Outside the Black Box: Back to Basics

Summary. *Analyzing the trend in the energy imbalance at the top of the atmosphere as measured by satellites, delivers a "natural" climate sensitivity of 0.3 K/W/m^2. That is at, or very close to the inverse of the Planck feedback parameter as could be expected. Starting from the basic energy balance, it is shown that the high climate sensitivities as used by the IPCC are just a result from the invalid assumption that global warming is caused by greenhouse gasses only. Climate feedbacks to explain those high values are no more than necessary artifacts needed to support this mis-conception. At present conditions it is calculated from a simple analytical expression that the IPCC climate sensitivity is 3.2x too high. That implies that the global warming as measured since 1980, is for about 2/3rd the result of an increase in incoming solar power and can only for 1/3rd be attributed to an increase in GHG's, at max. This analysis is supported by radiation data from NASA's CERES-project (2000-2020).*

A couple of years ago, I made a simple estimate of the temperature effect of the more than 10% brightening over the last 4 decades in The Netherlands [1]. The Royal Dutch Metrological Institute (KNMI) attributed only 0.2^{o}C to that brightening [2], whereas my methodology resulted in about 1^{o}C. That would leave only 1/3 of the observed 1.5 ^{o}C warming to the effect of greenhouse gasses (GHG's). I coupled "brightening" to less clouds, and came to an estimate for the sensitivity to cloud change (cc) of about 0.1 K/%cc.
In the subsequent discussion with the KNMI, the only argument against my approach boiled down to: "*sophisticated climate models tell us something different*, *so your simplistic model must be wrong"*. Several other methods to determine this cloud-sensitivity, all delivered similar results. Finally, I concluded that KNMI referred to cloud-feedback results from climate models, whereas I was looking to the effect of an independent change in cloudiness. Next, I compared both views against existing trends in cloudiness, surface temperatures, etc. from satellite data [3]. When matched to trends in cloud-coverage, Global Circulation Model (GCM)-derived cloud-feedbacks delivered a climate condition close to a runaway scenario. Whereas my own idea of an independent forcing due to clouds acting as shutters (modulating solar input) delivered very surprisingly, that the sum of all feedbacks outside the basic Planck feedback parameter, became all of a sudden (almost) zero [3].

Those results confirmed my notion that high values for climate feedbacks are not real but artifacts from climate models. If temperature-induced feedbacks occur as a result of increased GHG's, in itself a plausible idea, they have to be *by definition* "small". Our climate is very stable and the Plank feedback will accommodate any perturbation from a small forcing, even from 2xCO_2, easily. All those feedbacks *should*, and *are* in my opinion small, 2nd order effects, or already incorporated in that parameter as confirmed by the outcome of my feedback analysis [3]. For that reason, I also used a slightly modified Planck feedback parameter for the fundamental climate sensitivity in the recurrent relation of the Climate Model Checker (CMC) in my WUWT-contribution "Outside the Black Box" [4].

But how to prove that the IPCC/GCM climate sensitivities are <u>fundamentally</u> wrong?

That quest started with a kind of "reverse engineering" of my CMC [4] using the same data, T_S form HadCrut5 [7], the greenhouse gas (GHG) forcing F_{GHG} from NASA/GISS [6] and calculate the climate sensitivity as $-1/\lambda = \Delta T_S/\Delta F_{GHG}$ (see eq.3 further on) over the last century. In order to use this sensitivity as a good proxy to the Equilibrium Climate Sensitivity ECS, long periods of 15 years were applied for determining the average slopes in $T_S(t)$ and $F_{GHG}(t)$. Results are plotted in fig.1, but given the small ΔF_{GHG} values before say 1920, one should take the values before that time, not too serious. The still rocky (black) curve shows that $\Delta T_S/\Delta F_{GHG}$ yields "any" value for the climate sensitivity, even

