynamics (a cold region passively causing a temperature increase in a hotter region) because heat is equivalent to energy, and therefore *any* radiative energy is additive to temperature, regardless of its flux density. Never mind the laws of thermodynamics or the direction of temperature/heat flow as specified by them. Never mention the reality that the insolation into the photosphere is actually 9000K.

Fourth, let us set up a conservation of energy formula which randomly gives a not completely irrational analysis – as long as the formula is not applied to any other photosphere. Therefore let us simply declare that because we can set up some equations which show *something*, that we have thus proven our desired thesis of a radiative greenhouse effect.

Thus, we have proven that there exists a radiative greenhouse effect in stellar photospheres, where the cooler top-of-photosphere layer raises the temperature of the warmer bottom-of-photosphere layer.

It might be argued that this is an unfair analysis because the radiative greenhouse model shown in Figure 1 is only a simple model used for demonstrating the idea. But this is exactly the point: Why would we utilize a model, admitted to therefore be false, to teach a concept which only this model produces? Why is there not a better simplified model with better simplified equations to demonstrate the effect? How do we know there really exists an effect to demonstrate at all, when the philosophy we use to demonstrate the effect is itself tautologous, and non-physical in the reality of its properties and boundary conditions? The point is, the photospheric model works because it represents what is real, and the standard radiative GHE model fails because it represents *nothing real*, but only what is fictional.

If this wasn't worrisome enough, the fact of the matter is that this type of model *is* used by various institutions to demonstrate the greenhouse effect, and it *does* represent an ideology, and a paradigm, under which research into the atmosphere is conducted. It doesn't matter if the simple model of Figure 1 is only for demonstration – it represents a paradigm. Anyone who subscribes to the radiative greenhouse model atmosphere, and that is almost everybody, subscribes to the idea that an (completely arbitrarily) artificially cool solar insolation can be passively amplified by an even cooler atmosphere such as to increase the temperature of the tautologously already-warmer ground by an invented scheme of radiative heat transfer, and that an effect like this is necessary because denying the existence of day & night is a reasonable approximation to the system. This is *only* a belief system which comes out of this type of model radiative greenhouse. And it is a philosophy of physics which is completely tautologous, based on completely fictional and imaginary boundary and input conditions. *It simply isn't real.* In the end, it is not even actually possible to satisfy the *first criteria* of atmospheric modelling listed above, which is to create a plane-parallel model for the terrestrial atmosphere, for the very fact of the reality that this is not what exists on the Earth, even in approximation or abstraction. You can do it for a stellar photosphere, but you cannot do it for the Earth, because it is not what exists.

Experimental Methods

Experimentally, the postulate of a radiative greenhouse effect is simple to test. Such experimental methods will be discussed here, but first, we must understand what it is exactly we are testing. In his book, "Now, Are You Ready To Learn Economics", American Patriot and polymath Lyndon LaRouche (www.larouchepac.com) describes the act of cognition as something qualitatively unique and superior to the simple act of learning. We read on pp 81-82:

> "What is Cognition?
>
> The discoveries of what are later experimentally validated as universal physical principles, are prompted by the demonstration of those qualities of paradoxes, the which are not susceptible of formal solution by means of the deductive and other methods of the philosophical reductionists. Such paradoxes are typified by the ontological paradox of Plato's **Parmenides** dialogue; the impossibility of solving such by deductive methods, is typified by the case of that historical Parmenides, whose method Plato referenced in that dialogue. A successful solution is generated when

something occurs, the which is sometimes described as an ignited flash of insight, to produce a validatable *hypothesis* in that person's mind.

The acceptance of that hypothesis by other persons within society, requires that two special conditions be satisfied. First, the same experience of insight must be replicated, independently, within the sovereign cognitive precincts of at least one other individual's mind. Second, that hypothesis, so generated, must be shown to be an existent, efficient principle, by means of experimental demonstration of the efficiency of its wilful application to the physical domain as a whole. The latter such experiments belong to the class which Riemann defined as *unique*: it is not sufficient to show experimentally that the prescribed effect might be produced; it must also be demonstrated that that hypothetical universal principle coheres, in a multiply connected way, with all validated other universal physical principles.

The crucial point is, that the only way in which we can generate a functionally efficient notion of such a cognitive idea existing in another mind, is the three-step method of sharing such an experience (paradox, hypothesis, validation), as I have just identified this summarily. In such cases, we know three essential things. First, we know, independently of our cognitive processes, the paradox which prompted the generation of a discovery of principle, as the only feasible solution to that paradox. Thirdly, we know the manifest experimental proof of the proposed solution. Thus, by sharing the first and third of those steps, we are able to correlate the specific act of cognition, the second step, in the other mind, with that recallable experience of cognition we experience in our own.

Finally, by comparing that specific, recallable experience, with a similar but different experience of the same functional type, respecting a different paradox, hypothesis, and proof of principle, we are able to begin to discriminate consciously and wilfully among the cognitive experiences specific to each such hypothesis. This ability, so prompted, permits us to recognize each such repeatable cognitive act as a distinct idea within the mind, and to give it a recognizable name, which then identifies that act; that generates the class of what are called *Platonic Ideas*. The way in which hypotheses are generated, by Socratic method, in Plato's dialogues, is a now age-old exercise in training the mind to build up a repertoire of nested such Platonic ideas. After Plato, this became the age-old Classical method of cognitive education in globally extended European civilization.

Given that the standard atmospheric radiative greenhouse model proves itself to be invalid if applied to planetary atmospheres in general, and that there seems to be no *room* in which to have a radiative greenhouse effect in operation as fundamental and constantly-occurring behaviour of physics for the terrestrial-ensemble itself, we can hardly allow the idea of a radiative greenhouse effect to be given the status of a universal principle. But if it were a universal principle, i.e. a fundamental behaviour of physics in general, we should be able to apply said principle experimentally and thus prove the hypothesis.

