

Is the Greenhouse Effect a Sky Dragon Myth?

A Dialogue with the Authors of Slaying the Sky Dragon

Dr D Weston Allen – meet the author [here](#) 10/10/12

INTRODUCTION

My book, [The Weather Makers Re-Examined](#), published in 2011 by Irenic Publications, was a comprehensive and damning critique of Tim Flannery's alarming best seller which claimed 'we are *The Weather Makers*'. I now examine *Slaying the Sky Dragon* (SSD), a full frontal attack on the greenhouse theory or 'sky dragon' by eight authors who refer to themselves as the '*Slayers*' (p.358) – a term I adopt when referring to them. This 358 page book was published in 2011 by Stairway Press in WA (USA).

Defining the sky dragon

The 'greenhouse theory' gradually evolved from the seminal work and limited understanding¹ of [Joseph Fourier](#) in the 1820s, John Tyndall in the 1860s, [Svante Arrhenius](#) in 1896-1908, [Guy Callendar](#) in 1938 to [Gilbert Plass](#) in the 1950s. It holds that solar radiation penetrates Earth's atmosphere to reach the surface which is warmed by the absorption of this electromagnetic energy. The warmed surface emits infrared radiation, and much of this outgoing longwave radiation (OLR) is intercepted by trace gases in the atmosphere. Some of this energy is radiated back to Earth's surface where it is absorbed as thermal energy, thus enhancing solar warming of the surface by day and slowing cooling by night. Since glass on a greenhouse also absorbs and re-radiates infrared (IR) radiation, this atmospheric phenomenon became known as the 'greenhouse effect' (GHE), and the trace gases are referred to as 'greenhouse gases' (GHG).

As real greenhouses work primarily by limiting convection, and GHGs by promoting it, SSD refers to them as 'IR-absorbing gases'. Comprising less than half of one percent (0.5%) of Earth's atmosphere, these gases are scattered somewhat unevenly through the atmosphere and across the globe. Most of the GHE, particularly over the tropics, is due to water vapour (H₂O) and clouds in the [troposphere](#), the bottom layer of the atmosphere where convective mixing and weather occurs. The [tropopause](#), separating the troposphere from the stratosphere, increases in altitude from about 8km over polar regions to about 17km over the tropics. Above the stratosphere is the cold mesosphere (about 50-85km altitude) and then the very warm thin thermosphere which merges into the exosphere (at 350-800km altitude depending on solar activity). The troposphere contains about 80% of the mass of the atmosphere and the top of the atmosphere (TOA) is generally considered to be about 100km above Earth's surface.

Without any IR-absorbing GHGs in the atmosphere, all radiative energy losses balancing solar input would occur at Earth's surface. According to the laws of radiation, the average temperature at the surface would then be about -18°C, nearly 33°C colder than the observed mean value. While IR is radiated to space from the surface and atmosphere, the average loss occurs where the temperature is actually -18°C at an altitude of around 5km. The more GHGs in the atmosphere the higher this average radiative layer; and since the temperature below it increases by about 6.5°C/km (the lapse rate), the higher this layer the higher the temperature at Earth's surface. This critique will examine only the basics of this very complex subject.

Setting the stage for the battle

We know that carbon dioxide (CO₂) has been accumulating in the atmosphere for several centuries, particularly over the past fifty years; and it is generally considered that the main reason is the burning of

fossil fuels. This increase in atmospheric level and its greenhouse effect is widely thought to be a significant factor in the global warming observed over that time. Global warming also results in increased evaporation and atmospheric water vapour; and this is thought by mainstream climatologists to produce a positive feedback cycle which increases the 'climate sensitivity' to a doubling of atmospheric CO₂ from about 1°C (without feedbacks) to about 3°C (1.5-4.5°C). While 'alarmists' accept this without question and often push the figure much higher, sceptical scientists (e.g. Richard Lindzen and Roy Spencer) argue that the models are too sensitive to CO₂; that the net feedback is negative due to increased evaporative cooling and cloud cover, and that climate sensitivity is therefore less than 1°C. Such sceptical scientists do not deny the greenhouse effect or question *whether* human activity is warming the planet, but only by *how much*.

Since global warming became apparent and political in the 1980s with the birth of the Intergovernmental Panel on Climate Change (IPCC), attitudes and positions have become increasingly polarised. The 1992 Rio Earth Summit's cleverly contrived definition of 'climate change' as being 'anthropogenic change *only*' resulted in two opposing groups of deniers: those who deny any prehuman 'climate change' and those who deny any manmade climate change. While the former imagine a runaway greenhouse catastrophe, the latter deny any greenhouse warming at all. We thus have extreme alarmists and extreme sceptics.

Slayers of the sky dragon

The authors of *Slaying the Sky Dragon* are firmly in the latter camp. They don't deny climate change, only man-made climate change; but they do deny any greenhouse effect or greenhouse gas. Indeed, they claim that all IR-absorbing gases including water vapour have only a *cooling* effect. They deny any human contribution to global warming; and they refer to those who regard such warming as real but fairly trivial, compared to natural variability, as 'lukewarmers' or 'lukes'. This author happily confesses to being a 'lukewarmer' aligned with neither extreme.

Setting out to slay a sky dragon that they don't believe exists; the Slayers confidently seek to engage the enemy. Presumably speaking for the whole team, Hans Schreuder laments:

The authors would much like to exchange ideas about the scientific basis upon which human-caused climate alarm is based, but sadly no debate – through no fault of the *Slaying the Sky Dragon* authors – has ever been entered into. Despite many detailed written exchanges, no scientific debate has ever been held between truly scientific skeptics and the obviously unscientific alarmists; only between the alarmists and the lukewarm skeptics, all of whom subscribe without question to the concepts of a 'greenhouse effect', 'greenhouse gases' and 'radiative forcing' (p.209).

Perhaps the Slayers might have more luck entering into such a debate if they refrained from *ad hominem* attacks and calling would-be opponents '**obviously unscientific**', '**academic eggheads**' (p.52). They could also show more willingness to exchange ideas and concede points rather than debating opponents to score points. Schreuder thinks lukewarmers simply have the wrong winning strategy: "**Human-generated greenhouse gases are warming the earth but not as much as alarmists say' never was a good debating strategy for skeptical academics and it's probably too late for them now.**" (p. 223)

There is a great deal in SSD with which I wholeheartedly agree, much of which I ignore in this critique. On the other hand, I found many arguments that reveal misunderstandings, misrepresentations, errors or half-truths. There are also contradictory statements by different authors and sometimes by the same author. These include fundamental differences on how the atmosphere is heated and how it radiates that heat.

I have learnt a lot about atmospheric physics while critiquing this book, and I am grateful for that. I am also grateful to Professor Will Happer and Vincent Gray for their assistance. I also thank John O'Sullivan and

other SSD authors for their helpful feedback (see Appendix), for detecting several errors and for prompting the revision of some sections of this critique.

The chapters in *Slaying the Sky Dragon* are authored as follows:

Chapter	Pages	Author	Background
1 & 11	1-3, 85-162	Tim Ball	Emeritus Professor of Climatology, University of Winnipeg
2-10	5-83	Alan Siddons	Former Radio Chemist, now a science writer
12	163-187	Martin Hertzberg	Former US Naval meteorologist, PhD in Physical Chemistry
13-16	189-237	Hans Schreuder	Retired analytical chemist (http://ilovemycarbondioxide.com)
17	239-258	Joseph Olson	Retired civil engineer, now a science writer
18-19	259-312	Claes Johnson	Professor of Applied Mathematics, Royal Institute of Technology, Stockholm, Sweden
20	313-335	Charles Anderson	Materials Physicist with PhD from Case Western Reserve University
21	337-352	John O'Sullivan	Legal analyst and anti-corruption specialist

The above colour code applies to quotes throughout the text to highlight the relevant SSD author. With eight authors, many going over the same ground, the book tends to be repetitive and somewhat disorganised. Therefore, rather than going through the book from cover to cover point by point, I will examine it in a semblance of order based on the various arguments presented in the book, as follows:

1. THE BASIC SCIENCE	Page
a. Earth's Atmosphere and Greenhouse Gases	5
b. Electromagnetic and Thermal Energy	10
c. How Real Greenhouses (and Blankets) work	13
d. Tropical Rainforests and Deserts	15
e. The Atmosphere on other Planets	16
2. GREENHOUSE THEORY & MODELS	
a. Back-Radiation and Recycling of Energy	20
b. The Simple Educational or 'Standard' Model	23
c. Earth's Energy Budget	30
3. CARBON DIOXIDE & CLIMATE CHANGE	
a. Is Increased CO ₂ Anthropogenic or Natural?	35
b. Does CO ₂ produce Warming or does Warming produce CO ₂ ?	37
c. Are there are Other/Better Explanations for Global Warming?	41
d. Is Global Warming still Happening?	46
4. HAS CLIMATE SCIENCE BEEN CORRUPTED?	49

There is also a Summary and Conclusion on page 57, followed by References and Appendix (A, page 60) of email dialogue with the authors and (B, page 79) Vincent Gray's critique of SSD. The purpose of this critique is to see whether SSD accurately presents the science relating to the greenhouse theory and whether that theory is consistent with our understanding of physics and with empirical evidence. Is the greenhouse theory valid or a sky dragon myth? I first outline the key arguments found in SSD.

Arguments presented in Slaying the Sky Dragon

The atmosphere is warmed primarily by *conduction*, not by radiation; and so the major atmospheric gases (nitrogen and oxygen) are more likely to warm the trace IR-absorbing gases than visa-versa. The major gases also absorb and emit some IR radiation.

The IR-absorbing gases simply *scatter* IR radiation or otherwise pass any absorbed energy on immediately.

These trace gases absorb more solar radiation than OLR and thus *cool* Earth's surface; so they are *not greenhouse gases*; it is *water vapour* that makes tropical rainforests cooler than tropical deserts.

The glass on a greenhouse works *only* by limiting convection, not by back-radiation.

There is no such thing as *back-radiation* (no empirical evidence for it) and the postulated recycling of energy between Earth's surface and the atmosphere is a non-physical '*amplification*'.

Atmospheric IR radiation cannot affect Earth's surface temperature because heat cannot flow from the *cooler* atmosphere to the *warmer* surface in violation of the second law of thermodynamics.

Every planet with an atmosphere has a surface temperature higher than predicted; and the surface temperature of such planets rises in direct proportion to atmospheric pressure.

The lapse rate (declining temperature with altitude) is determined by gravity and the specific heat of the atmospheric gases, not by their ability to absorb IR radiation.

The GHE is supposed to *increase* lapse rates, but Earth's lapse rate (6.5K/km) is lower than predicted (9.8K/km), so the greenhouse theory is wrong.

Since emissions occur at *the TOA* at a mean altitude of 5km (where it is -18°C), the lapse rate alone explains the fact that Earth's effective blackbody temperature is 33°C below its surface temperature (15°C).

Based on a surface emissivity of '*about 0.7*', a GHE is not needed to balance Earth's energy budget.

Averaging Earth's energy budget over day and night in *flat earth* climate models is fundamentally flawed, and this invalidates all climate models.

Human emissions of CO₂ are not a problem since more than 98% is absorbed within a year.

Historically, temperature rises precede atmospheric CO₂ increases; so global warming produces more CO₂, released from warming oceans, never the opposite.

Increased geo-nuclear activity is warming the oceans from below and causing global warming.

Global temperatures have been going down rapidly.

The critical issue is not *climate sensitivity* (to a doubling of atmospheric CO₂ levels) or *how much* global warming is due to CO₂, because *none* of it is.

There is no empirical evidence for a GHE but ample evidence against it, as provided in SSD and at their website: [Principia Scientific International](#).

1. THE BASIC SCIENCE

a. Earth's Atmosphere and Greenhouse Gases

Schreuder: *“Carbon dioxide has no climate forcing effect and is not a greenhouse gas and, for that matter, neither is water vapour.”* (p.199)

The atmosphere is approximately 78% nitrogen (N₂), 21% oxygen (O₂) and 0.93% argon (Ar) – the three major gases. Greenhouse gases (GHGs) comprise less than 0.5% of the atmosphere. Argon is 24 times more plentiful than carbon dioxide (CO₂), which comprises just 0.039% of the atmosphere. The dominant GHG is water vapour, comprising 1-4% of molecules near Earth's surface and about 0.4% over the full atmosphere. Including clouds, it is thought to account for at least 75% of the GHE (67% in a cloudless sky); CO₂ for about 19% (24% in a cloudless sky) and nitrous oxide (N₂O), methane (CH₄) and ozone (O₃) for the remaining 6% (9% in a cloudless sky).² By far the most potent GHGs are the manufactured CFCs and other fluorides (e.g. NF₃, SF₆ used in the manufacture of solar panels), but their concentrations are insignificant.

SSD states that all atmospheric gases can absorb and emit IR radiation

Anderson: *“. . . small amounts are absorbed by oxygen, nitrogen, carbon dioxide and other IR-absorbing gases . . . nitrogen, oxygen, and argon, radiate IR radiation.”* (p.321, 323) Siddons: *“Moreover, 100% of this heated atmosphere is radiating IR towards the earth.”* (p.48)

The molecular structure of the major gases (**N=N**, **O=O**) does not permit asymmetric stretching or bending; so their dipole moment or electrical polarity cannot change; and so they can neither absorb nor emit IR radiation at atmospheric temperatures.

SSD states that CO₂ does not absorb IR radiation at all but merely scatters it – instantly

Schreuder: *“Carbon dioxide is not a greenhouse gas: it does not absorb and store infrared or near infrared in a way a sponge absorbs water and it does not transmit [he clearly means ‘absorb’] visible light – it is transparent to visible light. Any energy that hits a carbon dioxide molecule will create, at the same instant, an equal and opposite emission spectrum, giving the casual observer the false illusion that energy has been ‘absorbed’, whereas it has merely been scattered.”* (p.212, Emphasis mine)

IR-absorbing molecules such as CO₂ (**O=C=O**) can be asymmetrically stretched (**O=C= O**) or flexed (**O=C=O**) by specific wavelengths of IR radiation that change their dipole moment and vibrational state as shown [here](#). The most common greenhouse warming of CO₂ is the first vibrationally excited bending mode. The vibrational/rotational state of IR-excited H₂O molecules is shown [here](#). Electromagnetic (EM) energy is thus converted to vibrational/rotational energy. As the energised molecule rapidly returns to its normal state, this energy is released as IR radiation of the same absorbed wavelength. The random orientation of molecules means that this radiation is emitted in all directions from numerous molecules in a given space, *giving the false illusion that it has been merely scattered, whereas it has been absorbed and re-emitted.*

In a thin layer of atmosphere, less than 1.6% of Earth's radius, all radiation directed parallel to Earth's surface or outwards will escape to space unless intercepted by another IR-absorbing molecule; and all other radiation will reach Earth's surface unless intercepted by another such molecule, which may re-radiate it; so nearly half of the absorbed EM energy is re-radiated or back-radiated towards the surface. As shown later, virtually all of this EM energy reaching the surface is absorbed and converted to thermal energy.

SSD then admits that CO₂ can absorb IR radiation, but will instantly dissipate any heat gained

Schreuder: *“Some of the energy that hits the carbon dioxide molecule may well increase the temperature of that molecule . . . but that gained heat . . . will also be instantly dissipated by means of conduction with surrounding air molecules.”* (p.212, Emphasis mine)

Clearly, a CO₂ molecule can't both scatter and absorb an IR photon; nor does it *instantly* re-emit it or dissipate the absorbed energy. In the fraction of a second it takes to re-emit IR radiation, the excited/vibrating CO₂ molecule can collide with a cooler (less energetic) molecule (most likely nitrogen or oxygen) and pass on its vibrational energy as either vibrational or translational kinetic energy, heat being the transfer or flow of this thermal energy. As Anderson points out on page 327, collision frequency at sea level is about 6.9 billion per second, decreasing with altitude; so collisions dominate energy transfer from IR-excited molecules in the lower atmosphere and radiation dominates in the thin upper atmosphere where collisions are less frequent.

SSD can't agree on which gases excite which

Anderson correctly states: *“This phenomenal number of collisions spreads the IR energy absorbed by a water molecule or a CO₂ molecule near the ground to the dominant nitrogen and oxygen molecules very, very quickly.”* (p.328) But Siddons postulates: *“Considering, then, that CO₂ is only able to intercept about 8% of the earth's heat rays in the first place, and is outnumbered 2600 to 1, it's obvious that the majority gases excite trace gases far more than the other way around.”* (p.47) Water vapour has a far broader IR absorption spectrum than does CO₂ and is outnumbered only about 30 to 1 near the moist tropical surface. The situation is quite different in the upper atmosphere, where energy is transferred back from the major gases to those able to radiate IR to space; and so GHGs warm the lower atmosphere and cool it higher up.

SSD can't agree on how the atmosphere is warmed

Siddons says *“. . . it gets heated directly, not radiatively.”* (p.47) Schreuder can't quite make up his mind: *“The atmosphere is mostly warmed up from the heat that radiates off the surface of the earth”* (p.200) but *“Air is hardly warmed up by direct solar radiation (or any other radiation. . .) but is receptive to gaining or losing heat by means of conduction”*. (p.211) Martin Hertzberg accepts that *“. . . the colder atmosphere above”* absorbs infrared radiation *“emitted by the warmer atmosphere below”* but insists that *“. . . the flow of radiant energy from both the earth's surface and its atmosphere is entirely outward toward free space. . . . All the radiant flux is outward toward free space.”* (p.181-2)

Solar radiation heats the thermosphere (to over 1,000°C) and also the stratosphere, where the high-frequency UV radiation splits O₂ molecules into O⁻ ions, creating ozone (O₃) which absorbs more UV as well as some IR radiation. The troposphere, on the other hand, is warmed primarily from the bottom by conduction/convection and also by IR radiation from Earth's surface, which is warmed by solar radiation. The IR-absorbing gases *alone* permit the atmosphere to be warmed by this outgoing longwave radiation (OLR). Convection carries sensible heat and latent heat into the troposphere, where the latter is released as water vapour condenses. As shown later, some of this energy is indeed radiated back to the surface.

SSD insists that, by absorbing solar radiation, IR-absorbing gases *only cool* Earth's surface

Siddons correctly states *“. . . that IR-absorbing gases reduce the amount of radiation we receive from the sun.”* (p.44) Anderson goes further: *“IR-absorbing gases have a cooling effect on the ground.”* (p. 321)

And Olson declares: ***“Any radiation absorbed on its way to the Earth, never can warm the surface and can never be re-radiated at night.”*** (p.245) As shown later, this would soon result in Snowball Earth.

The emission spectra for the Sun and Earth are shown in Figure 1.1 (Figure 3 on page 307 of SSD) and the absorption spectra of the main greenhouse gases are shown individually and collectively in Figure 1.2 (similar to Fig.2 on page 326 of SSD). These are combined in Figure 1.3, where the functions are scaled to have equal area to represent Earth’s radiation balance, the surface area for energy loss from a spherical planet being four times that of its solar input. Note that the solar IR spectrum barely overlaps Earth’s IR spectrum (at around 4µm); that the absorption bands are narrower in the solar IR spectrum (0.7-4 µm); that most solar IR absorption occurs where the radiative flux is low (at around 2-3µm) whereas most OLR is absorbed where the flux is high; that the atmosphere therefore absorbs more OLR than solar IR over each full day; and so these gases should reduce surface cooling more than they reduce solar warming.

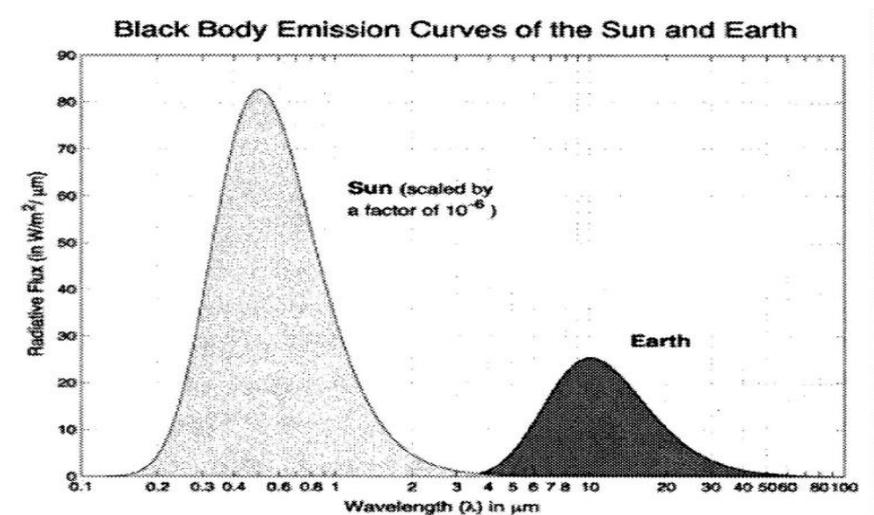


Figure 1.1 – From Figure 3 on page 307 of SSD

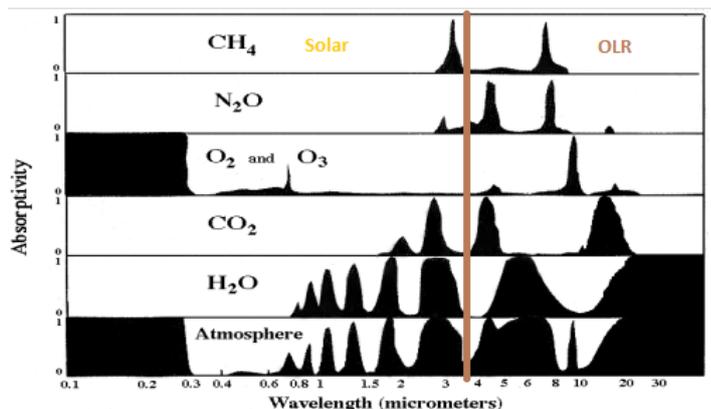
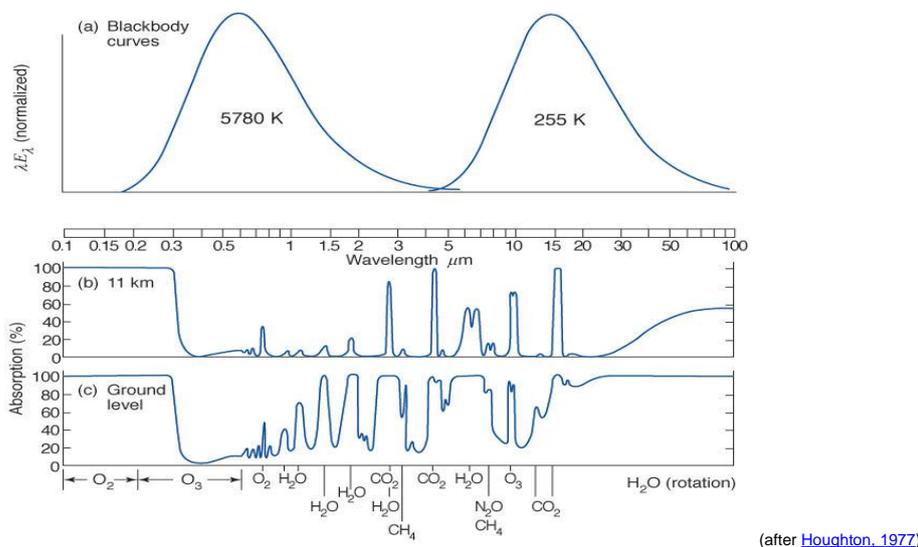


Figure 1.2: Absorption spectra of atmospheric gases individually and collectively (bottom). Solar IR is predominantly to the left of the red line and Earth’s OLR to the right of it. (1 micrometre µm = 1,000nm)

Source: http://www.atmos.ucla.edu/~liougst/Lecture/Lecture_3.pdf

Olson correctly states: ***“Carbon dioxide can absorb infrared sunlight only within two narrow spectrum bands. One of these bands is shared with water vapour, so this amount of radiation would be absorbed in the atmosphere regardless of CO₂ content unless there was zero humidity.”*** (p.245) Since CO₂ thus absorbs very little solar IR (low flux at 2-3µm) and a great deal more OLR (near peak flux at about 15µm), its warming effect exceeds its cooling effect by day (see Figs. 1.2 & 1.4). Since water vapour absorbs much more solar IR, it may well have a net cooling effect by day; but both gases reduce surface cooling by night.



**Figure 1.3: Top (a) – Blackbody spectral curves for the Sun (left) and Earth (right), scaled for energy balance
Middle (b) – Absorption spectra at 11km altitude
Bottom (c) – Absorption spectra for various greenhouse gases at ground level**

Whereas Anderson asserts that this absorption of solar radiation “. . . *is very cavalierly disregarded by strong greenhouse gas-effect advocates*” (p.319), mainstream scientists have long put it at about 19%, and recently increased it to nearly 23%. Just over half of this is in the UV and visible wavelengths, absorbed by stratospheric ozone, and by clouds and aerosols respectively (Fig. 1.4, similar to Fig. 1 on page 322 of SSD). An excellent summary of atmospheric absorption of solar radiation can be found [here](#).

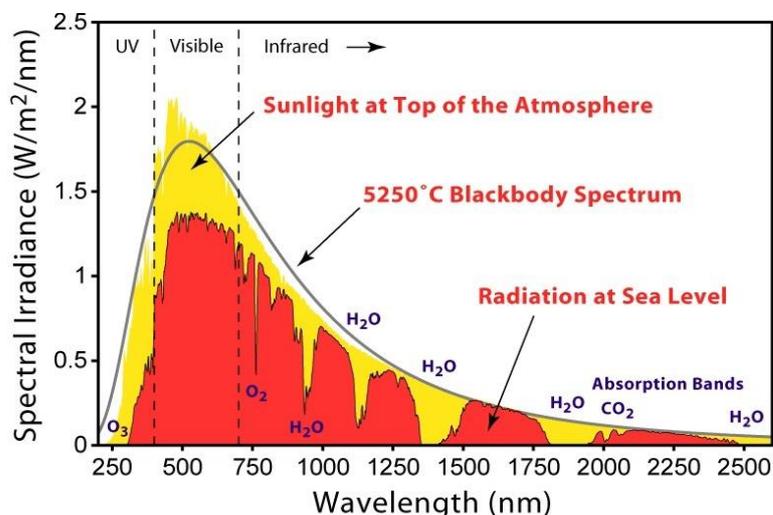


Figure 1.4: Solar Radiation Spectrum at Top of the Atmosphere (yellow) and at Sea Level (red).

Source: http://en.wikipedia.org/wiki/File:Solar_Spectrum.png

SSD can't agree on back-radiation

Schreuder admits: *“Thus only about 35% (at best) can be directed back to where it came from”* (p.194). Anderson also admits backradiation on page 328; but Johnson says it is *“. . . a reality-free, fictitious unphysical phenomenon.”* (p.281) And Siddons asserts: *“. . . just as there is no such thing as ‘back-convection’ . . . there’s no such thing as ‘back-radiation’.”* (p.55) He says *“. . . there are at least two versions of the greenhouse heating effect: back-radiation vs. reduced radiative cooling, neither of which has evidence to support it.”* (p.51)

His *two versions* are actually one and the same: backradiation reduces radiative cooling. And there is ample empirical evidence for atmospheric backradiation, as shown in Figure 1.5. The absorbed radiation bands visible from above can be seen from below radiating those same frequencies back to Earth. If this was convected heat, the same radiation bands would be increased both up and down.

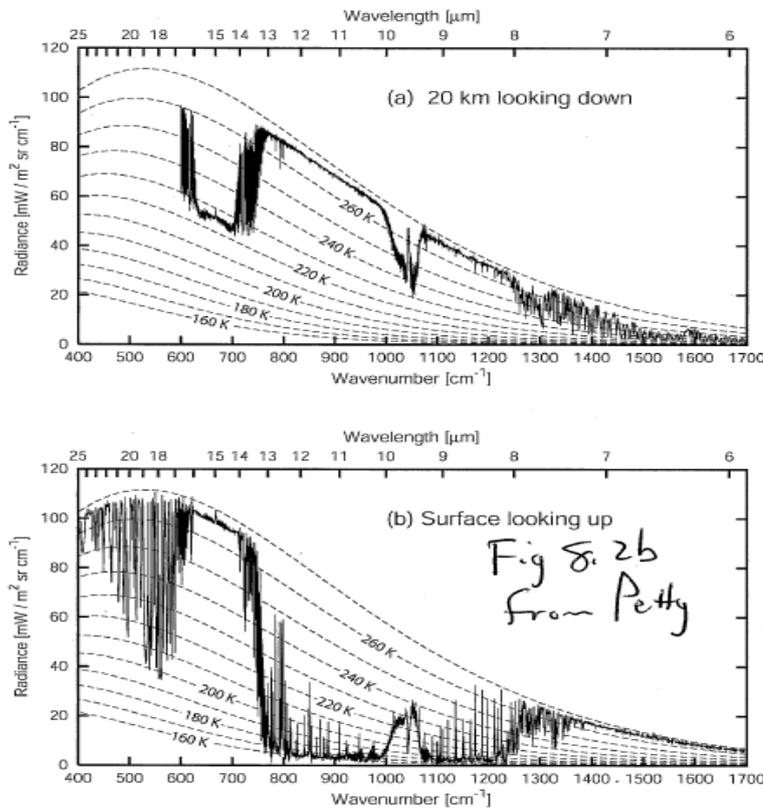


Fig. 8.2: Coincident measurements of the infrared emission spectrum of the cloud-free atmosphere at (a) 20 km looking downward over the polar ice sheet and (b) at the surface looking upward. (Data courtesy of David Tobin, Space Science and Engineering Center, University of Wisconsin-Madison.)

Figure 1.5: Absorption bands from above and below, as frequency (not wavelength)

Backradiation depends on the upper tropospheric temperature and the relative proportions of the various greenhouse gases in the atmosphere, as illustrated in Figure 1.6. Backradiation is thus much greater over the humid tropics, whereas absorption/backradiation bands for CO₂ (wave numbers 600-700/cm) and ozone (1000-1100/cm) are more prominent over the drier arctic regions.

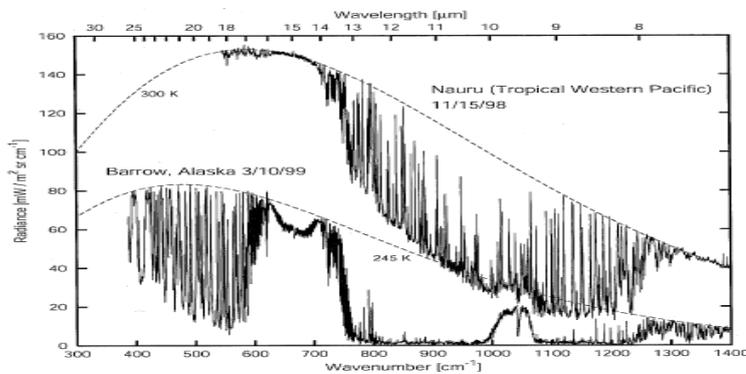


Fig. 8.1: Two examples of measured atmospheric emission spectra as seen from ground level looking up. Planck function curves corresponding to the approximate surface temperature in each case are superimposed (dashed lines). (Data courtesy of Robert Knuteson, Space Science and Engineering Center, University of Wisconsin-Madison.)

Figure 1.6: Observed atmospheric longwave radiation at ground level: Tropics (top) & Arctic (bottom)

b. Electromagnetic and Thermal Energy

Slayers are united and adamant that *back-radiation* cannot warm Earth's surface because heat *cannot flow* from a cooler atmosphere to a warmer surface

Schreuder puts it thus: *“. . . thermal energy cannot flow into itself, only into something that has less energy than itself. That's a law of nature”*. (p.216) Johnson wants to *“. . . distinguish between the two-way propagation of waves and the one-way propagation of heat energy by waves.”* (p.286 & 292).

Radiation (i.e. backradiation) is *not* 'thermal energy' or 'heat energy' and it does not *flow*. It is electromagnetic (EM) energy and it travels across empty space at the speed of light. It has two basic qualities:

1. **Frequency** (f), proportional to velocity (v) and inversely proportional to wavelength (λ):

$$f = \frac{v}{\lambda} \cdot \text{ or in a vacuum } f = \frac{c}{\lambda} \cdot \text{ where } c \text{ is the speed of light}$$

The wavelength determines the type of EM radiation. The shortest (highest frequency) is gamma radiation, followed by x-rays, ultraviolet (UV), visible light, infrared (IR), microwaves and radio waves are the longest (lowest frequency). EM radiation sometimes behaves as particles or photons, the energy of each photon being proportional to wave frequency. Claes Johnson not only denies this duality of EM radiation, but even asserts that *“. . . climate alarmism . . . is ultimately based on viewing radiation as streams of particles.”* (p.282)

2. **Radiative flux density** or power per unit area, usually measured in W/m², and sometimes referred to as intensity (**I**). It increases in proportion to the emitting source's temperature (**T**) to the fourth power, according to the Stefan-Boltzmann (S-B) equation: $I = \sigma T^4$ (W/m²) where **T** is in Kelvin (K) and σ is the Stefan-Boltzmann constant: $\sim 5.67 \times 10^{-8}$. And it decreases in proportion to the distance from the source squared, so it declines rapidly with increasing distance. Solar radiation on Mercury is therefore much stronger than on Venus or Earth.

Johnson talks of a *“. . . radiated spectrum . . . with all colours having the same temperature”* (p.303) and Siddons proposes that *“. . . if the signal emitted by a hundred degree body is directed back to it, the body 'reads' a hundred degree signal and responds accordingly, i.e., its temperature remains the same. . . the light an object emits is a temperature signal.”* (p.11)

All objects above absolute zero (zero K) emit EM radiation, mostly as IR but also as visible light as the temperature increases from dark to red-hot to white-hot; but the idea of 'temperature signals' in radiation is novel to say the least. The wavelengths emitted by an object radiating as a blackbody usually follow a bell-shaped curve (illustrated in Fig. 1.1). The higher the temperature the more the bell moves towards the shorter wavelengths. In Chapter 19, Johnson illustrates Wien's Displacement Law in his Figure 1, showing how the 'cut-off frequency' shifts to shorter wavelengths as the temperature of the source increases. The source, however, does not have to be hot to emit visible light (e.g. light-emitting diodes) or UV (lamps). Even in nature we find bioluminescence at the bottom of the ocean where it is very cold.

Johnson thinks *“. . . climate scientists focus on radiation only”* (p.265). He focuses on *conduction*, however, and sometimes fails to differentiate them: *“In radiation/conduction, increased heat transport couples to increased lapse rate”* (p.266). Schreuder likewise confuses them on page 190 of SSD.

Radiation and conduction transfer different forms of energy differently:

In **conduction**, *thermal energy* flows in **one direction** only, from warmer to cooler, and so a cold object **hastens** the cooling of a warmer one in contact with it.

In **radiation**, EM energy is transferred simultaneously in **both directions** between two separated emitting objects or regions, so that each **reduces** the radiative loss of the other.

A relatively warm object (e.g. clouds at $0^{\circ}\text{C} = 273$ Kelvin) surrounding an even warmer one (e.g. a planet at $15^{\circ}\text{C} = 288\text{K}$) thus **reduces** energy loss from the latter to space. While there is a net flow from warmer to cooler, the radiative loss from the warmer surface to outer space is reduced by the inward radiation from interposing clouds, which both emit and reflect IR radiation. That is why you need to rug up more when outdoors on a clear winter night than on an overcast one.