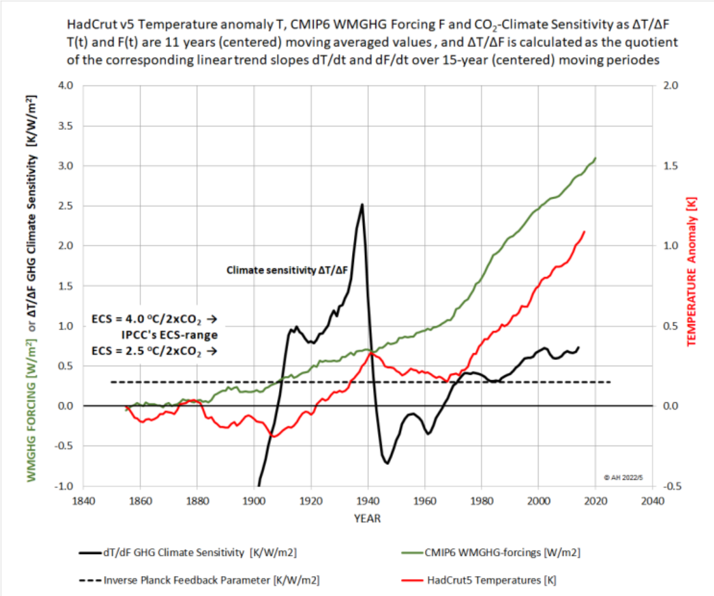

Fig. 1 Global surface temperature anomaly from HadCrut5 (red), MWMGHG forcings from NASA/GISS CMIP6 (green) and calculated climate sensitivity $\Delta T_S/\Delta F_{GHG}$ from 15-year long periods (black). The dashed curve indicates the inverse of the Planck feedback parameter. Indicated with arrows is the ECS range for the climate sensitivity from the IPCC

negative ones during 1950-1975, the years of "Global Cooling" that climate scientists seem to have forgotten. Our climate however, is pretty stable and accordingly, effects from just incremental amounts of extra GHG's over a period of 15 years, will not alter the climate sensitivity dramatically. If there was just the AGW-effect warming our climate, a smooth gradually rising temperature profile was to be expected. But what we see, looks quite different. If we translate this – 1/λ value of say the last decade 2010-2020 into a value for the ECS, the sensitivity that the IPCC is using in their communications, we get ~ 2°C. This is the supposed temperature increase from doubling the pre-industrial 280 ppm CO_2 according to ΔF_{2xCO2} = 3.0 W/m^2 from Van Wijngaarden and Happer [8]. Around 1980 that ECS would have been only about 1°C, but towards 1940 it would have been almost 8°C. To be followed by an extremely rapid decline towards -2°C around the fifties. Global Cooling was "alarming" indeed.

Once, I criticized the CMIP6 forcings [4] as being too high, but adapted values would only marginally change fig.1. It would anyhow show this "fingerprint" of natural causes for global warming. Not only that other forcings are at play, but also that they must be larger than the forcing by GHG's. Unless of course, our climate isn't the very stable system that I assume. So, when Willis Eschenbach was so kind to share his CERES-database on WUWT [5], I saw immediately opportunities to test that stability statement and some hypotheses I developed since these exercises described above.
That statement can indeed be easily checked with the CERES data over the period 2000-2020. All energy streams, either in the SW- or in the LW-channel are completely fixed to their prime streams SW_{IN} and LW_{OUT} respectively. I haven't seen ratios for which the annual averages changed more than about 0.3% over this period. Strong variations were only found between *all sky* and *clear sky,* with surprisingly different effects of clouds in either channel, and remarkable differences between Northern- and Southern Hemispheres. Those very stable *all sky* ratios, show how well-controlled our climate system ultimately works. And that implies, that we don't have to know much about what's going on inside this "black box" that we call "climate", to understand the effects of perturbations. This complex climate system reflected in for instance the Trenberth type diagrams, is fully governed by these two, spectrum-wise non-overlapping energy flows SW_{IN} and LW_{OUT}, and their values at TOA. These flows only "touch" each other at the Earth' surface where the first is being transferred into the latter and all the other energy flows are just "nice to know".