However, we must first understand the paradox. This is as opposed to the simple act of learning and repeating it, without actually comprehending it. If the paradox is mal-formed then whatever follows from it, however convincingly explained, is in fact merely arbitrary. The postulate-hypothesis of the radiative greenhouse effect develops out of the "paradox" of contrasting the average surface-air temperature at sea level to that of the *effective* radiative output of the Earth ensemble. Let us use analogy to comprehend the paradox: There is an orchard; on the south end, adjacent to a farmer's residence, is the first row of trees in the orchard, and these happen to be orange trees. Due to a multi-generational long surplus of oranges, the famer's ancestors had worked with the state to have it ordered, for the betterment of the greater number, and on pain of death, that farmers thenceforth only ever harvest the very first row of their orchard such that the market not be flooded with excess rotting product and thus upset the public stomach and crash the prices. In fact, the farmer cannot recall what his ancestors ever said about what was beyond the first row of orange trees, but he presumes that there are simply more orange trees. What the farmer doesn't remember is that it is only the first row of the orchard which are orange trees, while the other thirty-two rows of the orchard are, in fact, apple trees. The orange trees have grown in so thick that the farmer has never been able to see beyond this first row, and he only harvests the oranges from the south-side of the first row as the underbrush has become impenetrable to crossing over. Occasionally, a felled ripened apple from another row is picked up by a little creature, and due to some strange fright, the little creature drops the apple under an orange tree as it scurries out of the orchard. The farmer finds these apples, and while he finds it paradoxical that his orange trees seem to be producing the occasional apple, he dismisses the paradox by imagining that orange trees must occasionally emit an apple for wont of it. The farmer considers the first-row of orange trees to be entirely characteristic of his orchard.

However, are orange trees actually characteristic of the entire orchard ensemble? Of course, we know that they are not, and we physically qualify the glut of oranges to the dearth of apples with the physical justification that the farmer only harvests from the south-side of the first-row of the orchard, which happen to be oranges. Similarly, when we contrast the average surface-air temperature to that of the effective radiative temperature of the ensemble, without qualification or physical justification, as is done in the standard radiative greenhouse model, we too cannot expect in the least to understand or comprehend why such a difference should exist, and thus become prone to inventing a mythology to describe it. Now contrast that scenario of paradox to a properly qualified one: the temperature of the surface-air is $+15^0$C, and the effective radiative average of the ensemble is -18^0C, and we *expect* these temperatures to be different because the former one represents only a very small, and undoubtedly the warmest, fraction of the entire ensemble. But because we, like the farmer who only ever saw the first row of his orchard, spend most of our time upon the ground surface with the surface-air blowing around our bodies, it seems intuitive to think in terms of the surface-air temperature being representative of the entire ensemble, when in fact there is an entire glut of atmosphere only a short distance above us which is much colder than $+15^0$C, and that when accounted for, supplies the effective radiative temperature of -18^0C. We *expect* the aforementioned temperatures *to be* different due to the-already theoretically quantified distribution of temperature of a gas in a gravitational field via known equations related to existing universal principle, and including the bare logical necessity that the radiative average of an atmospheric ensemble be found in between its two boundaries, at altitude. The juxtaposition of these two qualitatively physically-dissimilar temperatures presents the initial paradox from which a back-radiative greenhouse effect is postulated. The problem of logic however, is that these two temperatures, -18^0C on the one hand, and $+15^0$C on the other, do not actually correspond to a physically meaningful *direct* contrast. The ground temperature is a different physical metric, completely, than the entire-system-ensemble effective radiative output temperature. In other words, the surface-air temperature represents only a tiny fraction of the entire thermal ensemble and so comparing its temperature to the entire-ensemble temperature is not meaningful without certain qualifications being made. It is the specific exclusion of the necessary qualifications, with the added application of fictional boundary conditions, which creates the tautologies found in the back-radiative greenhouse effect. If the existing physically justified pre-qualifications are sufficient to extinguish the paradox, as we have seen here, then there need be no other hypothesis put forward…there is no reason to multiply entities beyond necessity. The point is, we must occasionally re-assess the conditions of originating paradoxes in order to re-establish if they are actually logically and physically sound. Such is the domain of *higher* cognition and 'ignited flashes of insight' in relation to Natural Philosophy and paradigmatic advance beyond possibly-antiquated dogmas of 'establishment academia'.

Nevertheless, the experimental complexity in proving the radiative greenhouse effect for one way or the other is fodder to high-school and undergraduate physics laboratory settings. The hypothesis is simple: if thermal IR radiation is prevented from leaving an enclosure after having been down-converted from Solar insolation within the enclosure, then the temperature inside said enclosure should achieve a higher temperature than another enclosure which does *not* prevent the escape of thermal IR radiation. It should be pointed out immediately that this is not the way an actual botanist's greenhouse works, which heats due to the prevention of convective cooling – that is, hot air is trapped inside the greenhouse and so the greenhouse can't cool down, with its maximum temperature determined solely by the absorbed Solar insolation. In a real greenhouse the temperature inside is determined by the Solar input, rather than by postulated amplification effects from "trapped" IR energy.

The experimental requirements are simple, and should be reproduced by every physics and astronomy classroom from senior high-school through university and college graduation…the more people who perform this experiment, the better. If a radiative GHE universal physical principle exists, then lets experimentally prove it over and over again, as we do with so much else during scientific training; and if it doesn't exist, this is equally valuable to prove over and over again.

Radiative Greenhouse Effect – Experimentation on the Hypothesis

Goal & Philosophy:

Provide evidence that trapping LWIR (long-wave infrared) radiation inside an enclosure will cause it to equilibrate at a higher temperature than an otherwise identical enclosure but which doesn't trap LWIR. Two enclosures will be tested: the first will be constructed such as to experimentally simulate the model of the standard radiative greenhouse effect with greenhouse gases; the second will simulate an atmosphere with no greenhouse gases. For the experiment to successfully lend support to the hypothesis, we must expect that the enclosure which simulates a radiative greenhouse atmosphere will achieve a substantially higher equilibrium temperature 1) than the other, non-GHE enclosure, under identical or quantified circumstances, 2) than what a simple & direct application of the Stefan-Boltzmann equation would predict. If the experiment is not successful, then we must conclude with the null-hypothesis that there is no basis in fact for the postulates of the radiative GHE.

