Where did they get a crazy idea like that?

A discussion of “climate sensitivity” according to climate models and the real world

or

“Don't be mean to climate models – they're hypersensitive!”

A JunkScience.com investigation of global climate sensitivity in the real world and the claims published by the UNFCCC IPCC, based on climate model output.

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Abstract

Here we review claims of enhanced greenhouse warming and Earth's extreme sensitivity to added forcing. We find IPCC documentation to be internally inconsistent and vague to the point of obscurity. The IPCC has at times mis-described enhanced greenhouse forcing as occurring above the effective emission altitude. This mis-description has confused the issue and caused skeptics to claim, accurately on literal reading, that the IPCC's TOA greenhouse version is in violation of the Second Law of Thermodynamics, magically creating energy in a manner which would raise Earth's effective temperature. Examination of Earth's climate sensitivity by varied derivation reveals climate to be remarkably insensitive to changes in forcing from enhanced greenhouse effect. Initial forcing from $2xCO_2$ is found to be overstated in early model studies, an error compounded by the assumption net feedbacks are positive in nature. Evaluation of Earth's natural greenhouse effect reveals forcing-response to be considerably less than line by line spectral radiance evaluation would suggest. Net feedbacks are found to be negative. We conclude Earth's fully equilibrated surface response to $2xCO_2$ is expected to be less than 0.4 ºC. A state of climate emergency from enhanced greenhouse does not exist.

Don't be mean to climate models – they're hypersensitive!

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Climate models, or rather their output, form the entire basis for claims of Catastrophic Anthropogenic Global Warming (CAGW).

Without the output of climate models all we really have is an estimate of perhaps 0.7 ºC increase in the average global mean surface temperature since about 1750[1], a period viewed as the Industrial era.

Given that the early part of the period was unpleasantly cold and left at least Europe prone to famine and plague[2], that slight increase in temperature is generally seen as being quite welcome.

Before we get too excited, which temperature?

People talk about the global mean temperature all the time and casually mention global warming under varied nomenclature but rarely are they specific.

Most people are also quite surprised when we tell them that Earth's mean temperature hasn't changed at all from added greenhouse gases but it is quite true.

If we inhabited a neighboring star system and were sufficiently interested in Earth so as to be observing it we would note its insolation – the amount of radiation received from its star, Sol – its albedo – how it reflected inbound solar radiation - and its effective temperature – the energy radiated from Earth to maintain equilibrium temperature. These figures are related and Earth's effective emission temperature is a specific response to the radiation received from the sun. What our intrepid observers would not see, however, is any response to greenhouse effect, enhanced or otherwise.

That can't be right – everyone's very worried about greenhouse

Well, that's not entirely true. We, for example, would only be worried if greenhouse effect were declining.

We Earthlings are an ethnocentric bunch. We view what happens at the planet's non-gaseous surface as being the be-all and end-all but really what happens below Earth's effective emission altitude has no effect off-planet.

We had better explain this more fully.

Where to start?

A quick refresher in calculating Earth's expected mean surface temperature might be in order.

It often comes as something of a surprise to readers to find that this calculation is a little elastic. Depending on the source references used and the precision of the input parameters the resultant answers fall across a range and your mileage may vary, as they say.

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1 UNFCCC IPCC, p103, AR4 WG1 FAQs : http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-faqs.pdf
2 Appleby, Andrew B., Epidemics and Famine in the Little Ice Age, *Journal of Interdisciplinary History* Vol. 10, No. 4, pp 643-663

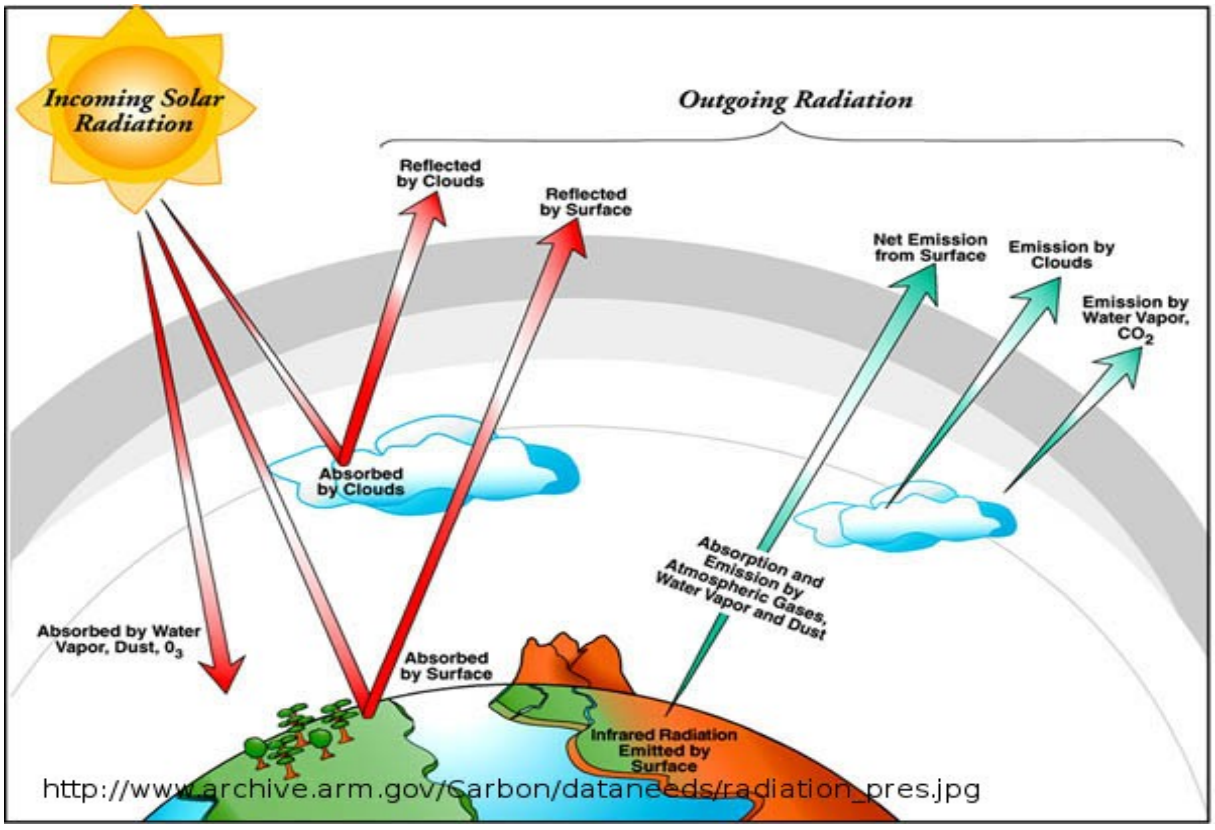
Necessary information are the effective emission temperature of the sun – we'll use NASA's *fact sheet*[3] for sun references here: $\mathbf{T_{sol}}$ 5,778 K; the sun's radius: $\mathbf{R_{sol}}$ 6.96 x 10^6 Km and; the earth-sun radius $\mathbf{R_{es}}$ of 1.496 x 10^8 Km. You will also need the value of the Stefan-Boltzmann Constant, $\boldsymbol{\sigma}$: 5.67 x 10^{-8} and Earth's albedo of 0.3 (yes, we realize Bond albedo is listed as 0.306 in NASA's Earth *fact sheet*[4] but we don't require that precision here). Emissivity ε is assumed to be 1 (everyone loves perfection).

To find the expected amount of solar energy arriving at the top of the atmosphere **TOA** then is a simple matter of calculating $\sigma \times T_{sol}^4 \times (R_{sol}/R_{es})^2$, which resolves to 1,368 W/m^2.

Of course the Earth isn't a stationary flat disk and to account for its rotation and curved surface we divide that value by 4 to find the average value of solar radiation at Earth's surface, giving us 342 W/m^2.

To convert that to a temperature is child's play as $(342/\sigma)^{1/4}$ = 279 K or 6 ºC, which is what the Earth would be as a pure blackbody (where ε=1) with no albedo or atmosphere.