But what about these large climate feedbacks? Fortunately, being stuck in a problem, there is always one way out: "**back to basics**". And that climate-basics is pretty straightforward the relation between surface temperature T_S, incoming shortwave solar energy SW_{IN} and outgoing longwave IR radiation LW_{OUT}, given by the Earth' energy balance at the top of the atmosphere (TOA) via:

$$C\, dT_S/dt = SW_{IN} - LW_{OUT} = F_{TOA} \qquad (1)$$

In eq.1, C is the effective thermal capacity per surface area of the Earth' system and T a system-characteristic temperature. In practice, the surface temperature T_S will be regarded as the characteristic climate-temperature for obvious reasons. In equilibrium, $\partial T_S/\partial t = F_{TOA} = 0$.

I am not going to repeat all the steps that one can find in any climate science textbook, but simply state the most important formula derived from eq.1, starting with the general assumption that changes in radiative flux at TOA are proportional to surface temperature changes:

$$\Delta F_{TOA} = \lambda \Delta T_S \qquad (2)$$

a 1st order linear relation between the temperature change ΔT_S and changes in radiative flux ΔF_{TOA}. It is independent from any assumption about what's driving our climate. The inverse of the constant λ can be regarded as our basic climate sensitivity. By introducing small perturbations in eq.1, so called forcings ΔF we derive the well-known relation often used to determine the climate sensitivity:

$$-1/\lambda = \Delta T_S/\Delta F \qquad (3)$$

In which ΔT_S is the change in surface temperature T_S, and ΔF the "forcing" that induces an imbalance. The term λ, which should in principle be equal to the one in eq.2, is now called a "feedback", in view of the climate response to compensate that forcing, and is therefore by convention "negative". This eq.3 holds for a complete restoration of equilibrium and that is only at "infinity". For a dynamic analysis we often see this formula with a denominator (ΔF – ΔN) where ΔN represents the (rest) imbalance at TOA. For a time period of say 2-3x the thermal relaxation time of our planet, estimated at 3-5 years, one can assume ΔN to be small and eq.3 is sufficiently accurate. I used eq.3 in fig.1 in this way to calculate -1/λ as the value of the climate sensitivity to GHG-forcings.
The last important relation to be used is the expression for the Planck feedback parameter:

$$-\lambda_{PL} = 4\, SW_{IN}/T_S \qquad (4)$$

The shortwave solar radiation SW_{IN} as used in eq.1. is in literature often written as $(1 - \alpha)\Phi_0$ with the albedo α and the average solar intensity Φ_0 in space. The Planck feedback parameter λ_{PL} determines the way our climate reacts to disturbances in the system. It is the consequence of eq.2 for our present climate and independent from any assumptions other than that the Stefan-Boltzmann law determines the LW energy flow from the surface. <u>Consequently, $-1/\lambda_{PL}$ should also be *by definition* our climate sensitivity to disturbances like the effects of GHG's.</u>

But apparently, climate scientists have other ideas. I shall come back on this issue, but first we are going to apply eq.2 to analyze some CERES data, in particular the radiation measurements at TOA. We'll look at *all sky* data only.
In fig.2 the values for SW_{IN} and LW_{OUT} at TOA are plotted for the period 2000-2020. These are moving annual averages to suppress all short-term variations. Nevertheless, they are still rather "rocky", but their trends seem stable, and in average, going up. Their absolute values can be questioned for their accuracy, but I just need their much more reliable slopes. We rewrite eq.2 for the climate sensitivity as:

$$1/\lambda = (\partial T_S/\partial t)/(\partial F_{TOA}/\partial t) \qquad (5)$$