<u>Supplies:</u>

1) A solar pyrometer (solarimeter) capable of reporting the instantaneous solar insolation to, say, approximately 1 Watt per square meter accuracy. Alternatively, photometric methods utilizing techniques from astronomy can be employed to broaden the experiment and its complexity for more advanced students.
2) At least two digital-display thermocouples.
3) A "backing" material of, say, thickest-ply Bristol Board with a *known* albedo. The general experiment should utilize board of near-zero albedo, but variations on the general experiment could utilize board of a much brighter albedo in order to explore those effects. Alternatively, a quality aerosol paint of known albedo could be used.
4) One pane of Solar-transparent, LWIR-reflective glass, to simulate GHGs; and one pane of Solar-transparent, LWIR-transparent glass, for simulating a GHG-free atmosphere. The panes should be of thick-enough construction that they are quire rigid.
5) A very small supply of lumber. Power drill. Wood glue.
6) A perfectly clear, blue-sky sunny day, preferably during the middle of summer when the Sun passes near the local zenith.
7) At least one assistant, if possible.

<u>Construction:</u>

1) Two boxes must be constructed; one to simulate an IR-trapping atmosphere, the other to act as a test reference baseline. Suggested box material is particle-board of at least one-half inch thickness.
2) The boxes can have a square base of 12-inches on a side, with walls placed on-top of the periphery, at 6-inches in height. The walls should be *glued* (**not** nailed) in place with a liberal supply of the appropriate wood-glue – it is *extremely* important that the interior of the box be 100% airtight...if it is not, there is no possibility for this experiment to give a meaningful result. There can be no exchange of air inside the box with outside air. Beading the inside intersection of the walls and the base with glue or black caulk may help.

3) Once the glue has cured, cut the Bristol Board (or other material of known albedo) to the proper dimension of the inside-base of the box, and then glue this backing in place in the bottom of the box. The backing should be at least a millimetre thick.
4) The thermocouple must be mounted inside the box, but its read-out wires must exit the box. Therefore, use a wood-drill of the smallest diameter possible which will allow the feeding of the thermocouple wires through the hole, and drill a hole through the center of the base of the box, starting from the inside and going out. When the thermocouple is fed-through, it should sit a couple of inches off of the inside base of the box. This hole ***must be sealed*** after the wires are fed through – wood glue or black caulk will suffice for plugging the hole.
5) Ensure the relevant glass-pane is clean, and cut to the same dimension as the open-face of the box, and glue the pane in place over top of the walls of the box ensuring there is no air-leakage between the pane and the wall tops whatsoever. The transparent front cover of the box **must** be of a solid type of appreciable thickness…this experiment will **not** mean anything if a loose-fitting plastic wrap (for example) is used in place of a solid transparent material.

You should now have at least one box, preferably both of them as specified, which is completely sealed to outside air, which has a thermocouple inside with attachment through the wood to a digital readout display, which has a backboard of known albedo, and which has a transparent front-face of the specified properties.

<u>Measurements:</u>

Preconditions:

1) A clear sunny day around the solar noon-time. Very little or zero wind. The experiment should commence about one-half hour before *Solar* noon, and finish by one-half hour after *Solar* noon.
2) The box must initially be out of the sunlight, and reading close to the ambient air-temperature.
3) A table for recording values. Values to be recorded are i) Time, ii) Solarimeter reading, iii) Thermocouple reading; these should be column headings with room for, say, 100 rows of measurements.

4) Ensure the solarimeter is properly set up to accurately read the solar insolation.

Procedure:

1) Ensure the data display and recording medium is ready to go.
2) Record the ambient temperature and time of measurement, before the box is placed in the Sunshine.
3) Place the boxes in direct sunlight such that the Sun's rays enter the box at a ninety-degree angle to the transparent face. This means there should be no shadows from the walls appearing in the inside of the box. An assistant is very helpful here. The boxes can be propped-up at the correct angle, and subsequent minute corrections to the box orientation can be made every five minutes to ensure no shadows are cast inside the box.
4) Begin recording the time, the solarimeter reading, and the thermocouple readings (for each box), **every two minutes**. Presumably, before an entire hour has elapsed, the interior temperatures of the boxes will have equilibrated and thus be no longer rising at any significant rate.
5) The experiment is finished once the temperatures have stopped appreciably rising inside the boxes, which means they are near thermal equilibrium with the solar insolation.

Data Analysis:

There are two analyses that can be performed here. The first is a simple direct comparison of the maximum temperatures of the boxes. If the radiative GHE is a real phenomenon, then the box with the LWIR-reflective panel should have achieved a much higher temperature than the box with the completely transparent panel. However, we may also quantify the results via a minor modification of the radiative greenhouse model equation {14}:

$$T = \sqrt[4]{\frac{F_{\odot}\left(1-\alpha\right)}{\sigma\left(1-f/2\right)}} \qquad \{36\}$$

from which we have the error analysis formula:

$$dT = \pm\frac{T}{4}\left[\left(\frac{dF_{\odot}}{F_{\odot}}\right)^2 + \left(\frac{d\alpha}{1-\alpha}\right)^2 + \left(\frac{df}{2-f}\right)^2\right]^{\frac{1}{2}} \qquad \{37\}$$

For the value $F_{\odot}$, simply use the mean value of the solarimeter readings; for $dF_{\odot}$, use the standard deviation of the readings. If the albedo of the backboard is known, but not its error, it would likely be sufficient to apply a 5% - 10% error for the albedo parameter, or use manufacturer specifications if available. The same can be applied for the '*f*' factor. If '*f*' was, say, 0.5 to 5%, albedo was 0.04 to 5%, and the solar flux was 1000 W/m^2 to 2%, then we would predict:

$$\begin{aligned} T &= 387.6 \pm 7.1\,K \\ &= 114.6 \pm 7.1\ ^0C \end{aligned}$$

We can compare this to the simple & direct application of the Stefan-Boltzmann equation from equation{8}:

$$T = \sqrt[4]{\frac{F_{\odot}\left(1-\alpha_{\oplus}\right)}{\sigma}} \qquad \{38\}$$

for which the error analysis is:

$$dT = \pm \frac{T}{4}\left[\left(\frac{dF_{\odot}}{F_{\odot}}\right)^2 + \left(\frac{d\alpha}{1-\alpha}\right)^2\right]^{\frac{1}{2}} \qquad \{39\}$$

