476

The most unexpected surprise in climate change:

Greenhouse gases do not absorb enough heat to explain observed global warming.

Heat is not a discrete amount as widely assumed.

Heat is observed to be a continuum.

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2. Heat is currently defined as thermal energy in transit

Thermal energy is observed to flow spontaneously only from higher temperature to lower temperature.

The higher the temperature of a body of matter, the higher the amount of heat that is assumed to be flowing from it.

The amount of heat is currently defined as the number of joules per second (which is Watts) flowing through a surface area of one square meter (W m^{-2}). One joule is the amount required to raise the temperature of one gram of water 0.24°C.

Amounts of heat are assumed to be additive:

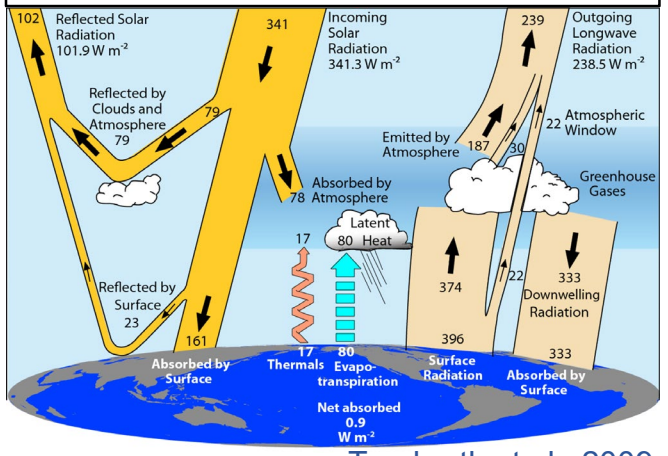
net heat = total heat in minus total heat out

On the global scale, Fourier (1822) concluded that Earth would get hotter if the amount of solar radiation absorbed by Earth was more than the amount of terrestrial radiation lost to space. Upper figure suggests current warming is caused by a net amount absorbed of +0.9 W m^{-2}.

Greenhouse-warming theory is founded on this basic assumption that amounts of heat are additive.

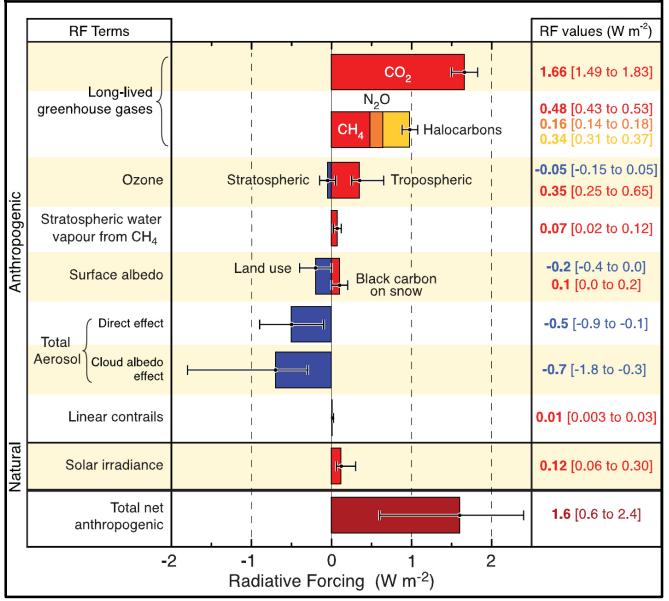
The effects of gases and aerosols on the net transfer of heat through the atmosphere are quantified as amounts of radiative forcing.

Global Energy Flows in W m^{-2}



Trenberth et al., 2009

Radiative Forcing Components



IPCC, 2013

3. But what physically is thermal energy internal to matter?

What is happening at the molecular level that results in what we perceive as temperature?

The chemical bonds that hold atoms together into molecules are well known not to be rigid.