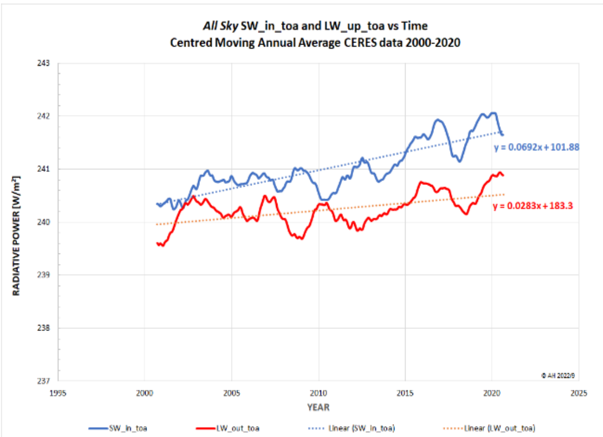

Fig. 2. The SW and LW radiation components at TOA from the CERES data (centered moving annual averages). The absolute values are probably "tuned" by NASA to fit OHC data [10].

One can now directly calculate the climate sensitivity that governed our climate during that period. With the slopes that the CERES data provide: $\partial/\partial t\ (SW_{IN}\text{-}LW_{OUT}) = 0.41\ W/m^2$/decade (fig.2), and from $\partial T_S/\partial t = 0.125$ K/decade, we calculate $1/\lambda = 0.30/K/W/m^2$. I could also have used the UAH LT trend of 0.13 K/decade, with $1/\lambda = 0.32/K/W/m^2$ but that wouldn't have changed the conclusion that $1/\lambda$ is remarkably close to this "basic" Planck value of $-1/\lambda_{PL} = 0.30\ K/W/m^2$ as derived from eq.4.

This cannot be a coincidence and clearly shows that the CERES data do not support the outcomes of GCM calculations: there are no large climate sensitivities, nor significant feedbacks. These CERES measurements confirm what basic climate science predicts (if not prescribes), that our climate is first and for all, controlled by the inverse of the Planck feedback parameter of about 0.3 K/W/m².

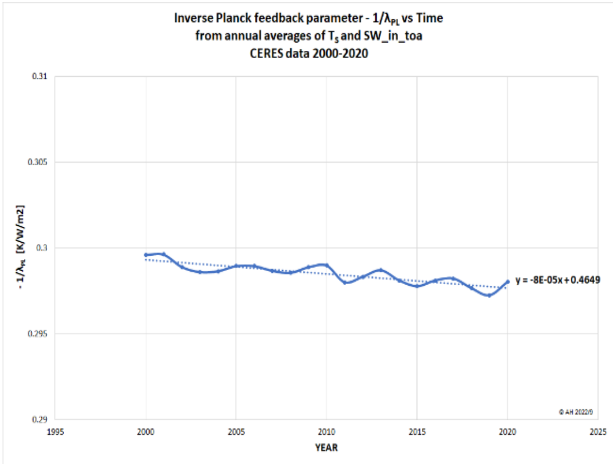

Fig. 3. Inverse Planck feedback as derived from the CERES data, by dividing the surface temperature by the incoming solar radiation. The declining slope contradicts the AGW-hypothesis.

We can also look at the "stability" of the Planck feedback parameter and see how that value evolves over time. In fig.3, $-1/\lambda_{PL}$ is plotted vs. time, as calculated through eq.4 from the values derived from the CERES data. To suppress noise, annual averages are used to calculate its value $(4SW_{IN}/T_S)^{-1}$ over the period 2000-2020. Fig.3 makes immediately clear the high stability of this climate sensitivity (mind the scale) with less than 0.2% change over 20 years. But moreover, it is declining and that is <u>contrary to what can be expected from an amplified warming effect of a high ECS with large feedbacks</u>. Since GHG's don't act on the SW-channel, the nominator of eq.4 should be constant while the denominator should increase. That implies:
$-1/\lambda_{PL}$ should increase with warming/time, if the AGW-hypothesis would be correct. It doesn't.
It simply shows that the SW_{IN} component is growing instead, as already clear from fig.2, and even faster than the surface temperature T_S, can follow.