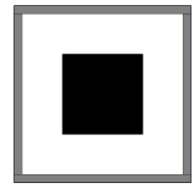
Utilizing the same parameters as previously, we then predict:

$$\begin{aligned} T &= 360.7 \pm 4.9K \\ &= 87.7 \pm 4.9\ ^0C \end{aligned}$$

The above examples show that if there is anything like a radiative greenhouse effect principle borne-out of accepted physics, then it should be extremely easy to detect as the temperature difference between these two scenarios, using entirely reasonable values, is very significant. We see that if the original solar insolation is high enough, we could quite literally boil our tea and reach well-over 100^{0}C with the added effect of trapped LWIR radiation, by simple passive means. Our theoretical results can be compared to the real-world temperature measurements, and a very successful experiment would have the temperature of the boxes falling within the error bounds of these predictions.

Further Research:

A further empirical test of a postulate from the radiative greenhouse model can be performed. If the hypothesis of day-time & night-time denial is valid, then we can also experimentally simulate the conditions under which it is assumed to be valid. That is, if the surface area of the output is four times that of the input, then we should expect a factor of $\sqrt{2}$ decrease in the equilibrium temperature. The same boxes can be used as before, but this time, leave only a central square of one-quarter the surface area of the base covered with the low-albedo material. Then, mask off the rest of the outer perimeter of the surface area with something of *very* high albedo, preferably very close to an albedo of 1. What we then have is a solar insolation absorbing enclosure, which will *not* absorb radiation over four-times of the surface area as that absorbing radiation. In an identical manner to that of the standard radiative GHE model, we can predict what the equilibrium temperature of this enclosure should be, by averaging the solar insolation over the *entire* surface area of the base, rather than just over the absorbing area…heat will be transferred from the black area to the white area by the hot air inside and by conduction, and so the entire surface area will be outputting radiation and so will reduce the radiative equilibrium temperature. In this case we use identically that of equation {14}



$$T = \sqrt[4]{\frac{F_{\odot}\left(1-\alpha\ \right)}{4\sigma\left(1-f/2\right)}}$$

which still has exactly the same error analysis formula as from equation {37}. Using the same parameter values as our previous example, we calculate

$$\begin{aligned} T &= 274.1 \pm 7.1\, K \\ &= 1.1 \pm 7.1\ {}^{0}C \end{aligned}$$

Using the Stefan-Boltzmann equation from equation {8}

$$T = \sqrt[4]{\frac{F_{\odot}\left(1-\alpha_{\oplus}\right)}{4\sigma}}$$

we calculate

$$\begin{aligned} T &= 255.1 \pm 4.9 K \\ &= -17.9 \pm 4.9\ {}^{0}C \end{aligned}$$

These temperatures will generally be cooler than the ambient conditions at most locations in summer time, save for places of very high altitude. Of course, we expect this analysis to be incorrect for the very same reasons that the standard radiative GHE model is incorrect. The actual insolation over one-quarter of the surface area equates to upwards of 121^{0}C in temperature generation; how this temperature is conserved is entirely dependent upon the system's heat capacity and emissivity, and we have no justification for making the assumption that the radiating temperature will be $\sqrt{2}$ less simply because we arbitrarily reduced the input flux by a factor of four.

The Realistic Terrestrial System Model

Graphical Overview of the Radiative Thermodynamic Ensemble

Let us develop a physically accurate diagrammatic model of radiative input and output for the Earth ensemble. We should expect such a model to efficiently represent multiple aspects of the physical reality of the system it represents, with physically accurate boundary conditions, and output parameters. Such a model is shown below in Figure 6.