The temperature response is determined mainly by the intensity of the EM energy and also by the surface characteristics in relation to wavelength. Many stars are hotter than our Sun and radiate at higher frequencies (shorter wavelengths), but the intensity of their light and impact on Earth is negligible. Radio waves, on the other hand, are very long (measured in metres rather than nanometres) and yet we use them at high intensity in medicine to ablate or destroy tissue. A corollary of [Kirchhoff's law](#) of thermal radiation is that a surface that is a good emitter of specific wavelengths is also a good absorber of those same wavelengths. Since Earth's surface emits and receives backradiation of the same IR wavelengths, it will absorb virtually all backradiation that impacts it.

If an object is radiating energy of the same intensity as it is receiving (and absorbing), energy lost will equal energy gained. It is in thermal equilibrium and there is no net transfer. But that does not mean there is no transfer, as Siddons asserts: *“. . . if the earth were a self-luminous body radiating the same 1368 watts per square meter the sun aims at it, nothing would happen. No heating would occur and there would be no transfer of energy. . . . an energy transfer can only occur where a difference exists.”* (p.8-9) Supposing Earth did emit 1368 W/m^2 , solar irradiation would continue – it doesn't stop when it sees a warm object ahead. Nor does the warm object stop radiating energy when it sees equivalent radiation coming. There may be no NET transfer of energy, but that doesn't mean there is 'no transfer of energy'. Moreover, since 30% of solar radiation is reflected into space by Earth's atmosphere, clouds and surface, it absorbs only about 960 W/m^2 of insolation and so would actually lose 408 W/m^2 of energy.

The [laws of thermodynamics](#) state that:

1. **Energy** can be transferred in form or location as heat or work but cannot be created or destroyed – it is **invariably conserved**. Electromagnetic energy, however weak or whatever the source, is transferred to any surface that absorbs it. No matter how many complex equations or convoluted arguments Slayers throw at it, backradiation cannot simply disappear when absorbed by a surface.
2. The energy not available for work (entropy) increases in any isolated system not in thermal equilibrium as it evolves toward thermal equilibrium. Thus, thermal energy always flows spontaneously as heat from regions of high temperature to those of lower temperature. Schreuder says this *“is the very essence of the second law of thermodynamics”* (p.208) and attacks those who apply the law to 'whole systems' (p.251). But the second part is a corollary of the first part relating to **entropy within an isolated system**, which Earth's surface-atmosphere is not, being cyclically impacted by solar radiation, magnetic flux and cosmic rays.
3. Entropy approaches a constant value as the temperature approaches absolute zero, at which point entropy also becomes zero.

4. The Zeroth law states that if two systems are in thermal equilibrium with a third system, they must be in equilibrium with each other. This law helps define the notion of [temperature](#).

Contrary to Schreuder's assertion that *"Radiant units do NOT combine in reality"* (p.217 Emphasis his), multiple sources of radiation do indeed have a combined effect on a surface that absorbs them. A black surface being irradiated by a nearby 200W incandescent bulb will increase in temperature if it is then also irradiated by an adjacent 100W bulb.

Atmospheric radiation likewise adds to the solar radiation warming Earth's surface during the day. Even at night there are multiple sources of radiation (from the atmosphere, clouds and Moon) combining at the surface to impact its temperature. To deny this is to deny the first law of thermodynamics.

In summary:

- Certain trace gases in the atmosphere can absorb and re-radiate IR from Earth's surface
- About half of this re-radiated EM energy is directed back to the surface = 'back-radiation'
- Backradiation from the atmosphere is based on sound scientific principles and empirical evidence – it has been observed and measured
- Having the same wavelengths as OLR, it is almost completely absorbed by Earth's surface according to Kirchhoff's law
- All EM radiation absorbed by an object is converted to thermal, electrical or chemical energy
- To deny this is to deny the first law of thermodynamics
- Energy from absorbed IR radiation increases the vibrational state of the molecules in a solid, and this thermal energy is measured as temperature
- Backradiation can add to solar radiation and thus enhance solar warming by day as well as slow the radiative cooling of Earth's surface by night
- This is the essence of the greenhouse effect (GHE) that renders Earth's surface warmer than expected from the Stefan-Boltzmann law of radiation

c. How real Greenhouses (and Blankets) work

The "greenhouse effect" is the warming of climate that results when the atmosphere traps heat radiating from Earth toward space. Certain gases in the atmosphere resemble glass in a greenhouse, allowing sunlight to pass into the "greenhouse," but blocking Earth's heat from escaping into space. ([NASA](#))

On page 43 of SSD, Siddons quotes Professor Robert Wood describing his greenhouse experiment over a century ago. Wood compared the temperatures in two black cardboard boxes exposed to the sun, one covered with glass, which absorbs and reradiates some infrared (IR) and the other with rock-salt, which doesn't. He found that the air in his rock-salt box got hotter faster because all solar IR went straight through. Siddons concludes: *“. . . greenhouses merely suppress convective heat-loss, preventing the heated air from dissipating. It's the air that's trapped, not radiation; glass's response to infrared (IR) has nothing to do with it. . . . any infrared radiation absorbed by the glass is immediately re-radiated (scattered in all directions) by that glass – it does not constitute a radiative barrier.”* (p.63)

Siddons fails to point out that the net effect of radiation being 'scattered in all directions' from a sheet of glass, is that nearly half is radiated from each surface and a tiny amount from the cut edges. The atmosphere, of course, has no edges. During the day, nearly half of the absorbed solar IR plus half of the absorbed outgoing IR would be radiated back into the greenhouse if the glass were not externally cooled by convection. At night, the glass absorbs outgoing IR radiation and radiates some back, thus reducing the radiative cooling that would occur with rock-salt or other IR-transparent material. Wood didn't carry his experiment into the night. Neither, unfortunately, did [Nasif Nahle](#) who replicated Wood's findings, which Slayers rely on as empirical evidence against a GHE. Vincent Gray¹ points out that:

Nobody seems to have noticed it is all different at night, or even when the sun is not shining. Then, the loss of heat by radiation and convection by the whole structure and its contents is reduced by the heat which is stored by the interior air. In addition the extra moisture in the air is deposited, releasing latent heat.

The glass therefore limits convection (by far the major effect) and also provides a partial radiative barrier (a very minor effect), rendering a greenhouse cooler by day and warmer by night than would an IR-transparent material. Siddons is thus correct in what he affirms, but wrong in what he denies. Moreover, his statement that *“. . . the selective absorptivity of glass became the very basis for the atmospheric theory,”* (p.44) is misleading. It may be the basis for the analogy but not for the theory itself.

Schreuder says: *“If glass lets visible wavelengths of sunlight in but doesn't let invisible long-wavelengths (infrared) out, thus raising the temperature inside, then glass thermometers have been misleading us for centuries.”* (p.209) Apart from the fact that conduction dwarfs radiation in the use of thermometers, Schreuder implies a disbelief in the IR-absorbing capacity of glass. Siddons likewise reveals his scepticism with a *'Thermal IR Image of a House, Showing IR Radiation Passing Through the Glass Windows.'* (p.64) As early as 1850, Melloni discovered that glass absorbs IR radiation. The amount of IR radiation absorbed by glass varies greatly according to the OH content in the melt and how it is melted; and the warmer the glass the more IR it can absorb. Transmittance curves for various types of glass can be seen [here](#).

The greenhouse analogy has weaknesses. Unlike the IR-absorbing gases interspersed throughout the lower atmosphere, greenhouse glass is a thin solid at the top that limits convection by day and stores very little heat for the night. But it does absorb and re-radiate infrared. Should we abandon a commonly used term because of a misconception about the primary function of glass in a greenhouse? If we are happy to use such terms as 'sunrise' (it doesn't rise), 'new moon' (it's not new) and 'melancholic' (it is not due to black bile), should we reject 'greenhouse' in relation to the atmosphere simply because the analogy is imperfect? I think not.

Blanket analogy

Stationary air is a poor heat conductor, and thus a good insulator. Blankets trap tiny pockets of air. After reminding us that 'the blanket effect' is a *"favourite expression used by climate alarmists and skeptics alike"* (p.196), Shreuder points out that a blanket keeps us warm by limiting convection, as does glass on a greenhouse. But he fails to mention that it also greatly limits heat loss by radiation, far more so than the glass on a greenhouse.

Shreuder also forgets about radiation when he says *"space is not cold. Space has no temperature"* (p.196) and *". . . earth is already enveloped in the perfect 'blanket': the vacuum of space."* (p.214) If he could step into space at night without a heated spacesuit, radiating 1,000 Watts (assuming average build), he would quickly feel very cold indeed. Space provides no barrier at all to heat loss by radiation; nor does 99.5% of Earth's atmosphere. Without a thin blanket of IR-absorbing gases, mainly water vapour, Earth's surface would be very much colder at night.

Analogies are never perfect, but that doesn't mean they shouldn't be used to help explain complex concepts.

d. Tropical Rainforests and Deserts

SSD presents these as evidence that water *vapour* cools Earth's surface by day and warms it at night by virtue of its heat capacity

Shreuder: “. . . *water vapour makes the tropics cooler during the day than it would be without the vapour. Just think of a dry desert and a tropical region at the exact same latitude (in Southern Africa for instance). Dry desert: hot during the day, cold during the night. Tropical region: cooler than the desert during the day, not as cold during the night.*” (p.197)

A desert in the tropics is of course a ‘tropical region’; but we can overlook that and accept that he is comparing dry and wet tropics. He further states: “*Water vapour has a huge capacity for latent heat (hidden heat) and that's the only reason that the tropics are so much 'warmer' at night than more temperate zones.*” (ibid) Forgetting about water on the surface and in clouds, Schreuder imagines that the heat held in the tiny percentage of water vapour in humid tropical air is all that keeps it warm overnight.

Forgetting about latent heat, he later asserts: “*At no stage though does water vapour add warmth to the atmosphere*” (p.200). An order of magnitude greater than the sensible heat in water vapour, latent heat does indeed *add warmth to the atmosphere* as it condenses to water droplets; and radiates this to the surface, as shown by cloud images in Figures 1.7 and 1.8.



Figure 1.7: Visible

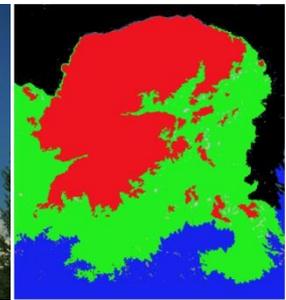


Figure 1.8: 10µm IR

Speaking of deserts, he says: “*Absence of water vapour allows more of the sun's radiation to reach the ground and thus create a warmer earth locally when compared to an atmosphere that holds greater water vapour and is at the same latitude.*” (p.214) Schreuder's comparison of the two climates is correct but his reason is almost entirely wrong. Since desert sands reflect about 40% of solar radiation while rainforests reflect less than 15%, and photosynthesis in the forest accounts for only about 1% of solar radiation, deserts should be much cooler than rainforests.

It is not water *vapour* but *water itself* that makes the difference. Every gram evaporated requires 540-600 Calories. Evaporative cooling from plants (evapo-transpiration), pools and soil, increasing by 5.7% with every degree Celsius,³ is what keeps the wet tropics much cooler than a desert by day. The heat used in evaporating water becomes the ‘latent heat’ in the water vapour. With extensive absorption bands and high ‘specific heat’, this water vapour absorbs yet more heat from IR radiation near the surface (Fig. 1.3). This heat is transported by convection high into the troposphere, where the latent heat is released as it reaches the dew point temperature at altitude (or at night) and forms cloud droplets (or fog). And the only way that heat can return to the tropical surface is via IR radiation. Failing to appreciate the role of evaporation and condensation, Schreuder also fails to differentiate [latent heat](#) from [specific heat](#), water's capacity to hold and transfer large amounts of [sensible heat](#). Olson clarifies this on page 250.

The nights are warmer in wet tropics because of *water*: more surface water and water-laden vegetation (retaining sensible heat), more water vapour (sensible heat, latent heat and IR-absorption with backradiation) and more clouds (emitting IR and reflecting OLR).

Saying that water *vapour* is ‘the only reason’ the wet tropics are so much warmer at night indicates that Schreuder doesn't know how much he doesn't know.

e. The Atmosphere on Other Planets

In Chapter 4 of SSD, Siddons examines the impact of an atmosphere on temperature gradients of various planets in the solar system, first asking: ***“IF SCIENTISTS OF the past had known that the temperature of every planet with an atmosphere rises in direct proportion to atmospheric pressure, do you suppose they would have come up with a theory that attributed heating to the presence of certain trace gases that occupy less than one percent of our atmosphere? No, of course they wouldn’t have.”*** (p.19)

The next nine pages are taken up with graphical illustrations of atmospheric temperatures (on the X-axis) against altitude (on the Y axis) for Jupiter, Saturn, Uranus, Neptune, Venus, Earth, and finally for all of them (except Venus) plus Mars and Saturn’s moon, Titan (Fig. 1.9). Shreuder also reproduces this on page 191. These show temperature decreasing with altitude through the troposphere, then increasing through the stratosphere. Below each graph is the rhetorical question: ***“Is that the greenhouse effect at work?”*** And he concludes this chapter with an argument against the greenhouse effect on the basis that ***“. . . every planet is warmer than predicted.”*** (p.28 Emphasis his)

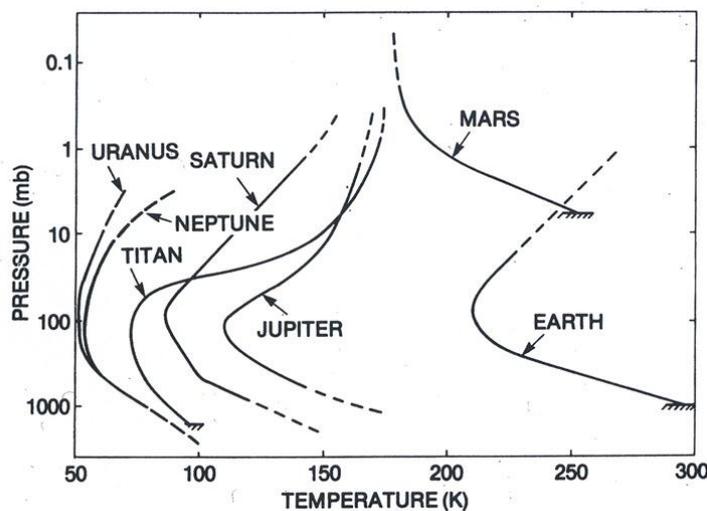


Figure 1.9 (8 in SSD): Pressure vs. Temperature of the Atmospheric Planets. Source: [Colorado University](#)

On the other hand, as Hertzberg says ***“. . . it is clear that the atmosphere helps to cool the Earth-atmosphere system”*** (p.181). So, does an atmosphere make the surface of a planet warmer or cooler? Of course it is both – cooler by day and warmer by night. Schreuder clarifies this on pages 200-209, where he compares the diurnal temperatures on Earth with those on the Moon, which receives the same insolation as Earth but has no atmosphere or water, and he refers to our atmosphere as ***“. . . a warming blanket during the hours of darkness”***. Siddons also nicely illustrates this when he examines lunar temperatures in Chapter 5 of SSD. The Moon’s surface temperature drops from a daytime maximum of about 385K (+112°C) to a minimum of just 100K (-173°C) at night, a diurnal temperature range (DTR) of around 285°C.

Siddons states: ***“Sunlit temperatures on the earth’s surface are appreciatively less than those on our neighbour the moon, because our atmosphere intercepts incoming radiation.”*** (p.77) Yes, but there are more important reasons. First, the lunar day is about 28 times longer than ours, so it has much longer to heat (and cool). Second, the moon has no oceans to act as a thermal flywheel to smooth diurnal fluctuations. Water covers over 70% of Earth’s surface and nearly 80% of the tropics, and its thermal mass is enormous. Ocean currents also transport heat from the tropics to higher latitudes. Third, Earth’s atmosphere reduces daytime temperatures and DTR by conduction/convection and wind, transporting vast

quantities of sensible and latent heat from the surface, between land and oceans, and from the tropics to higher latitudes. Trace gases in Earth’s atmosphere also reduce DTR by absorbing both solar and outgoing radiation and radiating it back to the surface, reducing radiative losses at night. As GHGs have increased, the global DTR has diminished.⁴ Increasing atmospheric [aerosols](#) and urban heat also reduce Earth’s DTR.

Siddons points out that the average lunar temperature (approx. 204K) is around 70K **lower** than NASA’s estimated black-body temperature⁵ (p.41) whereas planets with an atmosphere have a surface temperature **higher** than their black-body temperature derived from the Stefan-Boltzmann (S-B) equation. Whereas the greenhouse theory attributes this difference to the presence of greenhouse gases (Fig. 1.10), Siddons reasons that the presence of any atmosphere will make the surface warmer than predicted.

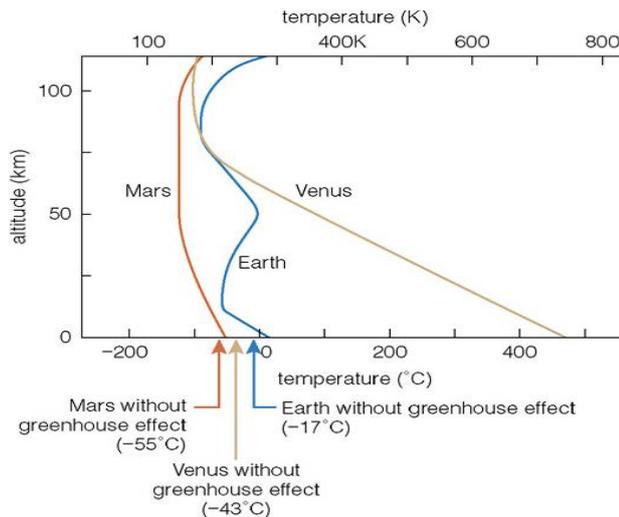


Figure 1.10: The postulated effect of atmospheric greenhouse gases on the surface temperature of Earth, Mars and Venus. Source: [Colorado University](#)

This is so because any atmosphere will transport heat from the sunlit surface to the unlit surface. Since radiation from a surface is proportional to temperature to the fourth power (T^4), a sunlit surface that is cooled by contact with an atmosphere loses much less heat by radiation than would an uncooled one. Since the net diurnal radiative losses are thus lower, the mean temperature is higher. Greenhouse gases facilitate this by elevating the emission level and by reducing radiative losses from the surface at night.

Siddons, Johnson and other Slayers also argue that any atmosphere warms the surface by ‘adiabatic compression’; **“that the temperature of every planet with an atmosphere rises in direct proportion to atmospheric pressure”** (i.e. with decreasing altitude).

Adiabatic Lapse Rate

In the troposphere of all planets with an atmosphere, temperature and pressure decline with altitude; and this rate of decline is called the [lapse rate](#). As air is warmed from below, it expands and rises, cooling as it does so by converting thermal energy into work and potential energy. The *adiabatic* lapse rate (Γ) refers to the change in temperature (dT) of a parcel of atmosphere as it moves up or down a certain distance (dz) without exchanging energy with its surroundings: $\Gamma = -\frac{dT}{dz}$ K/km (K = Kelvin, $0^\circ\text{C} = 273\text{K}$)

The dry adiabatic lapse rate (Γ_a) of an atmosphere in [hydrostatic equilibrium](#) is derived [thermodynamically](#) from the planet’s [standard gravity](#) (g) and the [specific heat at constant pressure](#) (C_p) of its atmospheric gases: $\Gamma_a = -\frac{dT}{dz} = \frac{g}{C_p}$ Earth’s dry adiabatic lapse rate is thus approx. $\frac{9.8}{1.0} = 9.8$ K/km.

Why then is the observed lapse rate only **6.5K/km** or less? Can it be calculated, as claimed by Johnson? Does 'atmospheric pressure' drive the lapse rate and warm a surface by 'adiabatic compression', as inferred in SSD? Or does a warm surface drive the lapse rate? Without a heat-pump at the bottom of the atmosphere, the second law of thermodynamics [precludes](#) a lapse rate. Indeed, it inverts if warming from above exceeds that from below, as in the stratosphere and over Antarctica during winter. Overnight inversions are not uncommon in middle latitudes, and would be far more frequent and extensive without backradiation, as shown later. The observed [environmental lapse rate](#) thus [varies greatly](#) across the globe and over time. [Empirical observations](#) in the Northern Hemisphere indicate a lapse rate of 6.4K/km from the equator to 30°N, declining to 3.6K/km at 70°N in January; and 6.3K/km from the equator to 50°N declining to 4.7K/km at 70°N in July.

Johnson asserts: *"Climate alarmism, as advocated by IPCC, is based on the assumption that radiation alone sets the initial lapse rate of 10°C/km, which then in reality is moderated by thermodynamics to an observed 6.5°C/km. Doubled CO₂ would then increase the initial lapse rate and with further positive thermodynamic feedback, the IPCC predicts an alarming climate sensitivity of 3°C . . ."* (p.266). Rather, thermodynamics sets the adiabatic lapse rate which is then moderated by local radiation and atmospheric conditions. A turbulent atmosphere is neither in equilibrium nor at constant pressure. Aerosols, clouds, water vapour and other GHGs *reduce* lapse rates by absorbing radiation and reducing surface insolation.

The **moist adiabatic lapse rate** for saturated air is only about 5K/km. Johnson deduces: *"With the double heat capacity of saturated moist air we obtain an isentropic moist adiabatic lapse of 5°C/km."* (p.273) But the 'heat capacity of saturated moist air' is nowhere near double that of dry air. A cubic metre of saturated air at 30°C at sea level weighs 1,200 grams and contains just 30.4 grams of water vapour.⁶ The heat capacity of the *water vapour* might be nearly double that of air, but the heat capacity of *saturated air* is only 5% greater than that for dry air. So you can't simply divide 10°C/km by 2 to get the moist adiabatic lapse rate which, moreover, is due not to the [heat capacity](#) but to the *latent heat* in moist air. Water vapour releases enormous quantities of latent heat as it rises to the dew point temperature and condenses into cloud droplets. This convective process continues ever upward until the air is dry, after which the lapse rate approaches 10K/km near the tropopause.

Air being a poor thermal conductor, warming of the atmosphere above the surface would be a much slower process without the presence of water vapour and CO₂. By absorbing IR radiation in the lower troposphere they warm it and promote convection there, warming the tropical mid-troposphere the most; and by emitting IR high in the troposphere they cool it and slow convection there. The release of latent heat and absorbed energy drives the convection of moist air high into the tropical troposphere, pushing up the tropical tropopause layer, the coldest layer of the atmosphere, to around 17km. As this cold air moves poleward and subsides, potential energy is converted back to thermal energy, reducing lapse rates and warming the surface in the middle and higher latitudes. As [William Kininmonth](#) explains, this is the essence of the GHE:

The low values of infrared radiation to space over the equatorial regions of deep convection are due to the high cloud tops and their very low temperatures (see Box 2). In those tropical regions where subsiding unsaturated air predominates and where clouds are absent or whose tops only reach low altitudes, such as the eastern Pacific Ocean, the effective emission layer is from much lower in the atmosphere and total infrared radiation to space is higher. . . .

Understanding radiation processes in isolation is not sufficient to explain the elevated temperature of the Earth's surface (the greenhouse effect). As has already been noted, solar radiation tends to warm the surface and infrared radiation tends to cool the atmosphere. Convection is necessary to distribute energy through the atmosphere from the boundary layer. It is the combination of radiation and convection that constitutes

the greenhouse effect and keeps the surface warmer than the upper troposphere. In the absence of greenhouse gases infrared radiation to space would emanate from the surface. The global radiation balance would be determined at the Earth's surface and the surface temperature would be, on average, about -19°C .

A planet's surface temperature is therefore not simply determined by its gravity or atmospheric pressure. Jupiter has a gravitational force more than twice Earth's, but a lapse rate of just 2K/km. Saturn is also much larger than Earth but has a lapse rate of less than 1K/km. As listed in SSD, Jupiter's atmosphere contains water, methane and ammonia – all GHGs – and Saturn's contains water and ammonia.

Venus

Venus is smaller than Earth with less gravity but has a very thick (large and heavy) atmosphere which is 96.5% CO_2 . Since the specific heat of CO_2 increases with temperature, the theoretical lapse rate on Venus increases from 7.7K/km at the surface to over 11K/km at 60km altitude. The theoretical mean lapse rate is thus 9.4K/km but the observed mean is somewhat lower at 8K/km. GHGs do *not* increase lapse rates.

Being closer to the Sun than Earth, Venus receives nearly twice as much solar radiation; but only about 20% of it penetrates the reflective sulphur clouds to reach the surface, which is nevertheless much hotter than Earth's surface. At around 740K, it is hot enough to melt lead, tin and zinc, and at least 40K hotter than Mercury, which is closer to the Sun. Moreover, the DTR on Venus is practically zero – the long nights are as hot as its long days (2,802 hours).

Such extraordinary findings are often given in support of the greenhouse effect of an atmosphere that is almost entirely CO_2 . In Chapter 12 of SSD, Hertzberg tells us about a distinguished atmospheric scientist and the President of the Combustion Institute both touting this standard mantra and both caught out by his question about the “. . . *adiabatic compression caused by its high surface pressure*”. Hertzberg makes a valid point. The atmospheric pressure at the surface of Venus is indeed about 92 times that on Earth. At this pressure, CO_2 is no longer strictly a gas but a supercritical fluid. The uniform temperature across day and night on Venus is facilitated by very fast retrograde winds increasing with altitude and circling the planet at up to 60 times its speed of rotation. Upwelling air over the dayside crossing to and down-welling over the night side results in adiabatic warming in the mesosphere (90-120km altitude). But this adiabatic compression only spreads the heat across the planet – it does not generate it.

The CO_2 absorption bands comprise a small fraction of the IR spectrum (see Fig. 1.2); they are nearly fully saturated at 0.1% (1,000ppm); the only other IR-absorbing gas on Venus is a miniscule amount of water vapour; so most OLR would escape Venus' atmosphere; and its GHE may be little greater than Earth's. Perhaps its reflective sulphur clouds are more important than CO_2 in trapping solar energy at the surface.

In conclusion, Siddons is correct in pointing out that the surface temperature of all planets with an atmosphere is higher than expected – not because of atmospheric pressure *per se* but because an atmosphere tends to cool the sunlit surface and warm the unlit surface. Greenhouse gases greatly facilitate this, and most if not all the planets illustrated in SSD have atmospheric GHGs. Furthermore, lapse rates tend to be lower than expected on planets with atmospheric GHGs, especially water vapour. The GHE can be explained by the convective elevation of the radiative emission layer, driven by conduction, the latent heat of vaporisation/condensation and the absorption/emission of OLR. In the next section, we examine the traditional greenhouse theory based entirely on the radiation that drives the heat-pump.

2. Greenhouse Theory and Models

a. Back-Radiation and Recycling of Energy

The 'greenhouse theory' is based on the finding that Earth's surface is warmer than expected; that this is due to outgoing IR radiation being absorbed and reradiated in all directions by atmospheric GHGs; that half of this is radiated outwards to space and the other half back to the surface where it is absorbed and reradiated; and that this cycle is repeated until all of the original energy is lost to space as outgoing longwave radiation (OLR).

On page 52 of SSD, Siddons ridicules this: *“. . . if the UN's depiction of a magical heat magnifying mechanism isn't enough to make you laugh, Dr Michael Pidwirny, who runs Physical Geography.net brings it into closer focus. . . .”*; and he reproduces the following illustration (Fig. 2.1).

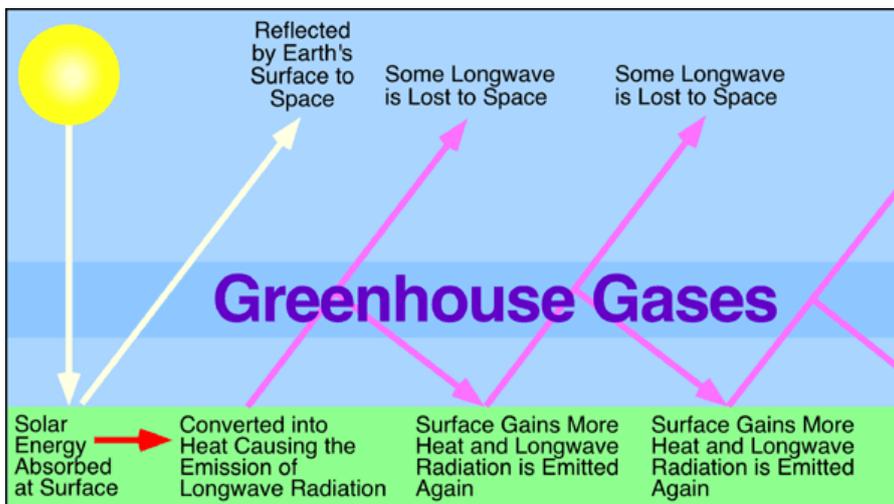


Figure 2.1: Greenhouse Theory according to [Pidwirny](#).

Siddons continues: *“As you can see, with greenhouse physics, anything goes. Once you decide thermal energy can be counted multiple times, you can get any temperature you want. For more than a century now, the theory of an atmospheric greenhouse-effect gained ground only because academic eggheads lost contact with reality, having never grasped basic physics.”*

Shreuder likewise caricatures the greenhouse theory: *“. . . if reflecting heat back to a heat source raises its temperature, then just reflecting it again will raise its temperature even more, and so on, until one watt of input generates a billion watts of power. That's clearly impossible. Yet this child's version of science has charmed much of the world into uncritical belief.”* (p.194) He goes on to quote the American Meteorological Society: *“The component that is radiated downward warms Earth's surface more than would occur if only the direct sunlight were absorbed.”* He then claims *“That definition is 100% wrong on all counts”* (p.201 Emphasis his), providing as evidence nothing more than seven largely irrelevant quotes from Nasif Nahle, Will Alexander, Ian Plimer and Claes Johnson.

Simplistic explanations of the greenhouse theory often state that backradiation 'warms' Earth's surface, without clarifying that it can only assist solar warming by day and 'slow cooling' at night. Slayers likewise loosely speak of IR-absorbing gasses 'cooling' Earth's surface, instead of impeding solar warming. Pidwirny's depiction also gives the unfortunate impression of an endless cycle of amplification. More

accurate depictions show backradiation arrows of reducing dimensions as outgoing longwave radiation is progressively lost to space. Perhaps Pidwirny also overstates his case (emphasis mine):

About **90%** of the longwave radiation emitted from the Earth's surface is absorbed by the atmosphere's *greenhouse gases*. . . . The greenhouse gas molecules then begin radiating longwave energy **primarily** back to the Earth's surface where it once again creates heat energy.

Because atmospheric water vapour varies across the globe, being lowest over the poles and highest over the tropics, the percentage of surface radiation absorbed (and back-radiated) by the atmosphere also varies (Fig. 1.6). Estimates range from less than 70% to over 90%. On page 6 of his paper, [The Model Atmospheric Greenhouse Effect](#), Joseph Postma, an astrophysicist who has now joined the Slayers, “. . . calculated that the atmosphere absorbs 77% ($f = 0.77$) of the radiation emitted from the ground.” To simplify the maths and see how it might work, let's accept 80% for now.

According to the greenhouse theory, half of that absorbed 80% (40%) is radiated back to the surface where it is absorbed and re-emitted; 80% of that (=32% of the original radiation) is absorbed by the atmosphere and half (16%) is again back-radiated, absorbed and re-emitted; 80% of that (12.8% of the original) is again absorbed and half (6.4%) back-radiated, absorbed and re-emitted. Subsequent back-radiations would be just 2.6%, 1%, 0.4%, 0.2% and 0.07% of the original surface radiation. So the total proportion back-radiated is $40 + 16 + 6.4 + 2.6 + 1 + 0.4 + 0.2 + 0.07 = 66.7\%$ or two thirds of the original IR radiation.

If most of the infrared radiation comes back to the surface, it will still cool at night, only more slowly than otherwise. During the day, higher surface temperatures result in much more outgoing longwave radiation, a third of it being lost to space. So statements like **'you can get any temperature you want'** or **'one watt of input generates a billion watts of power'** destroy straw men, not the real sky dragon.

Charles Anderson, author of the second-last chapter, is the only Slayer to acknowledge this repeating backradiation: **"The half returned to the ground would soon be radiated again from the ground and the process would repeat."** (p.328) His **"65% efficiency"** for IR-absorbing gases would result in backradiation of 48.1% of the original outgoing IR. As we shall see later, this is probably too low.

Thermos flask analogy

Similar backradiation and recycling occurs in a thermos, only far more efficiently than in the atmosphere. The vacuum between the inner and outer glass layers of the flask practically eliminates heat loss by conduction and the highly reflective surface inside the outer layer almost eliminates heat loss by radiation from the inner layer.

While Slayers accuse greenhouse advocates of focusing on radiation, they focus on conduction and often confuse the two. Hans Schreuder, for example, thinks he proves a point by stating that **'space is not cold'** and that Earth **". . . is completely encapsulated by a perfect thermal insulator: the vacuum of space."** (p.190) A vacuum is indeed a perfect insulator against conduction; but it is the worst possible insulator against radiation, providing no barrier at all.

Schreuder discusses only conduction and convection in relation to a **'vacuum flask'** (p. 196). Siddons, however, rightly includes radiation: **"This is how the reflective coating in a thermos helps keep coffee hot. . . . The reflective coating in a thermos serves to expose hot coffee to its own emission, which thereby sustains its temperature."** (p.11) He also correctly states **"decrease its radiation per se, i.e., block it, and it simply stays at that temperature, like coffee in a thermos."** (p.51) Indeed, almost all of the radiation from the central container is reflected back from the inner surface of the outer glass layer of a thermos.

Whereas Johnson thinks the *“recirculation of energy is nonphysical”* (p.285), this is precisely what a thermos does. The coffee would cool much faster if that reflective coating was removed. The glass would then absorb much of the IR radiation passing through it, and radiate half of it back to the central flask, as does Earth’s atmosphere. If it were both non-reflective and IR-transparent, the coffee would cool even faster, as would Earth’s surface were there no IR-absorbing gases.

Greenhouse gases don’t heat Earth’s surface at night, any more than a thermos heats the coffee inside it, but they certainly slow its cooling. The empirical evidence is in the reduced rate of cooling, as we shall now see. Some readers might wish to gloss over the complex arguments and mathematics in the next section.

b. The Simple Educational or 'Standard' Model

Solar radiation at the **top of the atmosphere (TOA)**, about 100km above Earth's surface,⁷ has been considered a fairly constant **1368 watts per square meter (W/m²)**. It varies during Earth's orbit, however, and probably averages slightly less than this (1361-5 W/m² according to recent [measurements](#)).

Earth's average **albedo** (reflectance) is considered to be around 0.30, which means that 30% of the solar radiation (about 410 W/m²) is reflected into space from Earth's atmosphere (6%), clouds (20%) and surface (4%). Anderson mistakenly thinks all **"30% is reflected from Earth's surface"** (p.323). Earth's total albedo alters little over time despite changes in snow and ice, which are much more reflective than water, because cloud cover increases as Arctic sea ice melts.⁸ This reflection leaves about **958W/m²** of solar irradiance to impact Earth's temperature.