I haven't put any model-assumptions in the above analysis, but just looked to the data. And those data don't show any signs of large climate sensitivities and/or large feedbacks.
How to justify this with that "*settled*" climate science? Let's first look to how and why climate feedbacks have been introduced. The derivation of eq.2-4 is based on a linear approximation so, 2nd order effects could be the reason to develop λ with extra terms as those temperature feedbacks. But then, these 2nd order feedbacks should be *by definition,* small.
In this case however, I assume those large feedbacks to be just a postulate to "make up" for the difference between observation/GCM calculation, and the result obtained by applying eq.3 with λ_{PL} as proportionality. Fig.1 shows, that the latter simply delivers by far not enough warming since 1980. For the calculated temperature anomalies from GCM's it's even worse. According to eq.3 we have apparently a large inequality, which cannot be from a 2nd order effect in our climate's reaction:

$$\Delta T_S = -\Delta F_{GHG}/\lambda_{AGW} \gg -\Delta F_{GHG}/\lambda_{PL} \qquad (6)$$

Here the subscript AGW is used to indicate that this reasoning is coupled to the AGW-hypothesis where all climate changes are due to increasing GHG's only. Now to get the "correct" warming associated with this "known" forcing, the generally accepted solution is to adapt the climate sensitivity by introducing the concept of extra climate feedbacks according to:

$\lambda_{AGW} = \lambda_{PL} + \lambda_1 + \lambda_2 + \lambda_3 + ... = \lambda_{PL} + \sum \lambda_i = \lambda_{PL} + \lambda_{FB}$ (7)

The Plank feedback parameter keeps playing its role, but it is obvious from eq.6 that the combined feedbacks λ_{FB} needs to be large and with an opposite sign to λ_{PL} to get $|\lambda_{AGW}| << |\lambda_{PL}|$. Mind, that these combined feedbacks display a "feedforward" character and thus, enhance warming effects from GHG-forcings to fit a higher-than-expected ΔT_S. The arguments that this is a good idea, are all very plausible. Take the so-called Water Vapor feedback λ_{WV}: increasing GHG's yield warming, which enhances water-evaporation. Warmer air can contain more water vapor. Being a strong greenhouse gas itself, more water vapor yields a higher temperature. Or take the Albedo feedback λ_{AL}: higher temperatures melt the polar caps, thus decreasing the overall reflection. Less reflection implies more solar energy absorption by the Earth and so, it warms. These are all scientifically "sound" arguments.

But at what temperature will that feedforward mechanism finally stop? Moreover, we certainly had climate changes in the past with warming effects similar to those that GHG's induce today. So, these feedbacks should already be "part and parcel" of the Planck feedback. What makes GHG-forcings then so special? The analysis of λ_{PL} and the climate sensitivity derived from the CERES radiation imbalance data, are giving a clear answer: ***nothing special*! The real issue is: climate sensitivity is a (near) fixed parameter, and not a freely adaptable one depending on to the kind of forcing at hand. Large feedbacks are just due to the misconception that GHG's are "*the only show in town*".**

The inequality in eq.6 can also be restored by changing ΔF while keeping $\lambda_{AGW} = \lambda_{PL}$. Just accept another forcing ΔF_{SW} next to the GHG-forcing ΔF_{GHG}, as I did intuitively in analyzing cloud-effects [3]:

$\Delta T_S = -(\Delta F_{GHG} + \Delta F_{SW})/\lambda_{PL}$ (8)

The subscript SW indicates a forcing that primarily acts on the SW_{IN}-channel in eq.1. That is not by speculation, but the only option to explain the positive change in SW_{IN} as well as LW_{OUT}, as in fig.2. <u>The AGW-hypothesis can simply never explain an increasing LW_{OUT} by growing GHG-forcings only</u>! *The reasoning behind that statement is simple: although ΔF_{SW} and ΔF_{GHG} are both forcings that increase the surface temperature, they display rather different "fingerprints" at TOA. A GHG-forcing ΔF_{GHG} will lower LW_{OUT} and the climate reaction to increase T_S is fed by a constant SW_{IN}. That increase in T_S will eventually restore the lowered LW_{OUT} to its <u>old</u> value (see also fig.4). In case of a shortwave forcing ΔF_{SW}, ΔT_S comes directly from this additional SW_{IN} and thus, <u>will increase</u> LW_{OUT} <u>permanently</u>. In a dynamic situation with an increasing forcing, a GHG-forcing with e.g., $\partial F_{GHG}/\partial t$ = constant, will yield $\partial LW_{OUT}/\partial t \approx \partial SW_{IN}/\partial t = 0$. But a $\partial F_{SW}/\partial t$ = constant i.e., $\partial SW_{IN}/\partial t > 0$, will yield $\partial LW_{OUT}/\partial t > 0$. Both positive slopes in the SW-case are the "fingerprint" at TOA as presently observed (see fig.2).*

