

Disagreement between the Warming of the Surface by the Downwelling Radiation Hypothesis and the Theory of the Electromagnetic Radiation Pressure.

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Abstract:

This article is related to my previous article *Induced Emission and Heat Stored by Air, Water and Dry Clay Soil* (17). This new assessment demonstrates that the idea of a downwelling radiation from the atmosphere which warms up the surface is not viable in the real world.

Through simple calculations of the Electromagnetic Radiation Pressure (P_{emr}) (4) exerted by the three systems implied in the thermal energy transfer, i.e. the Sun, the Earth's atmosphere and the Earth's surface, I demonstrate that the down-welling radiation hypothesis divulged by the proponents of the anthropogenic global warming (2) and the energy budget proposed by Kiehl and Trenberth (1) are incompatible with the laws of thermodynamics.

Introduction:

The Electromagnetic Radiation Pressure (P_{emr}) is defined as the force per unit area exerted by a photon stream produced by a thermodynamic system (designated the source) upon the surface of another system (designated the target). (5)

For the thermodynamic system comprised by the Sun and the Earth, the main sources of photons are the solar photon stream, originated in the Sun's surface, and the surface photon stream, originated in the Earth's surface.

The thermodynamic system Earth is formed by other subsystems, specifically, cryosphere, hydrosphere, lithosphere and biosphere. (6) The four thermodynamic subsystems have an effect on and are affected by the Earth's climate. The bulk part of the energy involved in Earth's climate system is provided by the Sun. (6) (7)

In the last years, the proponents of the anthropogenic global warming have struggled against the second law of thermodynamics because it contradicts the main argument of their hypothesis, which argues that the energy emitted by the atmosphere heats up the surface. (1) (2) (8) (9) (10)

However, this idea of a downwelling radiation that heats up the surface enters in obvious conflict with the Astrophysics, thermodynamics and quantum mechanics. The conflict is so serious that many attempts of nullifying the second law of thermodynamics have been perpetrated by the anthropogenic global warming proponents (11).

Other authors have gone out from the scientific standards by confusing the real concept of the second law of thermodynamics. Those authors declare that the second law of thermodynamics does not settle on that hot systems cannot be warmed up by colder systems, i.e. they claim, through odd syllogisms without experimental or observational support, that a thermodynamic system in a high energy density state can increase its internal energy by means of absorbing energy emitted by another system in a low energy density state (12). Obviously, those are ambiguous and pseudoscientific arguments.

Is on the last observation that I decided to resort to thermodynamics, heat transfer physics and quantum mechanics for demonstrating the falseness of the idea that the downwelling radiation emitted by the atmosphere heats up the surface of the Earth.

The macroscopic directionality of the flow of the energy is easily observed everywhere in daily life. For example, if we have a metallic rod with one of its ends applied over a heat source, after some time, the end of the rod which is far from the source of heat -the colder extreme- will be warmed up.

We found another subtler example, but more useful than the previous example given the objective of this article, when we blow up a balloon with smoke, the smoke will exert an internal pressure on the walls of the balloon causing that the internal pressure of the balloon is greater than the pressure of the air upon the balloon walls. When we pierce the globe, the smoke escapes by the orifice and disperses in the atmosphere until disappearing from sight. This means that the pressure is also exerted following the universal directionality from denser states to less dense states. (3)

In 1871, James Clerk Maxwell discovered theoretically the statistical probability of the existence of the Electromagnetic Radiation Pressure (P_{emr}) (13). In 1901, Pyotr Nikolayevich Lebedev confirmed the irrefutable existence of the P_{emr} (14), and in 1901, E. F. Nichols and G. F. Hull (15) verified Maxwell's theory and Lebedev's experimental results.

The P_{em} is exerted by all streams of energy radiated by any thermodynamic system and you can measure it everywhere in the universe, with the appropriate instruments, e.g. Torsion Balance. (18)

1. Determination of the P_{emr} exerted by the solar photon stream on the Earth's surface:

<<Addendum on 20 July 2010--- The formula to determine the Electromagnetic Radiation Pressure (P_{emr}) of a photon stream is as follows:

$$P_{emr} = S/c \quad (\text{Ref. 4 and 5})$$

Where P_{emr} is Electromagnetic Radiation Pressure, S is for the intensity of the radiation emitted by the energy source expressed in (N * m/s) /m², and c is the speed of light expressed in m/s.>> (End of addendum).

The P_{emr} of the solar photon stream upon Earth's surface (target) is:

$$P_{emr\ Sun} = \Phi E_{Sun} / c \quad (\text{Ref. 4, 5, 15, 16, 18})$$

Where ΦE_{Sun} is the flux of the solar energy radiation per square meter and c is 2.99909301×10^8 (m/s).