In addition to the 30% of reflected solar radiation, another 19% (260 W/m²) or more is absorbed by the atmosphere, leaving around 51% to be absorbed at Earth's surface (Fig. 2.2). This 19% was recently revised to 22.9% (312 W/m²); and this means that only **47% (646 W/m²)** of TOA insolation is absorbed at Earth's surface. The atmosphere therefore transmits about 51% (47% + the 4% reflected at the surface). Anderson thinks **"about 65%"** is transmitted and yet has **". . . the energy warming the surface . . . about 622 W/m²."** (p.323) He thus has too much solar radiation being transmitted and too little of it being absorbed.

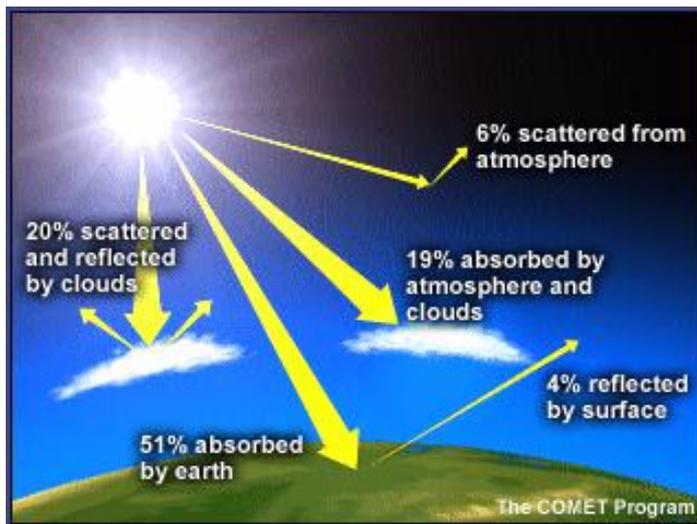


Figure 2.2: Interaction of Solar Radiation on Earth's Atmosphere and Surface

Source: http://www.ucar.edu/learn/1_3_1.htm

Global Averaging in Educational Greenhouse Models

In simple educational models, which Slayers like to call the 'Standard Model', this insolation is averaged over Earth's entire surface. The surface area of a sphere is four times the area of a cross-section through its centre ($4\pi r^2$). So 1368 W/m² divided by four gives **342 W/m²** at the TOA, and the absorbed amount of 958W/m² divided by four gives an average of **239.5W/m²**. It is of course double this amount on the sunlit hemisphere, double again at the sunlit centre, and simultaneously nil over the opposite hemisphere.

The relationship between energy radiated (E) and the temperature (T) of the radiating surface is determined by the Stefan-Boltzmann (S-B) equation:

$$E = \sigma T^4 \text{ (W/m}^2\text{) where } T \text{ is in Kelvin (K) and } \sigma \text{ is the Stefan-Boltzmann constant: } \sim 5.67 \times 10^{-8}$$

To remain in thermal equilibrium, Earth must radiate the same amount of energy as it absorbs. We can therefore use the S-B equation to determine Earth's average temperature:

$$T = (E/\sigma)^{-1/4} = (240/5.67 \times 10^{-8})^{-1/4} = 255K = -18^{\circ}C$$

We know from observations, however, that Earth's average surface temperature is much higher, varying from 12.2°C in January to 15.9°C in July,⁹ and averaging about 14.5°C (272.5K); and this is 17.0°C higher than the predicted -18°C.

Whereas proponents of the greenhouse theory put this difference down to the greenhouse effect, SSD puts it down to a thermodynamically determined lapse rate. Based on lapse rate calculations (32.5K divided by 6.5K/km = 5km), Johnson puts the **"TOA at an altitude of 5km"** (p.266). Anderson makes the same mistake on pages 317 and 318. Earth's effective blackbody temperature of 255K might be found at an altitude of about 5km, but that does not make it the TOA. Half of the mass of the atmosphere is above 5km.

Emissivity

The S-B equation applies to surfaces that absorb and emit radiation as a perfect black body, and Earth is a grey body. For a grey body with an emissivity (ϵ) less than 1, the S-B equation becomes:

$$E = \epsilon\sigma T^4 \quad \text{and} \quad T = (E/\epsilon\sigma)^{-1/4}$$

Hertzberg points out that **'the controlling factor'** in the S-B equation is the ratio of **'absorptivity to the emissivity'** (p.171) and he nicely plots emissivity against temperature for various albedo ratios in his Figure 1 on page 174. He also points out that these are quite heterogeneous across Earth's surface (p.176). Mistakenly thinking Earth's surface reflects 30% of solar radiation and that IR emissivity equals solar absorptivity, Anderson wrongly assumes emissivity to be **"about 0.7"** (p.316, 323). The emissivities for various surfaces (determined by Wilber in 1999) are shown in Figure 2.3.

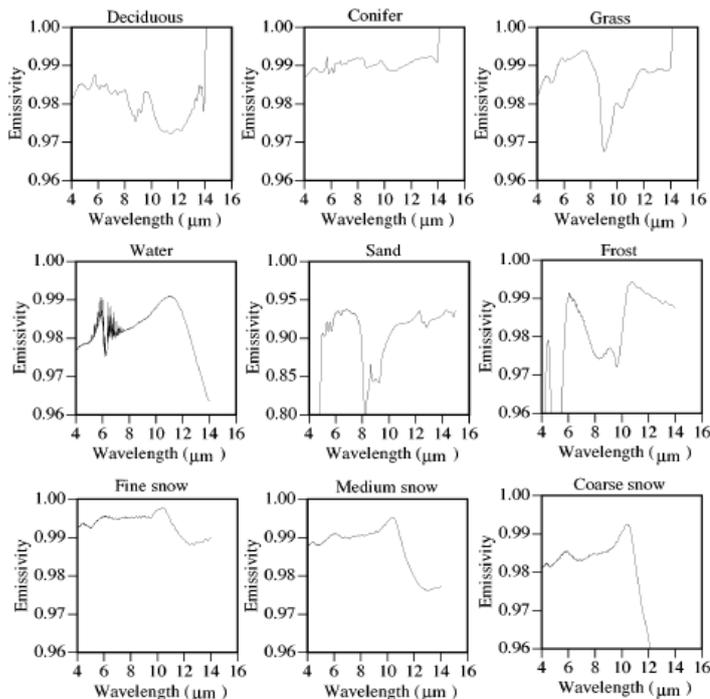


Figure 2.3: Emissivity from Laboratory Measurements for 9 Surfaces.

Source: *Surface Emissivity Maps for use in Satellite Retrievals of Longwave Radiation* by [Wilber](#) (1999).

Since the 4-16 μ m wavelength band accounts for just over half of Earth's IR emissions, and since the emissivity of the water covering at least 75% of Earth's surface appears to decline rapidly beyond 12 μ m, Earth's emissivity may be lower than these charts suggest. The average emissivity must be less than 0.99 (for medium snow, forest and grass), probably less than 0.98 (for water) and likely less than 0.97, since the emissivity of desert sand covering large areas in Africa and Australia is only about 0.9. In the absence of a definitive value, let's accept 0.95 as a reasonable approximation for the emissivity (ϵ) of Earth's surface.

This would mean that Earth's surface at 287.5K (14.5 $^{\circ}$ C) would be radiating 95% of that calculated using the blackbody S-B equation: $0.95 \times 387.4\text{W/m}^2 = 368\text{W/m}^2$. The equivalent blackbody temperature for that amount of radiated energy is just 10.8 $^{\circ}$ C. In other words, consideration of Earth's emissivity could reduce the need for a greenhouse effect by 19.4 W/m^2 which corresponds to 3.7 $^{\circ}$ C. But that still leaves a gap of 28.8 $^{\circ}$ C (= 32.5 - 3.7). So we still have a problem explaining the high surface temperature.

Anderson attempts to address this by examining the radiant energy equilibrium within a sphere. He takes the Earth's radius as ". . . **about 6,376,000 metres, so the sphere in radiant equilibrium with space has a radius slightly larger – about 6,376,000 (sic) metres.**" (315) Note that both his figures are the same. According to [NASA](#), his first one should be 6,371,000m. He then correctly calculates that the slightly smaller solid sphere should have a temperature 0.1 $^{\circ}$ C warmer – hardly impressive. So he then uses his low emissivity of 0.7 and correctly calculates (on p.316) that this would bring the average surface temperature up to 278.89K (nearly 6 $^{\circ}$ C). But this is still over 8.5K (8.5 $^{\circ}$ C) below its observed average. Moreover, if absorptivity was also just 0.7, he would still have a deficit equivalent to 32.5 $^{\circ}$ C.

Anderson then thinks that ". . . **the heat capacities of the Earth's land and water and atmosphere . . . may well be the source of the additional 9K temperature increase found at Earth's surface.**" (p.319) But a huge heat capacity is useless if you can't heat it. Without backradiation there is no spare energy to store. Indeed, as we shall see, the oceans would have to surrender stored heat even during the day. The Slayers have thus given themselves an insoluble problem. Rather than attempting to address it, however, they simply go on the attack, criticising the averaging methodology used in simple energy balance calculations.

SSD lampoons the 'Mother of all Averages'

Since only one half of the Earth is receiving all of the solar radiation at any given time, the Slayers ridicule the averaging of it over the entire surface. Schreuder confidently and unequivocally states: "**Computer simulations regard the earth as a flat disc**" (p.233). Siddons is sarcastic: ". . . **342W is what a modeller takes as the energy impinging on every square meter of the planet all at once. All at once. . . . a modeler's (sic) sun never sets.**" (p.6, his emphasis) "**There's a problem with this, however. And a huge one at that because radiance and temperature don't operate 1 to 1 together but on the basis of a 4th power law. . . . In other words, an object that has doubled its temperature is 16 times (2 to the 4th power) more energetic than before.**" (p.31) Siddons is correct on this.

He then uses the S-B equation to calculate the average surface temperature of a blackbody sphere exposed to 100 W/m^2 by the traditional averaging method (=145K), then calculates the exposed and non-exposed hemispheres separately (=172K and 3K respectively) and correctly shows that the average of these (87.5K) is just "**60% of the temperature predicted for a sphere**". He concludes: "**For decades, this has been an unrecognised error in standard blackbody calculations for planets**" (p.32); and he insists that: "**A rational estimate must begin by assuming a half-lit and half-dark sphere and proceed from there.**" (p.34)

So let's apply Siddons' method to Earth and see how much difference his method actually makes.

As we saw earlier, the atmosphere absorbs nearly 23% (312 W/m²) of the incoming 958 W/m² radiation, leaving just 646 W/m² to reach the surface directly. According to Hertzberg and Olson, none of that absorbed energy can reach Earth's surface; so the *sunlit hemisphere*, being twice the area of its cross-section, receives no more than 323 W/m² (half of 646 W/m²). Allowing for an emissivity of 0.95, that amount of radiation would be sufficient to bring the **sunlit surface temperature** to just 278.2K (5.2°C).

If we use Anderson's surface insolation on page 323 of 622 W/m² (= 311 W/m² over a hemisphere) and an emissivity of 0.95 (not his erroneous 0.7), we get a chilly *sunlit surface temperature* of just 276K (3°C). Unlike other Slayers, however, Anderson concedes: **"At night, IR-absorbing gases may retard radiative cooling of the ground"** (p.333). Even so, that hemisphere would rapidly freeze over. To his credit, Anderson is the only Slayer to address this issue.

Now let's see what happens if we allow half of the solar radiation absorbed by the atmosphere (half of 312 = 156 W/m²) to reach Earth's surface indirectly. The energy received at the centre of the surface would now be **802 W/m²** (646 + 156) which is **401 W/m²** averaged over the entire sunlit hemisphere. Assuming an emissivity of 0.95 and no backradiation, this would be sufficient to give an average daytime surface temperature of 293.7K (20.7°C). Given this mean daytime temperature and a mean diurnal temperature of 287.5K (14.5°C), the mean night time temperature would have to be 281.3K (8.3°C). The resulting diurnal temperature range (DTR) of 12.4°C is fairly close to that observed across most of the globe.

Using these figures and assuming Earth's surface to emit uniformly as a blackbody over each hemisphere (correcting for emissivity would make little difference here), we obtain the following from the S-B equation:

Method	Surface temperature	Radiation Emitted W/m ²	Average W/m ² over 24 hr
Traditional: D+N	287.5K (14.5°C)	387.4	387.4
Siddons: Daytime	293.7K (20.7°C)	422	
Night time	282.3K (8.3°C)	355	388.5

So the simplest of models *underestimates* greenhouse warming by just 1.1 W/m² (388.5 – 387.4) or 0.3%. According to the Slayers, that tiny error invalidates all climate models, even complex coupled general circulation models (GCMs) run on powerful computers. Siddons hemispheric-averaging method is better but still quite crude. A more precise gridded analysis improves a model's accuracy by perhaps 6 W/m². When Trenberth et al (2009)¹¹ performed a spatial analysis of the diurnal and annual cycle using the S-B equation with emissivity ϵ set to 1, they found:

If we define a global mean as T_g , then $T = T_g + T'$, where the T' refers to departures from the global mean in either time or space. Therefore, $T_4 = T_g^4(1 + T'/T_g)^4$. We expand the bracket and take the global mean, so that the T' and T_3 terms vanish, and then $T_4 = T_g^4(1 + 6[T'/T_g]^2 + (T'/T_g)^4)$. (2)

The ratio T'/T_g is relatively small. For 1961–90, Jones et al. (1999) estimate that T_g is 287.0 K, and the largest fluctuations in time correspond to the annual cycle of 15.9°C in July to 12.2°C in January, or 1.3%. Accordingly, the extra terms are negligible for temporal variations owing to the compensation from the different hemispheres in day versus night or winter versus summer. However, spatially time-averaged temperatures can vary from –40°C in polar regions to 30°C in the tropical deserts. With a 28.7-K variation (10% of global mean) the last term in (2) is negligible, but the second term becomes a nontrivial 6% increase.

To compute these effects more exactly, we have taken the surface skin temperature from the NRA at T62 resolution and 6-h sampling and computed the correct global mean surface radiation from (1) as 396.4 W m⁻². If we instead take the daily average values, thereby removing the diurnal cycle effects, the value drops to 396.1 W m⁻², or a small negative bias. However, large changes occur if we first take the global mean temperature. In that case the answer is the same for 6-hourly, daily, or climatological means at 389.2 W m⁻². Hence, the lack of resolution of the spatial structure leads to a low bias of about 7.2 W m⁻². Indeed, when we compare the surface upward radiation from reanalyses that resolve the full spatial structure the values range from 393.4 to 396.0 W m⁻².

The surface emissivity is not unity, except perhaps in snow and ice regions, and it tends to be lowest in sand and desert regions, thereby slightly offsetting effects of the high temperatures on LW upwelling radiation. It also varies with spectral band (see Chédin et al. 2004, for discussion). Wilber et al. (1999) estimate the broadband water emissivity as 0.9907 and compute emissions for their best-estimated surface emissivity versus unity. Differences are up to 6 W m^{-2} in deserts, and can exceed 1.5 W m^{-2} in barren areas and shrublands. Similar rectification effects may occur for the back radiation to the surface, so that for KT97 the errors tend to offset, but the surface radiation exchanges should be enhanced by about 6 W m^{-2} .

What is important and ignored by Slayers, is the *direction* of the simple model's error. It means that Earth's surface *loses more heat* and thus receives *more backradiation* than the simple model suggests. It *underestimates* the GHE. Siddons' method is better, but not for his cause: his legitimate criticism of the simple *model* strengthens the greenhouse *theory*. Slayers nevertheless refuse to admit that their pyrrhic victory over a simplistic caricature of the sky dragon actually breathes more life into the real one.

Siddons reckons **“. . . the simple fact is that the earth's sunlit surface temperature is entirely consistent with solar irradiance alone – which likewise means that the greenhouse theory is demonstrably false.”** (p.78) Perhaps, but he forgets that Earth rotates, that the sunlit surface has to store energy for the night; and he has none to spare. Even with emissivity set at 0.95, he has just enough insolation for a daytime surface temperature of 20.7°C with nothing to spare for thermals, evaporation or heat storage. Indeed, his *sunlit hemisphere* would actually *lose energy* and *cool*, even with half the insolation absorbed by the atmosphere indirectly reaching the surface.

For the night, Siddons has to find 337 W/m^2 (95% of 355 W/m^2 as per the above table). Without back-radiation, where can he possibly find that energy? We would soon have Snowball Earth. To balance Earth's energy budget, there has to be some mechanism to enhance solar radiation by day and reduce heat loss by night.

The 'Standard Greenhouse Model'

On page 73, Siddons reproduces a greenhouse model diagram (Fig. 2.4) from the Washington University website: http://courses.washington.edu/pcc588/lectures_2008/588_lect_010708.pdf (not found).

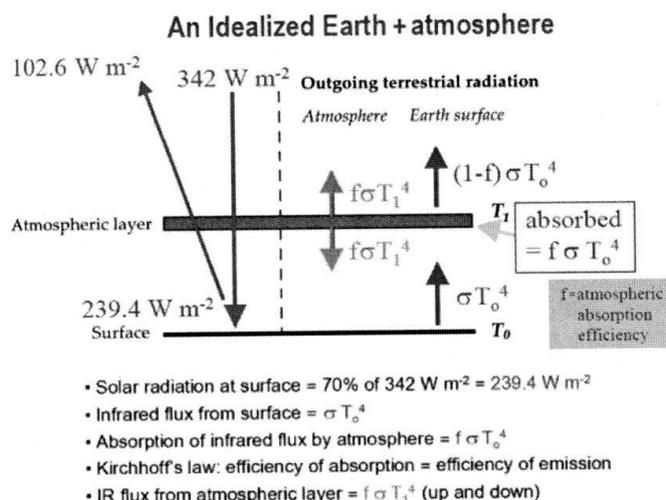


Figure 2.4: A simplistic greenhouse model of radiation at Earth's surface and atmospheric layer

To the left of a vertical dotted line is an arrow representing incoming solar radiation (342 W/m^2 averaged over the globe), 102.6 W/m^2 being reflected and 239.4 W/m^2 apparently reaching Earth's surface at temperature T_0 . To the right of the line is an arrow representing surface OLR with energy = σT_0^4 .

An absorptivity/emissivity fraction (f) of this radiation is absorbed by the atmospheric layer (represented by a thick horizontal line) attaining a temperature (T_1) and radiating $f\sigma T_1^4$ both up and down. The total radiation lost to space is thus:

$$f\sigma T_1^4 + (1 - f)\sigma T_0^4 \text{ which equals } \sigma T_0^4$$

This simplistic undergraduate model is misleading in several ways. First, the bottom of the atmospheric layer is in contact with Earth's surface. Second, 239.4 W/m^2 does not reach the surface since 22.9% of the 342 W/m^2 (about 78 W/m^2) is absorbed by the atmosphere. Failing to notice this or to properly address the physics, Siddons simply lampoons his own misinterpretation of it:

... call terrestrial 240 instead of 239.4 and picture a 50/50 scenario. The surface will emit only 120 W/m^2 to space because half is caught by the atmosphere. The atmosphere emits the 120 it has absorbed, bringing the earth to 'radiative equilibrium'. But that 120 is also radiated down to the surface, raising surface energy to 240 plus 120, i.e. 360 watts per square metre, quite a bit warmer now. A little more tweaking and you can get the surface to the requisite 390 W/m^2 , enough to bring the earth's average temperature to 15° Celsius.

If people are gullible enough to believe such a scenario, and apparently millions do, they deserve what's coming down the road at them. (p.74)

As we saw earlier, it is not a simple 50/50 scenario but a complex recycling of energy as also occurs in a thermos flask. Moreover, the energy radiated by the atmosphere is determined not just by f but also by its particular temperature ($f\sigma T_1^4$). Siddons then ridicules his own analogy of an infrared filter absorbing 500 W/m^2 from a radiant heater and re-radiating that energy outwards as well as back to the heater:

You get 1000 watts per square meter in all. Two heaters for the price of one. But that's not all. Remember, the radiant heater will be heated by its own re-directed energy and thereby emit even more energy – which the glass will absorb and double, which the heater will heat more . . . It's not only a perpetual motion machine – it accelerates to boot. (p.75)

His filter will indeed make the heating element hotter, but make no difference to the outflow of energy into the surroundings. Earth's greenhouse is no more a perpetual motion machine than is a thermos flask.

Rather than addressing uncertainties and constructively grappling with real issues with climate models, Slayers merely mock simple models, believing they thereby demolish all 'computer simulations'. Focusing on the 'flat disc fallacy', SSD largely ignores far more serious problems with climate models, especially those relating to clouds, aerosols, solar cycles and ocean oscillations. In addition to sarcasm, SSD presents little more than a few pages of quotations critical of models, a diagram showing the 'complexity of weather and climate' (p.154) and a critique of the temperature data used in climate modelling.

Slayers promote Postma's 'Realistic' Model

Although SSD does not present an alternative radiation model, the authors will refer you to *The Realistic Terrestrial System Model* presented by Joseph Postma in [The Model Atmospheric Greenhouse Effect](#). On page 34, Postma has a simple diagram of Earth with insolation from above and arrows representing OLR pointing to the right. He has a solar flux of 1370 W/m^2 (equivalent to 121°C) at the TOA and, allowing for albedo of 0.3, a 'Continuous Zenith System Input' of 958 W/m^2 (equivalent to 87.5°C) which he applies to a "zenith circle [which] is drawn to-scale in terms of the linear cross section of the sphere; it amounts to almost 50% of the diameter . . . This means that almost 50% of the cross-section of the Earth is continuously being insolated with radiative heating of $+87.5^\circ\text{C}$!"

According to my measurements on his model, the diameter of his zenith disc is indeed about 43% of Earth's diameter; but its area (πr^2) is actually less than 20% of Earth's cross-sectional area and thus less than 10% of the sunlit hemisphere's surface area. Arguing against the need for any greenhouse warming, Postma wants us to imagine that this warm circle covers almost half the sunlit hemisphere.

Postma then correctly calculates that "*The average input over the entire sun-lit hemisphere has an equivalent of +30°C input temperature.*" Making no mention here of insolation absorbed by the atmosphere, Postma leaves the impression that +30°C is the average *surface* input temperature. As we saw earlier, the average sunlit surface would reach only 5.2°C if none of this absorbed energy was radiated to the surface. Slayers are quick to point out that IR-absorbing gases *cool* Earth's surface and equally quick to forget about this when maximising solar *warming*.

Acknowledging that Earth's surface area radiating heat is four times that receiving solar radiation, Postma deals with the night-time problem as follows:

If we have upwards of +90°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°C.

Now that, dear reader is the finest Slayer model – showing that no greenhouse effect is required to keep Earth warm at night. No empirical evidence, no calculations, no energy budget. Just amplify daytime heating as much as you can, add thermal mass, spin the Earth fast enough and hope for the best!

C. Earth's Energy Budget

Kiehl and Trenberth¹⁰ published a paper on Earth's energy budget in 1997 (KT97), based largely on empirical observations from the Earth Radiation Budget Experiment (ERBE) from 1985 to 1989 (during which one ERBE satellite NOAA-9 failed), and their chart (Fig. 2.5) is reproduced on page 221 of SSD.

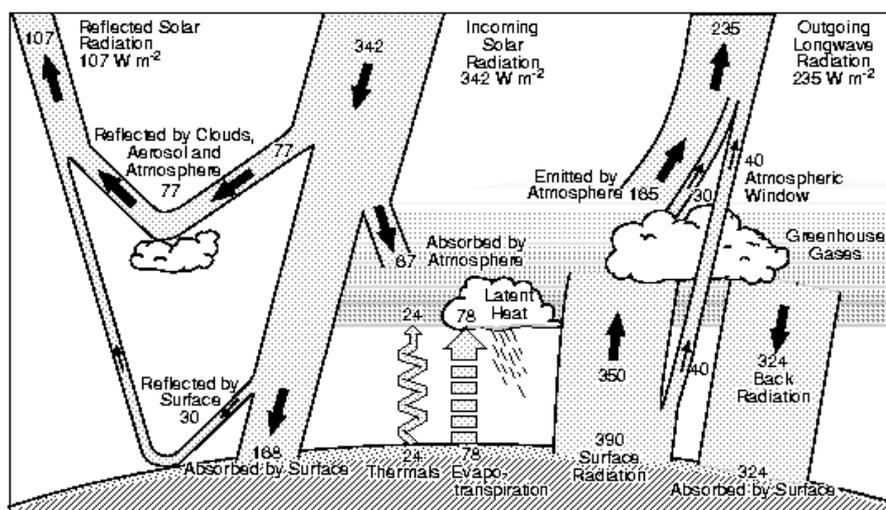


Figure 2.5: The [Kiehl-Trenberth](#) Energy Budget for Earth (1997)

Based on this KT97 chart and his own calculations, Siddons states (p.59):

Due to clouds and other obscuring factors, the actual surface average is given as only 168 W/m². That figure corresponds to -40°C on the surface, meaning that it has to rise by 55 degrees, not 33, in order to reach the accepted of +15. Anyone who tells you, then, that the 'greenhouse effect' makes the earth's surface 33 degrees warmer is merely confessing his (or her) own ignorance.

What Siddons failed to understand is that half of the estimated 67 W/m² absorbed by the atmosphere is also radiated to the surface, as is half of the 102 W/m² in convected heat from evaporation and thermals. This tally of 84.5 W/m² is included in KT97's 'Back Radiation' which, strictly speaking, it is not. So the total radiation before backradiation is 252.5 W/m² (168+84.5), and this corresponds to -14.7°C, not -40°C. By comparison, Anderson's 622 W/m² (p.323) is just 155.5 W/m² when averaged over the globe, making a very chilly -44°C for those who disallow any non-solar radiation to the surface.

Also failing to understand the radiative **recycling** that occurs in a thermos flask and the real world, Schreuder says: **"As the Kiehl-Trenberth model shows: 235 units go in, 235 units go out and 324 are generated in between."** (p.221, emphasis mine) He follows this with rhetorical questions implying inconsistency with the laws of thermodynamics: **". . . has anyone ever INVENTED a device that captures light, like capturing wind in a bottle?"** (Ibid, emphasis his) Why bother reading and carefully critiquing scientific literature when you can simply discredit it with a few silly questions?

During my email correspondence with the Slayers, Charles Anderson published the following critique of this budget (with my comments in black):

Back-Radiation and the Highly Fallacious Kiehl-Trenberth Energy Budget

10 July 2012 Charles Anderson

"The usual greenhouse gas calculation such as is offered up by the various Trenberth diagrams is highly dominated by the radiative transport of energy in the Earth's atmosphere. It leads to an unreasonable result for the situation I am

going to describe here. But first, my approach to the back-radiation problem was always to show that it was unrealistic on many levels. One cannot make a net gain of heat energy in a surface by returning a portion of the energy lost from a surface to it. This is especially true of any process that is said to lose half of the surface emitted energy to space immediately and to only re-absorb some part of half of the energy that was returned to the surface.”

The issue is not whether there is a ‘net gain’ but whether there is a reduced rate of loss of energy. And it is NOT ‘said’ by GHE proponents that the process loses ‘half of the emitted energy to space immediately’ but less than 10% of it, the other 90+% being absorbed by the atmosphere. Half of this is then lost to space and the other half recycled to the surface, losing more to space with every cycle until all is lost, thus slowing radiative losses as in a thermos.

“I went further and explained that only a small fraction of the energy emitted as radiation from the surface was re-emitted as radiation from an absorbing water or CO₂ molecule. With just these considerations alone, the upper limit on once radiated energy from the surface which is re-absorbed by the surface would be:

$(0.5) f$, where the 0.5 is the half of any IR absorbing molecule radiation which was not radiated into space and is radiated toward the surface. The fraction f is the fraction of the IR energy lost by the surface and absorbed by an IR absorbing molecule which is re-emitted before collisions have dissipated the energy absorbed. The fraction f is much less than one because most often the IR absorbing molecule undergoes collisions with other molecules and transfers much of the IR absorbed energy to other molecules before re-emission occurs. These other molecules are rarely water or CO₂ or other IR emitting molecules, so that energy is not returned to the surface as IR radiation. Thus much of the surface emitted IR radiation is dissipated to the 99.97% of the atmosphere molecules which are nitrogen, oxygen, or argon and are not IR emitters.”

But this thermal energy is convected and transferred back to the IR-emitters high in the troposphere, where is radiated both to space and back to Earth.

“Let us estimate the value of f . At sea level, the mean gas velocity is 459 m/s, the mean free path or distance between collisions is only 6.6×10^{-8} m or 66 nm, and the collision frequency is 6.9 billion/s. At an altitude of about 4000 m, the radiative transfer of energy competes about evenly with transfer by collisions. At 4000 m altitude, the frequency of gas molecule collisions is about 4.4 billion/s. We can use the equivalency of energy transfer by radiation and gas molecule collisions at the 4000 meter altitude to estimate the fraction of energy transfer by radiation of the total of energy transferred by radiation plus gas molecule collisions. At sea level, energy transfer by radiation is equivalent to about 4.4×10^9 collisions per second, so the fraction of energy transferred by radiation is about $4.4/(4.4 + 6.9) = 0.39$ of the total by gas molecule collisions and radiation. This suggests that about 1.5 times as much energy is transferred by gas collisions as by radiation at sea level.”

How do you derive your energy radiation at sea level as 4.4 billion/sec and why can you use this to derive a total tropospheric fraction (f)? I don’t understand your rationale or logic. Radiation dominates above 4000m for two reasons: reduced rate of collisions and reduced chance of the emitted photon being intercepted by other IR-absorbing molecules. Back-radiation to the surface thus occurs at all levels of the troposphere, and even in stratosphere by ozone, methane and fluorides.

“So at this point, the upper limit on IR radiation emitted from the surface which can be returned to the surface and absorbed by it is about: $(0.5) (0.39) = 0.195$

But, it does not follow that simply because this much back-radiated IR is incident upon the surface that it will be absorbed by the surface. During the roughly 8 hours of a day when the surface is warming under increasing sunlight and with a 2-hour lag for warming the ground, water, or air in a vicinity, none of this radiation may be absorbed, except when a cloud casts a shadow on a part of the area or at such points under the shadow of a tree of some such object. The absorbing ground has to be cooler than the ground from which the photon was emitted and subsequently absorbed by an IR-absorbing molecule in the atmosphere. During the remaining cooling hours of the day, roughly 16 hours, the surface is more likely to absorb such back-radiated energy. As a mean value for re-absorption of IR back-radiation, you have claimed the figure of 0.95, which I have seen claimed by others. I believe that value is much too high.”

In what research paper or reputable physics text can I find the dogma that ‘the absorbing ground has to be cooler than the ground from which the photon was emitted’? If the back-radiated IR is not absorbed by a warm sunlit surface, what happens to it? The first law of thermodynamics states that it cannot be lost. So, if none is absorbed, it must all be reflected. This means an albedo of 1.0 for IR, and that the surface reflects far more IR than visible EM radiation – the opposite of reality.

“Let us look at one of the Kiehl-Trenberth energy budgets for a moment: (Figure 2.5 above) According to this diagram, $67/342 = 0.196$ of the incoming solar radiation is absorbed by the atmosphere. $77/342 = 0.225$ is reflected by clouds and aerosols. The surface reflects $30/(30 + 168) = 0.152$ of the solar radiation incident upon the surface. Thermals cooling the surface dissipate $24/168 = 0.143$ of this incident radiation.

Now let us consider a midday calculation of the surface and do so where there is no cloud cover and where it is so dry that there is no evapotranspiration. What kind of surface temperature will we have. Since there are no clouds and I think clouds are the better part of the summed cloud and aerosol effect, let us assume the aerosol effect alone is 0.08. The midday radiation incident on the upper atmosphere is 1367 W/m^2 . Note that at midday, the incident radiation path length through the atmosphere is shorter than it is for the average daily values normally used, so losses in the atmosphere should be lower than these numbers. I will use them nonetheless. The radiation upon the ground is then: $(1 - 0.196) (1 - 0.08) (1 - 0.152) (1 - 0.143) 1367 \text{ W/m}^2 = 734.8 \text{ W/m}^2$ ”

I’m sorry, Charles, but your maths are wrong. You are calculating the fractions radiated at the surface based on incident radiation (168) but then multiply by TOA radiation (1367 or 342×4). The fraction of TOA irradiance is thus $30/342 \cong 0.088$, not 0.152. And the thermals fraction is $24/342 \cong 0.07$, not 0.143. This would actually increase your net radiation from 734.8 to 773.9 W/m^2 , and hence your surface temperature. Since there is no water to evaporate, you have not allowed for any loss by evapotranspiration. But since the ground temperature will be much hotter than the KT97 global average, your desert thermals will actually be much higher than 24 W/m^2 . So your figure may be more correct despite your error.

“The ground temperature is then found from:

$$734.8 \text{ W/m}^2 = \epsilon \sigma T^4, \epsilon = 0.95$$

$$T = 341.8 \text{ K} = 68.6^\circ\text{C} = 155.5^\circ\text{F}$$

But if you believe that the upper limit amount of back-radiation is 95% absorbed by the surface, then the incident radiation is:

$$(734.8 \text{ W/m}^2) (1 + 0.195(0.95)) = 870.9 \text{ W/m}^2$$

$$T = 356.6 \text{ K} = 83.4^\circ\text{C} = 182.2^\circ\text{F}$$

Now this is clearly much too hot and implies that even the addition of this upper limit of back-radiation which is much smaller than the back-radiation in the Kiehl-Trenberth diagram and energy budget is not physical.”

There are a few problems with your assumptions. First, you can use the Stefan-Boltzmann equation to determine temperature only where the surface is in equilibrium, and your directly overhead sun is constantly moving across Earth’s surface. The desert sand cools overnight and takes time to warm up. Before it can reach your 83.4°C , the overhead sun has moved on and it starts to cool again. Second, there is less water vapour in the atmosphere over a desert and therefore less back-radiation. But there is also less absorption of solar radiation, so these may cancel out. Third, there are no deserts on the equator and no weather stations in the middle of the Sahara to know how hot it gets there when the sun is close to being overhead during northern summers. Libya recorded over 58°C in 1922.

“Note that I did not follow the Kiehl-Trenberth diagram in subtracting the emitted radiation that corresponds to the Earth’s surface temperature. They subtract 390 W/m^2 and add back in 324 W/m^2 of back-radiation for their mean daily calculation. This would imply that if we had no atmosphere with IR absorbing gases in it, then there would be no back-radiation, so the total energy budget would look like:

$$(168 - 24 - 78 - 390) \text{ W/m}^2 = -324 \text{ W/m}^2,$$

which is nonsense. Of course you might say that the thermals would be different and if I have no absorbing IR gases, then I certainly do not have water evaporation and movement. This perhaps is a muddled situation.”

Of course it is nonsensical when you remove back-radiation (but not atmospheric absorption of solar radiation). You know that a blackbody surface at Earth’s average surface temperature of 288K (15°C) has to radiate 390 W/m^2 or 370.6 W/m^2 for a grey body with emissivity set at 0.95. Now if you add 102 W/m^2 for thermals and evapotranspiration, you get 472.6 W/m^2 of energy losses at the surface. And you have an input of only 342 W/m^2 at the TOA. Even if the atmosphere absorbs none of that and none is reflected, you are still 30.6 W/m^2 short at the surface. So, rather than storing heat by day, your surface would lose at least 31 W/m^2 and up to ten times that allowing for reflection and atmospheric absorption. If your surface loses so much heat by day, how can it possibly stay warm at night? Even if you reduce thermals and evapotranspiration to nil, your surface will still freeze over.