Adherents to the AGW-hypothesis will immediately claim that large feedbacks affecting the SW_{IN} component such as Albedo- and Cloud feedback will produce a similar pattern to that $\Delta F_{SW} > 0$ case. True, but just *in principle* as there are a number of arguments against that claim. First of all, the strongest feedback *i.e.*, from Water Vapor acts on the LW-channel suppressing LW_{OUT} even further. Secondly, Albedo- and Cloud feedback deliver together not much more than 1 $W/m^2/K$ [13], which can never explain the 1.38 W/m^2 increase in the SW_{IN} as measured by CERES. It would require an accompanying temperature increase of 1 – 1.5 °C between 2000 and 2020, which is far beyond any observation. However, most importantly, it would only be possible when the slopes of the two trends are much closer, in line with a much larger climate sensitivity. The analysis applying eq.5 on the CERES data in fig.2 has shown already that $(\partial SW_{IN}/\partial t - \partial LW_{OUT}/\partial t)$ is determined by the Planck feedback only. Other feedbacks just don't play much of a role in fig.2.

There are several options for such SW_{IN}-forcings. Clouds, and in particular the low hanging clouds, are for me option #1 as they influence both SW- and LW channels, be it quite differently. From the Cloud

Radiative Effect (CRE) out of CERES data, we know that the net-effect favors a ΔF_{SW} contribution in eq.8, as also concluded in my earlier work [1][3]. Since clouds do act on SW_{IN} in a different way than on LW_{OUT}, we don't even need a change in average cloudiness. *A re-distribution over the various latitudes is sufficient as ($SW_{IN} - LW_{OUT}$) varies from highly positive to highly negative, going from the equator to the poles* [12]. Changes in the stratospheric Ozone, and/or in UV-radiation related changes due to the cyclic behavior of the Sun, provide possibilities for solar-related forcings as well. But other explanations are certainly not to be excluded.

Eq.8 also clarifies a major characteristic of the AGW-hypothesis, namely $\Delta F_{SW} = 0$. Given the options for ΔF_{SW}, one could also state that the AGW-hypothesis "denies" natural causes for global warming. This is exactly IPCC's position [9] and implicitly, also applied in GCM calculations.

The difference between these two options, either introduce extra feedbacks (the AGW-hypothesis), or accept other forcings (this work), can be easily demonstrated. Consider a climate with the option for a step-wise change at t = 0 in the GHG forcing ΔF_{GHG} by +/- ΔR, and for a forcing in the SW channel ΔF_{SW} (ΔSW in fig.4) variable in the same way: +/- ΔR. In fig.4 the evolution over time of the components that govern these two different views on their warming effect, is graphically displayed

