LETTERS TO PROGRESS IN PHYSICS

Global Warming and the Microwave Background

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In the work, the importance of assigning the microwave background to the Earth is addressed while emphasizing the consequences for global climate change. Climate models can only produce meaningful forecasts when they consider the real magnitude of all radiative processes. The oceans and continents both contribute to terrestrial emissions. However, the extent of oceanic radiation, particularly in the microwave region, raises concerns. This is not only since the globe is covered with water, but because the oceans themselves are likely to be weaker emitters than currently believed. Should the microwave background truly be generated by the oceans of the Earth, our planet would be a much less efficient emitter of radiation in this region of the electromagnetic spectrum. Furthermore, the oceans would appear unable to increase their emissions in the microwave in response to temperature elevation, as predicted by Stefan's law. The results are significant relative to the modeling of global warming.

While controversy exits as to whether or not mankind has been an agent of global climate change, there is little dispute in the scientific community that the Earth is indeed warming [1–4]. Global warming may substantially alter the agricultural capacity and water cycles of our planet with dramatic human ramifications. With this in mind, if global warming is to be both understood and forecasted, climate modeling [5, 6] must be based on proper physical foundations. Through this letter, I wish to highlight that the modeling of the Earth's energy balance [5, 6] requires re-evaluation first of Kirchhoff's law of thermal emission [7–11] and its associated consequences for the application of Stefan's law [12], and second of the assignment of the microwave background [13, 14] to the oceans of the Earth [15, 16].

Regarding Kirchhoff's law [7], it is difficult to conceive that a central pillar of physics could be the subject of concern, both in its experimental formulation [8, 11] and in its theoretical proof [9, 10]. For those who have followed the arguments these past few years [8–11], it seems that a reconsideration of universality in blackbody radiation is in order. In short, there is no universality [9, 10] and each physical system must be treated with individualized care. The generalized application of Stefan's 4th power law [12] is unjustified in the analysis of global warming.

Relative to the microwave background, the reassignment is both unexpected and profound. Ever since its discovery [13] and assignment to the universe in 1965 [14], the microwave background has been considered a cornerstone of modern astrophysics. As such, the attributing of this background to the Earth brings consequences for physics [17]. Nonetheless, the global warming issue is of sufficient importance that its proper modeling [5, 6] should not be delayed by the continued misassignment of the true origin of the microwave background.

At the same time, it remains true that these are complex problems [1–21]. Kirchhoff's law of thermal emission has been in existence for nearly 150 years [7]. To question a fundamental law after many years [8–11] seems contrary to scientific logic, as scientists cannot be expected to verify the tenets of physics before any new advancement can be pursued. In this regard, the incorrect assignment of the microwave background to the universe [14] can be understood, although the accurate determination of temperatures from thermal emission spectra has always required thermal equilibrium with an enclosure [7–11]. This is something which could never be met in a cosmological origin for the microwave background, as I previously stated [18]. In the end, each signal requires a realistic physical origin [8, 9]. For the microwave background, the responsible physical entity will be the weak hydrogen bond between water molecules [15, 17].

With respect to the energy balance of the Earth [5, 6], its elucidation requires the determination of the relationship between absorbed (solar) and emitted (earthly) radiation. Usually, one is concerned with radiation in the infrared. However, substantial contributions can be made in the radio and microwave bands. While these energies are lower, their aggregate sums are non-negligible. Thus, in order to model climate change, the radiation balance of the Earth must be determined as a function of all frequencies from radio through the infrared.

In some climate models [5, 6], the radiation which the Earth emits is deduced by applying Stefan's law [12], at a given effective temperature, thereby treating the globe as a uniform blackbody source. In such an approach, oceanic contributions are undifferentiated from continental radiation. Yet, the thermal emission profiles of solid materials are dramatically different from one another [20]. Few solids, if any, adhere to Stefan's law. Even various forms of graphite [20] differ in their ability to emit radiation as a function of the 4th power of the temperature [12]. Stefan's law simply does not apply to most materials [20] and certainly will not apply to land masses which are covered with extensive vegetation. The thermal emission from liquids, especially water, is even more complicated and much less understood. While Stefan's law might appear to hold over narrow spectral ranges within the infrared, such band-like emissions fall far short of producing the emissive power expected at all frequencies, through the application of the 4th power relationship.

Since there is no universality [8, 9], it is implausible that the Earth can be modeled as emitting at a single effective temperature. The oceans cannot be treated as simple blackbody emitters, producing Planckian thermal spectra reflecting an effective temperature near 300 K [5, 6]. In fact, while water can provide strong emission bands in the infrared, further study will reveal that the entire spectrum is far from blackbody or Planckian at 300 K. This is particularly important in the microwave region.

If the oceans had been able to emit with an effective temperature near 300 K, they would be expected to produce an extensive radiation in the microwave region of the electromagnetic spectrum. In actuality, the oceans mimic a 3K blackbody in this frequency range [13, 15]. The oceans remain powerful emitters of thermal radiation at these frequencies, but much less powerful than would have been predicted if they could be treated as 300 K sources. Note, in this regard, that Stefan's law invokes a 4th power temperature dependence [12]. As a result, the oceans, while still emitting ample radiation in the microwave region [13], are actually poor emitters in this spectral range. This is true, if one compares their actual emission [13] with the emission corresponding to an effective temperature of 300 K [12], as is currently expected. The lower than expected efficiency of the oceans to emit thermal radiation, particularly in the microwave region, appears to have dire consequences for global warming.

It is well known that global warming models invoke negative feedback mechanisms [5, pp.352–354]. The first of these predicts that, as the Earth warms, it becomes an even better emitter of radiation, because the use of Stefan's law [12] now applies a fourth power exponential to an even higher temperature. As a result, the production of even more thermal photons is expected. In practice, approximately 70% of the Earth is covered with water, and its thermal emissions in the microwave regions are not expected to increase in the slightest as a response to temperature elevation. Should the hydrogen bonding system within water actually be the oscillator responsible for the microwave background [15, 21], then this system cannot easily respond to increases in temperature, since the associated energy levels are already full at Earthly temperatures. This explains why the microwave background has always been observed to be independent of seasonal variations. For nearly 70% of the planet, the negative feedback mechanisms, brought by the application of Stefan's law, will not hold, at least in the microwave region of the spectrum.

It is well established that the inability of water bodies to efficiently emit radiation results in considerable retention of thermal energy within oceanic systems. Unable to dissipate heat through emission, the oceans turn to convection currents. This provides a driving force for oceanic currents and for hurricanes. Importantly, the secret to understanding oceanic behavior rests in large part with the microwave background. Its lack of seasonal variation constitutes a key parameter for modelers of global climate change and for the study of oceanic systems.

Given the centrality of global warming to human progress, it may be prudent to fully ascertain the Earth's emission profile, by using an array of satellites which continually monitor spectral emissions from the radio range through the infrared. Such an array, positioned in fixed orbit around the globe should be able to continuously monitor outgoing Earthly emissions. Using a satellite array, it should be possible to observe the ebb and flow of infrared radiation from the Earth in association with the diurnal cycle. In addition, the relative stability of microwave emission will once again be affirmed. Indeed, the latter has already been established long ago, by Penzias and Wilson [13]. Only when such findings are combined with increased direct solar, atmospheric, continental, and oceanic monitoring as a function of depth and global position, will scientists gain the insight required for the accurate analysis of climate change.

Dedication

This work is dedicated to my youngest sister, Mireille.

Submitted on November 21, 2008 / Accepted on December 05, 2008
First published online on December 08, 2008

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