“So let us consider the equivalent calculation technique for an isolated black body radiator in space with incident energy flux of I_i and an emitted radiation of I_e . But $I_i = I_e$, so then this approach would have us fallaciously conclude

that $l_i - l_e = 0 = \sigma T^4$ and $T = 0 \text{ K}$. (Yes, that is a fallacious use of the S-B equation)

The temperature of the body is determined by the incident radiation on it. The basic approach of the Kiehl-Trenberth diagram to radiation is nonsense. The energy budget is a farce based on bad physics. Indeed, when challenged on this issue, many proponents of man-made catastrophic global warming back down and say that the General Circulation Models are calculated primarily as air and water vapor circulation models and are not really consistent with the several variations of the Kiehl-Trenberth Energy Budget. Yet it is such fallacious budgets that the public has been fed as the basis for the claim that there are substantial effects on the Earth's surface temperature due to man's emissions of CO₂. Government websites have been full of these energy budgets, as have college classes. For their part, the range of results in the GCM computer models is too large to be consistent with the idea that climate science is settled and everyone agrees that it is understood." [End]

Anderson's 'several variations of the K-T energy budget' are actually updates. Trenberth, Fasullo and Kiehl (TFK09)¹¹ updated the KT97 energy budget (Fig. 2.6), based on observations and modelling by many researchers, better satellite data including CERES and MODIS, globally gridded reanalysis of spatial, annual and diurnal cycles, a better understanding of the hydrological cycle, ocean heat and the atmospheric transport of it.

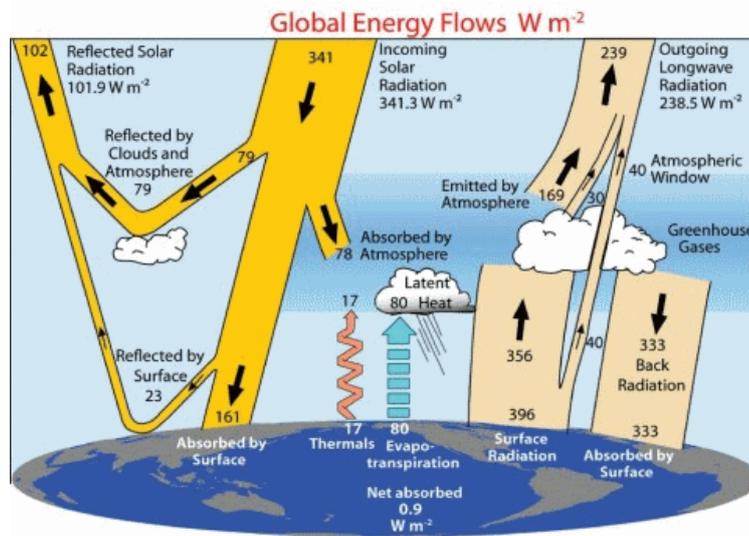


Figure 2.6: The global annual mean Earth's energy budget for the Mar 2000 to May 2004 (CERES) period (W m^{-2}). The broad arrows indicate the schematic flow of energy in proportion to their importance. Source: [Trenberth et al 2009](#)

While KT97 and TFK09 represent serious attempts to balance Earth's budget, they have many problems. As Vincent Gray points out,¹ the figures are "given as if they were known to an exact amount, when they actually represent averages of quantities that are very inaccurately known, or even just guessed. No estimates of accuracy are given for any of them." Various changes and uncertainties are discussed below, along with other authoritative values then available (in brackets) for evaporation and thermals:

- The solar 'constant' decreased from 342 W/m^2 (1368 at TOA) to 341.3 W/m^2 (1365 at TOA). It may average only 1361 W/m^2 over Earth's slightly elliptical orbit, being 1321 W/m^2 during aphelion and 1413 W/m^2 during [perihelion](#). This 7.9% variation is rather less than Olson's 10% (p.240).
- The reflected portion has dropped from 107 to 101.9 W/m^2 , from 31% to 29.8% of TOA irradiance, in line with satellite measurements of [albedo](#). This difference of 5.1 W/m^2 represents much more than the proposed warming from a doubling of atmospheric CO₂. Note that reflection from clouds has increased slightly while that from the surface declined from 30 to 23 W/m^2 , from 8.8% to 6.7% of TOA irradiance, presumably due to ice-loss, but still well above the 4% we allowed earlier. The percentage of surface insolation reflected has thus declined from 15.2% ($30/198$) to 12.5% ($23/184$), indicating increased surface absorptivity from 0.848 to 0.875.

- The solar radiation absorbed by the atmosphere has increased from 67 W/m² to 78.2 W/m², from 19.6% to 22.9% of TOA insolation, presumably due to increasing aerosols and water vapour (1.2% per decade). KT97 had also apparently underestimated absorption by aerosols by 2-5 W/m².
- Surface irradiation consequently fell from 168 W/m² to 161.2 W/m² in TFK2009, consistent with Anderson's statement that *"more water vapour and CO₂ in the atmosphere results in less-effective surface warming."* (p.321)
- Evaporation/latent heat increased from 78 (80.2, 82.3, 85.1) to 80 (83.1, 90.2) W/m².
- 'Thermals' or sensible heat resulting from conduction and convection decreased from 24 (15.3, 18.8) to 17 (15.6, 19.4) W/m² without any good explanation. Vincent Gray points out¹ that *"TFK09 chose a "Sensible Heat" figure of 27 W/msq for "Land" with other authorities giving 36.3 and 27.4 W/msq. They chose 12 W/msq for "Ocean" where the other authorities gave 11.7, 16.6, 14.6 and 10.8 W/msq."*
- OLR at Earth's surface increased from 390 to 396 W/m², indicating a mean surface temperature (MST) of 16.1°C (with emissivity set at 1) and a global warming rate of one degree per decade! The generally accepted MST used to be 14°C before it was increased to the 15°C which I used to calculate ORL at just 370.5 W/m² with emissivity set at 0.95 (see page 25).
- Backradiation increased even more in TFK2009, from 324 to 333 W/m², more over water and less over land – the opposite of what is expected with more atmospheric CO₂. A backradiation of 333 W/m² represents 81.4% of the surface radiation of 396 W/m², considerably more than the 66.6% I calculated on page 7. And it represents an atmospheric absorption efficiency of 91.4%, much higher than Anderson's 65%, higher than Postma's 77% and even higher than Pidwirny's 90%.
- Total radiation received by Earth's surface increased much less, from 492 (168 + 324) W/m² to 494 (161 + 333) W/m². Setting emissivity to 0.95 could reduce this requirement to about 470 W/m² and still be sufficient for evaporation, thermals and heat storage.
- OLR at the TOA increased from 235 in KT97 to 238.5 W/m² in TFK2009, nearly half (1.5 W/m²) being due to an earlier adjustment error.
- TFK2009 found a net forcing imbalance or 'Net Absorbed' at the TOA of 0.9 W/m². In view of all the rubbery figures on which it is based, the authors admitted uncertainty regarding this figure. Trenberth and his colleagues fail to factor photosynthesis into Earth's energy budget. Although it accounts for only about 1% of surface irradiation, the observed increase in global photosynthesis¹²¹³ associated with increased CO₂ and temperatures could account for some of the net imbalance.

Do the Slayers critically analyse the empirical data (from ERBE, CERES and MODIS) on which these energy budgets are based? Do they really comprehend the flow charts and issues involved? Or do they glibly dismiss them as fanciful cartoons based on a phony greenhouse and flat Earth? Can the Slayers provide a scientifically and mathematically sound alternative explanation for Earth's surface remaining so warm overnight? A large thermal mass is useless if you can't adequately heat it by day; and adiabatic compression cannot, by its very definition, add energy. Charles Anderson is the only author to attempt to balance Earth's energy budget (without any GHE/backradiation) and he made some fundamental errors.

In conclusion, SSD and its authors failed to debunk the widely accepted scientific explanation for a warmer than expected surface, failed to find any spare energy for heat storage by day and failed to provide a credible energy budget. Rejecting the GHE, they rely instead on an inadequate model, questionable assumptions and flawed mathematics.

Having seen earlier how water and its vapour, the dominant GHG, distribute heat across the globe and increase the mean surface temperature, we will now focus on carbon dioxide. Why is it increasing and are the consequences likely to be profound, trivial or nil? Might it even cool Earth's surface?

3. CARBON DIOXIDE and CLIMATE CHANGE

a. Is increasing CO₂ Anthropogenic or Natural?

The atmosphere contains about 780 gigatonnes of carbon (GtC), of which about 190Gt (nearly 25%) is exchanged annually with the oceans and biosphere. Man has been exhuming and burning fossilised carbon for several centuries and now contributes about 8GtC (or 30Gt of CO₂) annually to the atmosphere ([CDIAC](#)). That is about 1% of the total atmospheric carbon and nearly 4% of the total annual input.

Alarmists such as Al Gore and Tim Flannery would have us believe that this is causing atmospheric CO₂ to rise to dangerous levels. Pointing to the dramatic increase since 1958 (Fig. 3.1), they say it has been rising steadily from the preindustrial level of about 280ppm to 390ppm today and, unless urgent action is taken, will rise to over 600ppm by the end of this century with catastrophic consequences.

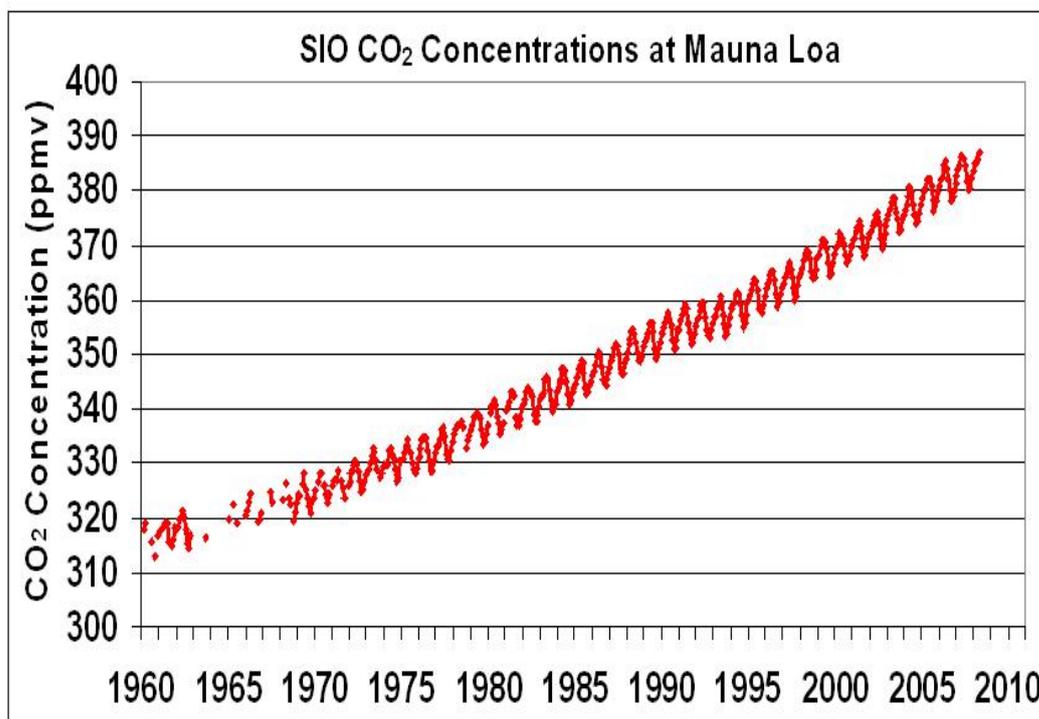


Figure 3.1: Atmospheric CO₂ levels at Hawaii's Mauna Loa Station, 1960-2009. Source: [CDIAC](#)

The Slayers are not alone in questioning the role of fossil fuel emissions in the current rise in atmospheric CO₂. Over the past 500,000 years, the concentration of CO₂ in the atmosphere varied from interglacial highs of 280-300ppm to lows of around 180ppm towards the end of each Ice Age (Fig. 3.2). Early in the present Holocene interglacial period, CO₂ levels exceeded 330ppm for centuries and went as high as 348ppm.¹⁴ Between 800 and 1800CE, it fluctuated between 260ppm and 320ppm.¹⁵

Concerning the human contribution, Shreuder states that *“. . . human activities constitute about 3% of the yearly emissions total. More than 98% of this total is absorbed within a year . . . as a maximum, only 14PPMV (Parts Per Million by Volume) of the increased levels of carbon dioxide can be ascribed to human activities, as indicated by figures provided by the U.S. Department of Energy and the IPCC.”* (p.194) I have no idea where he got his 'more than 98%' from – certainly not the U.S. Department of Energy or IPCC.

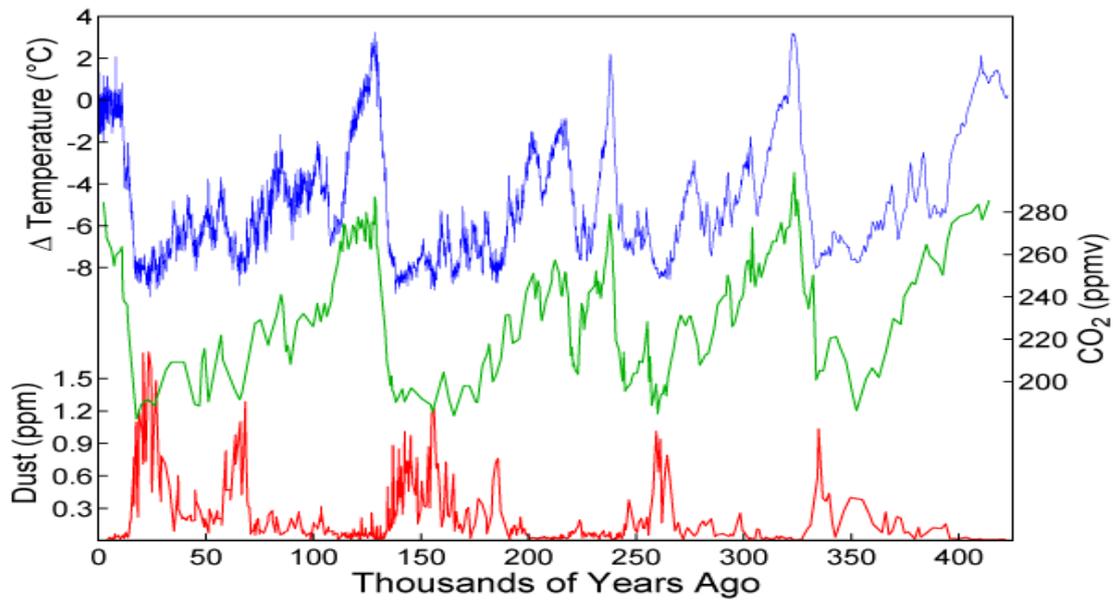


Figure 3.2: Temperature, CO₂ and dust record from the Vostok ice core over the past 420,000 years.

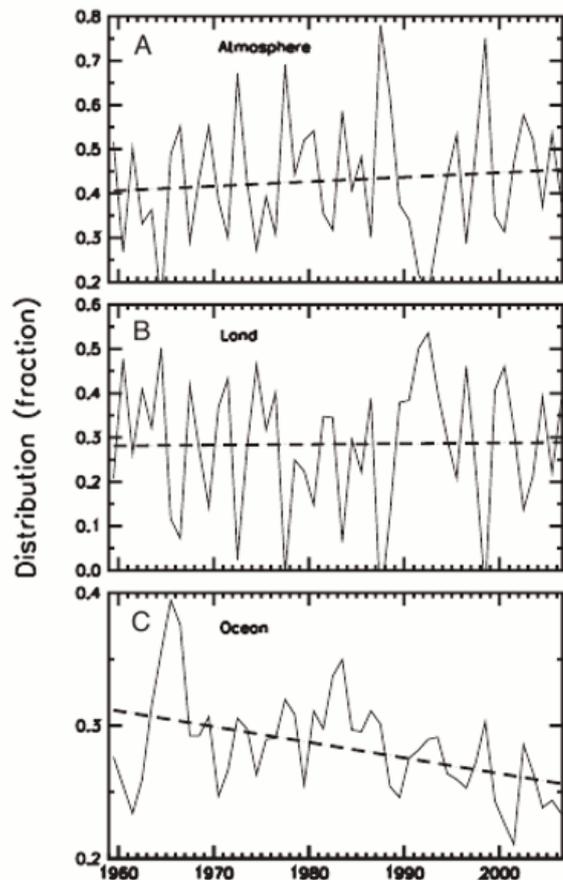
Source: http://p6.hostingprod.com/@treks.org/arctic_vostok-ice-core-petit.png

The proportion of annual human emissions naturally sequestered fluctuates considerably. Since records began in 1958, it has averaged 57% with no significant long term trend.^{16 17} If annual emissions are increasing and 43% of it remains aloft, that has to be contributing to the increasing atmospheric CO₂. Moreover, the proportion of human emissions absorbed by the oceans has been declining (Fig. 3.3).

The altering ratio of carbon isotopes in the atmosphere is also consistent with increasing carbon from fossil fuels; as are falling atmospheric oxygen levels due to depletion from burning fossil fuels (Manning 2006). The analysis of corals also reveals a recent sharp rise in the isotopic pattern of carbon found in fossil fuels (Pelejero 2005). The continuous interchange of low ¹³C from fossil fuels with all carbon isotopes in the oceans and biosphere makes the current atmospheric figure of about 4% [difficult to interpret](#). But we can be fairly certain that fossil fuels have contributed significantly to the recent rise in atmospheric CO₂.

Figure 3.3: - Fraction of the total human emissions (fossil fuel burning & land use change) that remain in the: a) atmosphere, b) land vegetation and soil, c) the oceans.

[From Canadell \(2007\)](#)



b. Does CO₂ produce Warming or does warming produce CO₂?

In interpreting the correlation between CO₂ and temperature in the Vostok ice core data (Fig. 3.2), Al Gore inferred that the rising CO₂ caused the temperature to rise. Hertzberg challenges this:

First, the correlation between temperature and CO₂ has been going on for about half a million years, long before any significant human production of CO₂, which began only about 150 years ago. Thus it is reasonable to argue that the current increase in CO₂ . . . is merely the continuation of a natural process that has nothing whatever to do with human activity.

Gore also fails to ask the most logical question: where did all that CO₂ come from during those past warming periods . . . from the same place that the current increase is coming from, from the oceans. . . . But the real 'clincher' that separates the scientists from the propagandists comes from the most-significant fact Gore fails to mention. The same Vostok data show that changes in temperature always precede the changes in atmospheric CO₂ by about 500-1500 years. . . . Any objective scientist looking at that data would conclude that it is the warming that is causing the CO₂ increases, not the other way around as Gore claimed.

There is no doubt that the rise in temperature preceded the rise in CO₂ (Fig. 3.4) and that the CO₂ came from the oceans. And a Norwegian study of 8 parameters from January 1980 to December 2011 reported:

The maximum positive correlation between CO₂ and temperature is found for CO₂ lagging 11–12 months in relation to global sea surface temperature, 9.5-10 months to global surface air temperature, and about 9 months to global lower troposphere temperature. The correlation between changes in ocean temperatures and atmospheric CO₂ is high, but do not explain all observed changes.¹⁸

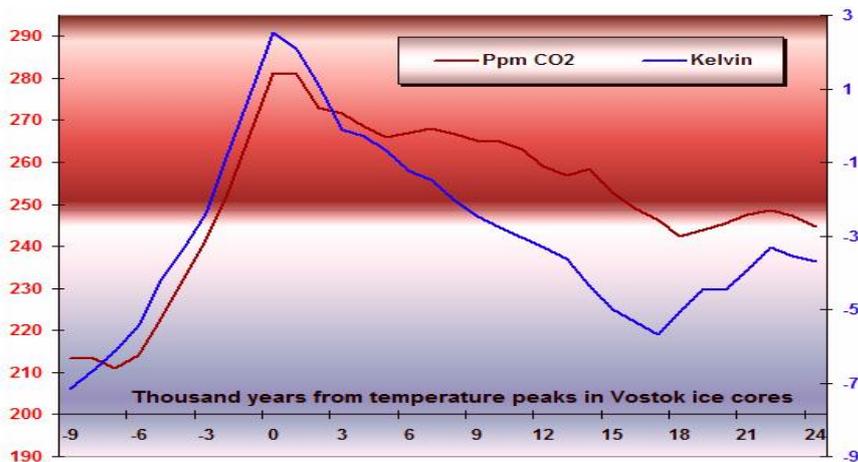


Figure 3.4: Compilation of actual data from all major temperature peaks in the Vostok Ice Core in Fig. 18

Source: Frank Lansner v, 2009¹⁹

It is also evident that the temperature rise accelerates as CO₂ increases, and both peak simultaneously. Temperature-induced photosynthesis and carbon sequestration in the biosphere initially outpaces out-gassing of CO₂ from slowly warming oceans, slightly reducing atmospheric CO₂; and it later limits the rise in atmospheric CO₂ and temperature, permitting the onset of another ice age triggered by the Milanković cycles of orbital variations referred to by Hertzberg (page 185). While Gore presented only one angle of this complex relationship, so do the Slayers. If the present rise in atmospheric CO₂ was entirely due to out-gassing from the oceans, we would expect the pH of the oceans to be rising – alkalinity should be increasing as dissolved CO₂ diminishes – but we find the very [opposite](#). The oceans have been absorbing more CO₂ than they have been releasing; and the rising atmospheric CO₂ may well contribute to rising temperatures.

SSD says carbon dioxide has not driven climate in the past

Olson says: *“If you refer to the Geocraft.com 600 million year chart below, you will first notice there is no apparent correlation or causation between CO₂ and temperature.”* (p.248) Olson’s Figure 1 (Fig. 3.5 here) is based on GEOCARB, a geochemical model of uncertain levels of CO₂ in the dim distant past.

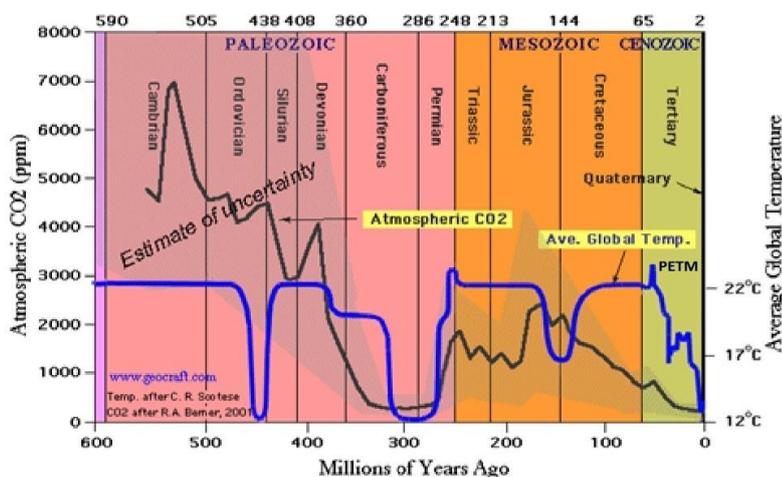


Figure 3.5: GEOCARB model of atmospheric CO₂ and temperature over the past 600million years.

Concerning dating accuracy, Tim Ball says: *“Even the most sophisticated technique, radiocarbon dating, only covers approximately 70,000 years with an error factor that increases as you go back in time.”* (p.138) Olson nevertheless implicitly accepted very ancient proxy data, but then questions relatively recent tree-ring proxies used in the famous hockey stick temperature chart, concluding: *“All predictions of past conditions are proxy data and subject to two obvious error paths. First is the level of degradation of the samples over time and second that past conditions were very similar to current conditions.”* (p.252) By ‘predictions’ he surely means ‘estimations’ of past conditions; and his ‘error paths’ are surely more applicable to conditions hundreds of millions of years ago than to those of the last millennium.

After pointing out that precipitation complicates tree-ring proxies for temperature in the MBH 99 hockey stick graph, Ball continues: *“Second, they overlapped the tree ring reconstruction with the modern temperature record and that is unrealistic.”* (p138) That is precisely how proxies are validated. Moreover, the [IPCC \(TAR\) acknowledged](#):

Several important caveats must be borne in mind when using tree-ring data for palaeoclimate reconstructions. Not least is the intrinsic sampling bias. Tree-ring information is available only in terrestrial regions, so is not available over substantial regions of the globe, and the climate signals contained in tree-ring density or width data reflect a complex biological response to climate forcing. . . . Furthermore, the biological response to climate forcing may change over time. There is evidence, for example, that high latitude tree-ring density variations have changed in their response to temperature in recent decades, associated with possible non-climatic factors (Briffa et al., 1998a). By contrast, Vaganov et al. (1999) have presented evidence that such changes may actually be climatic and result from the effects of increasing winter precipitation on the starting date of the growing season (see [Section 2.7.2.2](#)). Carbon dioxide fertilization may also have an influence, particularly on high-elevation drought-sensitive tree species, although attempts have been made to correct for this effect where appropriate (Mann et al., 1999). Thus climate reconstructions based entirely on tree-ring data are susceptible to several sources of contamination or non-stationarity of response.

On page 229 of SSD, Schreuder quotes Ian Plimer: *“The proof that CO₂ does not drive climate is shown by previous glaciations. The Ordovician-Silurian and Jurassic-Cretaceous glaciations occurred when the atmospheric content was more than 4,000ppm and about 2,000ppm respectively. . . . If the popular catastrophist view is accepted, there should have been a runaway greenhouse when CO₂ was more than 4,000ppm. Instead, there were glaciations. This has never been explained by those who argue that human additions of CO₂ will produce global warming.”*

Well, actually they have come up with a number of explanations. First, Gondwana probably moved into the South Polar Region at the time of the Ordovician-Silurian event around 445 million years ago. Second, [they](#) highlight uncertainties about the CO₂ level during that relatively brief glaciation:

Plimer's stated value of 4000ppmv or greater is taken from Robert Berner's GEOCARB, a well-known geochemical model of ancient CO₂. As the Ordovician was so long ago, there are huge uncertainties for that time period (according to the model, CO₂ was between an incredible 2400 and 9000 ppmv.) Crucially, GEOCARB has a 10 million year timestep, leading Berner to explicitly advise against using his model to estimate Late Ordovician CO₂ levels due its inability to account for short-term CO₂ fluctuations. He noted that "exact values of CO₂... should not be taken literally.

What about evidence for any of these short-term CO₂ fluctuations? Recent research has uncovered evidence for lower ocean temperatures during the Ordovician than previously thought, creating ideal conditions for a huge spurt in marine biodiversity and correspondingly large drawdown of CO₂ from the atmosphere through carbon burial in the ocean. A period of mountain-building was also underway (the so-called Taconic orogeny) increasing the amount of rock weathering taking place and subsequently lowering CO₂ levels even further. The evidence is definitely there for a short-term disruption of the carbon cycle.

Another important factor is the sun. During the Ordovician, it would have been several percent dimmer according to established nuclear models of main sequence stars. Surprisingly, this raises the CO₂ threshold for glaciation to a staggering 3000 ppmv or so. This also explains (along with the logarithmic forcing effect of CO₂) why a runaway greenhouse didn't occur: with a dimmer sun, high CO₂ is necessary to stop the Earth freezing over.

During the relatively brief Jurassic-Cretaceous period, there was considerable volcanic activity, the glaciation was limited to high-latitude alpine regions and temperatures were probably several degrees warmer than now (Fig. 3.5); and, as Olson points out on page 253, the atmosphere was very different then.

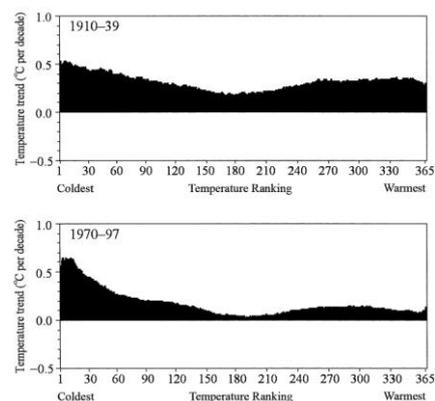
SSD says carbon dioxide is not driving present climate, nor can it

Schreuder declares: ***"Despite much rhetoric and research over the past decades, there is not a single piece of actual evidence that the now-maligned carbon dioxide molecule causes global warming . . . no such evidence can ever be found. Carbon dioxide (CO₂) at less than 400 parts per million by volume, does not and cannot influence either the atmospheric temperature or the climate in any measurable way."*** (p.189) And again, ***"there is no sign of CO₂-caused warming at all . . ."*** (p.223) Moreover, ***"the human race can do nothing to cause either warming or cooling . . ."*** (p.237) He provides no basis for such emphatic certainty.

From satellite data over the 1973-2003 period, [Griggs & Harries 2004](#) found reduced OLR at wavelengths corresponding to the CO₂ and methane absorption spectra, indicating that increased atmospheric levels had reduced radiative losses to space. Surface measurements also show increasing downward infrared radiation, particularly at CO₂ absorption wavelengths ([Wang 2009](#)). The finding that nights are warming faster than days (Fig. 3.6) is also consistent with greenhouse warming⁴ ([Alexander 2006](#)).

Figure 3.6: Trend in Night-time Low Temperatures indicates greenhouse warming of winter nights in the US during 1970-1997 (bottom) compared to predominantly solar warming during 1910-1939 (top), from Michaels & Balling, 2009.

Whereas the first period shows a fairly even warming trend throughout the year, the second period shows that the coldest winter nights warmed the most. Of course, the urban heat island effect also impacts minimum temperatures more than maximums.



Carbon dioxide is the most important GHG after water vapour. Some argue that it is more important than water vapour in determining Earth's surface temperature because it influences the amount of water vapour in the atmosphere. There is still a great deal of uncertainty, however, about the fate and effects of that water vapour. While we know that CO₂ is increasing and can be fairly certain that it is increasing radiative forcing, we can't be sure of the exact extent and likely consequences. As atmospheric CO₂ increases, the extra GHE decreases exponentially. Calculations of IR radiation at 70km altitude for the US Standard Atmosphere, using the [MODTRAN3](#) radiation model of the of the University of Chicago, show that the first 50ppm produces 70% of the reduction in IR radiation to space as levels increase from zero to 800ppm (more than twice the present level). In [Unmasking 'An Inconvenient Truth'](#), Kininmonth explains:

The radiative forcing due to carbon dioxide is largest for the first 50 ppm (19.2 W/m²). For each doubling of concentration thereafter the increase in radiative forcing is only about 3 W/m². . . .

The reasons that a further increase of carbon dioxide concentration has little additional effect on infrared radiation to space are twofold; carbon dioxide is well mixed through the atmosphere, and the gas is radiatively active (high absorptivity and emissivity) in its characteristic wavelength bands. As a consequence, in those wavelengths the effective emission height for radiation to space is high in the atmosphere. At a concentration of 50 ppm the effective emission layer for the carbon dioxide bands is already in the stratosphere, where temperature changes little with height.

Satellite derived emission spectra of outgoing longwave radiation show that the effective emission temperature in the carbon dioxide bands is generally about -52°C, a temperature characteristic of the stratosphere and in agreement with calculations. Adding more carbon dioxide to the atmosphere will elevate the height of the effective emission layer but will not appreciably change the effective emission temperature. As a consequence there will be little change in outgoing infrared radiation, or radiative forcing, relevant to the active bands when carbon dioxide concentration is increased. . . .

IPCC calculates the 'radiative forcing', or reduction in infrared emission to space, resulting from doubling of atmospheric carbon dioxide concentrations above pre-industrial levels, to be about 4 W/m². At the average effective emission temperature of the Earth (-19°C) a reduction of 4 W/m² in the infrared radiation emanating from the troposphere translates to a reduction in the earth's effective emission temperature of about 1°C. A rise in temperature of 1°C in the middle to high troposphere (the effective emission layer of infrared radiation to space) is necessary to restore the infrared radiation to space and offset the impact from doubling the carbon dioxide concentration.

A characteristic of the moist adiabatic temperature lapse rate (the rate of temperature decrease with height of air ascending buoyantly in convection clouds) is the amplification of actual temperature difference with height between adiabats. That is, as the surface temperature rises, the rise in temperature in the high troposphere is amplified by approximately 2 to 3 times (see Box 4). A temperature increase of between 0.3°C and 0.5°C at the surface is all that is required to achieve a rise in temperature of 1°C in the high troposphere (the necessary compensation for the 'radiative forcing' from a doubling of carbon dioxide concentration).

The changes to the temperature at the surface and lower troposphere that are necessary to compensate for radiative forcing will be also cause a change in the surface energy budget. A warmer atmosphere with constant relative humidity will increase the downward infrared radiation at the surface. It is the increased back radiation from the atmosphere that provides the energy necessary to offset the enhanced conduction, evaporation and infrared emission at the warmer surface temperature. Overall, the direct impact from a doubling of atmospheric carbon dioxide concentration above pre-industrial levels will have a relatively small impact on global temperature, and significantly less than 1°C. (p.22-26)

It must also be kept in mind that there are many positive benefits from increasing atmospheric carbon dioxide, not least being increased plant growth and food production. Canberra economist, Tim Curtin (2009)²⁰ has shown that as atmospheric CO₂ increased by 11.2% from 1980 to 2003, global food production increased by 62.8%, fertiliser use increased by just 27.5% and land use barely increased at all. Ainsworth and Long (2005)²¹ found that increasing the atmospheric CO₂ increased heat and drought tolerance of many plants and rendered them more resistant to the toxic effects of ozone. Perhaps Olson makes a valid point: ***"To demonise such an innocent and vital component of life betrays a deeper seated hatred for life."*** (p.255) Perhaps it is also possible to have too much of a good thing – but how much is too much? The answer to that question, not raised in SSD, is beyond the scope of this critique.

c. Are there Other/Better Explanations for Global Warming?

Geo-Nuclear Energy

Whereas Schreuder recognises that volcanic and other geothermal energy contributes very little to Earth's energy budget (p.200), Olson says *"Earth's fission energy is substantial and variable. This internal energy is not included and (sic) any climate model energy flow."* (p.247) Based on articles in Physics World (2003) and New Scientist (2005), he says: *"There has been an order of magnitude increase since the first IPCC models were developed."* (ibid) Without any supporting evidence, Olson then asserts: *"Dramatic changes in these fission reactions are the cause of long term climate events like Ice Ages."* (p.248)

Geothermal energy, while very difficult to measure, is thought to account for about 0.025% of Earth's energy.²² Even 10 times that is not very much. While such an increase could theoretically account for some surface warming, it could not account for the observed TOA radiation imbalance (forcing). Indeed, it would have to be *added* to the TFK09 figure of 0.9W/m².

Cosmic Cycles

Olson is on more solid ground regarding Milanković and solar cycles (p.243) but doesn't elaborate on these. Anderson points out that: *"The solar cycle variation of UV light, at 0.5 to 0.8%, is much larger than the visible light variance (0.22%)."* (p.320)

Two satellite instruments aboard NASA's Solar Radiation and Climate Experiment (SORCE) mission – the Total Solar Irradiance Monitor (TIM) and the spectral Solar Irradiance Monitor (SIM) – have made daily measurements of the sun's brightness since 2003. NASA's Adam Voiland reports: *"TIM and its predecessor instruments, whose records of irradiance began in 1978, show that the sun's output varies by about 0.1 percent as the sun cycles through periods of high and low electromagnetic energy every eleven years or so."*²³ SIM reveals that the variation across the spectrum is even greater. Total solar irradiance changed little from 2004 to 2007, but SIM found that the ultraviolet (UV) radiation decreased dramatically (Fig. 3.7).