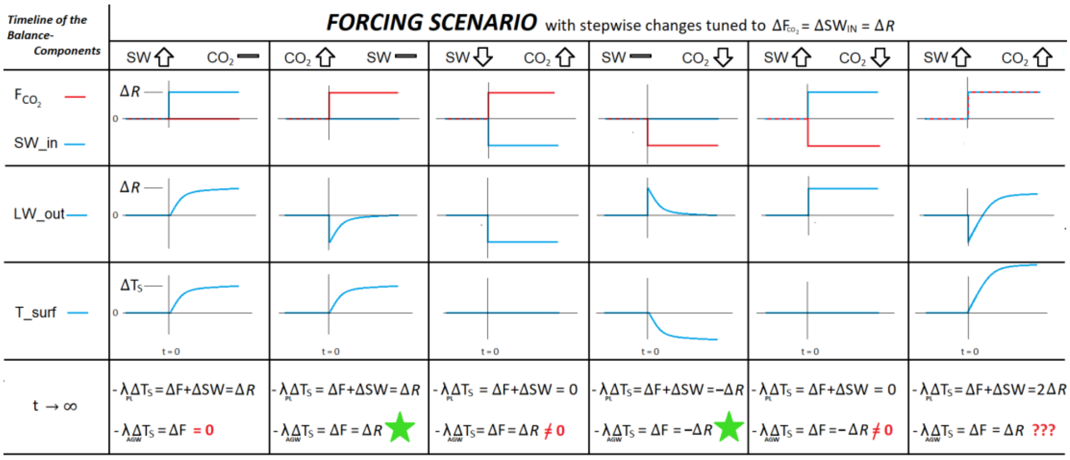

Fig.4 Six different forcing scenarios as vertical columns with combinations of stepwise changes (or none) at t = 0. Responses in ΔF and ΔSW_{IN}, are depicted in the first row, the response in LW_{OUT} in the second, and the surface temperature response ΔT_S is shown in the third row. In the 4th row the final state ($t \rightarrow \infty$) of eq. 8 (upper line) and eq.6 (lower line) are calculated. For the answers of eq.6 to these scenario's red and green markings are used as traffic-light colors for a quick visual judgement on the validity of the expression in representing the end-climate-state (see text).

for the 6 most obvious combinations. The final changes in $\lambda\Delta T_S$ from these two views, are also given and compared to the expected value in that particular scenario.
Scenario #6 shows what happens today in reality: a rising temperature combined with a rising LW but also a rising SW. Scenario #2 reflects todays IPCC-view. Interesting are scenario #3 and #5 with an identical "zero net-warming" response. What to recommend here? Stop emitting CO_2 in case of #3? For these scenarios with canceling forces for which no warming occurs, eq. 6 produces large, non-zero results. As expected, eq.6 yields no warming from a solar forcing only. The scenarios with GHG-forcings only, are of course correctly represented by eq.6. All others are simply wrong.
As eq. 8 "delivers" in all scenarios as expected, it simply shows its validity and correctness. And thus: <u>the generally in climate science applied eq.6, is based on the wrong assumption of $\Delta F_{SW} = 0$.</u>
No wonder, that the IPCC still keeps this wide range of ECS values. It just depends on the time and circumstances *i.e.,* the value of ΔF_{SW}, what ECS value eq.6 yields; just look to the facts in fig.1.

It is interesting now to calculate the ratio of the derived climate sensitivities out of both views, by eliminating ΔT_S in combining eq.6 and eq.8 (with AGW and PL as the usual subscripts also for ECS):

$$\mathbf{ECS_{AGW}/ECS_{PL} = \lambda_{PL}/\lambda_{AGW} = (\Delta F_{GHG} + \Delta F_{SW})/(\Delta F_{GHG}) = 1 + \Delta F_{SW}/\Delta F_{GHG}} \quad (8)$$

For the period 2000-2020 we find from the CERES data (fig.2) $\Delta F_{SW} = \Delta SW_{IN} = 1.38$ W/m^2. From the CMIP6 forcings [6] we derive $\Delta F_{GHG} = 0.64$ W/m^2, making the ratio $\Delta F_{SW}/\Delta F_{GHG} = 2.2$.
The climate sensitivity that the IPCC is promoting is thus 3.2x the "real" sensitivity of our climate system i.e., the inverse of the Planck feedback parameter!
This factor of 3 or more sounds pretty familiar, doesn't it? To legitimize it, the concept of climate feedbacks to bridge that gap between fake and reality had to be introduced. They look like scientifically "sound" effects but are not based on falsifiable physics. They are constructs with only one purpose: to compensate for the denial of natural effects that can cause global warming.