The solar power received by the Earth at the upper atmosphere is 1365.5 ((N * m/s) /m²). The total power reflected by the upper atmosphere, the clouds and the surface of the Earth is approximately 31%. Thus, the total incident solar power on the surface of the Earth is:

$$P_{emr\ Sun} = 1365.5 \text{ ((N * m/s) /m}^2) * (1 - 0.31) = 942.195 \text{ ((N * m/s) /m}^2).$$

Therefore, the P_{emr} by the incident solar radiation upon the Earth's surface is:

$$P_{emr\ Sun} = 942.195 \text{ ((N * m/s) /m}^2) / 2.99792458 \times 10^8 \text{ (m/s)} = 3.1453 \times 10^{-6} \text{ N/m}^2 \text{ (4)}$$

$$\text{Also, } 3.1453 \times 10^{-6} \text{ N/m}^2 = \mathbf{3.1453 \mu Pa}$$

$$\text{And } \mathbf{3.1453 \mu Pa = 3.1017 \times 10^{-11} atm}$$

Consequently, the P_{emr} of solar radiation is 3.1017×10^{-11} atm.

2. Determination of the P_{emr} exerted by the photon stream from an atmospheric mixture of absorbent gases (AG), including carbon dioxide but excluding water vapor, upon any target:

Considering the mixture of atmospheric absorbent gases (G_a) alone -including carbon dioxide but excluding water vapor in the whole mixture of gases in the atmosphere, the P_{em} exerted by the photon stream originated by G_a is:

$$\Phi E_{G_a} = 32 \text{ ((N * m/s) /m}^2)$$

$$P_{emr\ Ga} = 32 \text{ ((N * m/s) /m}^2) / 2.99792458 \times 10^8 \text{ (m/s)} = 1.07 \times 10^{-7} \text{ N/m}^2 = \mathbf{0.107 \mu Pa}$$

$$P_{emr\ Ga} = 0.107 \mu Pa = \mathbf{1.05601 \times 10^{-12} atm}$$

Therefore, the P_{emr} exerted by the solar photon stream is 29.37 times higher than the P_{emr} exerted by the atmospheric mixture of absorbent gases, including the carbon dioxide and excluding the water vapor, photon stream.

3. Determination of the P_{emr} exerted by the atmospheric photon stream, including 5% of water vapor, upon any target:

$$\Phi E_{atm} = 146.35 \text{ ((N * m/s) /m}^2)$$

$$P_{emr\ atm} = 146.35 \text{ ((N * m/s) /m}^2) / 2.99792458 \times 10^8 \text{ (m/s)} = 4.88 \times 10^{-7} \text{ N/m}^2 = \\ = \mathbf{0.488 \mu Pa} \text{ (ref. 4)}$$

$$P_{emr\ atm} = \mathbf{0.488 \mu Pa} = \mathbf{4.82 \times 10^{-12} atm}$$

Therefore, the P_{emr} exerted by the solar photon stream is 6 times higher than the P_{emr} exerted by the whole atmosphere.

4. Determination of the P_{emr} exerted by atmospheric carbon dioxide photon stream, upon any target:

$$\Phi E_{atm} = 10.2 \text{ ((N * m/s) /m}^2)$$

$$P_{emr\ CO_2} = 10.2 \text{ ((N * m/s) /m}^2) / 2.99792458 \times 10^8 \text{ (m/s)} = 3.4 \times 10^{-8} \text{ N/m}^2 = 0.034 \mu Pa \\ (4)$$

$$P_{emr\ CO_2} = 0.034 \mu Pa = 3.3554 \times 10^{-13} atm$$

Consequently, the contribution of carbon dioxide to the P_{emr} exerted by the whole atmosphere upon any target is barely 7%. The P_{emr} created by the whole atmosphere, excluding the fraction exerted by the carbon dioxide, is more than 14 times higher than the P_{emr} exerted by the carbon dioxide alone.

5. Determination of the P_{emr} exerted by the surface photon stream upon any target:

$$\Phi E_{surface} = 315.383 ((N * m/s) / m^2)$$

The total power exerted by the surface towards the atmosphere is as follows:

$$\begin{aligned} P_{tot\ surface} &= P_{emitted} + P_{reflected} = 277.64 ((N * m/s) / m^2) + 37.743 ((N * m/s) / m^2) = \\ &= 315.383 ((N * m/s) / m^2). \end{aligned}$$

Therefore, the photon stream radiation pressure from the surface to the atmosphere is:

$$\begin{aligned} P_{emr\ surface} &= 315.383 ((N * m/s) / m^2) / 2.99792458 \times 10^8 (m/s) = 1.052 \times 10^{-6} N/m^2 = \\ &= 1.052 \mu Pa. \end{aligned}$$

$$P_{emr\ surface} = 1.052 \mu Pa = 1.038 \times 10^{-11} atm$$

Therefore, the P_{emr} exerted by the surface photon stream is ~2 times higher than the P_{emr} exerted by the whole atmosphere; on the other hand, the P_{emr} of the solar photon stream is ~3 times higher than the P_{emr} exerted by the surface photon stream. The P_{emr} exerted by the surface on any target is 31 times higher than the P_{emr} exerted by carbon dioxide alone.