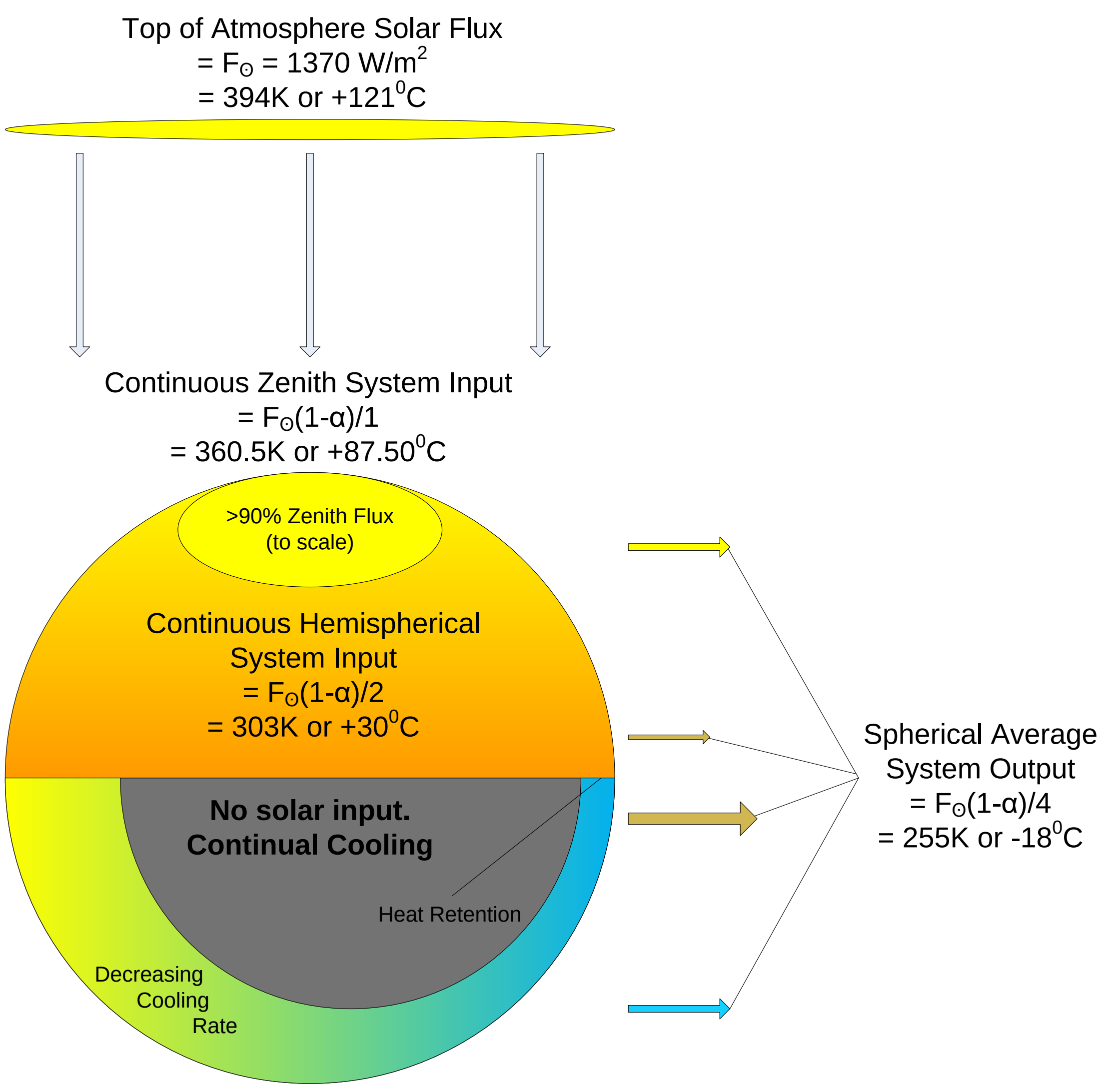


Figure 6: "Outside the System" view of the radiative interaction. Earth is in fact, on average, *cooler* than the solar radiative input temperature. With this single physical reality, the need to postulate a radiative greenhouse effect evaporates. Image credit: J.E.P.

We can develop an understanding of this simple "Outside the System" model by reading it from initial input to final output. The model may look much more complicated than the fictional model greenhouse discussed earlier, but nonetheless this is science and it is a model which is easily taught to children. It is a quasi-multidimensional model, and should not be looked at simply as an intact sphere rotating in some direction. The physics during the day-time vs. night-time is different, and thus needs to be separated, rather than denying the existence of day and night.

The solar energy flux density reaching the Earth is $F_{\odot} = 1370 \ W/m^2$, which is a temperature equivalent of 394K or +121^{0}C. This energy flux density is reduced by the reflective albedo losses from the Earth, and so becomes reduced to 360.5K or +87.5^{0}C at the input. The portion of the Earth which is closest to the Sun is disk-like, and this is indicated by the solid ellipse drawn at the solar zenith. Allowing for a deviation from perpendicularity of no more than 10%, the zenith circle is drawn to-scale in terms of the linear cross section of the sphere; it amounts to almost 50% of the diameter, and can be calculated to occupy a surface area greater than one-third larger than the entire continent of North America. This means that almost 50% of the cross-section of the Earth is continuously being insolated with radiative heating of +87.5^{0}C! Circling this area is for illustrative purposes only, and obviously, would not form any sort of absolute constraint or geographical area of the surface because the solar insolation varies as the smooth cosine function.

The average input over the entire sun-lit hemisphere has an equivalent of +30^{0}C input temperature. But we *cannot and do not* treat this as a physically real average over the entire hemisphere, because then we would force ourselves into a position of forgetting about the physics at the zenith, and be thus required to invent a fiction to explain the temperature found there, as the standard greenhouse model illogic would have us do it. The shading of the day-lit hemisphere graphically reminds us that the solar flux is reduced by the cosine of the solar zenith angle (i.e. is maximum at the zenith, and zero around the periphery).

Moving to the night-side, we see that there is in fact no solar heating input at all. This is in direct opposition to the standard radiative model greenhouse, which assumes that the sun shines on both sides of the Earth, but merely at a quarter of the intensity (it is not clear how this assumption passed a basic "sanity check" in the standard model). It is very instructive for greenhouse-model believing scientists to attend any kindergarten classroom where the teacher will very expertly craft a Styrofoam ball of about 6 inches in diameter, painting it the colours of the Earth. Then, turning all the lights low in the classroom and shutting the curtains, the teacher will bring in a single incandescent light bulb to represent the Sun. When the Styrofoam-ball Earth is placed near the lighted bulb, it will be observed by most children that only half of the "Earth" is illuminated by the Sun, and the other half is in the ball's own shadow. This explains the difference between day-time and night-time, and is a very worthwhile educational experience if one has never been exposed to it before. The astute student will observe that the lighting intensity is brightest where the ball is closest to the light-bulb-Sun, dimmest around the periphery, and non-existent on the rear.

The "cooling strip" at the bottom around the periphery of the night-side hemisphere indicates two aspects regarding the thermodynamic physics. First, the cooling rate is directly proportional to the temperature, so that as the temperature decreases via radiative loss to space, the rate of decrease of temperature also decreases. Second, not all the heat gained in the day-time is lost over the night time, and a significant amount of heat remains upon sun-rise. This latter reality is due to two things: 1) the simple thermal capacity of the system, 2) the fast rate of rotation of the Earth. It is indicative of the fact that the Solar insolation heats the Earth faster than the Earth can cool. This is enough to tell you that the radiative balance should not be found at the specific surface boundary of the Earth, but rather at the ensemble average which must be within the atmosphere. If we have upwards of $+90^0$C developing on the ground surface of the Earth from solar heating, over half or more of the cross-section of the Earth, and the thermal capacity of the system is large and the rotation of the Earth relatively fast, then it is impossible for enough cooling to take place at night-time and satisfy an average ground temperature of -18^0C. The average of the system *has* to be within the atmosphere, as a simple matter of rational logical deduction which we demonstrated earlier, and thus the average temperature near the ground *has* to be higher than -18^0C, as we have already quantified.