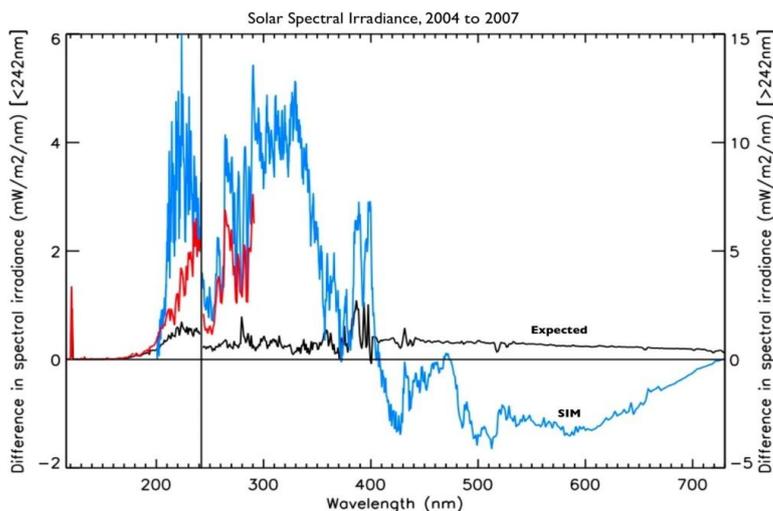


Figure 3.7: NASA's Solar Irradiance Monitor (SIM) measurements across the spectrum: 2004-2007.

The decrease in UV radiation (less than 400 nm) was 4 to 6 times more than expected (black line). The red line represents measurements from another UV-sensing instrument: SOLSTICE. Visible light (400-700 nm) was slightly greater than expected. Note: different scales are used for values at wavelengths less and more than 242nm (left and right axes respectively). Source: Voiland, 2010 (Credit: Joanna Haigh/Imperial College London)

Courtillot et al (2007)²⁴ reviewed the evidence for causes of climate change over various time scales ranging from 10 years to a million years and concluded (emphasis mine):

*Evidence for correlations, which invoke Milankovic forcing in the core, either directly or through changes in ice distribution and moments of inertia of the Earth, is still tenuous. Correlation between decadal changes in amplitude of geomagnetic variations of external origin, solar irradiance and global temperature is stronger. It suggests that **solar irradiance could have been a major forcing function of climate until the mid-1980s**, when “anomalous” warming becomes apparent. . . .*

*A proposed mechanism involves variations in the geometry of the geomagnetic field (f.i. tilt of the dipole to lower latitudes), resulting in enhanced cosmic-ray induced nucleation of clouds. **No forcing factor, be it changes in CO₂ concentration in the atmosphere or changes in cosmic ray flux modulated by solar activity and geomagnetism, or possibly other factors, can at present be neglected or shown to be the overwhelming single driver of climate change in past centuries.** Intensive data acquisition is required to further probe indications that the Earth’s and Sun’s magnetic fields may have significant bearing on climate change at certain time scales.*

Scafetta and West (2006)²⁵ found a strong correlation between Northern Hemisphere temperature over the past 400 years and three reconstructions of total solar irradiance (TSI) during the same period (Fig. 3.8). They estimated “. . . that the sun contributed as much as 45 percent to 50 percent of the 1900-2000 global warming and 25 percent to 30 percent of the 1980-2000 global warming.”

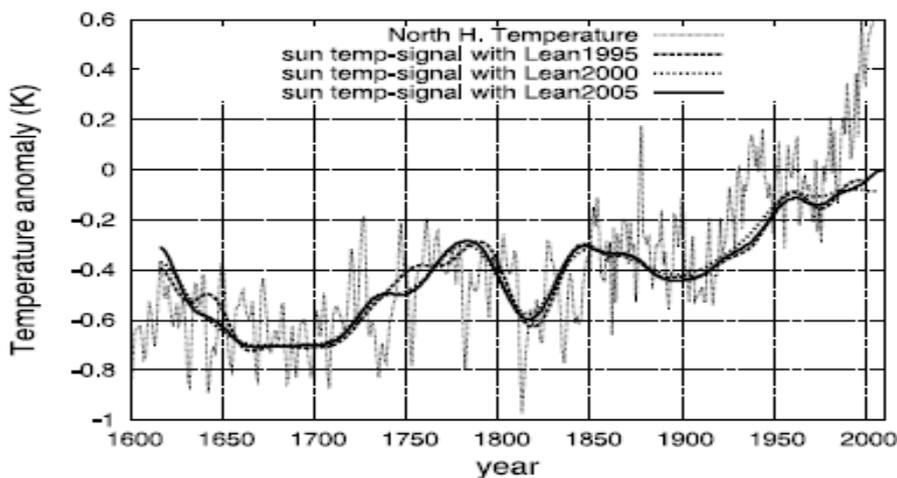


Figure 3.8: Parallel trends in solar irradiance and Northern Hemisphere temperatures.

Source: Scafetta and West, 2006

On pages 177-8 of SSD, Hertzberg referred to Heinrich Svensmark’s cloud chamber study²⁶ and theory that a strong solar magnetic field reduces low cloud formation by shielding Earth against cosmic rays²⁷ and postulation that the consequent minor changes in albedo could explain the modest changes in temperature observed over the 20th century. Krivova and Solanki (2003)²⁸ found a strong correlation between cosmic ray flux and global temperature prior to 1985, after which there was a divergence (Fig. 3.9). As discussed later, it is likely that ‘homogeneity adjustments’ to the surface temperature record accounts for some of this divergence.

The decline in low cloud cover and albedo in the late 20th century (Fig.3.10) was thought to be due to increasing CO₂; but the increase after 2001 was associated with a dramatic decline in sunspot activity and solar magnetic flux, an unusually long solar cycle and increasing cosmic rays (Fig. 3.11).²⁹ The last solar minimum lasted 10 months longer than usual, making it the longest in a century, and the magnetic field strength of sunspots declined from 2700 to 2000 gauss.³⁰

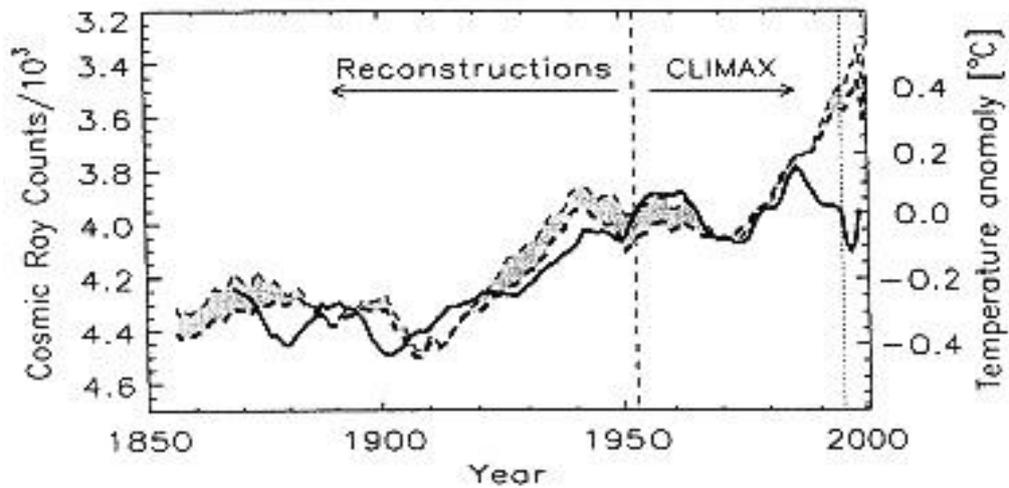


Figure 3.9: Cosmic ray flux (solid line) and global temperature anomaly from reconstructions pre-1952 and observations post-1952. Source: Krivova and Solanki, 2003

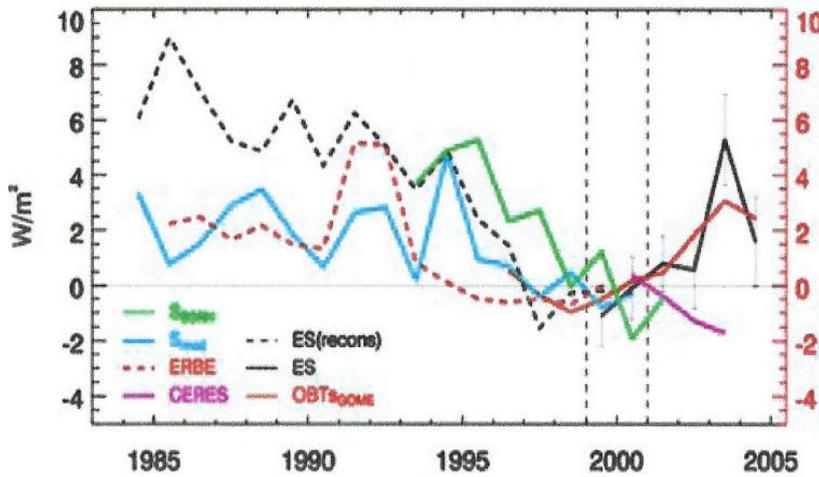


Figure 3.10: Annual albedo anomalies (relative to 1999-2001) derived from: Lunar Earthshine (ES) reconstructed (broken black) and actual (solid black); ERBE (broken red); OBT_{GOME} (red); Satellite cloud S_{mod} (blue) and S_{SBRN} (green) Source: Palle et al, 2005³¹

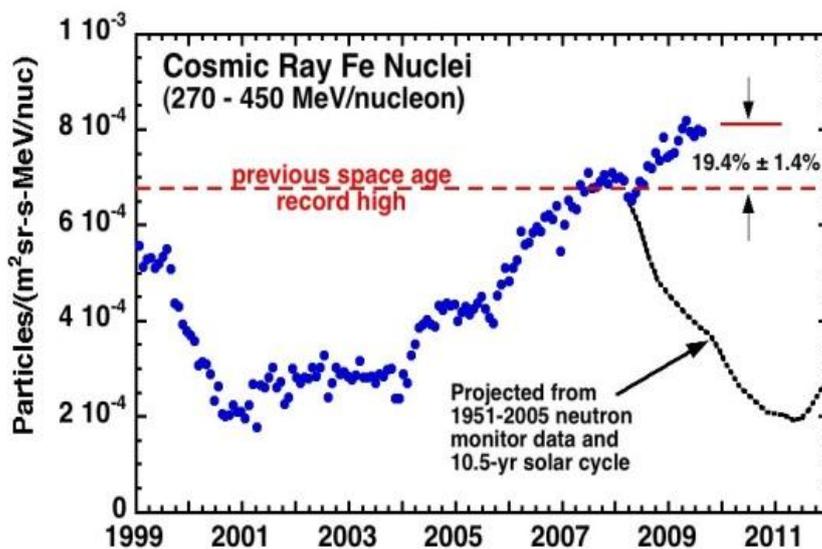


Figure 3.11: Energetic iron nuclei counted by the Cosmic Ray Isotope Spectrometer on NASA's ACE spacecraft. Source: <http://solarscience.msfc.nasa.gov/predict.shtml>

Judith Curry highlights some solar uncertainties:

There is significant uncertainty, not only in solar reconstructions, but in the interpretation of satellite measurements since 1980. There is a 6 W m⁻² discrepancy in the baseline measurements across different satellite systems, plus significant differences in trends since 1980. There is 5 W m⁻² discrepancy in the reconstructions in the first few decades of the 20th century. For reference, the 20th century CO₂ forcing is 1.7 W m⁻².³²

In The Earth's Radiation Energy Balance, Dr. Steve Ackerman states:

The solar and terrestrial properties of clouds have offsetting effects in terms of the energy balance of the planet. In the longwave, clouds generally reduce the radiation emission to space and thus result in a heating of the planet. While in the solar (or shortwave), clouds reduce the absorbed solar radiation, due to a generally higher albedo than the underlying surface, and thus result in a cooling of the planet.

The latest results from ERBE indicate that in the global mean, clouds reduce the radiative heating of the planet. This cooling is a function of season and ranges from approximately -13 to -21 Wm⁻². While these values may seem small, they should be compared with the 4 Wm⁻² heating predicted by a doubling of carbon dioxide concentration.

In terms of hemispheric averages, the longwave and shortwave cloud forcing tend to balance each other in the winter hemisphere. In the summer hemisphere, the negative shortwave cloud forcing dominates the positive longwave cloud forcing, and the clouds result in a cooling. For deep convection the solar and longwave effects also cancel.³³

As cloud cover decreased from 1980-2000, stratospheric water vapour increased, and the opposite has happened since 2000.³⁴ The reason is uncertain but it may well be related to solar and ocean cycles.

Ocean Cycles or Oscillations

Hertzberg tells us about a symposium he attended in 1989 where *“. . . a paper was presented describing a model in which greenhouse gas induced temperature changes in the atmosphere were driving the Earth's ocean circulation. I had to heckle the speaker with the obvious fact that he had it 'backasswards'. Meteorologists know from the El Nino phenomenon, the moderate temperatures caused by the Gulf Stream, the development and motions of hurricanes and typhoons, and the periodic monsoons in Asia and elsewhere, that it is the other way around: namely, the distribution of land and ocean and ocean currents drive the atmospheric circulation.”* (p. 165)

This is overwhelmingly the case – the atmosphere piggybacks on the ocean. Atmospheric temperature fluctuations correlate strongly with ocean cycles. Joseph D'Aleo, former Chairman of the American Meteorological Society, combined the standardised data bases for the Pacific Decadal Oscillations (PDO) and the Atlantic Multidecadal Oscillation (AMO), then ran a multiple regression analysis with U.S. temperature data and found a strong correlation (Fig. 3.12). When he added total solar irradiance (TSI) and CO₂ to this analysis, the r² correlation increased from 0.85 to 0.89.

The interplay between ocean and atmospheric temperatures, trade winds and the ENSO phenomenon is very complex. The main ENSO driver is the Interdecadal Pacific Oscillation (IPO) of sea surface temperature (SST) which varies on inter-decadal time scales.³⁵ It is connected to solar³⁶ and lunar³⁷ cycles. Kiem et al (2003)³⁸ showed that El Niños tend to dominate when the IPO Index is positive (1924 -1943 and 1979-97) and La Niñas dominate when the IPO Index is negative (1946 - 1976 and since 2000).

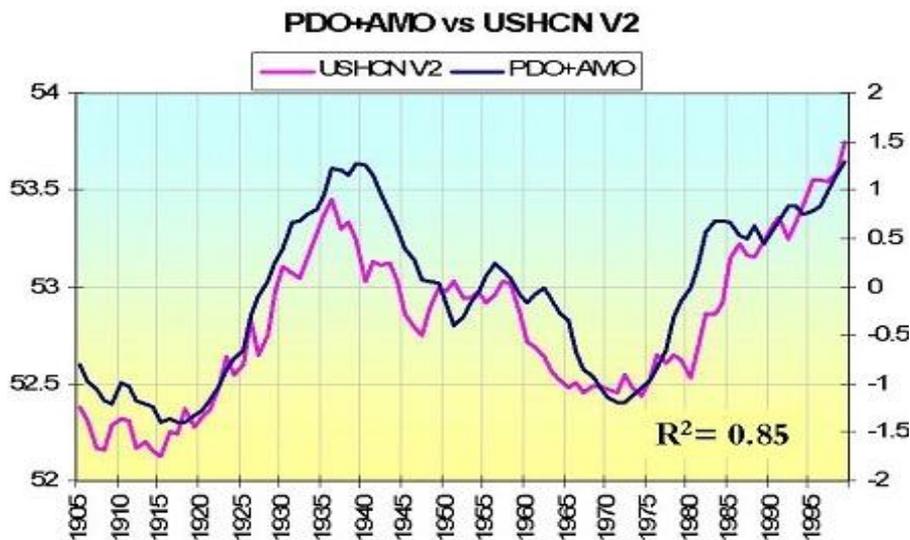


Figure 3.12: Pacific and Atlantic Oscillations vs. USA Temperature, 1905-2000.

Source: [D'Aleo, 2007. Icecap.](#)

The oceans are warmed by solar radiation and cooled by conduction and convection in the atmosphere. Increasing solar radiation results in warmer oceans; and increasing backradiation likewise results in slight warming of the ocean surface, largely offset by increased evaporative cooling. Oscillations in the overturning of warm surface water with cool deep water can either accentuate or mask global warming. Alarmists celebrate the former and deniers celebrate the latter. Realists recognise both

Alarmists think that 80% or more of 20th century warming was anthropogenic. Deniers think none of it was. Realists take an intermediate position. From a multi-scale analysis of historical global temperature changes, researchers at China's Nanjing University concluded that the 20th century anthropogenic "influence weight on global temperature variation accounts for no more than 40.19%, smaller than those of the natural climate changes."³⁹ The exact amount, however, remains uncertain and controversial.

The crux of the controversy in climate science is climate sensitivity to CO₂, determined by positive and negative feedbacks. By denying any greenhouse effect or climate sensitivity, the Slayers have excluded themselves from this debate.

Perhaps realising the weakness of Olson's alternative explanations, Schreuder questions global warming itself – the subject of the next section.

d. Is Global Warming still happening?

Schreuder asserts: *“Any and all alarmist predictions and observations have been decisively disproved over the past decade, whilst global temperatures have been going down rapidly instead of ever up as had been so widely predicted by the constant tweaking of climate models.”* (p.195) Furthermore: *“Global warming (which has by now – 2010 – been reversed to pre-alarm days) . . .”* (p.210); and he quotes Joe D’Aleo: *“Given the current global cooling now in its 8th year . . . ”* (p.228).

It is true that surface warming over the last 15 years has been very modest (Figs. 3.13 and 3.14). Although the 1998 El Niño was slightly warmer than the 2010 El Niño, temperatures are hardly ‘going down rapidly’.

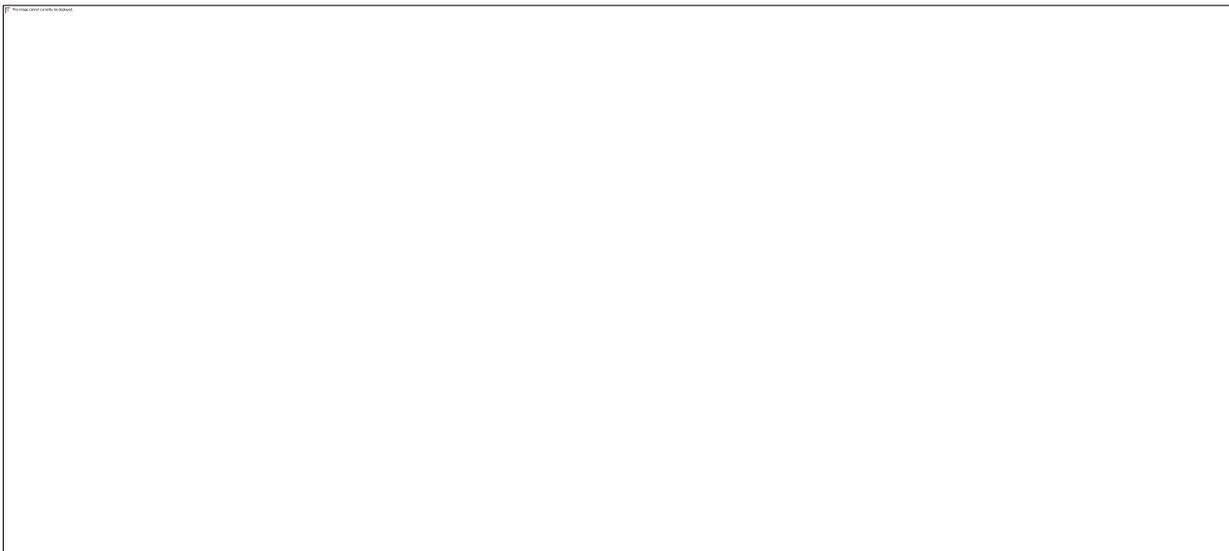


Figure 3.13: Annual mean surface temperature from 1997 to 2011. Source: Hadley Climate Research Unit

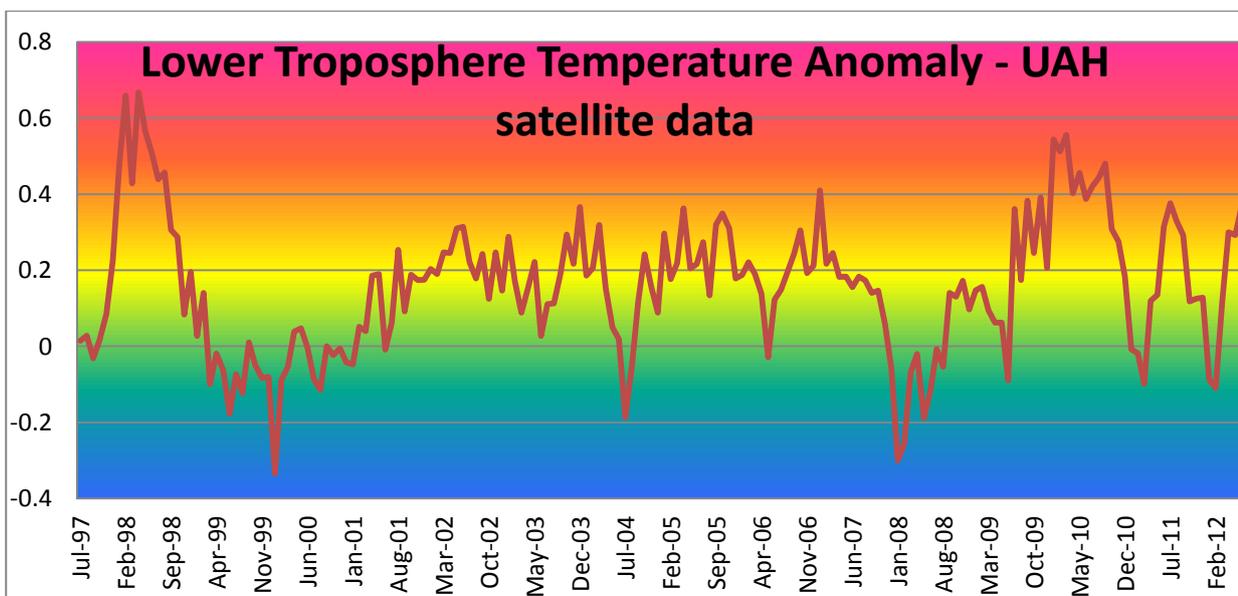


Figure 3.14: Monthly temperature anomaly of the lower troposphere over 15 years (1997 to 2012)

Source: [UAH satellite data](#) (updated July 2012)

This pause in surface warming coincided with the IPO turning negative (Fig. 3.15). Although the ocean surface may not now be warming, heat continues to accumulate in the deeper ocean (Fig. 3.16).

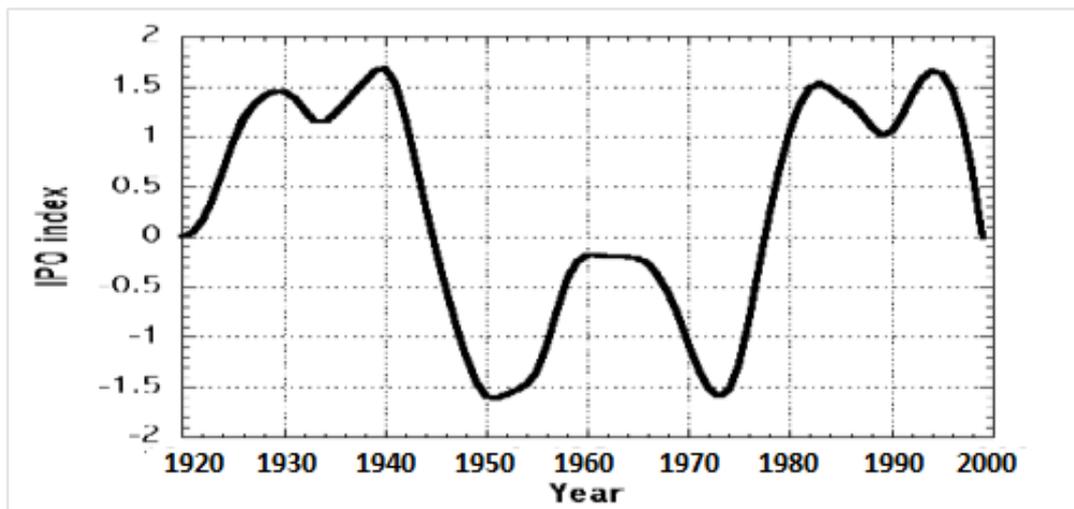


Figure 3.15: Interdecadal Pacific Oscillation (IPO) of Sea Surface Temperature (smoothed) 1920 to 2000.

Source: Kiem et al, 2003

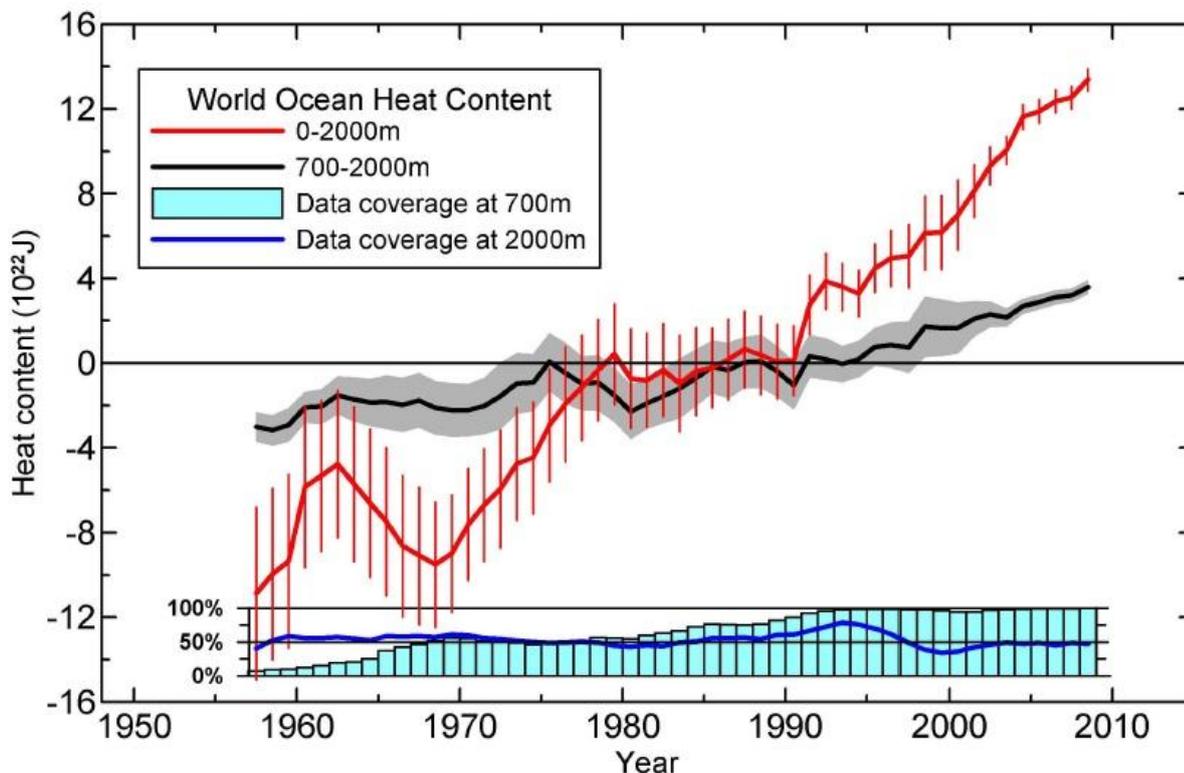


Figure 3.16: World ocean heat content (10^{22} J) for the 0-2000m (red) and 700-2000m (black) layers based on running pentadal (five-year) analyses. Reference period is 1955-2006. Each pentadal estimate is plotted at the midpoint of the 5-year period. The vertical bars represent ± 2 times the standard error of the mean (S.E.) about the pentadal estimate for the 0-2000m estimates and the grey-shaded area represent ± 2 *S.E. about the pentadal estimate for the 700-2000m estimates. The blue bar chart at the bottom represents the percentage of one-degree squares (globally) that have at least four pentadal one-degree square anomaly values used in their computation at 700m depth. Blue line is the same as for the bar chart but for 2000m depth. From Levitus et al. (2012)⁴⁰

When [Levitus et al \(2000\)](#) analysed temperatures in the top 3000m of the oceans for the period 1948–98, they found that the heat content increased by about 2×10^{23} joules (J) from the mid-1950s to the mid-1990s. This corresponded to a volume mean warming of 0.06°C and a forcing of 0.3 W/m^2 . The heat content of the top 300m increased by about 10^{23} J or 0.31°C .

In their recent paper, [Levitus et al \(2012\)](#) analysed the top 2000m and 700–2000m for the period 1955–2006. The heat content in the top 2000m had increased by 2.4×10^{23} J, corresponding to a volume mean warming of 0.09°C and a forcing factor of 0.39W/m^2 . The corresponding increases in the 700–2000m layer were 1.6×10^{23} J and 0.27W/m^2 . They also found that heat accumulated in the top 750m in the period from 1990 to 2009 at a forcing rate of 0.45W/m^2 . Data from [NOAA](#), however, shows very little increase in the top 700m since 2003. It is interesting to note in Figure 3.16 that data coverage has increased dramatically at 700m but not at all for 2000m, where coverage is still barely 50%.

It is also interesting to note that there was a pause or small decline in heat accumulation from 1976 to 1991, coinciding with the IPO turning strongly positive (Fig. 3.15), after which heat proceeded to accumulate at much the same rate as prior to that period. In an article on [Oceanic Deep Heat](#) for the Global Warming Policy Foundation, David Whitehouse points out that: *“The plateau seen between 1980 – 90 is unexplained. A major question is, of course what happened before the mid-1950s? Only with such data can the modern increases in heat content be put into it proper context and anthropogenic influences detected from natural ones.”*

The situation in the very deep ocean is even more uncertain. Purkey and Johnson (2010)⁴¹ found evidence of warming by “. . . about 0.03°C per decade in the deep Southern Ocean and less elsewhere” since 1990. How long did this heat take to get there? It was once thought to be a thousand years, then some centuries; and now some say it is only a matter of decades. So is this medieval warming, 19th century rewarming after the Little Ice Age, early 20th century solar warming or very recent warming – who knows? The rate of warming appears to decrease with increasing depth, consistent with warming by radiation from above rather than geothermal warming from below, as proposed by Olson (see Appendix). Increased solar warming seems most likely, penetrating very much deeper than longwave backradiation.

As I have argued in [The Weather Makers Re-Examined](#), global warming this century is very unlikely to be catastrophic for either man or the planet. Indeed, further warming is likely to be beneficial for human health and prosperity.^{42 43} From 14 peer-reviewed papers on the likely impacts on the GDP and human welfare of temperatures higher than now – by 1°C (2 studies), 2.5°C (10 studies) and 3°C (2 studies) – the optimal temperature appears to be about 1°C warmer than now. This would result in about 2% increase in GDP. Not until the global temperature increases by more than 2.3°C would GDP drop below today’s level (Fig. 3.17).

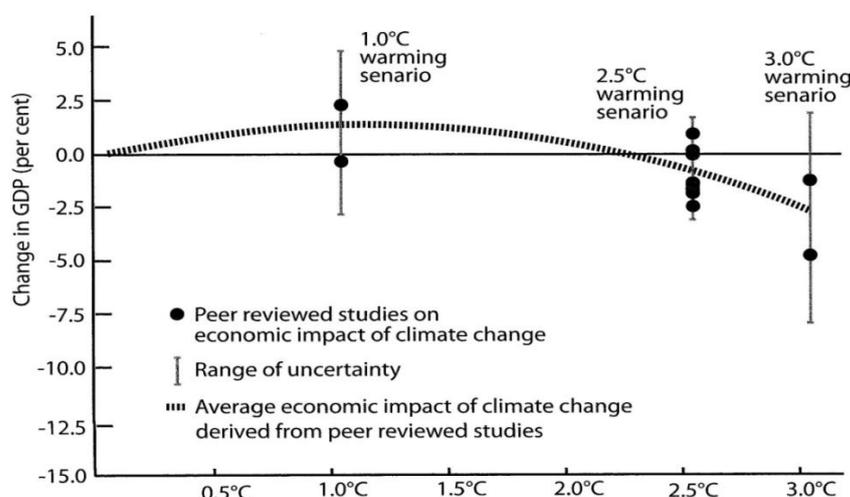


Figure 3.17: Economic impact of climate change – Warming Scenarios 1°C , 2.5°C and 3°C .
Source: Richard Tol 2010⁴⁴

4. HAS CLIMATE SCIENCE BEEN CORRUPTED?

Tim Ball begins Chapter 11 of SSD by looking at the philosophy of 'Climate Alarmism', how the 'green religion' has filled an existential vacuum, taken the moral high ground and coopted science in a way that made it more prophetic and dogmatic than the religion it replaced (p.85-100).

Corruption of climate science at CRU

Ball then launches into the history of climate research, beginning with the pioneer of climate research, Hubert Lamb, who founded the Climatic Research Unit (CRU) at the University East Anglia, wrote the two-volume classics: *Climate: Past, Present and Future* in 1977 and assisted Ball with his doctoral thesis. After quoting Lamb's autobiographical reference to *“. . . an understandable difference of opinion between me and the scientist, Dr Tom Wigley,”* Ball continues:

Wigley became the Director of the CRU prior to moving to a position in the U.S. Phil Jones replaced him as Director and was in charge through the period covered by the now infamous leaked emails that discloses the manipulation and corruption that makes this book necessary. It's obvious from the emails that Wigley is the grandfather figure controlling the corruption of climate science . . . his career is a classic example of what is wrong with climate science. Educated as a mathematical physicist he gravitated to climate and carbon-cycle modelling. . . . His training has nothing to do with any of those topics (p.103-6).

Despite eight whitewashing investigations, the leaked CRU emails do reveal a close-knit international clique colluding to fudge figures, hide data or destroy it, hijack debate and scientific journals, boycott those they couldn't, bully reviewers and editors to block contrary papers, oust any deemed to be sceptics, denigrate sceptical scientists, rejoice over their demise, contrive a consensus and manipulate the media to maximise alarm and research funding.^{45 46} Their righteous quest to save the planet apparently justified any means! Far from 'controlling the corruption', however, Tom Wigley emerged from those leaked emails as a stickler for evidence, even rebuking Michael Mann (of 'hockey stick' fame): *"Mike, the figure you sent is very deceptive."* Sceptics need to be careful not to emulate alarmists who specialise in *ad hominem* attacks.

In addition to the charge of corruption, Ball questions Wigley's credentials in climate science, which was not his original training. Of the eight authors of SSD, only two (Ball and Hertzberg) had training in meteorology. Two are chemists, one is an engineer, one a mathematician, one a physicist and one is a lawyer. And they all pontificate on climate. There seems to be double standards here. Personally, I don't think it matters all that much so long as the person is grounded in scientific principles and methodologies, keeps abreast of the research and knows how to properly assess it. I wonder how many Slayers could match Wigley's knowledge and understanding of the peer-reviewed climate literature.