Alternatively, the surface exerts a P_{emr} 27 times higher than the P_{emr} exerted by the atmospheric mixture of absorbent gases, including carbon dioxide and excluding water vapor.

Finally, the P_{emr} exerted by the solar photon stream upon any target is 31 times higher than the P_{emr} exerted by the carbon dioxide alone upon any target.

Analysis:

The photons of the solar photon stream always flow towards the surface, because the surface has a lower P_{emr} than the solar photon stream.

Conversely, the photons of the surface photon stream always flow towards the atmosphere, which has a lower P_{emr} than the surface photon stream (the absolute pressure exerted by the atmospheric carbon dioxide photon stream is 3.3554×10^{-13} atm).

If one understand the diagram on the Earth's energy budget by Kiehl and Trenberth (1) exactly as it is said, the pressure exerted by both the surface's and the atmosphere's photon streams would be equal, so the P_{emr} will be in thermodynamic equilibrium and there would not be any interchange of photons between both systems. As a result, the temperature of the surface would be the temperature of air and vice versa.

Although the magnitude of the natural P_{emr} is small, it expounds, unquestionably, why the warming of the surface by the downwelling radiation emitted by the atmosphere is physically impossible.

Once again, correct physics contradicts allegations of proponents of an anthropogenic global warming due to the downwelling radiation emitted by "greenhouse" gases and also demystifies the allegations that the second law of thermodynamics is imaginary.

BIBLIOGRAPHY AND REFERENCES:

1. Kiehl, J. T. and Trenberth, Kevin E. *Earth's Annual Global Mean Energy Budget*. Bulletin of the American Meteorological Society. Vol. 78; No. 2; February 1997. Pp. 197-208
2. Pavlakis, K. G., Hatzidimitriou, D., C. Matsoukas, Drakakis, E., Hatzianastassiou, N., Vardavas, I. *Ten-year Global Distribution of Downwelling Longwave Radiation*. Atmos. Chem. Phys. Discuss., 3, pp. 5099–5137, 2003.
www.atmos-chem-phys.org/acpd/3/5099/ (Last reading on July 8, 2010).
3. Nelson, B., Rayne, E., Bembenek, S. *The Second Law of Thermodynamics*. <http://www.physlink.com/Education/AskExperts/ae261.cfm?CFID=8941463&CFTOKEN=77570068>
4. Lang, Kenneth. 2006. *Astrophysical Formulae*. Springer-Verlag Berlin Heidelberg. Vol. 1. Sections 1.11 and 1.12.
5. Maoz, Dan. *Astrophysics in a Nutshell*. 2007. Princeton University Press, Princeton, NJ. Pp. 36-41
6. Peixoto, José P., Oort, Abraham H. 1992. *Physics of Climate*. Springer-Verlag New York Inc. New York.
7. Odum, Eugene P. and Barrel, Gary W. *Fundamentos de Ecología-Quinta Edición*. 2006. International Thompson Editores, S. A. de C. V. México, Distrito Federal.
8. NASA-EOS. *Clouds and Radiation*. <http://earthobservatory.nasa.gov/Features/Clouds/> Last reading on July 8, 2010.
9. *The Earth's radiation budget and the Greenhouse Effect*. <http://www.atmosphere.mpg.de/enid/252.html> Last reading on July 8, 2010.
10. *The greenhouse Effect*. http://en.wikipedia.org/wiki/Greenhouse_effect Last reading on July 8, 2010.
11. *The Imaginary Second Law of Thermodynamics*. Last reading on July 8, 2010.

12. [The Greenhouse Effect and the Second Law of Thermodynamics](#). Last reading on July 8, 2010.
13. *James Clerk Maxwell-Biography*. <http://www.phy.hr/~dpaar/fizicari/xmaxwell.html>. Last reading on July 8, 2010.
14. *Pyotr Nikolayevich Lebedev-Biography*. <http://www.britannica.com/EBchecked/topic/334217/Pyotr-Nikolayevich-Lebedev>. Last reading on July 8, 2010.
15. E. F. Nichols and G. F. Hull. *A Preliminary Communication on the Pressure of Heat and Light Radiation*. 190. Phys. Rev. No. 13, Pp. 307–320. http://prola.aps.org/abstract/PRI/v13/i5/p307_1. Last reading on July 8, 2010.
16. Serway, R. A. *Physics-3rd Revised Edition*. 1993. McGraw-Hill/Interamericana Editores, S. A. de C. V. México, D. F. Pp. 136-137.
17. Nahle, N. *Didactic Article: Induced Emission and Heat Stored*. 21 May 2009. Biology Cabinet Organization. http://www.biocab.org/Induced_Emission.html
18. *Radiation Pressure*. <http://scienceworld.wolfram.com/physics/RadiationPressure.html>. Last visited on 7 July 2010.