Allowing for albedo of 30% reduces this value to 239 W/m^2 or 255 K (-18 ºC). This is Earth's effective emission temperature.



Living at the bottom of the atmosphere as we do we are naturally interested in the surface temperature, so now we add back in the feedback from the atmosphere, sometimes called “Back Radiation” but commonly referred to as “greenhouse effect” (GHE). Because there are common lines of spectral radiance between radiation from the atmosphere and the less-energetic portion of solar radiation it is not possible to measure and define precisely but the net effect is to increase downwelling radiation (or

3 Goddard Space Flight Center – NASA http://nssdc.gsfc.nasa.gov/planetary/factsheet/sunfact.html accessed July 2012
4 Goddard Space Flight Center – NASA http://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html accessed July 2012

flux) with a feedback of ~39%, defined by *Trenberth*[5] as 155 W/m^2. That is 239 + 155 = 394 W/m^2 which resolves to 289 K or 16 ºC. We may need to revisit that, in fact we will.

Interestingly, none of the near-surface global mean surface temperature time series of which we are aware actually base their anomalies on temperatures that high. NCDC base theirs on 13.9 ºC[6] and the others use 14 ºC[7,8]. Even after adding the warming believed to have occurred since 1750 Earth still measures cooler than its calculated "should be" temperature, although within range of rounding errors.

Notable points

In our brief description of calculating Earth's expected temperature above we kept it simple and tried to keep digression to a minimum. There are some points we need to highlight and some we really need to stress.

Firstly, when we reduced incoming solar radiation for albedo (or "reflection", if you prefer) we derived Earth's temperature as 255 K. Total incoming radiation after taking albedo into account determines the effective emission temperature for our planet without its atmosphere (or greenhouse effect, at least).

Confusingly for some, *it is still* the effective emission temperature for our planet with its atmosphere - just not at the surface but at the effective emission *altitude*. This is the point at which incoming solar radiation (shortwave) is balanced by outgoing (longwave) radiation from Earth. What greenhouse effect does is to raise the effective emission *altitude* but *not* raise its effective emission *temperature*.

Secondly, albedo reduces the effective temperature by 24 K by reducing the inflow of energy into the system, changing albedo *would* change the effective temperature.

Thirdly, feedback, or greenhouse effect, *adds no energy to the system* as a whole. As previously noted it raises the altitude of effective emission but does not alter the energy balance between incoming and outgoing radiation in any way whatsoever[9].

"Global warming" isn't really about a change in planetary temperature at all. That is whatever the sun makes it and it equilibrates such that whatever energy comes into the system is balanced by that which leaves. At present that makes Earth's effective temperature approximately 255 K (-18 ºC).

Being creatures of the surface we are naturally more interested in temperatures there, so we are interested in the feedback that makes our lives possible.

The feedback occurs because the lower atmosphere is warmed by the non-gaseous surface through conduction, evaporation and transpiration and through absorption of infrared radiation. Like everything of non-zero temperature the molecules of the atmosphere emit thermal radiation as a spontaneous function of entropy. Some of these emissions are intercepted by Earth's surface and this is the feedback we calculated above.

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5 Earth's Annual Global Mean Energy Budget, J. T. Kiehl and Kevin E. Trenberth, National Center for Atmospheric Research, Boulder, Colorado: http://www.cgd.ucar.edu/cas/Trenberth/trenberth.papers/KiehlTrenbBAMS97.pdf

6 National Climatic Data Center: "Anomalies are provided as departures from the 20th century average (1901-2000)." http://www.ncdc.noaa.gov/cmb-faq/anomalies.php#mean accessed July 2012

7 NASA Goddard Institute for Space Studies: The Elusive absolute Surface Air Temperature (SAT) http://data.giss.nasa.gov/gistemp/abs_temp.html accessed July 2012

8 Met Office Hadley Centre: The absolute global-average annual temperature:1961-90 average = 14.0°C. http://www.metoffice.gov.uk/hadobs/indicators/index.html accessed July 2012

9 Of course, altering the surface temperature of our nice wet planet could change the cloud area and type, or the area of bright ice and snowfields or otherwise cause changes in albedo and changing that can alter the planet's effective temperature.

It's a model world

Now, we don't want to be seen as being particularly critical of climate models.

We have learned a great deal from using models to help us explain what we see in the open atmosphere and this is certainly what they are designed for. We correctly know them as *process* models.

And it isn't their fault some people misuse them either, trying to make them into *prognostic* models, something for which they never designed and at which task they have no hope of ever succeeding.

Unfortunately, models are no more perfect than their programmers and so, due to missing parameters and unknown unknowns they are brutally forced to deliver specific answers.

Climate models have been *forced* to tell lies. They don't *want* to do this, they are simply doing as they are told.

In fact they don't even *know* they are doing this because they are lied to in the form of provided parameters which do not match the real world they are meant to represent.

Models have been artificially kludged into providing specified outputs to match historically observed surface temperatures, which they do with varying degrees of success (pun intended).

This doesn't matter so much while we are simply trying to understand what we observe, getting the right answer for the wrong reason isn't necessarily critical. It makes a major difference, however, when trying to predict the future.

The science is "settled"

Very often we hear how the debate has moved on and the science is settled.

The science might be settled as far as some are concerned but perhaps we moved on too early.

Vast sums are spent trying to take the Earth's surface temperature – or at least trying to take local temperatures and statistically merge them into an odd construct known as the "globally averaged temperature".

Whole teams are devoted to monitoring this even though there is no such place as "Globally Averaged". It isn't even presented as a real temperature but as an "anomaly" (a difference from an expected "globally averaged temperature" rather than the actual temperature).

Bizarrely this "global" temperature relies on a subset of land surface measures (measured in whole degrees) merged with sea surface temperatures derived by other means and becomes 3-decimal precise.

NASA's Goddard Institute for Space Studies (GISS, a.k.a. "The House of Hansen") suggests *we add the previous full year's anomaly to 14.0 ºC (287.15 K)* to derive an actual temperature[10], so depending on the year that is something under 288 K and in fair agreement with the other major temperature time series.

Note that in regard to Earth's precise temperature even the House of Hansen states explicitly: "*For the global mean, the most trusted models produce a value of roughly 14°C, i.e. 57.2°F, but it may easily be anywhere between 56 and 58°F and regionally, let alone locally, the situation is even worse.*"[11]

10 NASA Goddard Institute for Space Studies: The Elusive absolute Surface Air Temperature (SAT) http://data.giss.nasa.gov/gistemp/abs_temp.html accessed July 2012

11 Ibid.

Quaintly, models are tuned to derive a mean annual temperature of 287 K (14 ºC) and 14 ºC is used because most models derive it. Climate science is often like that.

There are also near-global atmospheric measures derived from satellite-mounted Microwave Sounding Units but of course these provide a mere three-decade-long time series. These indicate Earth's lower atmosphere has warmed slightly but apparently is not doing so at present.