The intergovernmental Panel on Climate Change (IPCC)

In [*The Weather Makers Re-Examined*](#), I outline the history of the IPCC, highlighting its political purposes and procedural problems, as does Ball. Publishing its *Summary for Policymakers* before the Scientific Report is finalised, and decreeing that any changes to it *"shall be those necessary to ensure consistency with the Summary for Policymakers"*, the IPCC puts the political cart before the scientific horse. Ball also criticises the IPCC endorsement of the questionable 'hockey stick' graphs that effectively eliminated the Medieval Warm Period and showed 'unprecedented' millennial warming during the 20th century.

Ball could also have mentioned the 2007 IPCC report that the Himalayan glaciers would disappear by 2035 or sooner, based on a 2005 WWF report, itself based on speculation by an obscure glaciologist in *New*

Scientist in 1999.⁴⁷ After this ‘glaciagate’ scandal broke in January 2010, the Inter-Academy Council (IAC) reviewed the IPCC and found that peer-reviewed journals comprised only 62 percent of all references cited:

An analysis of the 14,000 references cited in the Third Assessment Report found that peer-reviewed journal articles comprised 84 per cent of references in Working Group I, but only 59 per cent of references in Working Group II and 36 per cent of references in Working Group III (Bjurström and Polk, 2010⁴⁸).

Ball correctly points out that: **“Consensus is neither a scientific fact nor important in science, but is very important in politics.”** (p.122) Indeed, many scientific breakthroughs are made against the consensus of the day. He also points out that only a small handful of scientists were responsible for the critical section of the 2007 Fourth Assessment Report (AR4). This was confirmed by Hulme and Mahony (2010):⁴⁹

Claims such as ‘2,500 of the world’s leading scientists have reached a consensus that human activities are having a significant influence on the climate’ are disingenuous. That particular consensus judgement, as are many others in the IPCC reports, is reached by only a few dozen experts in the specific field of detection and attribution studies.

Corrupted surface temperature record

On pages 157-8, Ball lists 15 problems with the surface temperature record from Joseph D’Aleo and Anthony Watts. Of particular interest is his number 7: **“Numerous peer-reviewed papers in recent years have shown the overstatement of observed longer term warming is 30-50% from heat-island contamination alone.”**

A study of weather balloon data over US cities by Kalnay and Cai (2003)⁵⁰ indicated that urban heat accounted for 0.2°C, or nearly a third of the IPCC’s 0.63°C warming for the 20th century. The 2001 IPCC report allowed just 0.055°C.⁵¹

John O’Sullivan revisits this issue in the final chapter of SSD, where he analyses ‘**homogenization adjustments**’ to the raw temperature data. He first shows how this was done in New Zealand by the National Institute of Water and Atmospheric Research (NIWA) in their New Zealand Temperature Record (NZTR). Figure 4.1 (not shown in SSD) shows the raw NZ data and Figure 4.2 shows the NIWA adjusted data. An increase of nearly one degree per century miraculously appears!

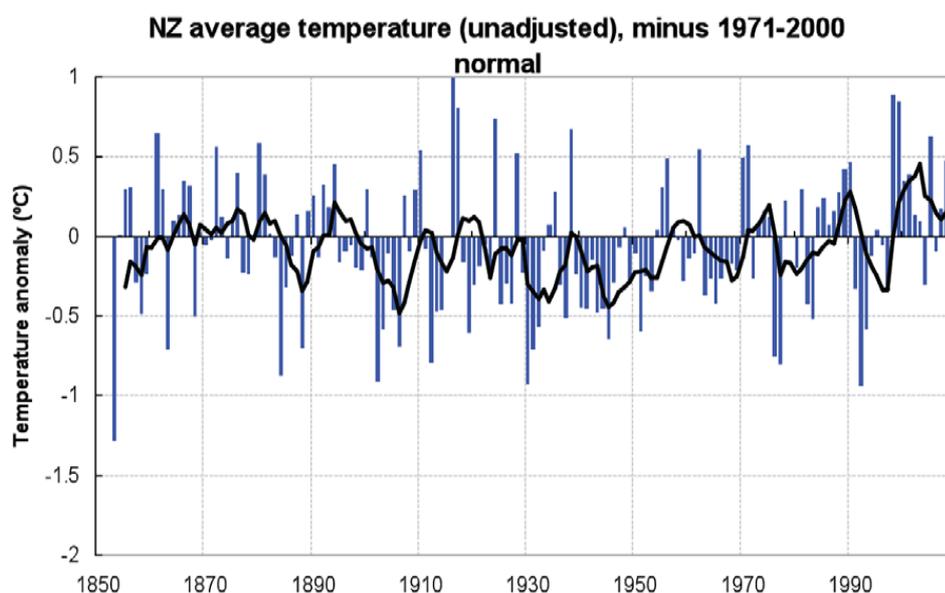


Figure 4.1: Temperature anomaly based on raw New Zealand temperature data (1850-2009)

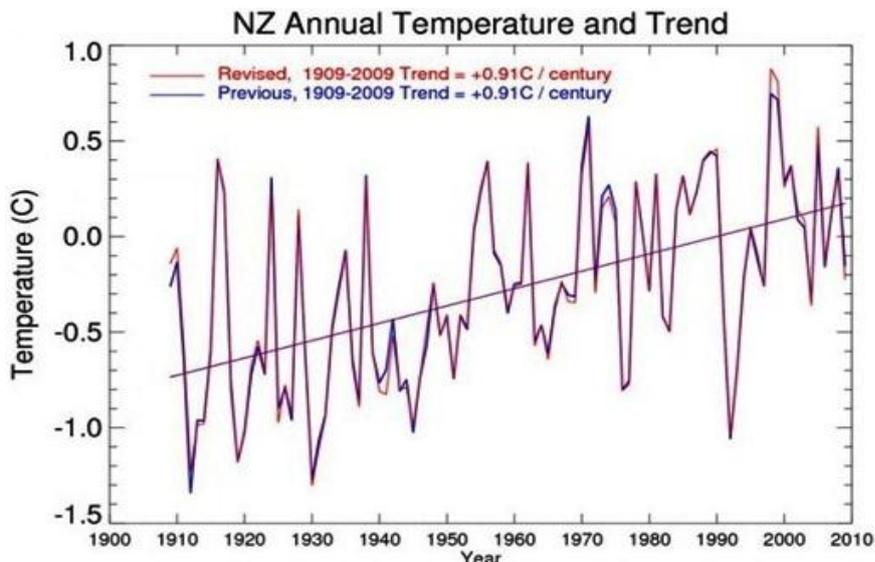


Figure 4.2: Adjusted NIWA temperature data (1910-2010) ⁵²

O’Sullivan describes how the New Zealand Climate Science Coalition (NZCSC) was repeatedly frustrated in its attempts to have NIWA explain how this warming trend was created. Consequently, following his legal thread and the *stare decisis* principle:

NZCSC petitioned the high court of New Zealand to force NIWA (effectively the Kiwi government) to validate their national weather service’s reconstruction of antipodean temperature – or strike it down. . .

Before the matter could be put to the court for a final judgment NIWA’s statement of defense gave up the fight. . . . Controverting all previous policy statements, the NZ government now wishes it to be known that the country has never maintained an official record; all such published data was only intended for internal research purposes and not as evidence to prove the country warmed due to human emissions of carbon dioxide.

However, all such data had shamelessly been hyped up via the IPCC as the gold standard of the entire New Zealand temperature history and for decades cited by pro-green advocates as proof of antipodean man-made climate warming. Along with the discredited Australian (BOM) records, the NZ numbers represented the cornerstone of Australasia/ South Pacific (Oceania) warming. Significantly . . . we may now infer that at least one quarter of the world’s ‘official’ climate record is discredited and an unjustified carbon tax is being extorted.

According to NZCSC, climate scientists cooked the books by using the same alleged ‘trick’ employed by British and American doomsaying scientists. This involves subtly imposing a warming bias during what is known as the *homogenization* process that occurs when climate data need to be adjusted. (p.339-41)

Under the heading **Homogenization Explained**, O’Sullivan says (p. 341-2):

According to an article in *Mathematical geosciences*, homogenization of climate data needs to be done because ‘non-climatic factors make data unrepresentative of the actual climate variation’. The great irony is that the justification made for the need to ‘homogenize’ data is because if it isn’t then the ‘conclusions of climate and hydrological studies are potentially biased’.

Did you get that? Climate scientists need to add their own spin to the raw temperatures because if they don’t then they are less reliable!

. . . the independent inquiry into Climategate chaired by Lord Oxburgh . . . found that . . . climatologists were overly guided by ‘subjective’ bias.

These ‘adjustments’ are deemed necessary because of variable station location quality, changes in observation times, measurement technologies (e.g. manual to automated thermometers) and urban heat island (UHI) effect over time. These adjustments to the US Historical Climatology Network (USHCN) made by the National Climate Data Centre (NCDC) at NOAA are shown in Figure 4.3.

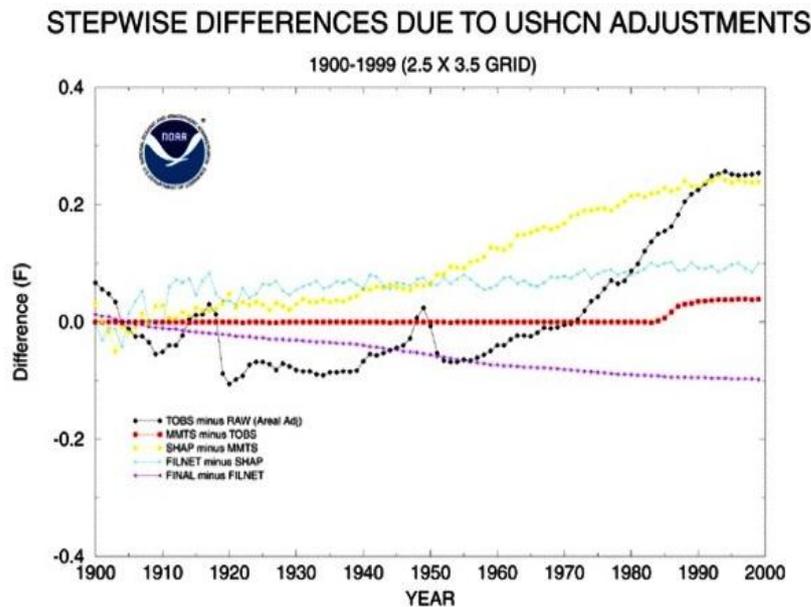


Figure 4.3: NOAA’s USHCN temperature data adjustments for 1900-2000.
Station Location Quality – yellow Time of Observation – black
Measurement Technologies – red UHI - purple

Source: [NCDC/NOAA](http://www.ncdc.noaa.gov)

Note that all but UHI add significant warming to the temperature record, the net effect of this being to increase 20th century warming by 0.3°C (0.54°F). The inconvenient warm 1915–1945 period was adjusted downwards in the ‘time of observation’ adjustments, which then ramped up in the late 20th century. Moreover, the UHI adjustment looks suspiciously small and linear.

Former NASA scientist, Edward Long (2010),⁵³ looked at the NCDC raw and adjusted **rural data**, comparing it with their **urban data**. He found that the raw unadjusted rural and urban data correlated very closely until 1965, when the urban data escalated rapidly (Fig. 4.4). Instead of adjusting the contaminated urban data down, however, the rural data was adjusted up to closely match it. This more than doubled late 20th century warming from 0.4°F to over 1.0°F (Fig. 4.5).

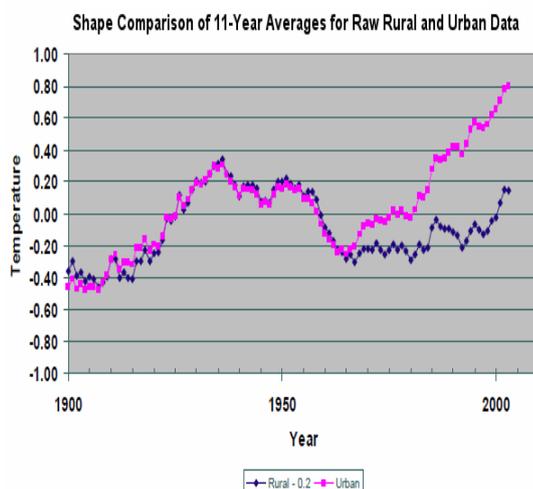


Figure 4.4: Raw USHCN Temperature Data (°F) 1900-2000

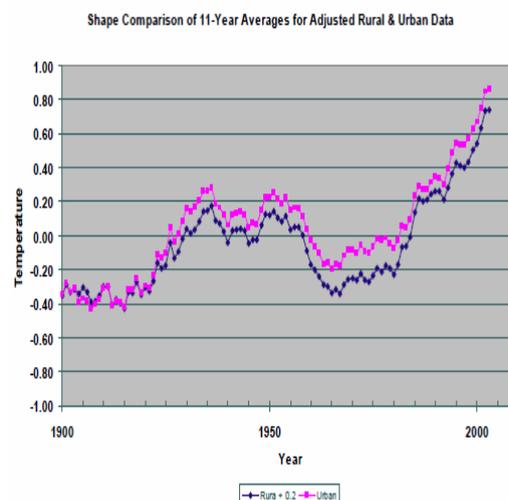


Figure 4.5: Adjusted USHCN Temperature Data (°F)

How much of the late 20th century warming is urban heat, unrelated to CO₂? McKittrick and Michaels (2007)⁵⁴ found that surface temperature was contaminated by **socioeconomic determinants**, especially in countries where real income is growing, and correcting for this “. . . reduces the estimated 1980-2002 global average temperature trend by about half.” [Watts et al \(2012\)](#) found that WMO-compliant weather stations across the US indicated a 0.155°C/decade increase from 1979-2008; but non-compliant stations gave 0.248°C/decade and the NOAA adjusted data gave 0.309°C/decade, double the real increase.

In April 2012, [Steirou and Koutsoyiannis](#) presented a paper at the European Sciences Union General Assembly in Vienna, in which they analysed data over a century or more and ending in 1990 or later. They found that: “In 2/3 of the stations examined the homogenization procedure increased positive temperature trends, decreased negative trends or changed negative trends to positive.” The global temperature increase in the raw data was 0.42°C and in the adjusted data 0.75°C, an addition of 81%.

[Willis Eschenbach](#) found that NCDC’s Global Historical Climatology Network (GHCN) also adjusted Australian data, turning a century of cooling into one of warming. Their ‘homogeneity adjustments’ added more than 2°C to raw data from Darwin airport sites, resulting in a gradient of 6°C per century at one site (Figs. 4.6 and 4.7). O’Sullivan refers to this on page 344.

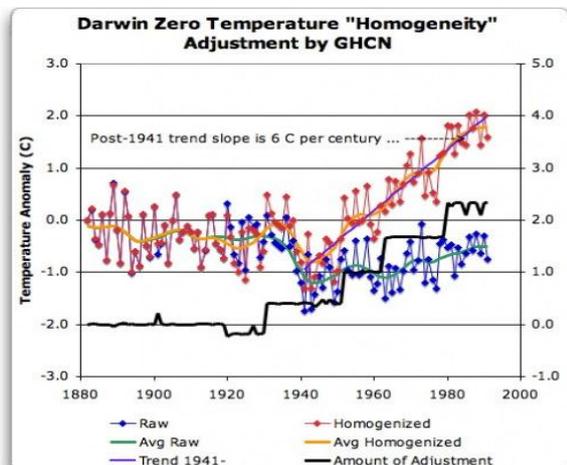
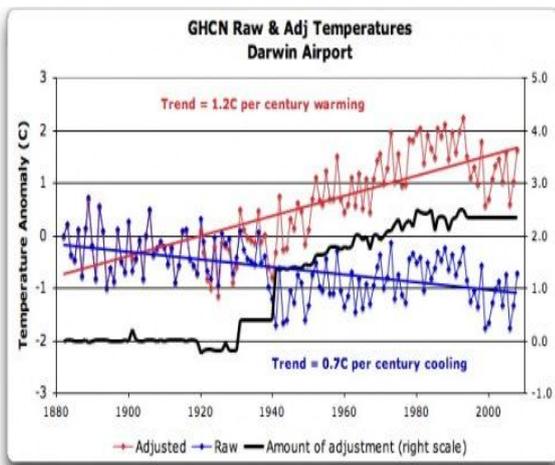


Figure 4.6: GHCN Adjustments to Darwin Airport **Figure 4.7: Homogeneity Adjustments at Darwin Zero.** Black line shows amount and timing of adjustments against temperature scale on right.

When the UK’s Climatic Research Unit (CRU) at East Anglia adjusted for contaminants in 2000, it too lowered the *early* 20th century temperatures, thus enhancing 20th century warming (CRUT2v), and went even further in 2007 (CRUT3v).⁵⁵ NASA’s Goddard Institute of Space Studies (GISS) likewise adjusted raw temperature data to turn cooling into warming (Figs. 4.8 and 4.9).

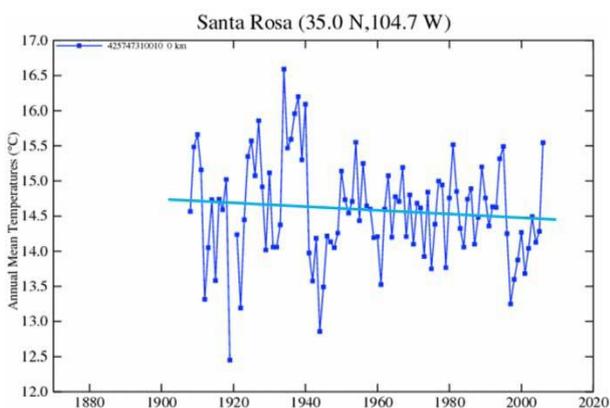


Figure 4.8: GISS Raw data showing a cooling trend

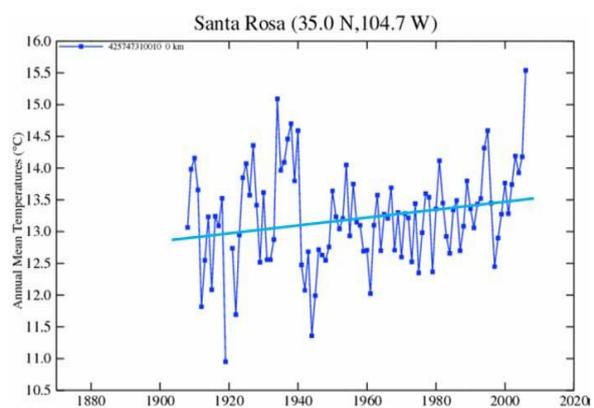


Figure 4.9: Processed GISS data showing warming

GISS also readjusted their data over time to amplify that warming by 26%, from 0.35°C/century to 0.44°C/century (Figs. 4.10 and 4.11).

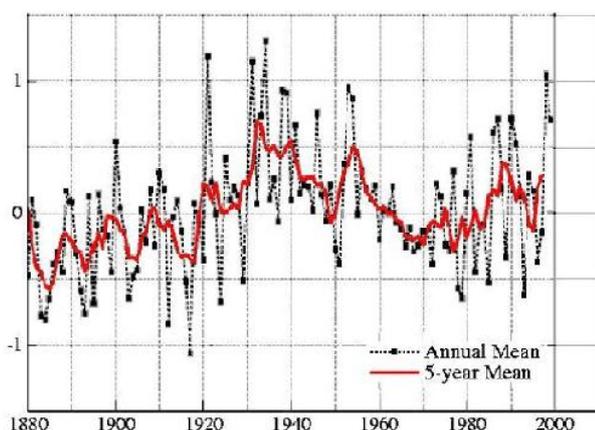


Figure 4.10: GISS 1999 processed US temperature data

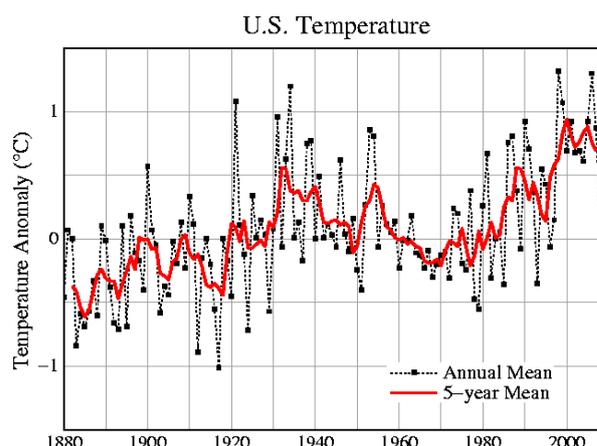


Figure 4.11: GISS 2010 processed US data

Source: <http://data.giss.nasa.gov/gistemp/graphs/fig.D.lrg.gif>

On page 346, O’Sullivan deals with **Disappearing Temperature Stations**. He says *“ . . . climate fraudsters sought to manufacture a warming bias in the future by causing the ‘disappearance’ of 806 inconvenient cooler weather stations around the world . . . in a single year with no explanation from the Global Historical Climatology Network (GHCN) ”*.

It is certainly true that when the NCDC eliminated ‘unreliable’ US weather stations from their Climate Data (CD), creating the new Historical Climatology Network (HCN), warming was added. For GISS, the number of weather stations and their global coverage has been declining since 1970 (Fig. 4.12). And in December 2009, Moscow’s Institute of Economic Analysis (EIA)⁵⁶ accused the UK’s Hadley Centre of cherry-picking just 25% of Russia’s weather stations to amplify warming by 42% for one eighth of the planet.^{57 58}

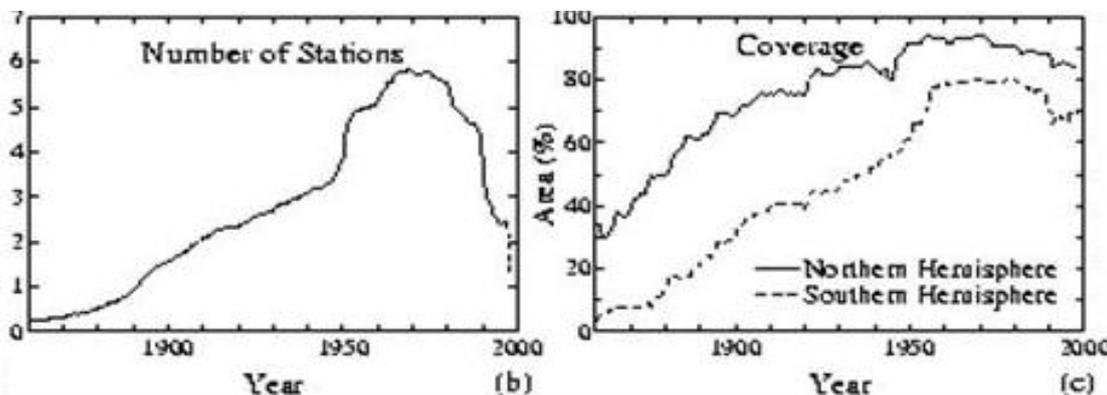


Figure 4.12: Number of weather stations and global coverage (%) over time.

Source: [GISS Surface Temperature Analysis Station Data](http://data.giss.nasa.gov/gistemp/stations/)

Global warming is a reality, but late 20th century warming is almost certainly not as great as we have been led to believe. See [The Weather Makers Re-Examined](#) for further evidence of that and substantiation of O’Sullivan’s concerns about homogeneity adjustments, quality of weather stations, reduction in their number, cherry picking and other means of inflating recent warming.

Destroying the Evidence

After pointing out that *“ . . . scientists must keep their working calculations so that other scientists can test the reasonableness of those adjustments ”*, O’Sullivan looks for evidence of compliance, first in NZ:

After a protracted delay, NIWA was forced to admit it has no record of why and when any adjustments were made to the nation's climate data. Independent auditors have shown that older data was fudged to make past temperature appear cooler, while modern data was inexplicably ramped up to portray a warming trend that is not backed up by the actual thermometer numbers. (p.343)

He then goes after the big fish at Britain's CRU (p. 349-50):

Professor Jones, of the Climatic Research Unit, University of East Anglia, the world's leading centre for climate data homogenization, instructed his colleagues to destroy all such data and not submit it to McIntyre's lawful FOIA requests. As history now shows, Jones was targeted for criminal investigation due to his unequivocal admissions of misconduct in the leaked Climategate emails. The subsequent official investigations by the UK Information Commissioners' Office (ICO) substantiated the claim that potentially incriminating calculations (metadata) formulated by government researchers in the homogenization process had been destroyed – a wanton criminal act.

Leaked emails written by Jones proved he threatened to destroy his data rather than allow McIntyre to see it . . . and when the ICO investigated they discovered Jones had, indeed, destroyed the data. Apologists for the crime assert that Jones did not destroy original raw temperature records.

This may be true; However, Jones did destroy his adjustments that would have been key evidence as to his intentions to commit climate fraud. Legal analysts argue the destroyed evidence would likely have proved Jones et al acted with fraudulent intent. Indeed, statistical forensic experts affirm that if they had been allowed to have examined the data before 'the Jones dog ate it', then any unwarranted adjustments could be readily identified as being caused by faulty system programs or on a one-by-one basis consciously manipulated with the intention to fraudulently deceive. . . . The confession to the crime by Jones is absolute as he provides the prosecutor with both the 'guilty mind' *mens rea* and 'unlawful act' *actus reus*.

O'Sullivan points out that Jones got off on a technicality – *“the short stature of limitations (only six months) had expired.”* He further argues that *“the matter should have been passed to the Serious Fraud Office (SFO) . . . If the British government had applied due diligence then a prosecution under the Fraud Act may still be pursued. . . . For their failure to act, the Home Office and Crown Prosecution Service are complicit in a nonfeasance (failure to act) for not placing the matter in the hands of the SFO, the one department both mandated and particularly skilled to investigate such cases. The investigation was instead assigned to Norfolk Constabulary.”* (ibid) The Norfolk police were subsequently too preoccupied protecting Jones from alleged death threats to pursue the question of his criminality.

After stepping down for a time, Professor Jones returned to his work at CRU and retains the esteem of his peers. Compare that with the fate of Australian obstetrician and gynaecologist, Dr William McBride, who achieved world fame for linking thalidomide to an epidemic of birth defects in 1961; and who was struck off the Australian medical register in 1993 for deliberately falsifying data linking Debendox to birth defects a decade earlier. More recently, Professor Marc Hauser, a popular and decorated senior scientist at Harvard University left in disgrace after fraudulently falsifying data in his experiments.⁵⁹

There is no doubt that some zealous scientists have lost their objectivity and become crusaders. Whether or not Phil Jones is guilty of scientific fraud and criminal destruction of evidence (and spared by virtue of being politically correct), scientists who are less than open and honest have given sceptics ample reason for doubt. Investigations that fail to find the obvious only push that doubt further towards denial. The whole climate community and their research findings, however sound, become suspect when the few bad apples are not identified and isolated; and it allows the Slayers to infer that the whole barrel is rotten.

Some climate scientists have also revealed their bias by selectively attacking sceptical publications while turning a blind eye to alarmist equivalents. Kurt Lambeck, for example, when president of the Australian Academy of Science, tore into Ian Plimer's book, *Heaven & Earth* on ABC's Lateline (27/04/2009), stating: "He has ignored a lot of information and he has twisted, I believe, a lot of information. There are a lot of references to various papers, some of mine included in that, but many of them are simply misquoted or misrepresented. . . . The science... It's sloppy." Why did Lambeck not expose the numerous errors, exaggerations and poor scholarship in Tim Flannery's 2005 book, *The Weather Makers*, and why was Flannery even made a Fellow of his prestigious Academy after his scholarship was exposed? Lambeck strained at Plimer's politically incorrect gnats after swallowing Flannery's politically correct camels.

NASA's Gavin Schmidt at [Real Climate](#) points out a few errors in Martin Durkin's documentary *The Great Global Warming Swindle* but overlooked those in Al Gore's documentary *An Inconvenient Truth*. As O'Sullivan points out on page 337, this docudrama was found by a British court in 2007 to contain nine glaring scientific errors.

The Slayers, unfortunately, are not exempt from this selective bias. They vigorously attack suspect science and anyone supporting a GHE, but overlook errors and contradictions among themselves. In my extensive correspondence with the group over several months, I saw some glowing endorsements of a colleagues' contribution but not one correction of a colleague's error, of which there were quite a few. Their critical faculties were too selectively focused on me. While boasting of empiricism, many of their dogmatic assertions are not backed by empirical evidence. While lauding the scientific method, they tend to rely instead on the opinions of selected 'authorities'. Schreuder has over twelve pages of such quotations.

I critiqued *The Weather Makers* because I found it to be scientifically flawed, presenting numerous errors, exaggerations, half-truths and uncertainties as facts. And I critiqued SSD for much the same reason. Whereas Tim Flannery chose to ignore my critique, most Slayers engaged with me, some in a combative spirit at first but ending in a mostly friendly discussion of the science. I thank them for their specific and helpful criticisms and suggestions; and Alan Siddons for alerting me to a careless mathematical error. I commend Claes Johnson and Charles Anderson for admitting errors in SSD, and especially Charles for being thoughtful and specific, for conceding backradiation and for grappling with Earth's energy budget. I hope the rest of the team will get behind these men as they work together on these issues when revising SSD for a second edition.

5. SUMMARY & CONCLUSION

The GHE is real; and the slain sky dragon is only a caricature. The sky dragon may now be sleeping under a quiet sun and negative IPO, but it is still alive and keeping us pleasantly warm. We cannot yet predict the future with much certainty; but heat is accumulating in the oceans; and the IPO will one day turn positive again. Will the sky dragon awaken and catch its would-be Slayers unawares – who knows?

The Slayers are mostly correct in what they affirm, but wrong in what they deny. Focusing on the one-way transfer of heat by conduction, they overlook two-way energy transfer by radiation and deny backradiation. Focusing on the second law of thermodynamics, they deny any effect of backradiation under the first law.

Focusing on restricted convection in real greenhouses, Slayers deny the infrared-absorbing properties of glass and any atmospheric greenhouse analogy. Focusing on the IR-absorbing role of atmospheric gases in reducing surface insolation (radiative heating), they deny or ignore the role these gases play in absorbing and re-radiating outgoing IR radiation from Earth's surface.

Focusing on the role of an atmosphere and its lapse rate to explain warmer than expected planetary surfaces, the Slayers deny any role for greenhouse gases.

Finding fault with simple greenhouse models that average solar radiation over Earth's entire surface and thus ignore day and night, Slayers think this invalidates the GHE and all climate models. But the direction of the error in the greenhouse *model* actually strengthens the greenhouse *theory* by increasing the requirement for backradiation to balance Earth's energy budget.

Focusing on natural sources of atmospheric carbon dioxide, Slayers minimise the human contribution. Focusing on the fact that warming increases atmospheric CO₂, they deny that increased CO₂ can produce any warming. While presenting implausible causes for global warming, SSD also denies such warming.

Finding legitimate fault with some climate 'science', the Slayers toss the baby out with the bathwater. Appropriately questioning catastrophic anthropogenic global warming (CAGW), they deny any AGW, GHE, GHG or climate sensitivity to CO₂.

By painting extreme sceptics and realistic sceptics with the same brush, alarmists are thus provided with an easy target: instead of addressing uncertainties surrounding feedbacks and climate sensitivity, alarmists have only to prove greenhouse-deniers wrong.

It is hoped that this critique will help to focus the great climate debate where it belongs, and create more light than heat in that debate. There is a great deal more to learn about climate and the greenhouse effect, and scope for more research. I hope that the Slayers can make a positive contribution to that.

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APPENDIX A – Email Dialogue with the Authors

On Tue, Jun 26, 2012 at 7:41 AM, JOHN OSULLIVAN wrote:

Dear Wes,

Thanks for the attached PDF of your detailed review of our book which I am sure was done with sincere and honest intentions. Upon my cursory browse through it I expect my colleagues will disagree with your analysis and interpretation of the science. I will invite my co-authors (and other colleagues) to provide their own critique of your review, which due to their prior commitments, may take some time. But certainly, if you have the fullest confidence in your analysis please do go ahead and publish this without awaiting such feedback as we always welcome open debate.

Many thanks,

John

<http://www.slayingtheskydragon.com/>

On Tuesday, 26 June 2012 5:41 PM, Joe Olson wrote

To: Dad's User Page; JOHN OSULLIVAN **Cc:** David Weston Allen; SiddonsAlan; Dr TimothyBall; ClaesJohnson; JoeOlson; MartinHertzberg; CharlesAnderson; DougCotton; JoePostma; JoeBastardi; PierreLatour; CarlBrehmer

Subject: Re: Review for comment - Slaying the Sky Dragon

Malcolm et al

having just completed a first read of the Allen critique, i reply....again, thanks for the detailed effort....but the bias and errors are numerous....there is NO basis for 'back radiation' in Physics....review the Nasif Nahle experiment at Principia Scientific for proof....

the CO2 absorption/emission cycle is a billionth of a second with a longer frequency emission that is invisible to additional CO2 absorption....doubling CO2 does not double OLR....you underestimate the volume, origin and flux of Earth's elemental CO2...

see "Volcanic CO2" by Timothy Casey....see my "Earth's Missing Geothermal Flux" as well....the Siddons mentioned "reflective coating in a thermos keeping coffee hot" you mention on your pg 8 does reflect heat....how much ?

next time you get a chill go stand in front of a mirror to warm up....a three atom molecule in does not reflect, it scatters without 'reflecting' energy....on your pg 44, 45 you mention "deep ocean warming" causing climate cycles with $\sim 0.3 \text{ W/m}^2$ which is in the range of Earth fission variations....ocean heat is not sub ducted from the surface....it is delivered from below....SSD was a point in time perspective....in the year and a half since we have all met more scientists [mostly online].... we shared more thoughts and refined our message....we invite you to visit Principia Scientific International for our peer reviewed work....in particular Joe Postmas articles on GHE....Nahle redo of the R Woods experiment.... we do all hope to "share more light than heat"....[the warmists produce enough heat]....

Joe Olson

Sent: Thursday, 28 June 2012 10:21 PM

To: Joe Olson

Subject: RE: Review for comment - Slaying the Sky Dragon

Dear Joe

Thank you for your comments. I will look at the Nasif Nahle experiment. Do you have a reference for the CO2 absorption/emission cycle of a billionth of a second? I never said doubling CO2 would double OLR – it should actually reduce it. I have read Timothy Casey and quoted him in my book exposing Tim Flannery. I made it very clear in my review that backradiation on its own can't warm the surface, but can reduce radiative loss. You won't cool as fast in front of a mirror as you would in front of open empty space. I have read Postma's papers and critiqued them. Have you done the maths to see determine how much spare heat there is by day to prevent the night from freezing – without any atmospheric radiation? I am as opposed as anyone to our draconian carbon tax. But you don't have to compromise science to oppose it. Indeed, politicians take more notice if they see that you have grappled with all the scientific evidence.