Finally, the "System Output" is drawn as a three-dimensional "roof", indicating that the output of the system comes from all of the Earth's spherical ensemble. It is drawn at ninety-degrees to the input to indicate that the output flux density is not some simple or direct equality with the input, as a great deal of physics has transpired between the input and output. The *total energy* is conserved, but it occurs over different surface areas, and so the *flux density* is not conserved. That the effective Blackbody radiative output balance can be calculated via the Stefan-Boltzmann law is a wonder of modern science, but it is incorrect to equate the effective radiative output temperature to the average radiative input temperature, as is done in the standard model greenhouse, for the geometry is not the same. Day and night exist! In fact, the Earth-ensemble can simply be understood as a down-converter of solar flux from a higher to a lower energy spectrum, with an extremely purist mathematical justification: the surface area of the output is *four-times* that of the input, and thus the energy flux density (temperature) and spectral profile of the output must be diminished.

This "outside" model gives a physically accurate overview of the actually-real input boundary conditions – these being the radiative input profiles over the sun-lit hemisphere. The rest of the system after this are *output* conditions, and are *not* parameters which should be set by the modeller. Rather, the cooling profile, and the aggregate output radiative spectrum, should be *free* parameters which a successful model *reproduces*, given the known input conditions. What the standard radiative model greenhouse does is the exact opposite of this: treating a free output parameter as a fixed input boundary condition, and then arbitrarily adjusting the rest of the input conditions, and inventing new fictional ones, in order to satisfy that original inversion of logic!

A further example of an output condition, which a physically accurate model would have to reproduce, is shown in Figure 7 below. It is well known that daily temperatures generally peak only well after solar-noon, anywhere between 2 and 4 pm. And it is also the case that the coolest daily temperature is found just after sunrise. The oblong band around the Earth in Figure 7 qualitatively illustrates this physical reality. There are extremely important physical reasons for this profile and they *must* come about as a natural consequence of the input and boundary conditions of the physics of the system, and *not* be set as modeling input constraints.

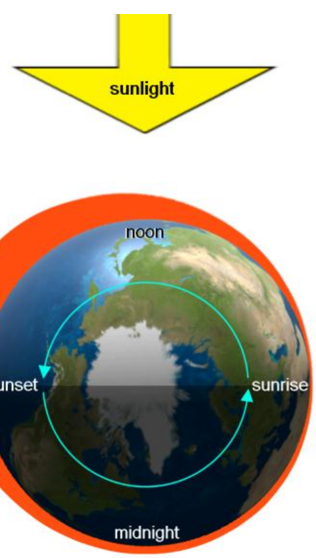


Figure 7: A diagrammatic perspective on the heating and cooling profile in the terrestrial system. Maximum ground-air temperature comes *after* the maximum solar zenith insolation; the coolest daily temperature is found just after sunrise. Image credit: Alan Siddons.

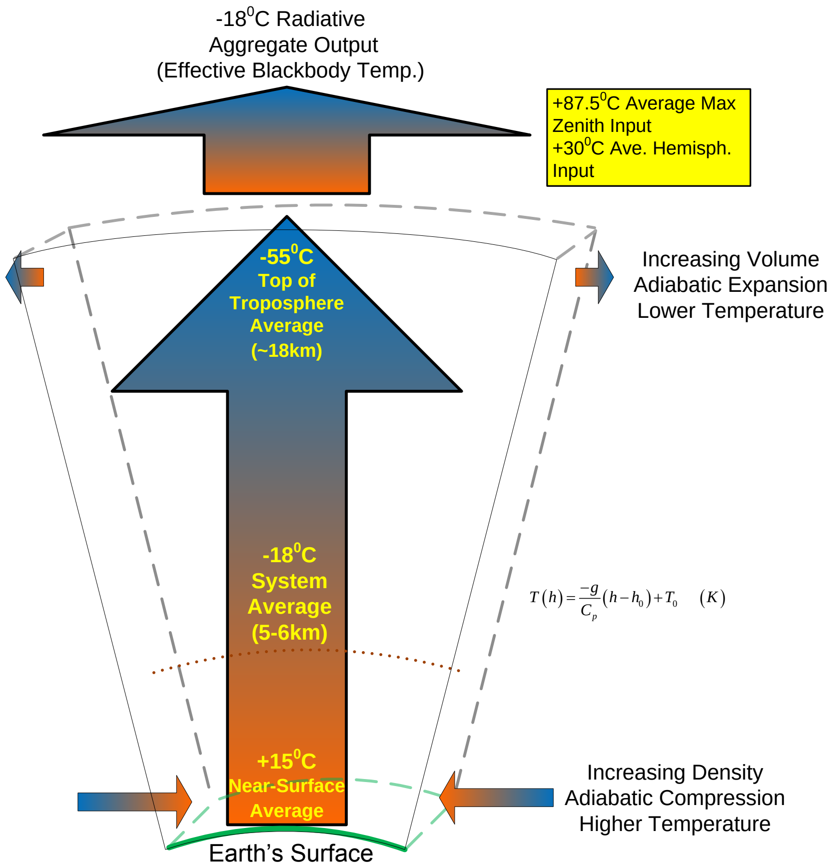


Figure 8: The "average" system atmosphere. The ground surface is colder than the radiative input, and the system average is logically found within the atmosphere. Image Credit: Derek Alker

In regards to the purely radiative & thermal situation, with actually physically real input and boundary conditions defined and output parameters described, we *may* present an effective-average diagrammatic description of the atmosphere, as shown above in Figure 8. However, such a diagrammatic description isn't really all that useful in regards to the actual physics, because there is no direct way to incorporate the physically-actual solar insolation, as shown in the upper-right box in the figure. The reason is because the situation during day or night is distinctly unique: the day time experiences a constant solar insolation of upwards of +90^{0}C, and +30^{0}C on average, while all the night time can do is continually cool and lose energy to space. It just isn't physically real to average those together – they need to be treated separately. Figure 8 can be a representation for the system average *after* treatment of a separate day & night physics; however, one *cannot start* from such an average and reproduce *the actual* unique physics that occurs during the day & night. The only thing that comes out of an average over day & night is merely an abstraction, and it is *only by starting within* such a non-physical abstraction that a radiative GHE can ostensibly be supported.

