Greenhouse Gases without Greenhouse Effect

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1 A Model of Atmospheric Greenhouse Effect

The Earth is supposed to be habitable because of an "atmospheric greenhouse effect" keeping the Earth surface temperature at cosy 15 C instead of a projected freezing -33 C without such an effect, commonly described as:

- *Trapping by greenhouse gases in the atmosphere of radiation from the Earth surface* [6].
- *Caused by an atmosphere containing gases that absorb and emit infrared radiation* [7].
- *To balance the absorbed incoming solar energy, the Earth must, on average, radiate the same amount of energy back to space. Because the Earth is much colder than the Sun, it radiates at much longer wavelengths, primarily in the infrared part of the spectrum. Much of this thermal radiation emitted by the land and ocean is absorbed by the atmosphere, including clouds, and reradiated back to Earth* [2].

We recall that a conventional greenhouse gets heated inside by letting incoming solar radiation pass through windows which block cooling convective heat exchange with the outside air. The fact that the windows absorb some outgoing infrared radiation plays a minor role: Fully transparent windows work fine, by blocking convection.

The so-called "greenhouse gases" in the atmosphere (mainly water vapour and to some extent CO_2) are supposed to heat the Earth surface, not by blocking convection, but by a "different process" [2] in vague terms described above in terms of absorption followed by reradiation [9, 1, 8].

The basic mathematical model for this atmospheric greenhouse effect presented in the literature, has the following form: Assume that the fraction f of the infrared radiation E_e emitted by the Earth surface is absorbed by an atmosphere layer, of which $\frac{f}{2}E_e$ is re-emitted back to the Earth surface, and $\frac{f}{2}E_e$ to outer space together with the

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$(1-f)E_e$ from the Earth passing through the layer, altogether $(1-\frac{f}{2})E_e$, which is to balance the incoming radiation E_0 from the Sun:

$$E_0 = (1-\frac{f}{2})E_e = \lambda E_e \tag{1}$$

with $\lambda = 1-\frac{f}{2}$. This elementary balance law is next connected to temperatures by Stefan-Boltzmann's Black Body Radiation Law:

$$E_e = cT_e^4, \quad E_0 = cT_0^4, \tag{2}$$

where c is a constant, T_e is the Earth surface temperature in Kelvin K, and T_0 is a fictitious estimated black body temperature of an Earth without atmosphere. There are two main candidates for T_0 connected to different effective black body Sun surface temperatures T_s: $T_0 = 255$ K with $T_s = 6000$ K and $T_0 = 273$ K with $T_s = 5778$ K, with the latter value seemingly closer to reality. Combining the formulas we get

$$T_e = \lambda^{-\frac{1}{4}}T_0 \quad \text{or } f = 2(1-\frac{T_0^4}{T_E^4}). \tag{3}$$

An observed $T_e = 288$ K combined with $T_0 = 255$ K corresponds to $f = 0.68$, while $T_0 = 273$ K gives $f = 0.38$.

2 Climate Sensitivity

Climate sensitivity measures the change dT_e of Earth surface temperature T_e under a change dE_0 of radiative forcing E_0. Differentiating $E_e = cT_e^4$, we have $dE_e = 4cT_e^3dT_e$, which can be written

$$dE_0 = \lambda dE_e = 4\lambda cT_e^3dT_e = 4\lambda\frac{E_e}{T_e}dT_e, \tag{4}$$

using that $E_e = cT_e^4$. Inserting now the observed values $E_e \approx 288$ ($Watts/m^2$) and $T_e = 288$ K, we get

$$dE_0 = 4\lambda dT_e, \tag{5}$$

and thus

$$dE_0 = 2.64dT_e \quad \text{with } f = 0.68 \quad \text{and } dE_0 = 3.24dT \quad \text{with } f = 0.38. \tag{6}$$

The *climate sensitivity* of the above model measured as $\frac{dT_e}{dE_0}$ thus lies in the range $0.25-0.4$. A radiative forcing $dE_0 = 2-4$ can be estimated to give a global warming $dT_e = 0.8-1.5$ or $dT \approx 1$ C, commonly presented as a basic value.

3 IPCC Prediction

IPCC predicts a global warming effect of $1.5-4.5$ C from doubling of CO_2 in the atmosphere, as a result of feed back starting with the basic value $dT \approx 1$ C and $dE_0 \approx 4\ Watts/m^2$ as estimated radiative forcing from doubled CO_2.

4 Another Climate Model

We now consider a different equally simplistic climate model based on Fourier's Law connecting heat flow to temperature gradient, in the form

$$E_0 = \kappa(T_e - T_a) \tag{7}$$

where T_a is an atmosphere temperature and κ a heat conduction coefficient. This is a linear model with $dE_0 = \kappa dT_e$, assuming T_a constant. Inserting $E_0 \approx 288$, $T_e = 288$ and $T_a = 255$ gives $\frac{1}{\kappa} = 0.11$ and thus $dT_e = 0.2 - 0.4$ for $dE_0 = 2 - 4$. Using instead $T_0 = 273$ we get $dT_e = 0.1 - 0.2$, which is a factor $5 - 10$ smaller than the basic value of IPCC of $dT_e \approx 1$.

5 Conclusion

We have considered two basic simplistic models for global climate, one model with radiation only based on Stefan-Boltzmann's Radiation Law used by IPCC to determine a basic value of climate sensitivity or global warming of 1 C upon doubling of CO_2, and another model with conduction only based on Fourier's Law with a climate sensitivity a facor $5 - 10$ smaller.

Neither model includes heat transport from convection-evaporation/condensation of crucial importance in the real atmopshere, and thus neither model can be used to draw any conclusion about climate sensitivity. Or turned the other way around: If Stefan-Boltzmann radiation is viewed as a valid model as IPCC does, then Fourier conduction can equally well be viewed as a valid model, with a factor 10 smaller climate sensitivity. One can also easily argue that the Fourier model should be closer to reality.

The alarmism of IPCC is based on an estimated global warming of 1 C derived from a simplistic radiation model which does not describe relevant physics, and thus lacks scientific rationale.

In the expressed support of IPCC by the Royal Swedish Academy of Sciences [5], this situation is described in the cryptic "The effect of greenhouse gases is well established".

References

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