It's all very energetic

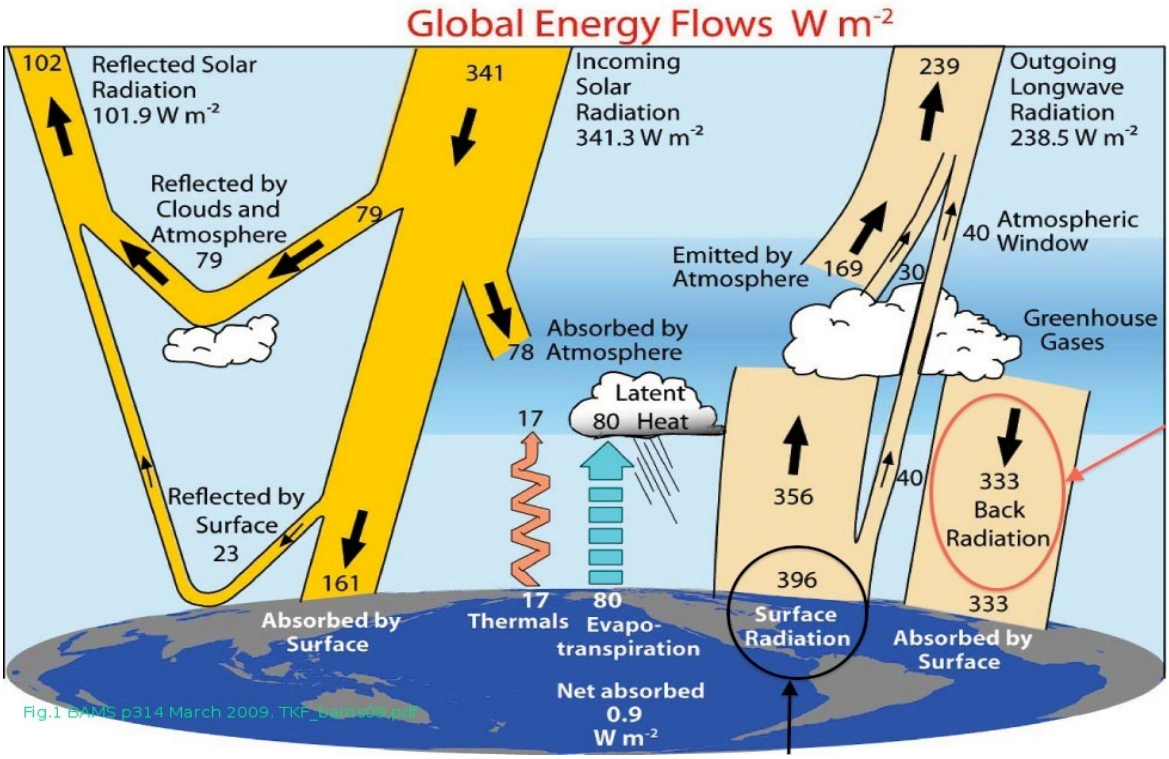
The concern about temperature is all about how energy flows through the atmosphere and drives our climate system.

Below we have a colorful graphic from *Trenberth, K. E., J. T. Fasullo, and J. Kiehl, 2008: Earth's global energy budget. Bull. Amer. Meteor. Soc.*[12].

We've highlighted a couple of items, firstly the "Back Radiation" figure, circled and arrowed in red. Back radiation is more commonly known as the Earth's "greenhouse effect".

Additionally we have arrowed and circled the "Surface Radiation" figure in black. This number was published and has been around and cited since 2008. It is also very likely wrong.

Trenberth's surface temperature number is given in Watts per meter squared (W/m^2) outbound radiation as 396 and using Stefan-Boltzmann $(396/\sigma)^{1/4}$ we get 289 K or 16 ºC – an apparent planetary fever. We suspect this was simply a product of balancing his calculation to allow for enhanced greenhouse effect. There's a bit of a problem with doing that though because subsequent work showed aerosols kept up to 5 W/m^2 from reaching the surface[13].



12 Kevin E. Trenberth, John T. Fasullo, and Jeffrey Kiehl, Earth's Global Energy Budget, National Center for Atmospheric Research, Boulder, Colorado : http://www.cgd.ucar.edu/cas/Trenberth/trenberth.papers/TFK_bams09.pdf

13 Ibid.

If Earth's average surface temperature was as high as expected at 288 K (15 ºC) then by S-B ($\sigma 288^4$) it should radiate at 390 W/m^2, suggesting Trenberth is overestimating by at least those few W/m^2, although he specifically states: "*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 Wm−2.*"[14]

We'll try a different calculation method shortly so let it pass for now.

Given the amount of hysterical concern over a possible warming of 2 ºC[15] you would think the "settled science" would try to get a little closer than yielding half that value to either variation in methodology or failing to recognize mitigating negative parameters.

5 or 6 W/m^2 may not seem much. After all, it is only about 1.5% of the calculated figure but the whole contention about doubling atmospheric carbon dioxide concerns a mere 3.7 W/m^2 and modelers have got that trivial change delivering all manner of bizarre warming estimates[16].

Table 3.10: Properties of emissions pathways for alternative ranges of CO2 and CO2-eq stabilization targets. Post-TAR stabilization scenarios in the scenario database (see also Sections 3.2 and 3.3); data source: after Nakicenovic et al., 2006 and Hanaoka et al., 2006)

Class	Anthropogenic addition to radiative forcing at stabilization (W/m^2)	Multi-gas concentration level (ppmv CO_2-eq)	Stabilization level for CO_2 only, consistent with multi-gas level (ppmv CO_2)	Number of scenario studies	Global mean temperature C increase above pre-industrial at equilibrium, using best estimate of climate sensitivity[c)]	Likely range of global mean temperature C increase above pre-industrial at equilibrium[a)]	Peaking year for CO_2 emissions[b)]	Change in global emissions in 2050 (% of 2000 emissions)[b)]
I	2.5-3.0	445-490	350-400	6	2.0-2.4	1.4-3.6	2000-2015	-85 to -50
II	3.0-3.5	490-535	400-440	18	2.4-2.8	1.6-4.2	2000-2020	-60 to -30
III	3.5-4.0	535-590	440-485	21	2.8-3.2	1.9-4.9	2010-2030	-30 to +5
IV	4.0-5.0	590-710	485-570	118	3.2-4.0	2.2-6.1	2020-2060	+10 to +60
V	5.0-6.0	710-855	570-660	9	4.0-4.9	2.7-7.3	2050-2080	+25 to +85
VI	6.0-7.5	855-1130	660-790	5	4.9-6.1	3.2-8.5	2060-2090	+90 to +140

Notes:

a. Warming for each stabilization class is calculated based on the variation of climate sensitivity between 2ºC –4.5ºC, which corresponds to the likely range of climate sensitivity as defined by Meehl et al. (2007,Chapter 10).

b. Ranges correspond to the 70% percentile of the post-TAR scenario distribution.

c. 'Best estimate' refers to the most likely value of climate sensitivity, i.e. the mode (see Meehl et al. (2007,Chapter 10) and Table 3.9

A single Watt difference delivering a range of 3.3 K and a 5 Watt spread of 7.1 K? Very flexible, these IPCC Watts.

Welcome to the murky world of climate sensitivity

It's been quite simple and straightforward to this point so there's just a matter of multiplying the expected change in forcing (denoted ΔF) by the climate sensitivity parameter (denoted λ) and we've got this surface warming by enhanced greenhouse thing squared away, right?

Uh, no. Sadly not.

14 Ibid.

15 United Nations Environment Programme Information Note: *How Close Are We to the Two Degree Limit?* Accessed July 2012: http://www.unep.org/PDF/PressReleases/temperature-briefing-21-02-10-final-e.pdf

16 IPCC AR4 WG3: 3.5.2 Linking emission scenarios to changes in global mean temperature, impacts and key vulnerabilities http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch3s3-5-2.html#table-3-10

In fact we can't even find a clear specification of *which* climate sensitivity parameter the IPCC is talking about in some of their publications and they certainly apply more than one.

By popular recounting Mrs Beeton's rabbit pie recipe instructed one to "*first catch your rabbit*", although this is apocryphal. We might, however, take that exhortation to heart and first define our climate sensitivity.

Finally, defining climate sensitivity

Unfortunately, there is no one single means of calculating such a useful value as "climate sensitivity" for the simple reason it is ill-defined. For this reason it always pays to check what precisely is being discussed and how it was derived. We will derive three apparently different 'flavors' here to start with.

Base case:

To begin with we can simply ask how sensitive is the Earth to total solar irradiation at top of atmosphere, less albedo and we get 255/(1368 x (1 – 0.3)) = 0.27, rounded to 0.3 K/(W/m^2)[17]. This is the Planck parameter and it reflects how extraterrestrials view the Earth. No feedbacks need apply because it considers the effective emission altitude where incoming and outgoing emissions are in equilibrium. Often designated as zero-feedback and denoted λ_0.