Kind regards

Wes Allen

From: "Charles Anderson"

To: "JOHN OSULLIVAN" Cc: "David Weston Allen", "SiddonsAlan", "Dr TimothyBall", "ClaesJohnson", "JoeOlson", "MartinHertzberg", "DougCotton", "JoePostma", "JoeBastardi", "PierreLatour", "MalcolmRoberts", "CarlBrehmer"
Sent: Wednesday, 27 June, 2012 7:48:33 PM GMT +10:00 Canberra / Melbourne / Sydney
Subject: Re: Review for comment - Slaying the Sky Dragon

Dear Wes,

I have so far only read a part of your review, but I would like to address the first three comments you made on my chapter in the book. The first is on this segment:

Because atmospheric water vapour varies across the globe, being lowest over the poles and highest over the tropics, the percentage of surface radiation absorbed (and back-radiated) by the atmosphere also varies (Fig. 1.2). Estimates range from less than 70% to over 90%. Let's accept 80% for now. According to the greenhouse theory, half of that absorbed 80% (40%) is radiated back to the surface where it is absorbed and re-emitted; 80% of that (=32% of the original radiation) is absorbed by the atmosphere and half (16%) is again back-radiated, absorbed and re-emitted; 80% of that (12.8% of the original) is again absorbed and half (6.4%) back-radiated, absorbed and re-emitted. Subsequent back-radiations would be just 2.6%, 1%, 0.4%, 0.2% and 0.07% of the original surface radiation. So the total proportion that is back-radiated is $40 + 16 + 6.4 + 2.6 + 1 + 0.4 + 0.2 + 0.07 = 66.7\%$ or two thirds of the original IR radiation.

If two thirds of Earth's radiation comes back to the surface, it will still cool at night, only more slowly than otherwise. During the day, higher surface temperatures result in much more outgoing longwave radiation, a third of it being lost to space. So it is ridiculous to say 'you can get any temperature you want' or 'one watt of input generates a billion watts of power'. It is easy to slay such straw men. Charles Anderson, author of the second-last chapter, is the only Slayer to acknowledge this repeating backradiation: "The half returned to the ground would soon be radiated again from the ground and the process would repeat." (p.328) His '65% efficiency' for IR-absorbing gases would result in backradiation of 48.1% of OLR. As we shall see later, this is probably too low.

This model for backradiation has an obvious fault in that the upper limit for backradiation is 50% since 50% of the IR radiation in this simple model is radiated off into space. Actually, it is less than 50% because the surface only absorbs 80% each time radiation is incident upon it, while space accepts the radiation with 100% efficiency. But, even the backradiation that would provide is grossly exaggerated for the reason I tried very hard to point out. Energy transport is not 100% by IR radiation. IR radiation in the lower atmosphere is absorbed by water or CO₂ after it has traversed a fairly short distance and then the very high rate of molecular collisions transforms most of the absorbed IR into kinetic energy distributed among all of the molecules of the atmosphere. That distributed energy is no longer available for transport back to the surface in the form of IR radiation.

In addition, on p.328, I said "The ground gives up approximately 45% of its energy by IR emissions and that energy would be absorbed by IR-absorbing gases with about 65% efficiency and half of that gas-absorbed energy would be quickly radiated off into space." With these approximations, energy leaving the surface and available to be returned as backradiation already has an upper limit of $0.45 (0.65) (0.8) (0.5) = 0.12$. Against this small effect, one has to measure the counteracting effect of IR absorbing gases at mid-day where they are keeping radiation from reaching the surface. On your p. 13, you say:

Contrary to Anderson's claims that "... small amounts are absorbed by oxygen, nitrogen, carbon dioxide and other IR-absorbing gases ... nitrogen, oxygen, and argon, radiate IR radiation" (p.321, 323), none of the three major gases either absorb or emit IR radiation at atmospheric temperatures.

The statement of p. 321 was about absorbing incoming solar radiation. Let me note that O₂ is both in my Fig. 2 and your Fig. 3.1 as an IR-absorber. N₂ is an IR absorber only when it is in the form of a dimer or trimer with either water or CO₂ most commonly or when ionization processes have acted to transform it chemically. These effects are small and probably ignored with some justification, but they are not yet very well-characterized, I suspect. It is usually good to keep an eye peeled for what one may not know enough about.

The statement on p.323 was about already warmed molecules and the dipole molecules do emit due to the acceleration and deceleration of electrons in their electron clouds. At the time I was thinking of this electromagnetic dipole oscillator radiation as very low energy IR, but it is actually in the microwave range given the temperatures in the atmosphere. The energy involved is small, but when people are excited about the Earth warming a few tenths of a degree C, I am not sure that the microwave radiation emitted from the Earth's atmosphere does not have effects on that scale. I have not done the calculation.

The last comment was:

Contrary to Anderson's assertion that the subject "... is very cavalierly disregarded by strong greenhouse gas-effect advocates" (p.319), it is generally accepted that about 19% of TOA solar radiation is absorbed, as illustrated in Figure 3.2 (similar to Fig. 1 on page 322 of SSD).

A 19% loss is much less than is seen in my Fig. 1 on page 322 and it sure looks less than in your Fig. 3.2. It is also less than I remember some time back finding in other sources, but that is now an old memory.

That is all I can do now.

Best wishes,

Charles

Charles R. Anderson, Ph.D.

Lab: (410) 740-8562

<http://andersonmaterials.blogspot.com/>

Sent: Jun 28, 2012 at 5:44 PM

Dear Charles

Thank you very much for your prompt response to my review. I was impressed that you were one of the few authors who recognised backradiation and looked seriously at Earth's radiation budget. The exact amounts of radiation absorbed and reflected seem rather uncertain, as outlined in page 30 of my review. Your figure 1 and my figure 3.2 are schematic rather than precise measurements. Absorption seems to be about 20% plus or minus 1-2% and reflection about 30%+/-1%. It seemed to me that you mistook total reflection at the TOA, clouds and surface as all happening at the surface. Earth's surface reflects only about 4% of total solar radiation at the TOA or about 7% of that reaching the surface, and most of this is in the short / visible wavelengths. Absorptivity is thus 0.93 (not 80%) across the spectrum and for IR alone it is close to unity (100%). Emissivity is probably about 0.95, so it would be appropriate to reduce each recycled component by 5%, which would make a small difference to the end result of 66.67%. But I don't necessarily go along with this figure, and much less with Trenberth's 91.4%.

In my figure 3.1, it is ozone rather than oxygen that is absorbing the IR, and the oxygen is absorbing only the short UV wavelengths that electrically convert it to ozone in the stratosphere. IR does not change the dipole moment of O₂ and N₂. Perhaps I need to clarify this in the text.

Kind regards

Wes Allen

From: Charles Anderson

Sent: Thursday, 28 June 2012 3:36 AM

To: David Weston Allen

Subject: Re: Review for comment - Slaying the Sky Dragon

Dear Wes,

Yes, the 70% of the amount of incident solar radiation that is at the top of the atmosphere is about what is incident upon the surface of the Earth. Then, it is commonly said that 95% of that is absorbed by the surface as heat. Let us calculate what this means as we sit in the open on a day when 70% of the outside the atmosphere radiation reaches the surface at mid-day:

Outside the atmosphere incident energy = $1368 \text{ W/m}^2 = 4 \times 342 \text{ w/m}^2$ value used in Trenberth diagrams and most mean calculations $0.7 (1368 \text{ W/m}^2) = 957.6 \text{ W/m}^2$ reaches the surface of the Earth.

Using your absorption value of 0.95, we have $957.6 \text{ W/m}^2 = (0.95) (5.6697 \times 10^{(-8)}) (T^4)$ and $T = 365.15\text{K} = 92\text{C}$.

Now, I have sat on the ground, grass, rock, bare dirt, even floated in water, in full sun many times and neither I nor the ground or water around me reached 92C. Fortunately. I like being alive.

Physics applied to complex systems can be confusing and a real challenge. It can be a very good thing to check some limiting situations about which you know something to see if you are on the wrong track somehow. The above calculation should ground us with respect to the belief that the Earth's surface absorbs 95% of the incident solar energy.

The effective absorption of incident solar radiation has to be much less than 95% and the absorption of backradiation is commonly at a much, much lower percentage which is highly dependent upon the time of day and other conditions. It says something important that we do not have good numbers for either of those values.

On the oxygen absorption issue, the important thing was that it played a role in reducing the solar radiation incident upon the ground. Sure, that role is due to ozone and any other ionized forms it is transformed into.

Best wishes,

Charles

Charles R. Anderson, Ph.D.

Sent: Thursday, 28 June 2012 10:01 PM

To: 'Charles Anderson'

Subject: RE: Review for comment - Slaying the Sky Dragon

Dear Charles

I commend you for looking at Earth's energy budget and grappling with the maths. However, you made two major errors:

First you forgot to subtract the 19-20% of TOA insolation that is absorbed by the atmosphere before reaching the surface. If you want more than that absorbed (as in your earlier email), you need to subtract even more. So, after 30% is reflected and 20% is absorbed, only half (50%) of the 1368 W/m^2 reaches the surface – i.e. 684 W/m^2 .

Then you forgot to divide this by 2 for the area of a **hemisphere**, rather than for a flat disc. So there are only 342 W/m^2 averaged over the sunlit hemisphere. And that corresponds to a temperature of just 5.7°C , or 9.3°C if we allow for an emissivity of 0.95.

I am not sure how you stand on this, but Hertzberg won't allow any radiation from the atmosphere. But if you allow half of the absorbed radiation to continue on to the surface, you would then have about 410 W/m^2 and 18.7°C , or 432 W/m^2 and 22.4°C with emissivity set at 0.95. So we are now fairly close to the average actual daytime surface temperature.

Without any backradiation, which your colleagues won't allow, however, there is no surplus heat for evaporation, thermals or heat storage in water or soil for the night. So the nights would freeze. So we need at least 200 W/m^2 and probably close to 300 W/m^2 of backradiation to prevent Snowball Earth. On page 623 of SSD you say the energy warming the surface is about 622 W/m^2 – not the 957.6 W/m^2 you now give here.

Kind regards

Wes Allen

To: 'JOHN OSULLIVAN'

Sent: Sunday, 1 July 2012, 20:50

Subject: RE: Review for comment - Slaying the Sky Dragon

Dear John

Thank you for conceding the mix up re Pat Michaels and Will Happer, for your permission to publish this email thread and for your request for further information. The information you seek is actually in my review, first in my Overview on page 5:

"Whereas Earth's energy budget is averaged over day and night in simple educational climate models, Slayers correctly show that this 'flat earth' model is inaccurate. They think that this discredits sophisticated computerised coupled general circulation models, which do have problems handling clouds, solar cycles and other natural variations"

And more fully on page 31:

"Trenberth et al admit uncertainties: "the biggest uncertainty and bias comes from the downward longwave radiation. This source of uncertainty is likely mainly from clouds." Rather than addressing these, however, the Slayers attack the accepted science and simple illustrative models, thinking they are thereby slaying the sky dragon and demolishing sophisticated coupled general circulation models run on powerful computers. While these still have serious limitations, especially in relation to clouds, solar cycles and ocean oscillations, they are far more robust than the Slayers imagine." The task I set myself in critiquing your book, Slaying the Sky Dragon, was first and foremost to see whether it accurately presented the established science on the subject of greenhouse gases and their effect on Earth's temperature. Unfortunately, it failed to do so. It denied that glass absorbs IR radiation. It denied (excepting Charles) that IR-absorbing gases radiate IR back to Earth's surface. It denied that any such radiation (even if it existed) could have any effect on Earth's surface temperature, thus denying the first law of thermodynamics. It postulated that space is a perfect insulator. It confused conduction and radiation. It got the absorptivity and emissivity of Earth's surface wrong by a large margin. It presented conflicting and incompatible opinions on how the atmosphere is heated. It revealed a limited understanding of lapse rates, overlooking latent heat and IR-absorbing gases, and why moist tropics are cooler than dry tropics. It claimed that nitrogen and oxygen absorb and emit IR radiation. In showing that computing radiative losses by day and night separately slightly increase Earth's net energy loss, it actually strengthened the case for greenhouse warming. Ridiculing Earth's energy budgets by others, SSD made no attempt to produce its own. Slayers seem unwilling or unable to show how the shaded hemisphere remains warm enough at night to prevent freezing. While they postulate heat storage by day for use at night, they have not shown the maths for sufficient surplus heat by day. Moreover, except for Charles, they have no way of bringing any radiant heat, latent heat or convected heat back to the surface by night. Their world would thus soon freeze over. Charles Anderson alone has attempted to address this major problem in SSD, and he got his maths wrong.

Why do you completely ignore all of these problems, John? How can you not begin to question your suppositions? Do you conveniently forget them by attacking a perceived weakness? Of course, that is what lawyers do. Unless the authors of SSD get serious, however, own up to the problems and present a plausible energy budget, they deserve to be ignored.

The second task I set myself was to establish that there is indeed a greenhouse effect, that the physics are sound, that there is empirical evidence for it, and that Earth's surface would indeed be very much colder without it. I think I achieved that. I did not set out to establish any particular greenhouse model, nor am I sufficiently qualified to do so. Indeed, I am not a strong supporter of climate models and their projections.

It would therefore be hypocritical and presumptuous of me to now come to their defence, and I will not be drawn to do so, even by a lawyer. My main criticism of SSD in this regard was that it equated the simplistic one-line models with far more sophisticated coupled general circulation models, thus revealing a profound ignorance of the latter. Secondly, attempts to discredit the latter by attacking averaging methods in the former is questionable and off target. Even if a computerised model did disregard night and day, its projections would be largely unaffected by this unless a very significant change in diurnal temperature variation happened over time, as explained in my review of SSD. Even though the models continue to evolve and improve, largely through the CMIP, there are far more significant and uncertain variables that render even the best of them unreliable; and a quick look at realclimate.org will show that even the modellers admit this. I will clarify this and my position on the models in my revision.

The uncertain variables are too numerous to elaborate fully here. In *The Weather Makers Re-examined*, for example, I show how recent studies on leaf density, evaporation and runoff put the 'climate sensitivity' of earlier models out by 0.6C. Denying the GHE, however, the Slayers have no interest in climate sensitivity and thus sideline themselves from the real debate. This is a great pity. Your enthusiasm and energies could be far better directed.

Kind regards
Wes Allen

From: JOHN OSULLIVAN Sent: Sunday, 1 July 2012 9:47 AM

To: David Weston Allen Cc: CharlesAnderson; DougCotton; SiddonsAlan; Dr TimothyBall; ClaesJohnson; JoeOlson; MartinHertzberg; JoePostma; JoeBastardi; PierreLatour; MalcolmRoberts

Subject: Re: Review for comment - Slaying the Sky Dragon

Wes,

I thank you for another prompt reply. However, you have dodged my probative questions and instead referred me to Page 5 of your critique. As such, you are merely re-stating a postulate after it has shown to be flawed and that is not a rebuttal.

I specifically asked you to address questions put to you which specifically relate to your unfounded assertion of the existence of "sophisticated" three-dimensional model(s) of the GHE but which you now admit you haven't seen - although you wish to continue to assert you have faith in (isn't that religion rather than science?).

As you say, I come at this debate from a legal perspective focusing on the substantive evidential issues. I will allow my scientific colleagues to engage separately with you on the minutiae. But on your evaluation of our science you already agree that my colleagues certainly refuted the discredited two-dimensional Standard Model, which we find is the only GHE model available to the public. From your analysis of our book you agree that we proved the Standard Model GHE relies wholly on "flat-earth physics" which you admit is "inaccurate."

Despite an absence of evidence in your favor you assert you wish to persist in your belief that there must be [a] more "sophisticated" version[s] of the GHE theory even though you admit you have never seen any such model[s]. Regardless of the fact you admit you have never seen any such model[s] you further concede such [a] model[s] has [have] "problems" but you do not identify what it [they] may be. Nonetheless, whatever "problems" there may be you still believe they cannot be related to those problems identified by my colleagues. Again, these are entirely faith-based, fact-free assertions running in stark contradiction to your dictum as to how scientists should operate.

Thus we may reasonably assert your mindset on this issue is unscientific and irrational because your beliefs override any rational concerns over the paucity of your evidence such that any assertions you now make in favor of those elusive "advanced GHE model[s]" can only be guesswork on your part. Therefore, unless you concede in this matter and modify your critique accordingly your following statement (Page 2) renders you liable to charges of hypocrisy:

"... a true scientist... seeks to be proven wrong while the propagandist seeks to win."

If you are not a propagandist and are open to address all the evidence then it is incumbent upon you to respond openly and fully to the questions I already posed to you in my previous email but which you appear to have either dodged or overlooked. Therefore, please now show good will and honest intentions and answer the following three questions:

(1.) If any of the 23 "sophisticated" GHE models you referred to are robust and capable of withstanding scrutiny then why do (tax payer-funded) climatologists illegally defy FOIA requests and prevent independent scrutiny?

(2.) If there is "consensus" and understanding based on the validity of such alleged sophisticated model(s) of the GHE then why are there 60 competing GHE "theories" taught on climatology courses at leading universities – all premised on the "toy" 2-D model my colleagues refuted?

(3.) If leading climatologists are privy to any such "sophisticated" 3-D GHE model(s) then why do top skeptic climatologists, Roy Spencer and Richard Lindzen, only rely on mutually contradictory 2-D versions of the "crude" Standard Model (a position fatal to one, if not both of them)?

If you are unable to satisfactorily answer these questions then you should be true to your critique's dictum on Page 2 and concede that no scientifically credible evidence is available to sustain the greenhouse gas hypothesis other than the already debunked 2-D model.

Many thanks,

John

P.S. I would be grateful if your replies would include all those recipients on the original email thread.

From: David Weston Allen Sent: Jul 3, 2012 12:43 AM

To: 'JOHN OSULLIVAN'

Cc: 'CharlesAnderson', 'DougCotton', 'SiddonsAlan', 'Dr TimothyBall', 'ClaesJohnson', 'JoeOlson', 'MartinHertzberg', 'JoePostma', 'JoeBastardi', 'PierreLatour', 'MalcolmRoberts', 'Bob'

Subject: Review for comment - Slaying the Sky Dragon

Dear John et al

Let me be perfectly frank. I was wrong! And I will alter the statement on page 32 of my review of SSD:

“Rather than addressing these, however, the Slayers attack the accepted science and simple illustrative models, thinking they are thereby slaying the sky dragon and demolishing sophisticated coupled general circulation models run on powerful computers. While these still have serious limitations, especially in relation to clouds, solar cycles and ocean oscillations, they are far more robust than the Slayers imagine.”

I now recognise that this statement (which I should point out does NOT affirm that these models are robust but rather more robust than Slayers imagine) is quite unfair and based on my ignorance of Slayer imaginations. What I should have said is that these coupled GCMs are more robust than SSD infers. Would you all be happy with that?

If there are any other statements in my review that any of you object to, or where you believe I am in error, please let me know and, if possible, provide supportive references or objective evidence.

Now let's all fess up about computer simulations and a flat Earth. On page 233, SSD categorically states: 'Computer simulations regard the earth as a flat disc'. It did not say 'some' computer simulations but implied that 'all' computer simulations regard Earth as a flat disc. Do you know that for an absolute truth? Where is your evidence? Or is it based on ignorance and assumption? Overlooking that, you now reverse the onus of proof and want me to 'prove' to you that they (or some of them at least) are not based on a flat disc.

Before I do that, I need to know what level of proof you require. In medicine, we have at least four levels of evidence ranging from expert opinion to multiple randomised double blind placebo controlled trials. Do you expect me to provide you with climate model computer programs or what? If so, which of you would have the competence to evaluate it/them? And on what basis would the rest of you accept the verdict? Would it not be based on faith in that individual's understanding of very complex algorithms and computer language? How do you know you can trust that? And how could a climate modeller know that he could trust you and your inevitable publicised judgement of his model? It all comes down to faith.

So let's all fess up to faith. On what basis, John, do you leave the minutiae of the science to your colleagues and accept their judgments – is it not faith? And on what basis do they accept the opinions of each other much of the time – is it not also faith? Or do they challenge each other to produce peer-reviewed papers to prove every point? Aren't you a bit hypocritical in accusing me of 'having faith', of 'religion', of being 'unscientific and irrational' when you have your trusted sources? And it seems to me that you have formed a clique (rather like the alarmist team), rehearsing your favourite mantras with almost evangelistic fervour as you sally forth to battle the sky dragon.

Now what is my basis for saying that coupled GCMs are far more 'sophisticated' than the simple one-line model in SSD? My eyes were opened to this when I read CMIP material while critiquing Tim Flannery's book. I referred to this in my last email but was unable to locate it until today:

<http://www.wcrp-climate.org/wgcm/references/sap3-climate-models.pdf>

When you have all read this 95 page document and checked all 550+ papers, put your hands on your hearts and tell me that coupled GCMs are not more sophisticated than the simple one-liner, and that they are all based on a flat disc. Of course, you may well reject this source. You may even be very suspicious and paranoid about it. That is your prerogative. I don't regard it as the gospel either, but it is far more scientific, circumspect and cautious than your beloved SSD. I strongly encourage you to read it carefully before making any more silly statements about these models, lest you further embarrass yourselves and become a complete laughing stock.

If having read this you still want me to enumerate problems with these models and do not have access to my book, *The Weather Makers Re-examined*, I will extract more sections from that book for you. From your opening paragraph, John, and in view of all the material I have so far included on the subject, I suspect that no amount of material I provide will satisfy you or prevent your relentless cross-examination. I can understand why Judith Curry and others discontinue dialogue with you. Unless you indicate a genuine desire to understand the science, I too will terminate correspondence, realising of course that this will only give you another scalp to arrogantly crow about, as being 'unable to answer' your questions. Rather, it will be a matter of 'can't be bothered'. If you likewise tested the statements of the 'scientists' in your team, there would be fewer contradictions in SSD.

Now what about your three tests of my 'good honest intentions' which I must answer in order to prove I am a scientist rather than a propagandist:

1. If any of the 23 “sophisticated” GHE models you referred to are robust and capable of withstanding scrutiny then why do (tax payer-funded) climatologists illegally defy FOIA requests and prevent independent scrutiny?

You want me to explain why climatologists defy FOIA requests, presumably yours. Are you serious? How could I possibly do that? You had better ask them. I am not their lawyer. Nor do I correspond with them or even know any of them. I cannot believe a lawyer would ask such a stupid question!

2. If there is “consensus” and understanding based on the validity of such alleged sophisticated model(s) of the GHE then why are there 60 competing GHE “theories” taught on climatology courses at leading universities – all premised on the “toy” 2-D model my colleagues refuted?

If you look at the CMIP document at the above URL, you will see that the modellers themselves discuss differences between the various models, and that climate modelling is a work in progress. As Tim says, only politicians talk about ‘consensus’. I certainly don’t. I have no idea if or why there are 60 theories – does that make me a propagandist?! Are all 60 different? How different? Not that I currently have the time or incentive to analyse them all. And it should be obvious to you after reading the CMIP material why the sophisticated models cannot be taught to undergraduates. Few postgraduates could understand their many complex algorithms.

3. If leading climatologists are privy to any such “sophisticated” 3-D GHE model(s) then why do top skeptic climatologists, Roy Spencer and Richard Lindzen, only rely on mutually contradictory 2-D versions of the “crude” Standard Model (a position fatal to one, if not both of them)?

Now I am expected to know what goes on in the heads of Lindzen and Spencer, and if I don’t, I am a propagandist! I did not find their positions on this in SSD. Am I expected to know the answers to all your questions about climate and climatologists in order to prove I am really a scientist? Come on! Yes, accuse me of being churlish or whatever, but your testing questions are worse than that. But I will say this about Lindzen and Spencer. I find their conflicts most reassuring. Unlike the Slayers who are either unaware of or happily ignore each other’s contradictions in their united cause, neither Spencer nor Lindzen let the other get away with perceived error. That is a hallmark of a scientist rather than a propagandist.

Finally, I have a few requests/questions for you.

1. MODELS: Please show me where any model (2-D or otherwise) is called ‘The Standard Model’ in the scientific literature. If you can’t, please stop referring to it as such. Can you conceive of a greenhouse theory or effect without a model, or are they synonymous in your thinking? Is it possible to demonstrate a greenhouse effect, or the need for one, without a model? Must such a model be absolutely perfect and complete to be valid? Is there a place for a simple model as an educational tool? What degree of error discredits or refutes a model? Would you accept a model that is 99.3% correct?

2. ENERGY BUDGET: Do you differentiate models and energy budgets? Have you yet calculated an energy budget for Earth – covering day and night for the entire globe? Can I please see it? If you have not or cannot, why?

I will be happy to answer more questions when you have answered mine. If you cannot, I will assume you have conceded defeat to a victorious sky dragon.

Kind regards

Wes Allen

From: JOHN OSULLIVAN **Sent:** Tuesday, 3 July 2012 1:38 AM

To: David Weston Allen **Cc:** JoeOlson; 'CharlesAnderson'; 'DougCotton'; 'SiddonsAlan'; 'Dr TimothyBall'; 'ClaesJohnson'; 'JoeOlson'; 'MartinHertzberg'; 'JoePostma'; 'JoeBastardi'; 'PierreLatour'; 'MalcolmRoberts'; 'Bob'

Subject: Re: [endless analysis of symptoms....does NOT treat disease]

Wes,

I am preparing a detailed answer to your previous long email. Hopefully you will have it today or tomorrow.

Thanks for your patience.

John

I heard no more from John O’Sullivan until 9 July and was excluded from subsequent correspondence inadvertently sent Bob Brinsmead and then forwarded it to me. Much of it is too embarrassing to the Slayers to include here. This is the next I heard from the group:

From: Joe Postma **Sent:** Saturday, 7 July 2012 7:55 PM

To: 'David Weston Allen'; 'JOHN OSULLIVAN' **Cc:** 'CharlesAnderson'; 'DougCotton'; 'SiddonsAlan'; 'Dr TimothyBall'; 'ClaesJohnson'; 'JoeOlson'; 'MartinHertzberg'; 'JoeBastardi'; 'PierreLatour'; 'MalcolmRoberts'

Subject: RE:

Dear Wes Allen,

We haven't received any emails from you since John sent his last one to you, dated Tuesday July 3. It began with, for reference so you can check if you have it:

"Dear Wes,

Thank you for your latest admission. It is to your credit you concede to being wrong. This isn't a sign of weakness – but of strength. However, by the tone of your answers to my three questions you appear angry and evasive about facts undermining other elements of your belief in the GHE. Perhaps this indicates your unwillingness to countenance the possibility of intentional fraud by climatologists? It's disappointing that you still persist in blind-faith assertions about how sophisticated (and thus reliable) the GCM's are"

It is included as an attachment here.

I would ask that you wait to hear from John, as he is certainly still around, and I am sure he might have some things left to say to try to help you understand the flaws in the GHE and the many sophistries therein.

In my opinion this particular discussion should have ceased a long time ago, as it was apparent how little progress was being made in it, at least from our perspective. One remaining and certainly pertinent fact, for the Slayers, is that there is not actually any un-manipulated (i.e. averaging problem) empirical data that can be found to provide evidence for the mechanism of the greenhouse effect. It seems apparent that only two things really exist to support the GHE postulate: 1) the "undergraduate" model which is the "Standard Model Greenhouse Effect" taught around the world at hundreds or thousands of universities and space agencies, which has now been admitted by you and other GHE advocates to be meaningless, and, 2) a "more advanced model" which is impossible to see, and whose documentation, some of which provided by you, never makes clear where and how the GHE is actually incorporated. This is not a minor problem or one to be "left to the experts", but a glaring warning light indicating "pseudoscience ahead". Empirical evidence for the greenhouse effect would be the obvious starting point for defining and defending the postulate, but this is never and has never been proffered - not without resorting to the gross and, as agreed by you, false approximations and misinterpretations of the standard flat-Earth model. The GHE has been put, by the Slayers, in no-man's-land, and so far there is nothing saving it except for hidden trenches. We (Slayers) have scored a ***major*** success, in getting essentially the entire community of both skeptics and alarmists alike, to agree that the "Standard Model" is nothing more than "a toy" and based on a purely fictional representation of the system. People are going to want to see the supposed "real GHE" and so this has put the Climate community on notice to produce the models and the code.

These types of logical problems which infect the entire science of climatism should make it perfectly clear that the greenhouse effect postulate is fabricated pseudoscience, and so while I can acknowledge the working time you've put in with this engagement, I cannot say that I appreciate your effort because I cannot understand why someone would defend the "status-quo" when the scientific standards used to defend it are so poor.

Empirical data will answer the question of the GHE for the world...data which does not need to be averaged into a flat Earth model such that a particular interpretation can be invented. We will keep you posted on such developments if they occur.

All the best,

JP

Here is my response (in black) to John's long email (in red)

Sent: Thursday, 12 July 2012 8:45 PM

To: 'john0sullivan' **Cc:** 'CharlesAnderson'; 'DougCotton'; 'SiddonsAlan'; 'Dr TimothyBall'; 'ClaesJohnson'; 'JoeOlson'; 'MartinHertzberg'; 'JoePostma'; 'JoeBastardi'; 'PierreLatour'; 'MalcolmRoberts'; 'Bob'

Subject: Apologies for Delayed Response

Gentlemen

Here is my response to John's 3 July email, received via Joe Postma on 7 July and confirmed by John on 9 July. I also attach Charles' critique of the KT budget with my comments.

Dear Wes,

Thank you for your latest admission. It is to your credit you concede to being wrong. This isn't a sign of weakness – but of strength. However, by the tone of your answers to my three questions you appear angry and evasive about facts undermining other elements of your belief in the GHE.

I apologise for my exasperation with your three 'questions', John, which I now realise should have been interpreted as rhetorical and left unanswered.

Perhaps this indicates your unwillingness to countenance the possibility of intentional fraud by climatologists?

In Chapter 9 of my review, I neither deny nor justify fraud in climatology, but make a case for accuracy, integrity and impartiality on all sides.

It's disappointing that you still persist in blind-faith assertions about how sophisticated (and thus reliable) the GCM's are - a red-herring fallacy and a shifting reference frame fallacy.

I regard 'sophisticated' as being very different from 'reliable'. I imagine you would have encountered some very sophisticated liars in your professional work, John. I have made my position on climate models quite clear – I have anything but blind-faith in them. Indeed, on pages 30-33 of *The Weather Makers Re-Examined*, I argued that the climate models used in 1975 were nowhere near as sophisticated as claimed by Tim Flannery. I devoted two chapters and nearly 40 pages to a critical examination of climate models. No one could read that and come away with the impression that I had blind faith in them. I thought that Malcolm, who has my book, might have clarified this with you. Would you like me to send you a copy?

For the avoidance of doubt please let me make it clear that my colleagues and I are advocates of the traditional scientific method. We didn't postulate the GHE. As per our principles we only need to discredit it. As such we are more akin to your profession's methodology than you are to post-normal Climatism. Like the medical profession we advocate ostensibly the process of hypothesis – deduction – predictions-observations - test of predictions-induction. We reject "secret" science that refuses to be openly subject to testing. For more information as to how we do this (based on the ideals of Karl Popper) take a look at our Principia Scientific International (PSI) website: <http://principia-scientific.org/index.php/why-is-psi-still-developing-a-science-policy.html>

Let's first be clear on definitions: the greenhouse effect (GHE) is not a greenhouse model – neither your 'standard model' nor a GCM. It is a proposed physical reality – an atmospheric phenomenon involving the recycling of EM energy. It is not dependent on a model for its existence, any more than electricity is dependent on an electrical circuit (diagram) for its existence. Nor is it dependent on the accuracy of any human model for its existence. The question is whether it a real phenomenon, not whether we fully understand it or whether the models are reliable. That is a separate issue.

The 'scientific method' requires that the GHE is consistent with known physical principles, that it can be observed and measured by independent observers, that observations are inconsistent with its absence, and that it cannot be disproved. My review provides evidence for all but the last point. The onus is therefore on you to disprove it. SSD has not done so. Nasif Nahle's daytime experiment didn't either. Nor does Postma's model. And you can't disprove a real phenomenon by simply showing that our present understanding of it is incomplete. Gravity and all its nuances existed before Newton, Einstein and Hawking.

As such, we are contemptuous of those "secret" GCM's because there should be no room for any secrecy in government (taxpayer-funded) science that claims to be addressing pressing and calamitous climate consequences. Because you say you also agree that "scientists should seek to be proven wrong" I have three main bones of contention with your position.

First, I am concerned that you still implicitly condone such an evasive mindset. You now appear to buy into their self-professed post-normal, anti-empirical methodology by now supplying us with a reference (a 2008 document from the U.S. Climate Change Science Program (USCCSP)) where there is actually no explicit demonstration of WHERE the GHE exists in it. You also didn't provide us with a clue where to look either. Instead you presented us 95 pages + 550 papers, but you don't appear to be aware of where to point for us to find the GHE.

I referred you to that CMIP website simply to show how sophisticated modern climate models are, not how reliable or complete they are. Joe Olson was apparently not alone in missing the point. I am fascinated that those shifting the goal posts should accuse the ball-kicker of 'a shifting reference frame fallacy'. I am also fascinated that those evading the numerous errors and contradictions highlighted in my SSD review and emails should now accuse me of condoning 'an evasive mindset'.

Second, a GCM is NOT a GHE model per se. It is a circulation model and, by the way, these ARE generally based on a flat surface. A circulation model is NOT a GHE model, and if a circulation model has a GHE in it, it needs to be explicitly inserted. Circulation patterns in the atmosphere based on fluid mechanics do not magically create a GHE – they are entirely unrelated. A programmer needs to explicitly state the mechanics of the GHE in such a sophisticated model.

Third, GHE defenders use what my colleagues have identified as the "Standard GHE Model" (not standard GCM model etc., our appellation is perfectly valid) to present an idea to the public and to convince themselves of something that ONLY that model produces. So far, we still do not have an example of where the GHE is in these more sophisticated models. The red-herring here is in saying that the GCM's have the greenhouse effect or reproduce it, when a GCM model is a fluid mechanics model which has no need of a GHE and whose equations would not be expected to create a GHE, and which would need to have a GHE explicitly included even if it is needed in such a model, which it isn't. So GHE defenders are shown to be duplicitous because they are now making damaging admissions about their alleged GHE such that only after the publication of SSD (November 2010) did they come out and admit NASA's K-T Earth energy budget (and all its variants) is a "toy."

Yes, it could be described as a 'toy' and an outdated one at that. If you read my review, you would notice my comparisons with a later version and my critique of them. As shown in my revised edition, comparing it with Joe Postma's model is like comparing a teenager's toy with a toddler's toy. Joe's looks more realistic superficially, but is very short on detail.

You say "Please show me where any model (2-D or otherwise) is called 'The Standard Model' in the scientific literature. If you can't, please stop referring to it as such." We (more specifically, Joe Postma) assimilated common features in those variants and presented it as the Standard Model GHE in his PSI papers because no one has done this before. This had to be done because, as I explained to you, there are more than 60 variants of the GHE taught on climatology courses at leading universities. Such was the confused and apparently disordered state of this so-called "settled science."

Only after we performed the task of distilling the essence of what climatologists generally present as the GHE did believers begin to adopt and present what we have identified as their Standard GHE Model to "get the idea across." In their words, they have admitted that the preferred flat-Earth model they use to "get the idea across" is a fiction and they are now uniformly accepting the Standard Model we devised as fairly representative of their "consensus" version. This is a great triumph for my colleagues because this admission of theirs has been entirely the result of SSD and Postma's papers.

OK, so let's accept that there is a simple Standard Educational GHE Model, of which there are many variations, but let's not confuse this with complex coupled GCMs.