Summary

The effective blackbody radiative ensemble temperature of Earth's surface and its atmosphere does not directly relate to the ground temperature. We should expect the surface-air temperature to be higher than the ensemble temperature because 1) the input flux density has a much higher temperature than -18^{0}C; 2) the temperature distribution of *any* atmosphere in thermal equilibrium with a source of heat is already one in which the surface-air temperature is higher than the effective radiative temperature of the ensemble.

To finish the summary, allow the author to paraphrase an email conversation while questions were generated from those who were reviewing this document. The author received a question regarding how the plane-parallel solar model explains the problem with what has been come to be known as the "P/4" (p-over-four) issue – this is the misapplication of mathematics to physics by which the standard model greenhouse denies the existence of day & night, and assumes that solar energy instantaneously impinges the entire surface area of the Earth at once, rather than just the day-lit hemisphere. The author responded:

> The P/4 problem is tangentially related to the plane parallel model for a photosphere. The plane parallel model works in a photosphere because a star *is* isotropic with latitude and longitude, and its physical properties change monotonically with depth – that is, at any one specific radial depth in the photosphere, the same physical conditions (temperature, pressure, composition) will be found at any latitude and longitude. This is why you can model it as a plane parallel atmosphere…because the only change of the physical parameters is with depth - there is no change with anything else. So therefore each "depth" is its own "plane" and has unique physical properties – it is a physically valid transformation of the coordinate system (sphere to plane). P/4 is not used in a star because it doesn't need to be, but a plane-parallel model can be used because all physical parameters change only with depth. So you stack layer upon layer upon layer and you get a smooth function of changing parameters with depth.
>
> So, then I compared that *good* physics model to the abuses of logic and physics in a plane parallel model for the terrestrial atmosphere. It doesn't work for Earth because there is *no* symmetry that can be exploited anywhere in *that* fashion. Related to this is where the standard GH model enters the P/4 approximation/assumption…in trying to

do something that seems reasonable to something that doesn't even exist and is fictional. There is *no* radial symmetry or isotropy with latitude and longitude because the source of heat is *not* constant vs. those parameters. Nor is it P/4. Nor is it a reasonable approximation to deny the existence of day and night. Etc etc. The plane-parallel model for a photosphere works because it represents what is *real* – a monotonic change of physical parameters with depth…this is all it represents and all it *needs* to represent. It doesn't work for the Earth because there is no symmetry and no simply-changing parameters vs. single metrics (ex. depth) to exploit.

Perhaps it is difficult to understand the full impact of these simple words. The standard GHE models the terrestrial atmosphere as something that *it isn't!* That is why I call it a fiction. They are modelling a fiction, and therefore as a direct and purist logical/philosophical requirement, the results of such a model is also fiction. It uses math, which has the potential of representing something real, to model a fiction, which is not real.

In terms of a logical equation: Union of reality with fiction = fiction. Or in binary logic, 1 & 0 = 0; true & false = false. False & false = false (which is actually what I demonstrated, in proving the equations of the model GHE are nonsensical, as well the model itself being fictional...you have nonsense applied to fiction). The only thing that is true is: true & true = true. What is true is that there is such a thing as an "adiabatic" temperature distribution; and what is true is that the bottom of the atmosphere should be warmer than the average of the entire ensemble; and what is true is that the ground-air temperature is still *much less* than the solar insolation; and what is true is that the solar insolation is 121^{0}C under the solar zenith, and an average of +30^{0}C; etc. You *can-not-fit* a back-radiative GHE into those truths.

Now for P/4, another look at it: A Watt is a Joule per *second*. In *one* second, in *one* square meter, you get 1370 Joules from the Sun. In every second that passes by, you get *another* 1370 Joules provided by the Sun (in a m^2). You do not get 1370 Joules in 24 hours...You get 1370 Joules *every second*. In 24 hours, you get 1370*24*60*60 = 118.4 Million Joules, in a square meter, under the solar zenith. It is an *instantaneous* flux ("instantaneous" being measured over one-second in this case). The Stefan-Boltzmann equation deals only with instantaneous fluxes - i.e. W/m2 or J/s/m2.

What the GH model tries to do with the S-B equation is to claim that the *input* is -18^{0}C, via division by 4 and thus spreading the instantaneous flux over both night and day; but this is *not* what the S-B equation is capable of doing. It deals *only* with instantaneous fluxes and their physically associated temperatures; therefore the instantaneous *input* is +121^{0}C at maximum, and +30^{0}C on average for the sun-lit hemisphere. The only thing -18^{0}C represents is the aggregate (meaning summed over all emitting sources, i.e. the surface plus everything in the atmosphere including non-GHG's [which *do* radiate!]) *instantaneous effective radiative output* of the Earth-ensemble if you assume what goes in equals what comes out. This does *not* mean it is "supposed" to be the ground temperature or the average of such.

This what my experiment discussion included: the discussion where ¾ of the box is masked off with a high-albedo surface. This is a *direct* analogue to how the standard GHE models the Earth. That is, the solar insolation is instantaneously spread over 4-times of the actual surface area of the box absorbing radiation, and therefore, the radiative output of the box should be 4 times less...i.e. freezing cold.

Then, in response to a follow-up query on how many planes are used in plane-parallel models, the author wrote:

To clarify just a little further: it is not restricted to just 2 parallel planes. In a solar photosphere, you would have, for your modeling resolution, as many parallel planes (each at subsequent depths) as you wanted, each plane with its own physical properties related to that depth. (As discussed: pressure, temperature, and composition change smoothly with depth.)