We've seen the base-case so we might as well view how the scary scenarios are derived.

Extreme case:

This is the new-equilibrium (post-feedback) parameter where the IPCC have decided that $2xCO_2 = 3.2$ ºC, apparently arbitrarily. Using *their formula*[18] for calculating the change in forcing (ΔF) from $2xCO_2$ of 5.35xLN(2) we have 3.7 W/m^2. Our derivation then is 3.2/3.7 to yield 0.9 K/(W/m^2). This is the λ value which delivers those lovely apocalyptic "story lines" so beloved by the media and which underlies Hansen's "Death Trains" sound-bite. It is also complete and utter nonsense.

Error in the extreme case calculation:

Of course the previous calculation is heavily loaded with additional positive "feedbacks" (marvelous magical multipliers) which necessarily adds more unstated W/m^2, mostly from a slightly warmer atmosphere being able to hold more water vapor.

Water vapor is the most abundant greenhouse gas, adding more of which should in turn heat the atmosphere and cause more evaporation while enabling more water vapor to be held in the atmosphere … (rinse and repeat ...).

We have no evidence this does in fact occur.

In *Weather and climate analyses using improved global water vapor observations*, Vonder Haar *et al*[19] found no global trend in global precipitable water over more than 20 years despite atmospheric carbon dioxide levels rising from 350 to 390 parts per million over the period.

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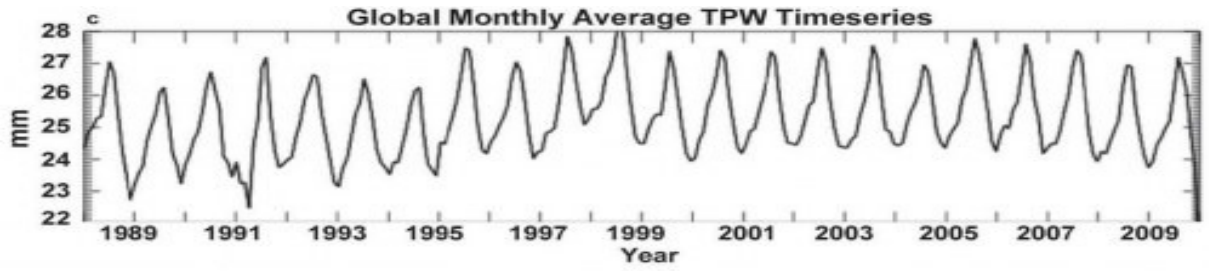
17 Note for nerds: this is the same rounded value that applies after application of Hölder's Inequality, so just feel superior that you know what that is and how to apply it and let it go, okay?

18 IPCC Third Assessment Report WG1 Simplified Expressions, Table 6.2: http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/222.htm#tab62

19 Vonder Haar, T. H., J. Bytheway, and J. M. Forsythe (2012), Weather and climate analyses using improved global water vapor observations, Geophys. Res. Lett.,doi:10.1029/2012GL052094, in press. http://www.agu.org/journals/pip/gl/2012GL052094-pip.pdf



This does not guarantee that no such effect exists although however sound the theory may be it has never actually been observed in the real world.

Nor is there evidence that any available "spare" outbound infrared radiation from the Earth exists waiting to be absorbed by additional greenhouse gas.

Failure to declare the additional wattage of alleged additional feedbacks as the extreme case does completely invalidates the extreme case sensitivity calculation.

How should we put this?

DON'T DO IT!

It's a completely rubbish calculation that vastly overstates climate sensitivity by omitting hypothetical feedbacks which have inflated the response and consequently has no known relationship with reality.

Change in forcing is actually defined as net down minus up radiation[20], i.e., it includes incoming solar radiation (because a small amount is absorbed by greenhouse gas) and every other downwelling Watt.

This makes our new-equilibrium calculation actually the difference between down radiation of 239 + 150 + 3.7 W/m2 resolved to 289 K minus our original 389 W/m^2 or resolved 288 K, so 1/3.7[21].

This of course returns us to our original Planck parameter, above.

Transitional state:

Let's look at how the IPCC determines climate sensitivity[22] for the intermediate or transitional state as climate responds to increased forcing:

> 6.2 Forcing-Response Relationship
>
> 6.2.1 Characteristics
>
> As discussed in the SAR, the change in the net irradiance at the tropopause, as defined in Section 6.1.1, is, to a first order, a good indicator of the equilibrium global mean (understood to be globally and annually averaged) surface temperature change. The climate sensitivity parameter (global mean surface temperature response ΔT_s to the radiative forcing ΔF) is defined as:
>
> $$\Delta T_s / \Delta F = \lambda \quad (6.1)$$

20 IPCC Climate Change 2007: Working Group I: The Physical Science Basis 2.2 Concept of Radiative Forcing: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-2.html

21 Note that without our rounding it should actually resolve to 1.2 K as expected since it is apparently based on exactly that figure derived by Hansen *et al* in their 1984 model study: http://pubs.giss.nasa.gov/abs/ha07600n.html

22 IPCC Third Assessment Report WG1 Forcing-Response Relationship: http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/216.htm

> (Dickinson, 1982; WMO, 1986; Cess et al., 1993). Equation (6.1) is defined for the transition of the surface-troposphere system from one equilibrium state to another in response to an externally imposed radiative perturbation. In the one-dimensional radiative-convective models, wherein the concept was first initiated, λ is a nearly invariant parameter (typically, about 0.5 K/(W/m^2); Ramanathan et al., 1985) for a variety of radiative forcings, thus introducing the notion of a possible universality of the relationship between forcing and response. It is this feature which has enabled the radiative forcing to be perceived as a useful tool for obtaining first-order estimates of the relative climate impacts of different imposed radiative perturbations. Although the value of the parameter "λ" can vary from one model to another, within each model it is found to be remarkably constant for a wide range of radiative perturbations (WMO, 1986). The invariance of λ has made the radiative forcing concept appealing as a convenient measure to estimate the global, annual mean surface temperature response, without taking the recourse to actually run and analyse, say, a three-dimensional atmosphere-ocean general circulation model (AOGCM) simulation.

This is explicitly stated to be transitional sensitivity rather than calculation for an equilibrated state as we typically do for deriving Earth's expected mean temperature and its natural greenhouse effect. As we see in the above, the IPCC is using model-established values, typically 0.5 K/(W/m^2) but stated to derive from global mean surface temperature response ΔT_s to the radiative forcing ΔF ($\Delta T_s / \Delta F = \lambda$).

Confused yet? Wait, there's more. In fact there's just about everything except the free steak knives.

Chapter 8 of the IPCC's AR4 WGI synthesis report poses the question "*What Explains the Current Spread in Models' Climate Sensitivity Estimates?*"[23] We could probably give them a somewhat acerbic response but let's just quietly state there is room for plenty of feedbacks and values appear optional.

Professor Mildew in the Greenhouse, with a Wrench

So, according to the definition quoted above the IPCC is talking about changes in forcing (ΔF) *at the tropopause* even though this is *not* where we expect to find enhanced greenhouse forcing.

In fact this is where such a sloppy description leads people into trouble.

By definition the atmosphere can not be cooler below the effective emission altitude[24] so that must be within the troposphere but at a lower altitude than the tropopause[25]. It must be so because temperatures at the top of the troposphere are well below Earth's effective temperature of 255 K. We *assume* although haven't seen it explicitly stated that *CDIAC*'s[26] figures are for net downwelling radiation at the tropopause too. Footnote 5 referring to "*the atmosphere below the stratosphere*" suggests that *might* be so but is not necessarily the case.

Pay attention here

We are somewhat concerned about this "*at the tropopause*" claim because added forcing there would add net downwelling radiation thus requiring an increase in outbound longwave radiation to achieve or maintain a new equilibrium with the increased forcing, so raising Earth's effective temperature.