From the ratio between ΔF_{SW} and ΔF_{GHG}, it is also clear that the Sun is responsible for about 2/3 of the observed warming since 2000, or even earlier. Whereas GHG's might be responsible for the rest. Indeed "might be", as I have just taken ΔF_{GHG} from an estimated/modelled forcing by NASA [6]. In "Outside the Black Box" on WUWT, I strongly questioned these data as being too high [4]. Nevertheless, this 2:1 ratio supports the assessment of the effect of brightening in The Netherlands [1] as well as my feedback analysis [3]. Globally, increasing SW_{IN} (fig.2), must have created most of the observed warming. The growth in the atmospheric concentration of CO_2 can only have played a minor role, as the rising LW_{OUT} radiation in fig.2 confirms this much larger SW-channel effect.

Anyhow, the final question remains: "*what about those wrong outcomes of GCM calculations?"*
Personally, I do believe that most scientists behind climate models do, and have always done, their utmost to simulate Earth' climate to the best of their knowledge. However, making them extremely detailed with complex surfaces, coupled oceans, melting ice-caps or whatever interactions "inside the box", will most probably not make a big difference in calculated climate sensitivities.
On the other hand, these high sensitivities, nor these accompanying large feedbacks are explicitly entered into GCM's algorithms; they are just the result of analyzing their outputs. So, we have to look for the point in the process where the AGW-assumption of "no natural forcings" *i.e.,* $\Delta SW_{IN} = 0$, has its impact and thus, "sneaks" into these GCM-simulations. To my understanding, that can only happen during the tuning process to generate a climate that runs over a long period with a constant behavior. Once such stability is created, that AGW-characteristic of $\Delta F_{SW} = 0$, is an integral part of this particular climate as internal dependencies are tuned to it. Then, adding extra GHG's to that tuned atmosphere to calculate its climate reactions, could very well deliver these exaggerated warmings. But such a stable and constant climate has never existed. History has shown strong natural fluctuations over and over again. Even during my own, human time scale, the unexplained Global Cooling of the 1950-1975 period has shown that nothing is constant in our climate. GCM-algorithms based on proper physics are probably not bad at all, except may be for the modelling of clouds. Their initial conditions to run them however, might be fundamentally wrong and distorting their output.

I cannot come up with any other explanation, and if valid, this can easily be solved by tuning to *e.g.,* these CERES data or other "known" climate (re-analysis) data from the recent past.
However, the real problem created with this analysis is, that forecasting with GCM's has become a useless and meaningless exercise as long as we cannot reliably forecast natural changes in SW_{IN}.
For the anthropogenic part it's pretty clear: with a growth to a maximum CO_2-level of 560 ppm, even under a realistic 'business as usual' scenario [11], there is certainly no more than about 0.4^{o}C to go.

Ad Huijser, October 2022

Added after completion: In a series of posts https://wattsupwiththat.com/2022/10/21/scatterplot-sensitivity/ , Willis Eschenbach recently published a number of scatterplots from 1x1 degree gridded CERES data. From these data, average climate sensitivities are calculated for solar radiation of $1/\lambda_{SW}$ = 0.16 K/W/m^2, and for the greenhouse effect $1/\lambda_{GHG}$ = 0.58 K/W/m^2, respectively (negative feedback signs are left out for simplicity). These values are derived by assigning surface temperatures to either pure solar ($\Delta F_{GHG} = 0$), or the pure GHG cause ($\Delta F_{SW} = 0$). By taking however, the relative contribution of the forcings by solar ΔF_{SW} and GHG's ΔF_{GHG} with a ratio of 2.2 as derived from eq.8 in this work into account, the average climate sensitivity for all forcings can be calculated as:

$$1/\lambda = (2.2 \times 1/\lambda_{SW} + 1 \times 1/\lambda_{GHG})/3.2 = 0.29 \text{ K/W/m}^2,$$

close enough to the 0.3 K/W/m^2 of the inverse Planck feedback parameter, to conclude that also in Eschenbach's analyses this Planck feedback parameter is the climate-change determining factor.

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