Then, at each layer, you have the energy and heat from below transferring through it to the next layer above – and note that heat flow is only *one-way*, from below (hotter) to above (cooler); there is no heat flow you would need to model going *back down*! Why *would* you model it like that? The laws of thermodynamics tell you which way the heat is flowing so why would you model it going *back*? So that's one thing a solar model *does not* do, and that the GHE model thinks it does.

Now for the terrestrial atmosphere, you could do the same *in-so-far* as having as many layers as you wanted. You could summarize that as a model with only two planes - the ground and atmosphere - to demonstrate the idea.

But…wait & think here for a second!

First: the plane-parallel model for the terrestrial atmosphere is simply *not* a valid approximation or transformation of coordinate systems…the physicality of the terrestrial system negates that possibility, because we don't have *that type* of symmetry to exploit, as we did for a star!

Second: whether it is many parallel planes in the model, or just the two planes of the ground & atmosphere, you do have a model where each plane transfers heat *back down* to the source, where it is hotter. The two-parallel-plane approximate model demonstrates that idea – that when summed all together, the "planes" of the atmosphere act to send heat *back down* to the source, *and also amplify it*, from -18^0C, to $+15^0$C.

Now, this is just a completely tautologous idea because you can *only* do this by *already* having a $+15^0$C ground temperature in the first place! I mean this is *the definition* of tautology! Of circular reasoning! It *should be* in the dictionary under the heading of tautology! And as Alan Siddons has pointed out, a tautology such as this should lead to run-away heating or perpetual energy machines if it was actual physics that could be engineered.

And as I have tried to explain in the paper, the GHE only comes out of a model such as this – that's *why* the model is demonstrated...because it *is* the model that produces the radiative GHE, and the model itself is inherently tautologous. That much is known by us all and has been by Alan Siddons for quite some time.

What I have done a little further is to show that the mathematics describing this model are inherently self-contradictory and nonsensical, and meaningless. It might be math, but it is *made up*, and, it contradicts itself and leads to nonsensical solutions. It might look like physics, but it just isn't. You may write 2+2=5 in as fancy of way as you want…and that's exactly what they've done. But, it isn't real.

And also the comparison to a solar photosphere plane-parallel model, which works because it is a valid approximation/model of the photosphere, because of the available physical & geometric symmetries, but the such of which are *not* present in the terrestrial case.

Authors Note

It should be obvious to any competent physicist what remaining, and new, questions need answering after this establishment of a realistic and non-fictional paradigm for understanding the terrestrial atmosphere. Experimental evidence would be a good place to start – but *real* experimentation, not just the stringing together of random words to form the meaningless sentence "The atmosphere is warm because of the greenhouse effect.", as if that means or proves *anything*. The experiment discussed in this paper should be sufficient, but I really do think the result will be null given that if there *were* a way to passively amplify radiative energy into a higher flux density while conserving or even increasing the surface area of its impingement (which mathematically *must* decrease the flux density and temperature by definition), it would have been discovered and engineered *long* ago.

But this leads us to an even larger, and in general much more important, problem in popular scientific discourse, and our human ability to even comprehend anything at all. The problem lies with definitions of terms and the simultaneous perception of their meaning. I will demonstrate the problem by using a colloquial and very common term which most people should be familiar with, no matter of educational class: "Climate Change Denier". This term is not offensive, for me, due to the connotations of holocaust denial – if that is *really* how or why the term was originally concocted, it is clearly enough to tell you that that someone feels very emotionally defensive about their beliefs in anthropogenic climate change. Rather, the term is much more offensive on a fundamentally intellectual and academic level: 1) the skeptic community of proper scientists has never denied the existence of climate change, 2) climate change is not synonymous with human influences, a-priori, 3) climate change is well-known to have always occurred in all time-scales and periods that humans have data for, 4) the only thing that one *can actually* deny about the climate is that it would be changing right now without human influence. The abuse and insult to logic by users of this term *should be* enough for any rational person to dismiss their claims out of hand, with no further justification necessary. A person simply *cannot* be a competent thinker and use this term with intention; nor could one have competent scientific values or principles in using this term while knowing what fraud it is.

Now, I used the term "day-time and night-time denial" within this paper, but I can use that term without compromising my conscience because that is what the atmospheric GHE model *actually really does*...it *really actually does* deny that there is such a thing as day and night on this planet

Earth. And as we have seen, it is only within the aberrations of this denial that one can create a model with a back-radiative atmospheric greenhouse effect. No compromise of my conscience, principles, or logic can occur in explaining what I have above, because no twist of the truth is necessary. I can only conclude that the language and definitions and terms used in the swath of so-called climate change science has somehow degraded to a point where it is actually no longer possible to have any semblance of a rational and aware discourse at all. Some properly rational person should conduct a study into just how such an abuse of otherwise rational language came to develop.

Another example is the term "greenhouse effect" itself. Very few people seem to be aware that what we call the "greenhouse effect" in the atmosphere is not actually the same thing as the "greenhouse effect" in a real greenhouse building[1]. That puts one automatically into the contention that, if you explain that there is no radiative GHE in the atmosphere, then people will respond with the confusion over the greenhouse effect in a real greenhouse which everyone knows really does exist, but without actually knowing *why* it exists. Isn't that just a wonderful example of misdirection? It is as if when you enter into discussion on global warming you enter a bizarro-world-opposite-land where terms and definitions mean either the opposite of what they should logically mean, or completely alternative things entirely.

Call it academic illiteracy. The act of reading is not sufficient qualification for being classed as literate: *comprehending* what is read is what is in the domain of actual human cognition. Such is, and will continue to be, impossible, so long as such abuse of language, reason, and the scientific method, is allowed to persist.

I would like to thank *Principia Scientific International* for their kind assistance with this text, its review, and its publication; however, any errors in the text are mine alone.

[1] Please see my previous paper, kindly hosted by Hans Schreuder at: http://www.ilovemycarbondioxide.com/pdf/Understanding_the_Atmosphere_Effect.pdf for discussion of the actual physics inside a real greenhouse.