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23 IPCC AR4 WG1 Chapter 8, p630 8.6.2.3 http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter8.pdf

24 IPCC TAR WG1 1.2.1 *Natural Forcing of the Climate System* p90 "Note that it is essential for the greenhouse effect that the temperature of the lower atmosphere is not constant (isothermal) but decreases with height."

25 Ibid. "The infrared radiation is effectively radiated back into space from an altitude with a temperature of, on average, -19°C, in balance with the incoming radiation" http://www.grida.no/climate/ipcc_tar/wg1/pdf/tar-01.pdf

26 Carbon Dioxide Information Analysis Center: Recent Greenhouse Gas Concentrations: http://cdiac.ornl.gov/pns/current_ghg.html

Greenhouse effect simply can not do that. Greenhouse effect does not and can not magically *create* energy. Greenhouse may raise the *altitude* of effective emission but it may not change the *temperature* of effective emission.

It is easy to see how people fall into the trap of claiming greenhouse effect violates the Second Law of Thermodynamics, which would be true if greenhouse really was allegedly creating energy by magic. Fortunately this is not the case, it's merely that for the convenience of simplified calculations we all *pretend* TOA is shorthand for that altitude in the atmosphere where GHE adds feedback to the equilibrated incoming solar radiation (simple, isn't it?).

The IPCC knows the TOA description to be wrong

Their description in the Third Assessment Report more properly describes Earth's energy balance and the greenhouse effect:

> 1.2.1 Natural Forcing of the Climate System [27]
>
> The Sun and the global energy balance
>
> The ultimate source of energy that drives the climate system is radiation from the Sun. About half of the radiation is in the visible short-wave part of the electromagnetic spectrum. The other half is mostly in the near-infrared part, with some in the ultraviolet part of the spectrum. Each square metre of the Earth's spherical surface outside the atmosphere receives an average throughout the year of 342 Watts of solar radiation, 31%[28] of which is immediately reflected back into space by clouds, by the atmosphere, and by the Earth's surface. The remaining 235 Wm-2[29] is partly absorbed by the atmosphere but most (168 Wm-2) warms the Earth's surface: the land and the ocean. The Earth's surface returns that heat to the atmosphere, partly as infrared radiation, partly as sensible heat and as water vapour which releases its heat when it condenses higher up in the atmosphere. This exchange of energy between surface and atmosphere maintains under present conditions a global mean temperature near the surface of 14°C[30], decreasing rapidly with height and reaching a mean temperature of –58°C at the top of the troposphere.
>
> For a stable climate, a balance is required between incoming solar radiation and the outgoing radiation emitted by the climate system. Therefore the climate system itself must radiate on average 235 Wm-2 back into space.

Obviously this description is more accurate by far, acknowledging both effective emission temperature and altitude.

In many respects it is extremely disappointing that the IPCC introduced the later mis-description of Earth's energy balance and greenhouse effect and continued it in Assessment Report Four (AR4).

One of the worst aspects of this misdirection has been to cause people to wrongly believe Earth's greenhouse effect violates the Second Law of Thermodynamics[31], which is most regrettable.

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27 IPCC TAR WG1 1.2.1 *Natural Forcing of the Climate System* p89 http://www.grida.no/climate/ipcc_tar/wg1/pdf/tar-01.pdf

28 Note that the IPCC is using a figure greater than Earth's Bond albedo of 0.305, which reduces the expected flux and derived temperature. We did warn you your mileage would vary with assumptions made.

29 As above

30 As above

31 Frank L. Lambert, Professor Emeritus Occidental College maintains a site on the 2nd Law here: http://secondlaw.oxy.edu/

The Scene of the Crime

The IPCC is (sometimes) adamant that doubling atmospheric carbon dioxide will deliver an increase in climate "forcing" of 3.7 W/m^2. Read about the formula *here*[32] but basically it's 5.35 times the natural log of 2.

The simplified expression can be used on any amount of atmospheric carbon dioxide we will conceivably encounter.

As an example with the recent "milestone" figure of 400 ppmv noted in a few places the calculation 5.35LN(400/280) yields 1.9 W/m^2.

We say "sometimes" because besides this logarithmic formula they also provide a linear value of 1.4x10^{-5} Watts per meter squared per part per billion or 0.014 W/m^2/ppm CO_2 (p iii, *AR4 WGI errata*)[33], which we have seen erroneously applied in forward projections.

Before attempting anything so silly users should note that this is derived from the logarithmic formula thus: 5.35LN(379/378) and will progressively overstate forcing with increasing concentration.

We'll return to the "settled science" of greenhouse effect shortly but we want to look briefly at the concept of climate forcing and climate sensitivity.

Basically climate *forcing* is that which alters energy flows within the climate system and climate *sensitivity* is how much the surface temperature changes as a result of the *forcing* change applied to induce that change.

In *Climate Change Science: An Analysis of Some Key Questions* (NAP, 2001), Climate, Climate Forcings, Climate Sensitivity, and Transient Climate Change pages *6* & *7* 2xCO_2's forcing is rounded to 4 W/m^2. This they note would raise surface temperature 1.2 ºC and then state:

> As just mentioned, a doubling of the concentration of carbon dioxide (from the pre-Industrial value of 280 parts per million) in the global atmosphere causes a forcing of 4W/m^2. The central value of the climate sensitivity to this change is a global average temperature increase of 3°C (5.4°F), but with a range from 1.5°C to 4.5°C (2.7 to 8.1°F) (based on climate system models: see *section 4*). The central value of 3°C is an amplification by a factor of 2.5 over the direct effect of 1.2°C (2.2°F). Well-documented climate changes during the history of Earth, especially the changes between the last major ice age (20,000 years ago) and the current warm period, imply that the climate sensitivity is near the 3°C value. However, the true climate sensitivity remains uncertain, in part because it is difficult to model the effect of cloud feedback.

The 1.2 ºC no-feedback case plus amplification actually dates to a model-exercise paper by Hansen *et al* in 1984[34]. Not something which inspires great confidence but we'll persevere.

More clues are to be found in the IPCC's AR4 WG1 Chapter 8, pp 631-632[35]:

> The water vapour feedback, operating alone on top of this, would at least double the response.[6] The water vapour feedback is, however, closely related to the lapse rate feedback (see above), and the two combined result in a feedback parameter of approximately 1 W m^{-2} °C^{-1}, corresponding to an amplification of the basic temperature response by approximately 50%. The surface albedo

32 IPCC Third Assessment Report WG1 Simplified Expressions, Table 6.2: http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/222.htm#tab62
33 IPCC AR4 WG1 Errata, p iii, Table 2.14 (Errata), http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-errata.pdf
34 Climate Sensitivity: Analysis of Feedback Mechanisms: http://pubs.giss.nasa.gov/abs/ha07600n.html
35 IPCC AR4 WG1 Chapter 8, pp 631-633 http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter8.pdf

> feedback amplifies the basic response by about 10%, and the cloud feedback does so by 10 to 50% depending on the GCM. Note, however, that because of the inherently nonlinear nature of the response to feedbacks, the final impact on sensitivity is not simply the sum of these responses. The effect of multiple positive feedbacks is that they mutually amplify each other's impact on climate sensitivity.
>
> Using feedback parameters from Figure 8.14, it can be estimated that in the presence of water vapour, lapse rate and surface albedo feedbacks, but in the absence of cloud feedbacks, current GCMs would predict a climate sensitivity (±1 standard deviation) of roughly 1.9°C ± 0.15°C (ignoring spread from radiative forcing differences). The mean and standard deviation of climate sensitivity estimates derived from current GCMs are larger (3.2°C ± 0.7°C) essentially because the GCMs all predict a positive cloud feedback (Figure 8.14) but strongly disagree on its magnitude.

Footnote 6 (referred to in the first line) reads:

> Under these simplifying assumptions the amplification of the global warming from a feedback parameter λ (in W m^{-2} $°C^{-1}$) with no other feedbacks operating is $1/(1 + \lambda/\lambda_p)$, where λ_p is the 'uniform temperature' radiative cooling response (of value approximately –3.2 W m^{-2} $°C^{-1}$; Bony et al., 2006). If *n* independent feedbacks operate, λ is replaced by ($\lambda_1 + \lambda_2 + ...\lambda_n$).