So, like them you are trying to say that the "real" GHE model exists somewhere else, and as such you do as they do and allude to "sophisticated" GCM's when doing so. But, like them you still can't point out where in the GCM's the GHE is. Also, be advised that a GCM is a fluid mechanics model for atmospheric circulation that is something that would never be expected to reproduce or contain a GHE in the first place, unless it was explicitly included. So it is an insult to our intelligence that you repeat their assertion that if we can't understand what is hidden in the GCM's, then we're stupid. But now you cite 'Synthesis and Assessment Product 3.1'(2008) by the U.S. Climate Change Science Program (USCCSP).

<http://www.wcrp-climate.org/wgcm/references/sap3-climate-models.pdf>

But this latest "best evidence" for your position was published two years before our SSD book. And then you infer that we (and by extension the rest of the world) are not smart enough to understand the models and so it is not worth showing them to us. But neither you nor I know whether this USCCSP document is premised on GCM's comports with the Standard flat-earth GHE Model we criticized and forced them to admit is a piece of fiction. As such you (and they) are in a major contradiction – a fatal contradiction unless you (or they) establish the Standard flat-earth GHE Model isn't a component of those GCM's.

I am sorry that you misinterpreted my email as implying that you're 'stupid'. That was not intended. It is just that I had not read anything by you or your team that indicated much insight into coupled GCMs. I consider my own knowledge and understanding of climate models to be very basic. But your correspondence with Joe Postma on 3 July (inadvertently forwarded to Bob Brinsmead and hence to me) reveals that you understand even less than I had assumed about the models you attack. When you don't even know what 'GCM' stands for, how can you be so sure that such models 'ARE generally based on a flat surface'? Perhaps I should have first referred you to a [Wikipedia](#) site to explain the difference between simple models and more complex general circulation models (GCMs), and very complex coupled atmosphere-oceanic GCMs. Not being a modeller, I can't say how or where the GHE is incorporated (every model being different anyway); but can you seriously imagine the modellers not incorporating it!

Given the complexity of the most sophisticated coupled AOGCMs, you would have to be naive to think that you can demolish them by demolishing the ultra-simple 'standard model' – which actually *underestimates* the GHE. You will see in my revised SSD review that the 'standard model', with its global averaging rather than Siddons' hemispherical averaging, underestimates the GHE by 1 W/m^2 . Such a small error ($1/390 = 0.26\%$) hardly renders it worthless as an educational tool. Trenberth's more complex gridded analysis increases DTR and hence this underestimation to 6 W/m^2 (1.5% error). The greater the error the more energy required – i.e. the more GHE needed. You cannot escape the fact that **your legitimate criticism of the simple model actually weakens your argument against a GHE**. If the same criticism applies to the most sophisticated AOGCMs, then they too are underestimating the GHE. While I am no more privy to their programs than you are, I doubt that modellers would want their models to *underestimate* it!

You then say "Can you conceive of a greenhouse theory or effect without a model, or are they synonymous in your thinking? Is it possible to demonstrate a greenhouse effect, or the need for one, without a model?" But what does this even mean? If it is a real physical principle then yes, it should be representable by a model. It may be interpreted that what you are stating is that believers want to have a GHE without having to have a demonstrable model for it or to have to prove it - other than hidden behind closed doors (in GCM's) where it can't be (dis)proven.

You then ask, "Must such a model be absolutely perfect and complete to be valid?" Of course not. But it must be valid in the first place, in order to ever be able to be complete or perfect. Then you ask, "Is there a place for a simple model as an educational tool? What degree of error discredits or refutes a model? Would you accept a model that is 99.3% correct?"

We would certainly say there is a place for a simple model – but only if it is valid. What refutes a model is when it is admitted to be a toy based in fiction. There's no "99.3% correct" for a model that is fiction: it is not even on the scale of being correct – being rendered useless and meaningless. Again, I assert that climatologists haven't shown how the GHE comes out of, or is inserted to, the GCM's etc. We have a great deal of hand-waving from them (and now you) on this point.

So you think an accuracy of 88.5% – 99.7% renders a simple educational model as 'useless and meaningless'! I would be very happy with an accuracy of 95% for such purposes.

Then you specifically reference the "ENERGY BUDGET" and ask: "Do you differentiate models and energy budgets?" By "model", what are you actually referring to? I find this question to be ambiguous, if not meaningless. Do you mean "differentiate between GCM's and energy budgets"? If so, that, too, would be meaningless. Of course anyone can differentiate between different things. The question is, where in the GCM's is the GHE? Show it. The onus is on climatologists, not us (as per Scientific Method). We've already successfully put them in the position of admitting that the "Standard GHE Model" is fake – unreal - so now they must show us what and where the real GHE is. As we have proved, climatologists were not forthcoming about the Standard GHE Model and its fakeness until we refuted it. So you cannot blame us for heightened suspicion about where this "real" GHE actually is, if it exists.

The 'real' GHE is in the troposphere and stratosphere, not in any model or impression of it. An energy budget for Earth is the product of calculations based on empirical evidence and modelling. It is not the model any more than a photograph is the camera.

You then ask: "Have you yet calculated an energy budget for Earth – covering day and night for the entire globe? Can I please see it? If you have not or cannot, why?"

Well, we are likewise still waiting for that from climatologists whereby they show us something more robust than the "toy" GHE mechanism. I fear you are now trying to re-frame the responsibility onto us when it is not us postulating the GHE "theory." It is for you (and them) to show us as per the traditional Scientific Method I cited above. Because my colleagues are adherents of the Scientific Method we prefer to employ actual experiments to test any such hypothesis (more on this below). We see the GHE believers have presented their hypothesis but beyond that stage their claims about CO₂ warming are failing badly and thus we urge them to apply due diligence and test their hypothesis by experiment (and not in lab flasks) but in Earth's open atmosphere, as we have done.

The only 'actual experiment' that can be done on the real atmospheric greenhouse is the global one being done incidentally by humanity and which climatologists have been monitoring with ERBE, CERES, MODIS etc. Nasif's experiment might have been useful had he continued it through the night.

I will sit up and take notice when you show me mathematically how Earth's surface can stay as warm as it does, especially at night, without any GHE. I have done the maths in my review of SSD and shown that a GHE-free Earth would soon be a snowball. It is up to you and your team to refute them, to show where my maths and/or physics are wrong. If you can't, you should acknowledge it and reconsider your position on a GHE.

I attach my critique of Charles' effort to discredit the K-T97 energy budget. I look forward to seeing an alternative detailed Slayer energy budget. When I see you balance that budget without any GHE or backradiation, you will have my support.

Like you medical professionals we like to work with empirical evidence. However, from your latest email its very apparent that you align with the U.S. Climate Change Science Program (USCCSP) which openly and explicitly advocates post-normal abandonment of empiricism. In this document there is no explicit demonstration of WHERE the GHE exists within in it. You haven't even provided us with a clue where to look either. You merely presented us 95 pages + 550 papers. As such, you appear to be unaware of where to point so we can find your elusive sky dragon "GHE 2."

Frankly, the USCCSP document is merely another hard sell of the already discredited 23 "sophisticated" models and a full on retreat from the traditional scientific method. We may fairly assert the USCCSP is advocating post-normalism above empiricism because they admit such on page 26:

" One goal of climate modeling is to decrease empiricism and base models as much as possible on well-established physical principles."

I am astonished that a medical doctor who pontificates on the one hand about doctors employing "four levels of evidence" and "randomized double blind placebo controlled trials" etc (all based on empiricism) has so easily abandoned empiricism. While "principles" cannot be explicitly construed as scientific laws - the term within post-normalism is undefined.

There is no dichotomy between empirical evidence and well-established physical principles; the latter usually being based on the former. Newton's laws of gravity were based on his empirical observations. We don't go and measure how fast an apple falls (for empirical data) when we want to do any calculations involving gravity – we use the appropriate formulae (physical principles). We likewise use the Stefan-Boltzmann equation where appropriate. Such formulae, equations or algorithms are easier to use and often more accurate than the best empirical data. They are usually derived from the analysis of a large empirical database and then tested against other empirical data to see if they fit. Others then try to prove that the formula or algorithm fails. If they can't, we use the formula with a fair degree of confidence. That is the scientific method. There may be limits or parameters within which the formula fits. Sometimes these can be determined theoretically and sometimes empirically. Sometimes the principle precedes the empirical evidence. Einstein's $E = MC^2$ was the 'physical principle' and the atom bomb exploding 40 years later was the 'empirical evidence'. Of course, both empirical data and the algorithms derived from them can be faulty or fudged. When I see certain signs I make an empirical diagnosis and treat it empirically, but further investigations sometimes proves that wrong. So empiricism is not foolproof either.

The propagandists in the USCCSP proclaim "success" for those 23 computer models but their success is only in refining hindcasts – not forecasts. Tim Ball has spent many years analyzing these failings and suggests there is intentional exaggeration and deception over the reliability of the models. See here:

<http://drtimball.com/2012/climate-change-of-the-ipcc-is-daylight-robberyclimate-change-of-the-ipcc-is-daylight-robbery/>

All models fail in forecasts because, as Ball demonstrates, " the models are the only place where CO2 precedes temperature increase." See here:

<http://drtimball.com/2012/computers-incapable-of-modeling-climate-billions-wasted-to-perpetuate-deception/>

But you and I both know the post-normal models have extremely low reliability because IPCC assessments show climatologists admit they have "low" or "very low" understanding of 13 of the 15 factors that drive climate (see: IPCC: Climate Change 2007: Working Group I: The Physical Science Basis; 2.9.1 Uncertainties in Radiative Forcing). Such is what constitutes "principles" in junk science. As we agree, it is partly for that reason that Trenberth admitted that the models fail to detect "missing heat."

Yes, I list those factors and more on page 32 of my book, The Weather Makers Re-examined.

As you may know, IPCC Lead Author on computer modeling, Andrew Weaver, is currently suing Ball for libel in the Supreme Court of British Columbia (and not doing so well). Like Ball I am persuaded that all such models are fraudulent and my legal opinion is that Ball will successfully defeat Weaver and win costs plus damages. I can say this with confidence because Weaver will not show the metadata for his GCM's to the court. As such that is a contempt of the rules of evidence rendering his case liable to summary dismissal. You see, the law is much like the scientific method and also requires openness. As such it will have no truck with post-normalism either.

The USCCSP (like Weaver) fudge the issue that their GHE theory isn't working. They still insist CO2 causes the "missing" warming they predicted. But they now say the warming isn't happening because it is being masked by what they claim are (unproven) negative feedbacks from aerosols (as per USCCSP Page 3). But climatologists have performed no experiments to validate whether aerosols cause positive or negative feedbacks. The USCCSP document is further damning evidence to show that the minds of climate scientists are entirely focused on attribution of mythical warming to CO2. Because they are post-normalists they despise the use of any experiments to affirm or refute their crumbling hypothesis.

Based on our collective years of study the 50+ experts of PSI are persuaded that junk "consensus" climate scientists won't dare countenance the possibility that CO2 has negative feedback and therefore program their computers accordingly. Moreover, CGM's are not evidence - only empirical validation by real-world observation works here. Climatologists shun any empirical experimentation because they fear that the results of such experiments may undermine their GHE hypothesis and leading them to be taken off the teat of man-made global warming funding. As is commonly accepted, there is increasing empirical evidence (inc. from satellites) showing less and less likelihood of any positive feedbacks from CO2 (thus no GHE).

Whether feedbacks to CO2 are positive or negative is immaterial to the existence of a GHE, but it determines changes in the GHE over time.

Knowing the real world data doesn't help their cause the post-normalists want to ignore it as revealed on Page 26 of the USCCSP document that states: " **One goal of climate modeling is to decrease empiricism and base models as much as possible on well-established physical principles.**"

That statement is an admission of the abandonment of the scientific method that places empirical verification of a hypothesis at the forefront of research. By contrast real scientists perform experiments and do not rely on failed computer models. Such experimental scientists include my colleagues Nasif Nahle and Carl Brehmer. Independently both men have performed rigorous tests that I invite you now address.

<http://principia-scientific.org/index.php/latest-news/the-greenhouse-effect-explored.html>

http://www.biocab.org/Observation_Backradiation.pdf

As already stated, these basic experiments are totally inadequate to disprove the GHE. You would need to monitor temperature over at least several days and nights and compare the means and trends in identical boxes with identical solar-transmitting tops but different absorbing qualities for the same IR spectrum as Earth's OLR.

If only Climatism would embrace the scientific method! Because of their aversion to empiricism and the tendency to secrecy and deceit I am firmly of the opinion that climate science tends to corruption as per my personal experience of misconduct. Pointedly, I am persuaded climate models have been fed junk data as revealed by my Satellitigate investigations. After my article was published NOAA initially complied with my complaint and ceased publication of further bogus data readings from the NOAA-16 satellite. But my evidence proved that for at least five years NOAA was selling and distributing to those modelers contaminated data with thousands of surface temperatures reading over 400 degrees Fahrenheit. This is an example of fraudulent empirical data!

<http://co2insanity.com/2010/10/06/satellitigate-update-by-john-osullivan/>

When I issued NOAA with an FOI request to ascertain the extent of the "errors" and whether the "errors" were perpetrated with fraudulent intent they denied me. As such we have no reason to have faith in assertions by modelers that their models are "reliable" while NOAA unlawfully defies FOIA requests to verify the quality of the proprietary data. So even if there are honest climate modelers out there they cannot possibly know how much, if any, of their data has been contaminated.

In this regard, and until climatologists get their own house in order, all your other questions are rendered moot and my colleagues and I shall adhere to the Scientific Method and ask you to follow the same empirical evidence-based principles and reject the GHE until provided with hard evidence of its validity.

Kind regards,
John

Good on you, John, for exposing error and fraud. I believe the models are too sensitive to CO₂ because the 20th century surface temperature record used to fine tune them has been cooked, and also because the cooling during 1945-75 was attributed only to aerosols and not also to a negative IPO. There has been a bias towards attributing change, whether cooling or warming, to man rather than to natural variability. You are right to be skeptical of the models, but you need to keep in mind that they are not the real atmospheric greenhouse.

We can be quite certain and thankful that the atmosphere absorbs and back-radiates IR, as Charles admits. What we can't yet be certain of is exactly how that alters as CO₂ increases in the context of numerous other climate variables. The fact that the climate models seem to have got that rather wrong over the last 15 years does not invalidate a real GHE.

We are both combating biased 'science'; we both think we are being true to science and the scientific method and we are both passionate about truth in science, and hence its reputation. That is more important than winning a debate or influencing politics. Until the evidence is as plain as a pikestaff to all who look at it, I hope we can agree to disagree without becoming disagreeable.

Kind regards
Wes Allen

On 2012-07-22, at 6:26 AM, Claes Johnson wrote:

OK Wes

So you think it is more than 0.3 C but less than 1 C, but no one really knows. But what are we then debating? We seem to agree on the essential point that climate alarmism bassooning 3 C is not backed by science, and thus should be abandoned for the benefit of mankind.

If we agree on the essence, from where to you get the urge to question little details in our book and make it public? Of course the book contains little errors here and there, but the real question is if the book presents valid criticism of the ruling paradigm threatening to send us back to stone age. Does it?

Best regards,
Claes

Sent: Monday, 23 July 2012 11:07 PM

To: 'Joe Bastardi'; 'Malcolm Roberts'; 'Bob' Cc: 'JOHN OSULLIVAN'; 'Claes Johnson'; 'Charles Anderson'; 'Pierre Latour'; 'RUTHHERTZBERG@msn.com'; 'Tim Ball'; 'Joe Postma'; 'DougCotton'; 'SiddonsAlan'; 'JoeOlson'

Subject: RE: Further Evidence and Physical Principles v2

Gentlemen

I am delighted, John, that "PSI is only interested in advancing the science". That too is my passion, and this partly answers Claes' question: "If we agree on the essence, from where to you get the urge to question little details in our book and make it public? Of course the book contains little errors here and there, but the real question is if the book presents valid criticism of the ruling paradigm threatening to send us back to stone age. Does it?"

I shall answer that question more fully further on. First, I hope you can appreciate the discordance between being 'only interested in advancing the science' and concerns with 'the ruling paradigm threatening to send us back to the stone age'. Second, if you are indeed 'ONLY interested in advancing the science', why do some of you get so defensive or angry as to make personal attacks or statements such as "What the hell has happened to science among alarmists and sceptics?" Yes, it is disappointing. Of course the science we are so concerned about does have political consequences. And we would be less than honest if we denied that our passion for the science has a political component. Otherwise, why aren't we all preoccupied with something else? Claes is being open and honest. I critiqued Flannery's alarmist book because I found it to be scientifically flawed, presenting numerous errors and scientific uncertainties as if they were certain facts. And I critiqued SSD for the same reason. My political bias is less important than truth in science. Whereas Flannery chose to ignore my critique, you have been decent enough to engage with me in discussing the science. Initially, I sensed a spirit of triumphalism as you cross-examined me, and I unfortunately reacted accordingly. But the court room thankfully gave way to open and frank discussion of the science, and I think we made some progress before getting sidetracked by perceived politics.

I am particularly grateful to Pierre, Charles, Claes and Tim for their engagement and candour, and for conceding the possibility of a GHE, however small. I agree with them that CO₂ plays a very minor (and greatly exaggerated) role in that. Thank you, Tim, for the nice graphs showing the relationship between temperature and CO₂ and the logarithmic

nature of that. I was familiar with the bar graph version, which is similar to the attached graph based on MODTRAN studies and calculations, before factoring in any feedbacks.

Joe Bastardi, you are right in pointing to the Interdecadal Pacific Oscillation (IPO) to explain most of the 1945-75 cooling and also the present pause in warming. Modellers mistakenly attributed that to aerosols - then and now. Unlike the alarmists, we can't be sure what the future climate will be, but we can be fairly confident that the IPO will turn positive again. In the meantime we will probably have more La Nina events than El Nino's. The sun, which was stronger last century than during the previous nine, is also unusually quiet at present and we don't know how long that will last. Who was it who said 'Listen to those who seek the truth and beware of those who have found it'? I think we should leave dogmatism to the alarmists.

I was genuine when I said I would love to see a revised version of SSD. But you will need to correct more than a few 'little errors here and there', and some of you might need to swallow some professional pride if you are to achieve a scientifically sound document that doesn't contradict itself. You first need to work together and agree on:

1. How the troposphere is heated - by both radiation and conduction/convection, as well as by latent heat from evaporation?
2. What happens to the solar radiation absorbed by the atmosphere - whether or not about half is re-radiated on to Earth's surface?
3. What happens to convected sensible and latent heat, and OLR absorbed by atmospheric gases - how much if any is radiated to the surface?
4. Whether CO₂ absorbs more solar IR than OLR and thus has a net cooling effect, or vice versa (comparing the emission and absorption spectra in my second-last email gives a clue)?
5. What is the mean absorptivity of Earth's surface for total solar, solar IR, longer wavelength IR? (all are greater than the 0.7 in SSD)
6. What is the mean emissivity of Earth's surface - 0.7, 0.95 or something in between?
7. What happens to non-solar IR radiation impacting Earth's surface - is it reflected, absorbed and converted to thermal energy, or merely dissipated/lost - contrary to the first law of thermodynamics? What is the essential difference between conduction and radiation? Is space really a perfect insulator?
8. Do multiple sources of EM radiation impacting a surface combine or not - where is the evidence?
9. Whether there is such a thing as a 'heat wave' or 'temperature signal' in EM radiation - much evidence is needed for such novel science
10. Whether the so-called Standard Model is the 'ruling paradigm sending us back to the stone age', or is the GHE more real than any model?
11. Is the tiny error in that model more important than the direction of that error, or does your invalidation of a simple model actually validate a real GHE?
12. Does glass absorb and re-radiate IR in all directions, including back to the source? Do you have evidence that it doesn't?
13. Do daytime experiments on glasshouses tell us anything about a greenhouse effect at night - can they possibly invalidate a GHE?
14. Can Earth's surface remain warm at night without any GHE - can you prove that mathematically? Can you provide a valid energy budget?
15. Do IR-absorbing gases increase, decrease or make no difference to lapse rates and what is the mainstream position on that?
16. Is there or is there not any such thing as back-radiation, recirculation of energy in a thermos or a GHE, however small?

Can I suggest that you appoint a small committee to work systematically through these issues and seek feedback from the others until you reach a consensus. If you can't, then you will need to clarify and specify differences of opinion in your revised version. If you still believe you can prove that there is absolutely no GHE whatsoever, even at night, then you should present a proper research paper on it. Such science is too important to put in a book that is likely to reach or impress very few in the science community. If Energy and Environment won't publish it, keep working on it until they will or until you change your minds.

If I can be of further help I would be glad to assist. However, I will be pretty busy over the next week preparing for an overseas trip, returning at the end of August, so please do not misinterpret any ignored emails or brief/terse responses.

Kind regards

Wes

On my return from holidays, I then sent the group a revised version of my critique and received from John Sullivan the following email, parts of which I have highlighted:

From: JOHN OSULLIVAN

Sent: Thursday, 6 September 2012 5:40 AM

To: David Weston Allen **Cc:** Jo Nova; Joe Olson; 'Doug Cotton'; 'Pierre Latour'; 'Bob'; 'Claes Johnson'; 'Charles Anderson'; 'Tim Ball'; 'Joe Postma'; 'SiddonsAlan'; 'JoeBastardi'; 'MalcolmRoberts'; Case Smit

Subject: Re: Final critique for comment and permission

Wes (and Jo Nova),

I am delighted that Jo appears to want to publish your critique of 'Slaying the Sky Dragon: Death of the Greenhouse Gas Theory' as this is in the best spirit of skeptical debate. I salute you and Jo for your honest efforts in bringing attention to discussion of these matters. But immediately I notice your review appears to want to play off the authors against each other with semantics over the "back radiation" issue. My fear is that this is due to your own failure to assimilate from our correspondence that there is marked difference between the **concept of "back radiation" as a phenomenon** and alleged heating from "back radiation" - the two are not the same thing and that you conflate them in your mind has led you to overlook that we don't.

Throughout your critique you defend the amorphous GHE (which you never pin down) with **handwaving references to "sophisticated" models**. But beyond that you offer no counter evidence to trump our refutation of the "simplistic" standard model (based on an amalgam of those 63 models we identified) that you - in our correspondence - agree we refuted.

Wes, you have rightly identified passages in some chapters that would benefit from more clarification and refinement. I would suggest to Jo that it is more helpful to her goal in seeking to advance the debate to be aware that a first edition will necessarily have some rough edges to be refined in subsequent editions. I'm pleased your revised review now incorporates mention of Postma's work. It is better for all concerned that mention is made of the fact that since publication the original 8 authors of SSD has become 50+ **experts** of Principia Scientific International publishing seven important papers advancing our science. There is also a groundbreaking eighth paper in the pipeline that applies compelling new experimental evidence to refute the GHE. It would be most beneficial for us all not to overlook the latest developments and recognize that Wes has done nothing here to identify for readers where they may readily lay their hands on and analyze a robust "official" version of anything other than the "toy" GHE model we refuted.

Since publication of SSD climatologists have agreed that we have successfully refuted the **Standard Model GHE as typified in the famous KT97 energy budget**. Indeed, the "Standard Model" GHE formulated by SSD is now accepted widely as the "toy" version of the GHE. In that regard you have also personally conceded in your emails with us that your belief in the GHE is in no small part premised on your blind faith in GCM's that you have neither seen nor examined. Indeed, as we keep insisting, beyond models there is no testable scientific basis for any belief in the existence in the GHE in Earth's open atmosphere. Moreover, no climatologist we have challenged has even been able to verify to our satisfaction that their models (with a GHE component) actually have any predictive success.

Therefore, as a skeptic we would have hoped you would have mentioned in your critique just how uncertain this "settled" science actually is. We pointed out that climatologists describe the greenhouse gas effect (GHE) as both **(a) an active heating mechanism and (b) as a slowed cooling mechanism. But these are contradictions in terms.** Which do you believe, Wes (Jo), is it (a) or (b)? So befuddled is this "science" that up till the 1980's it was claimed the GHE was the result of the mean radiating height caused by clouds. In basic terms climatologists had spoken of Earth's near-surface air temperature as being the result of the

lapse rate. While James Hansen's own 1980's version of the GHE made no mention of CO2. But then Hansen (and other GHE promoters) then went onto claim the GHE raises Earth's surface temperature by 33 degrees due to "back-radiation!" Please check your history and see the glaring anomalies.

We demonstrated that there are no less than 63 different versions of this "theory" taught at leading universities while we cite no less than 53 bogus authority statements (from NASA etc) specifically declaring the GHE DOES operate like a greenhouse. We are bemused that you also buy into the "**cold space**" fallacy - acceptance of this myth helps bolster belief in the "blanket" analogy for our atmosphere - yours is a complete failing to comprehend that the vacuum of space inhibits **heat transfer** 47 orders of magnitude greater than air.

Our book (and subsequent papers) argues that when other natural forces are considered there is no need to postulate a radiative greenhouse theory in the first place because (a) **there's more than enough Solar insolation to explain the ground temperature** (b) back-IR heat amplification is not supported experimentally, and (c) The so-called "delay" in cooling, or "the time taken by a Quantum/wave to exit the atmosphere after it has collided with a molecule of carbon dioxide" is **experimentally proven** to be a miserly ~4 milliseconds. For this see: http://www.biocab.org/Mean_Free_Path_Length_Photons.html

This "delay" in cooling has no measurable impact on heat retained by our atmosphere because - as satellite measurements prove - solar insolation values still happily equate with emissions. In sum, you concede Principia Scientific International (the "slayers" in newer incarnation) "destroy strawmen, not the real sky dragon." But what and where is the "real sky dragon"? No one can find it and you're not helping the search. You offer handwaving comments such as SSD "**focuses on suspect science**" and ignores a "plethora of solid research published in reputable peer-reviewed journals." Claims that the Slayers "ignore all such **evidence for back radiation** and greenhouse warming" need supporting to have a credible debate. But Wes offers no citations to back his own demand that postulates should be "backed by **empirical evidence**." (Page 57) Ok, Wes, please show your empirical evidence for the existence of a GHE in Earth's atmosphere. Instead, throughout your critique we see pronouncement from you that "There is no doubt that carbon dioxide is a greenhouse gas...." (Page 40). Proof please, Wes!

Sadly, when you accuse us of ad hom it seems you're speaking from both sides of your mouth. There are gratuitous ad homs of your own sprinkled about. For example, you talk of "Postma's **puny** model," our "**wacky** science" and infer we are not "true skeptics" because we "muddy the water" (Page 58). You then commit the cardinal sin against the scientific method by making the false claim that our **debunk** is invalid because we "fail" to "**replace** it with something better." Wow, I bet that would have Karl Popper spinning in his grave. From what we see in this critique there is plenty to suggest Wes is less a "true skeptic" than he thinks.

On a positive final note. We agree with Wes that we all had "a friendly discussion of the science" (P. 57). Obviously, we are delighted much of the book finds agreement. You have been helpful to us in identifying some chapters where authors could improve the use of language and eliminate apparent ambiguities. As such your input will be useful in our plans for a new and improved second edition for 2013.

Many thanks,

John

From: David Weston Allen

To: 'JOHN OSULLIVAN' **Cc:** Jo Nova; Joe Olson; 'Doug Cotton'; 'Pierre Latour'; 'Bob'; 'Claes Johnson'; 'Charles Anderson'; 'Tim Ball'; 'Joe Postma'; 'SiddonsAlan'; 'JoeBastardi'; 'MalcolmRoberts'; Case Smit'

Sent: Thursday, 13 September 2012, 7:04

Subject: RE: Final critique for comment and permission

John et al

Thanks for this. I have a few comments and questions related to your highlighted statements – for *brief* answers please.

Do you now admit that backradiation is a reality but that absorption of it has no thermal consequence? If not, what happens to that absorbed EM energy?

There is no 'handwaving'. In that 'final' version I sent you (now the penultimate version), the word 'sophisticated' occurs only once: Concerning the accuracy of dating, Tim Ball says: ***"Even the most sophisticated technique, radiocarbon dating, only covers approximately 70,000 years with an error factor that increases as you go back in time."*** (p.138)

What is your definition of an 'expert'?

Can you succinctly explain how your 'Standard Model GHE' is typified in the KT97 energy budget? Do the Slayers have a global energy budget?

Atmospheric radiation (resulting from absorbed solar energy and OLR, convected heat and latent heat) facilitates direct solar warming of Earth's surface by day and slows radiative losses by night. How are these mutually exclusive contradictions?

Where do I state that space is cold? Sure, without a heated space suit, you will rapidly become frigid in space – not because space is cold, but because there is no barrier to your radiative losses and no warm bodies surrounding and radiating you (as on Earth). Your 'heat transfer' relates to conduction not radiation – you continue to confuse the two.

Where is your maths to show that there is 'more than enough solar insolation to explain the ground temperature'? Since I found the exact opposite, can you specify where I went wrong on pages 27-28 of my 'final' critique? And while you are there, what do you say about the direction of the small error in the 'toy' model? Do you chose to ignore that? Is it too inconvenient?

I looked at the Nahle article via the link you provided, and found the 'miserly ~4ms' was **not 'experimentally proven'** but instead **theoretically calculated**. Do you know the difference? Which is empirical evidence? While the abstract is consistent with your statement, the body of the article states: "The result indicates that it takes quantum/waves approximately 5 *ms (milliseconds)* to cross the troposphere from the surface of the Earth after colliding with or being scattered by molecules of CO₂." Note that it is now 5ms (not 4) and that the quantum/wave crosses the troposphere (not the atmosphere), and that distance given is $r_{trop} = 700000\text{ cm}$ which is 7km (about half what it is in the tropics where it matters). But more to the point, the distance that light travels in the 'miserly' 5ms is about 1,500km, which means that it could traverse the troposphere 100-200+ times before exiting. Is this how Slayers typically do/interpret 'science'?

In case you have misinterpreted “focuses on suspect science”, I have changed that to “attack suspect science”.

Are not figures 1.5 and 1.6 on page 10 of my critique empirical evidence of backradiation?

Puny and wacky are derogatory but *not* ‘ad homs’ – against the man. I have changed this paragraph (on p 35).

I don’t expect you to agree with it, but I hope you find it less offensive.

Kind regards

Wes

This reply is the last I heard from the group:

From: JOHN OSULLIVAN [mailto:john0sullivan@btinternet.com]

Sent: Wednesday, 12 September 2012 1:12 PM

To: David Weston Allen

Cc: Jo Nova; Joe Olson; 'Doug Cotton'; 'Pierre Latour'; 'Bob'; 'Claes Johnson'; 'Charles Anderson'; 'Tim Ball'; 'Joe Postma'; 'SiddonsAlan'; 'JoeBastardi'; 'MalcolmRoberts'; Case Smit'

Subject: Re: Final critique for comment and permission

Wes,

Thanks for your revisions of the derogatory and gratuitous remarks. This is testament to your tact and diplomacy. I did get started on a considered reply to your email but my time has been taken up working on a detailed legal analysis of last Friday's woeful 'Kiwigate' decision by Justice Venning in dismissing the NZCSET petition. Frankly, you should go ahead and publish the newest version of your critique. I can't speak for others on the team but my opinion is its now time these questions got a thoroughly good public airing.

Best,

John

I have since made some further revisions after reading an article by William Kininmonth

APPENDIX B – BOOK REVIEW BY VINCENT GRAY:

“SLAYING THE SKY DRAGON; Death of the Greenhouse Theory: The Settled Climate Science- Revisited”

by Dr Tim Ball, Dr Claes Johnson, Dr Martin Herzberg, Joseph A Olsen, Alan Siddons, Dr Charles Anderson, Hans Schroeder. John O’Sullivan

Stairway Press Mount Vernon, Washington State USA 338 pages, 21 Chapters, 2011 \$9.95

"Slaying the Sky Dragon" is the result of an association of scientists, technologists and journalists who oppose the concept that the earth's climate is influenced by increases in carbon dioxide and other greenhouse gases. They have been seeking scientific reasons why this concept is wrong.

I have been in correspondence with members of this group for many years and I have been stimulated in my own thinking by their willingness to challenge the basic assumptions of this theory.

Tim Ball, who introduces the book with two Chapters on “Analysis of Climate Alarmism” identifies the individuals who have been mainly responsible in promoting climate alarmism and he provides an excellent summary of the scientific evidence against it. However, he does not quite realise how firmly the IPCC Reports are controlled by anonymous Government representatives, or that IPCC “projections” are a combination of model results with “scenarios” of the future.

Alan Siddons, who is a brilliant draftsman, provides the main arguments of the whole book, in nine Chapters. He shows that many assumptions of the climate models are difficult to justify.

These include

- The earth can be considered to be flat.
- The Sun shines day and night with the same intensity.
- The temperature of the surface is a constant.
- The energy system is in equilibrium.

In Chapter 8 he gives a list of nine official opinions on the nature of the “Greenhouse Effect” which contradict one another. They even include the Framework Convention on Climate Change which, I find, has now altered, to another which also contradicts others, It is amazing that several important bodies continue to believe the theory of Fourier, that greenhouses trap infra red radiation, when a wood burning stove with a glass front proves that infra red radiation has no difficulty passing through glass.

Alan Siddons and Hans Schreuder make a comparison between the moon which has almost no atmosphere, has a large difference in temperature between day and night, and the earth, where the difference is much less. This means that the earth's atmosphere has a major influence on the energy distribution in our climate, probably more important than infra red absorption by one of the minor "greenhouse gases". It also means that that the climate by day is different from the climate by night so that trying to amalgamate the two may not be justified.

Several authors show that simple fluid dynamics prove that convection and evaporation play an important part in the climate which is largely ignored by the IPCC. This means that through convection and evaporation, the atmosphere cools the surface by day and warms it at night, suggesting that the correct action of a greenhouse is also a cooling of its interior by day and warming it at night. So earth's energy is, after all, controlled by a genuine greenhouse effect?

Instead of drawing these rather important conclusions, several authors have chosen to challenge two fundamental Laws of Physics, the Second Law of Thermodynamics and the Stefan/Boltzmann Radiation Law.

One version of the Second Law is

“Heat cannot of itself flow from a cold body to a warmer body”

Several authors argue that this means that the atmosphere cannot radiate energy back to the earth (‘back radiation’), so the trace gas warming theory is wrong.

They have failed to notice the phrase “of itself”. A refrigerator is designed to remove heat from cool substances, but it needs an external energy source to do so. The climate also depends on an external energy source, the Sun. Without it, as happens every night, the earth would slowly lose heat by radiation until eventually its temperature would approach absolute zero and there would be no trace gas absorption. This process is interrupted every dawn and reversed.

Claes Johnson, a Professor of Applied Mathematics from the Royal Institute of Technology, Stockholm provides a good deal of mathematics and he uses the equations of fluid dynamics to confirm that convection and evaporation play a major part in the cooling of the earth’s surface

He also derives the Second Law of Thermodynamics, and Planck's and the Stefan/Boltzmann Radiation Laws. The two radiation laws are based only on the temperature of the emitter, yet he insists that “back radiation” is impossible because of the Second Law and radiation cannot be absorbed by a warmer body than the one that emitted it. This opinion disagrees with his own derivations.

Criticism of the IPCC in established scientific journals or in IPCC reports is currently almost impossible, so critics have little alternative except a volume such as this which combines original and effective challenges to current majority opinion with some inaccurate science and doubtful speculation.

The authors of this book deserve credit for the original insight into climate science they undoubtedly provide, but their work needs careful winnowing of the wheat from the chaff.

Vincent Gray. Wellington, New Zealand

25nd April 2011

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