SATELLITE DETECTION OF GLOBAL EMISSIVITY

All matter in the universe emits electromagnetic radiation. This emission occurs whether the object is alive or dead; hot or cold; solid, liquid, or gas. On the molecular level, this emission of photons occurs at discrete, largely unpredictable intervals. On the macroscopic level, where gazillions of molecules are involved, this emission of electromagnetic radiation is effectively continuous.

This emission of electromagnetic radiation may be measured in a variety of ways. The two that most interest us are intensity and mean wavelength. Both are related to the surface temperature of the matter involved, and both are related—to some degree—to the chemical nature of the matter. As the surface temperature increases, the intensity of emission increases and the mean wavelength of the emissions shortens. Thus, the emissivity of an object (such as our planet) may be used to measure the object’s surface temperature.

The amount of electromagnetic radiation emitted per unit area per unit time is given by the Stefan-Boltzmann Equation. This is,

$$\varepsilon = k\sigma T$$

Here, ε is the emissivity in units of energy, σ is a constant whose value depends upon what system of units you are using, T is the absolute temperature, and ***k*** is the coefficient of emissivity. The value of ***k*** is 1.0 for a perfect radiator/absorber (the “blackbody”), and is around 0.90 to 0.95 for the Earth as a globe.

Since the emissivity goes up with the fourth power of the temperature, it is obvious that even a small change in global temperature will have a relatively large change in global emissivity. Satellite sensors measure emissivity all the time, and over various bandwidths (most commonly, the ten-micron “window”). The evidence for any increases in global emissivity over the last sixty years or so that satellites have been in place, is—to put the kindest face on it—ambiguous. Most readings have actually shown a small decrease, but this could be an artifact of increasing sensitivity.

The wavelengths of emitted photons are also a function of the temperature. In general, for any given temperature, there will be a certain frequency or wavelength that is the most probable. Most of the photons will be emitted at or near this wavelength. Wien's Law gives this point of maximum intensity as:

$$\lambda = 2{,}898 / T$$

Here, λ is the wavelength in microns, and T the absolute temperature in degrees Kelvin.

Consequently, if the Earth is indeed warming, there should be a slight decrease in the mean wavelength (currently very close to 10 microns). No such decrease has been noted. In all fairness, it must be noted that this is a difficult measurement to make.

In summary, it should be noted that—although satellites are both capable of and sensitive enough to measure even small changes in the Earth's temperature—no such changes have been clearly noted.

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