Clear as mud, right?

Let's follow it through.

1. Water vapor feedback (WV) would at least double CO_2's response.
2. WV is strongly related to lapse rate feedback (LR).
3. The two combined (WV + LR) = ~1 K/(W/m^2).
4. These plus surface albedo (A) increase CO_2 forcing to ~2 ºC, an increase of ~50% (?)
5. Footnote 6 specifically instructs the summing of multiple feedbacks while the text insists they are multiplicative.
6. Then there's the question of clouds, which models always treat as positive forcing. Anyone sunning themselves only to be interrupted by over-shading cumulonimbus might disagree.

If we read the footnote correctly feedback lambda (λ) values vary as to temperature per W/m^2 – we guess some animals really are more equal than others. You can see why there are more than a few difficulties with "certainty".

Returning to *NAP*'s somewhat naive analysis above, an increase of 3 ºC raises the surface mean to 391 K and $\sigma 391^4$ yields 407 W/m^2, in case you were wondering.

If that response is from 4 W/m^2 change in forcing then how does it become 17 W/m^2 equilibrated at the surface? That's significantly more than the suggested 2.5 times amplification.

The 2.5 times multiplier apparently does not resolve and seems entirely unjustified as applied to surface temperature.

Moreover, it has to have undeclared additional forcings involved and is thus completely useless for the purposes of evaluating climate sensitivity, no wonder they have a range as large as 1.5 ºC - 4.5 ºC.

Quite obviously the world has not warmed to the expected extent even though most additional forcing from previous years will have equilibrated by now (that will get some arm-waving going).

Since Earth is under-responding to forcings believed applied then feedback parameters must necessarily be either *negative* or at least a whole lot *less positive* than modelers insist.

So far none of the figures taken from models on trust apparently resolve using established constants and relatively simple math.

What we need is another way of testing to see what Earth's net surface response to changes in forcing really is.

What we're trying to avoid

We've already come across a few things with which we are really uncomfortable: the concept that changes in forcing from greenhouse effect take place above the effective emission altitude *without* altering effective temperature and varied response values with some Watts being more equal than others. What we are really seeking is a consistent response at the surface – after all it's where we live.

How has Earth responded to enhanced greenhouse effect so far?

As previously noted, according to *CDIAC*[36] increased greenhouse gases collectively are already adding about 3 W/m^2 to Earth's natural greenhouse forcing. That should then yield at least three-fourths of the expected $2xCO_2$ warming and this is *in addition* to the amount added from black and brown carbon, reduced ice and snow albedo and everything else of which humanity stands accused.

Three-fourths of enhanced greenhouse effect should presumably deliver at least three-fourths of the expected warming of 3 ºC, which is ~2.3 ºC *over and above* that from changes in land use and so on but clearly no one really believes the world has warmed to that extent over the last 260-odd years. The IPCC says it's just 0.7 ºC (p103, *AR4 WG1 FAQs*)[37].

Should we expect this warming to be evident already?

In a word, yes.

In a few words, yes, of course.

We frequently hear that most warming “is in the pipeline” but frankly, that's a nonsense.

As the National Climatic Data Center points out[38], planet Earth changes its “global mean temperature” almost 4 ºC from January to July and back again due to the differing absorption of solar radiation by the northern land masses and the southern seas.

So much for the terror over a potential 2 ºC global mean temperature change:

Combined Mean Surface Temp.	J	F	M	A	M	J	J	A	S	O	N	D	Annual
1901 to 2000 (°C)	12.0	12.1	12.7	13.7	14.8	15.5	15.8	15.6	15.0	14.0	12.9	12.2	13.9
1901 to 2000 (°F)	53.6	53.9	54.9	56.7	58.6	59.9	60.4	60.1	59.0	57.1	55.2	54.0	57.0

36 Carbon Dioxide Information Analysis Center: Recent Greenhouse Gas Concentrations: http://cdiac.ornl.gov/pns/current_ghg.html

37 UNFCCC IPCC, p103, AR4 WG1 FAQs : http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-faqs.pdf

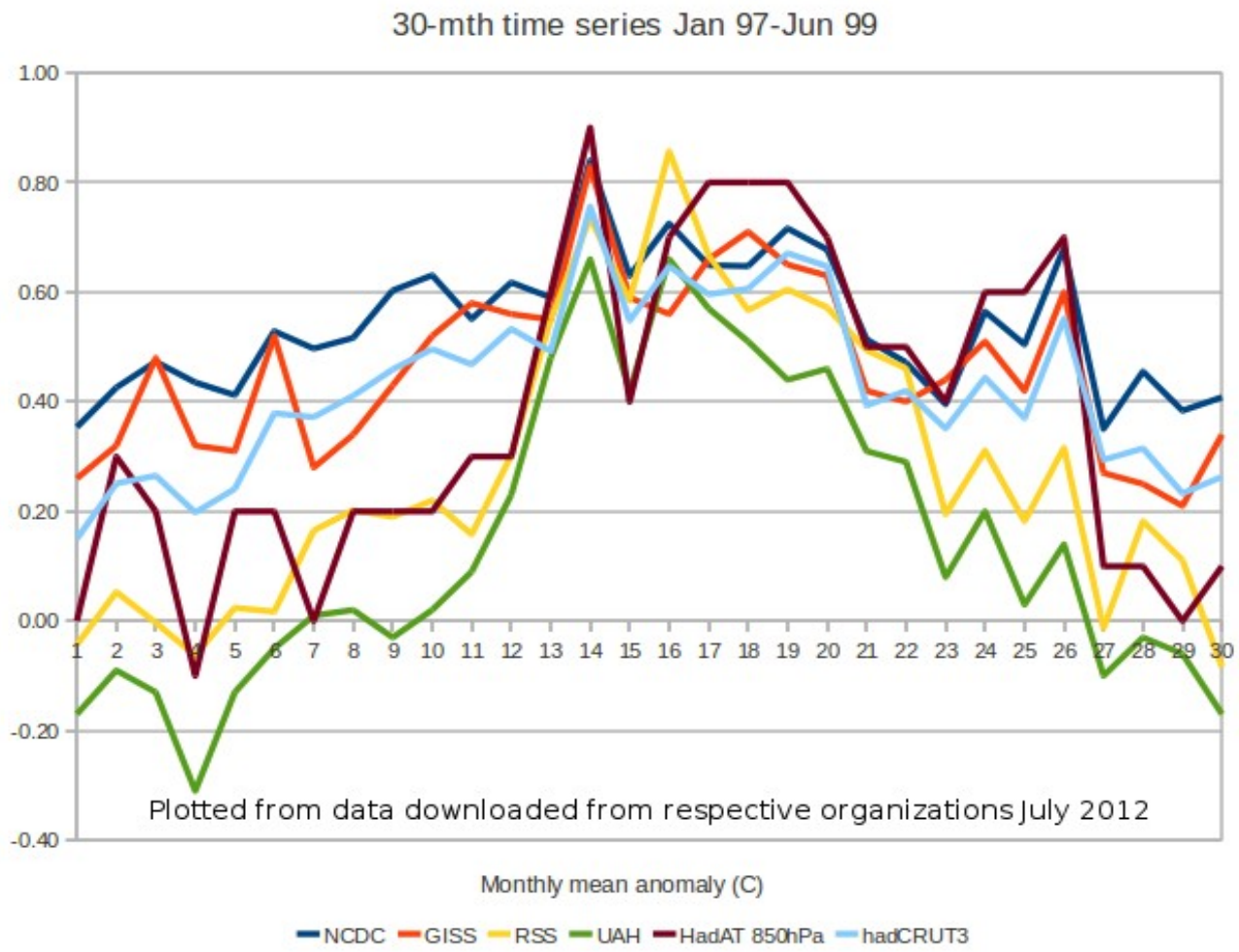
38 Global Mean Monthly Surface Temperature Estimates for the Base Period 1901 to 2000: http://www.ncdc.noaa.gov/cmb-faq/anomalies.php#mean

Speaking of terror over a potential 2 ºC global mean temperature change, check out the land surface change that occurs throughout the year, each and every year:

Land Surface Mean Temp.	J	F	M	A	M	J	J	A	S	O	N	D	Annual
1901 to 2000 (°C)	2.8	3.2	5.0	8.1	11.1	13.3	14.3	13.8	12.0	9.3	5.9	3.7	8.5
1901 to 2000 (°F)	37.0	37.8	40.8	46.5	52.0	55.9	57.8	56.9	53.6	48.7	42.6	38.7	47.3

Unless you believe this to be some sort of “planetary memory” of seasons experienced decades or centuries ago, Earth very obviously responds to changes in forcing quite rapidly.

For those inclined to believe tales of long lag times note that we can track Earth's response to El Niño warming *and the subsequent cooling* with only months-long lag, not years – below we depict the '97/'98 event with the major global temperature times series for the period.



Note that all time series peak in February of '98, with another smaller peak appearing again in April, before settling to “normal” by March of '99.

If that was a “super El Niño” its effect came and went in less than 30 months. Not a huge “lag time” really. Certainly it does not suggest any significant “heating in the pipeline” at all.

Earth is less sensitive than models.

From the perspective of theoretical physics there is nothing wrong with calculating the expected response via line by line spectral radiance as is being done with climate models (or, in several cases, AER's Rapid Radiative Transfer Model (RRTM) incorporated therein)[39]. The biggest problem is that *negative* feedbacks are not accounted for, largely because no one really knows how to do so yet.

Returning to Trenberth, above, the model-derived transitional sensitivity would make total greenhouse effect ~330 W/m^2 times by 0.5 K = 165 K and that, frankly, is a ridiculous number for our ΔT_s.

That would make Earth's mean surface temperature 420 K or almost 150 ºC. Something which is obviously not true because the oceans haven't boiled away.

This tells us that a climate sensitivity *at the surface* of 0.5 K/(W/m^2) is not correct in transition or otherwise and very obviously it cannot be.

The IPCC apparently knows this to be so because they don't use it for 2xCO_2 either since 4 W/m^2 x 0.5 yields 2 and 2 times their feedback multiplier factor of 2.5 equals 5, not 3 ºC as previously claimed.

As we derived in our calculation earlier, the Planck parameter λ_0 is 0.3 K/(W/m^2) and their 4 W/m^2 doubling of CO_2-only 1.2 K/4 also yields 0.3, so they are definitely using Planck and not the transitional 0.5 K/(W/m^2) or their own new-equilibrium parameter of 0.9 K/(W/m^2).

Although not explicitly stated we assume the IPCC considers λ_0 *with* 2.5 times inflation and post-equilibration λ as fungible and that this is where the new value of 3.2 K from 2xCO_2 came from in AR4. Either that or it's just the average of all model errors hoping it turns out about right[40].

But how is Earth really responding at the surface?

We already discovered that short-term surface response to 2xCO_2 cannot be as large as 3 ºC because Earth has not warmed the expected 2.3 ºC in response to the already added 3 W/m^2 from greenhouse gases since 1750 (as well as the various other increases, natural or otherwise).

It is not yet known, although plenty have suggested that rather than heating the surface more energy is being absorbed by and dispersed into the oceans. If true then we are good with that – *the hydrosphere is about 275 times the mass of the atmosphere*[41] and dispersing so little energy across so great a mass means we will never notice “global warming”.

There could be another reason Earth's surface isn't warming at the expected rate – we could simply be exhausting the greenhouse effect.

After all, there is not an infinite supply of outbound emissions of suitable wavelength to be absorbed by greenhouse gases. Adding more absorbers of a particular wavelength isn't very interesting when 100% of that wavelength radiation is already being absorbed.

Availability of outbound radiation in suitable wavelengths for absorbent species is beyond the scope of this discussion and remains for another investigation.

What we want to know is how the surface responds to downwelling radiation believed occurring now.

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39 Atmospheric & Environmental Research (AER) Radiative Transfer Working Group http://rtweb.aer.com/

40 IPCC AR4 WG1 10.5.4.1 The Multi-Model Ensemble Approach (or: Hoping many wrongs may turn out right): http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch10s10-5-4-1.html accessed July 2012.

41 Goddard Space Flight Center – NASA http://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html accessed July 2012

The climate-insensitive case

Using the IPCC's formula $\Delta T_s / \Delta F = \lambda$[42] then and subtracting the approximately 3 W/m^2 added from *additional greenhouse gases*[43] (various) from Trenberth's "Back Radiation" (which at least theoretically should contain all feedbacks both positive and negative operating *below* the effective emission altitude) we have a surface temperature change from natural greenhouse of 33 ºC (or K) for our ΔT_s and 330 W/m^2 for our ΔF, thus we derive 33/330 = 0.1 K/(W/m^2) rather than the IPCC's Planck parameter of 0.3 K/(W/m^2), their frequently cited transitional case 0.5 K/(W/m^2) or the truly extraordinary post-equilibrium 0.9 K/(W/m^2).

Trenberth's forcing figure for "Back Radiation" appears plausible in that it is similar to that of Pavlakis *et al*[44], who derived a 10-year average of 342-344 W/m^2 from World Radiation Monitoring Center - Baseline Surface Radiation Network (WRMC-BSRN) data. Besides which this is an eminently reasonable (and familiar) figure, equating to the temperature of the atmosphere below an altitude of about 1500m. Earth's effective temperature equates to that of the atmosphere at around 5,000m where it's about -18 ºC (higher in the tropics, lower in the frigid zones).

The figure 0.1 K/(W/m^2) makes sense on a watery planet with an atmosphere given the changes in albedo (reflectance of incoming solar radiation) due to bright clouds and ice and snow fields, so we have negative feedback by excluding more solar energy and damping the effect of the positive feedback from greenhouse gases.

Furthermore, positive and negative feedbacks, in the form of increased cloud absorption and albedo, also comfortably fit with the concept of tropical mid-tropospheric hyper warming that models predict but which has never been observed. Oh. Never mind...

Where did the IPCC get those numbers?

Exactly why the IPCC has run amok with the expected response from 2xCO_2 remains unclear but it could be as simple as a transposed decimal point, unnoticed in early drafts and preserved to this day.

As we've seen above, multiplying a theoretical warming of 1.2 ºC from 2xCO_2 by a factor of 2.5 makes no sense and delivers completely absurd surface climate sensitivity figures.

That it derives from an early Jim Hansen guess inspires very little confidence.

Regardless, multiplying by the factor *0.25* does deliver results which apparently match how the real world behaves.

The IPCC's simplified expression Radiative forcing (ΔF) from 2xCO_2 yields 3.7 W/m^2 and at our derived 0.1 K/(W/m^2) delivers +0.37 ºC.

When multiplied by 2.5 1.2 ºC yields 3.0 ºC while 1.2 ºC x 0.25 yields a much more reasonable 0.3 ºC. Again we suspect the IPCC is using positive feedback when negative would be appropriate.

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42 IPCC Third Assessment Report WG1 Forcing-Response Relationship: http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/216.htm

43 Carbon Dioxide Information Analysis Center: Recent Greenhouse Gas Concentrations: http://cdiac.ornl.gov/pns/current_ghg.html

44 Pavlakis K.G., et al Ten-year global distribution of downwelling longwave radiation, Atmos. Chem. Phys., 4, 127–142, 2004 http://www.atmos-chem-phys.net/4/127/2004/acp-4-127-2004.pdf

Could the planet be so insensitive to adding more carbon dioxide?

Actually, it could.

Dr. Roger Pielke Sr. made the effort *here*[45] to determine what portion of Earth's apparent warming was due to increasing atmospheric carbon dioxide. The format of the document suffered a little during change of web hosts but it is still quite readable.

Since Dr. Pielke's calculations were done there have of course been claims of much greater forcing from black and brown carbon (atmospheric soot and smoke), *inter alia* but his derived attribution of approximately half of all anthropogenic warming being attributable to CO_2 is quite sufficient for our purpose.

From CDIAC again, CO_2 is currently delivering about 1.8 W/m^2 added forcing, roughly half the expected doubling response of 3.7 W/m^2. Approximately half of Earth's estimated warming of 0.7 ºC since 1750 is believed from CO_2, that's just 0.35 ºC, while half the "expected" result of 3 ºC is 1.5 ºC.

Sherwood B. Idso used no less than eight natural experiments to derive a maximum temperature increase of 0.4 ºC from a doubling of CO_2 and a climate sensitivity factor (λ) of just 0.1 K/(W/m^2) for our planet past and present, along with our nearest celestial neighbors in his *seminal paper of 1998*[46] (linked for readers to peruse at leisure).

Here's the abstract:

> Over the course of the past 2 decades, I have analyzed a number of natural phenomena that reveal how Earth's near-surface air temperature responds to surface radiative perturbations. These studies all suggest that a 300 to 600 ppm doubling of the atmosphere's CO_2 concentration could raise the planet's mean surface air temperature by only about 0.4 °C. Even this modicum of warming may never be realized, however, for it could be negated by a number of planetary cooling forces that are intensified by warmer temperatures and by the strengthening of biological processes that are enhanced by the same rise in atmospheric CO_2 concentration that drives the warming. Several of these cooling forces have individually been estimated to be of equivalent magnitude, but of opposite sign, to the typically predicted greenhouse effect of a doubling of the air's CO_2 content, which suggests to me that little net temperature change will ultimately result from the ongoing buildup of CO_2 in Earth's atmosphere. Consequently, I am skeptical of the predictions of significant CO_2-induced global warming that are being made by state-of-the-art climate models and believe that much more work on a wide variety of research fronts will be required to properly resolve the issue.

You can't do that!

They say (perhaps not unreasonably) that we can't simply apply the IPCC's climate sensitivity calculation $\Delta T_s / \Delta F = \lambda$ directly to *net* greenhouse warming and *net* back radiation (GHE).

Okay. Why can't we?

It *is* closely approximating what the real world is doing complete with all feedbacks of *both* signs.

Moreover it is *exactly* as the IPCC prescribe in order to calculate our climate sensitivity factor λ.

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45 Pielke, Roger Sr., Climate Science, April 27, 2006: http://pielkeclimatesci.wordpress.com/2006/04/27/what-fraction-of-global-warming-is-due-to-the-radiative-forcing-of-increased-atmospheric-concentrations-of-co2/ accessed July 2012.

46 Idso, Sherwood B., Climate Research Vol. 10, pp 69-82: CO2-induced global warming: a skeptic's view of potential climate change: http://junksciencearchive.com/Greenhouse/idso98.pdf

More particularly it delivers an approximate fit with Pielke's ΔF from atmospheric CO_2 derived from the IPCC's published data.

Promisingly, it yields exactly the same result as Idso's eight natural experiments which in turn accord with other published experiments of the time.

Why does the IPCC make claims at odds with the empirical data?

Why did the IPCC turn from their own formulae?

Why does it pretend not to see the results of their own published methods?

What made them pursue model-generated gibberish rather than the empirical evidence right before us, on our own world and our near celestial neighbors?

The answers to these questions we could not find.

Nullius in verba

We don't expect *everyone* to rush off to plug the numbers into a spreadsheet to derive more accurate results than our rounded figures, although we hope that some of you might. Thus we'll simply point out that adding the 3.7 W/m^2 to surface insolation, minus albedo, plus feedback resolves to an increase of less than $^7/_{10}$ of one degree warming[47] and not Hansen's inflated 1.2 K, nor all the absurd numbers generated by climate models and their marvelous magical multipliers.

The immediate consequence of Hansen's inflated base case is of course that all subsequent calculations are virtually doubled. Thus the *NAP* "*Analysis of Key Questions*"[48] is immediately flawed. Rather than applying the 2.5 times multiplier to 1.2 K, resolving to 3 K for 2xCO_2 they should have used 0.7 times 2.5 = 1.75 K (we told you we'd never see the dreaded 2 ºC warming). Grade inflation is everywhere.

We know, too, that an atmosphere made wetter through increased evaporation will likely have more clouds providing more sunshade and so we find the multitude of always-positive feedback claims far from compelling.

We can measure more than 300 W/m^2 downwelling radiation and know that that delivers only about 30 ºC of warming, so why would we now expect the *last few* Watts of a logarithmic effect to be *exponentially* more potent?

We do not expect to pontificate with an official position and to be merely believed but place our calculations in the public domain to be tested and checked. We like to think that you will do so.

Finally. Let us ask is it possible fear of global warming is driven by an errant decimal point?

It could well be.

For all the billions of dollars thrown at climate research, the super-duper computers and the decades' worth of meetings in exotic locations, the IPCC still can't make up its collective mind *which* "sensitivity" it is talking about and still can't get close to matching the real-world with mathematical models.

Perhaps they should ask us for help – we can get a much better fit with an open-source spreadsheet.

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47 Yes, that really was a hint for you to try the calculation for yourselves – *nullius in verba*, remember?

48 Climate Change Science: An Analysis of Some Key Questions (2001) http://www.nap.edu/openbook.php?record_id=10139&page=7

Conclusion

You would expect vast research sums and significant effort to add clarity rather than confusion. Certainly we do.

It is extremely disappointing that this is not the case in climate science.

If anything we seem to have advanced at a pace inversely proportional to the effort and spending devoted to understanding climate and enhanced greenhouse effect, if any.

Essentially we have retreated from a first hazarded guess of a small effect acting on a well-described lower atmospheric warming to a situation of hysteria and mis-description.

The current situation is one of almost childish competition to apply the most outlandish magical multipliers imaginable to inflate a trivial theoretical warming to ridiculous extent in order to generate a need for yet more lavish funding “to avert looming disaster”.

This begins with an honest and logical step, the division of observed response, our changed surface temperature ΔT_s, by the change in forcing required to achieve it, our ΔF.

We have a stock formula for this: $\Delta T_s / \Delta F = \lambda$.

We even have direct example on which we may pattern enhanced greenhouse effect – Earth's natural greenhouse effect which by definition is complete with all necessary feedbacks of both signs.

We know Earth's greenhouse effect to be approximately 33 K and that this is driven by something over 330 W/m^2 of downwelling infrared radiation. We *know* Earth's climate sensitivity to greenhouse warming is a mere 0.1 $K/(W/m^2)$.

Each year Earth undergoes an oscillation of almost 4 ºC in mean temperature due to configuration of the continents, with mean land surface temperatures varying by three times greater amount.

Doubling the level of the essential trace gas CO_2 can only raise global mean temperature by an insignificant 0.4 ºC and constitutes no threat to humanity or the biosphere.

Many groups seek to alter society's energy supply for varied reasons but climate science provides no justification for so doing.

For the sake of science and society let us all stop misrepresenting the science and state categorically that the rising level of an essential trace gas constitutes no climate threat whatsoever.

Acknowledgements

JunkScience.com would like to gratefully acknowledge the assistance of the many helpful and might we say tolerant experts in their respective fields for their invaluable collaboration in the research for and formulation of this document.

We understand the career and employment pressures making public recognition of a skeptical position an all-too-frequently undesirable thing for those lacking tenure or the security of approaching retirement and thus pay mute tribute to the unsung heroes quietly working to restore sound science to a recently-hysterical debate.

You make our efforts worthwhile.

Special mention must be made of Christopher Monckton of Brenchley for a seemingly encyclopedic familiarity with UNFCCC IPCC documentation, providing a road-map through an otherwise almost impenetrable thicket of oblique, tangential and obscure references embedded seemingly purposefully in a jungle of verbiage.

To everyone then who made this document possible, thank you.

Barry Hearn
Editor, JunkScience.com