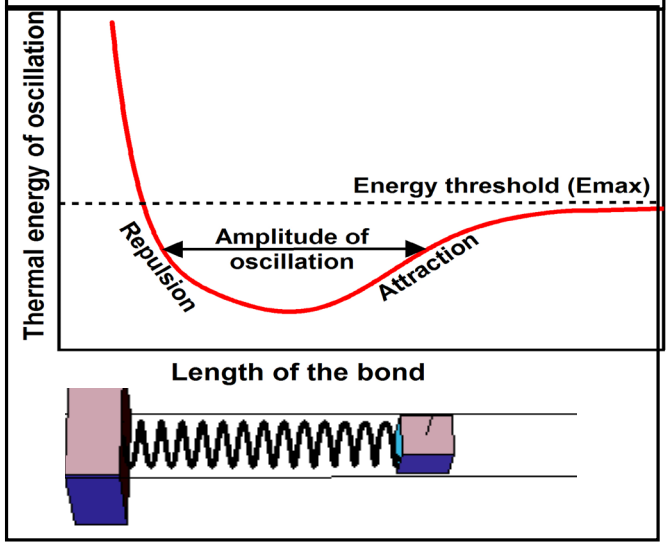
They are observed to oscillate between what we think of as electrodynamic forces of repulsion and attraction.

Each degree of freedom of each bond is a tiny oscillator on the surface of matter that seems to transmit its single frequency of oscillation by line of sight in the same way that a radio transmitter transmits its single frequency of operation.

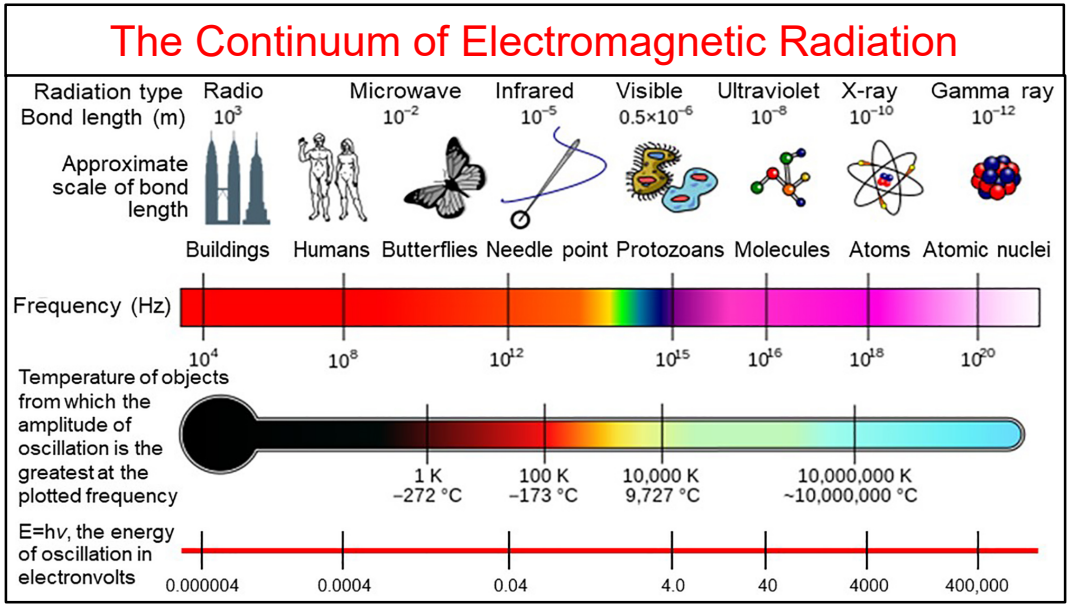
All of these molecular-bond-sized oscillators together form the continuum of electromagnetic radiation ranging from radio signals to gamma rays.

All frequencies of oscillation are present in all locations of air and space. What varies with location are the amplitudes of oscillation ranging from dominant to insignificant depending on the temperature of visible bodies of matter.

Oscillation of a Molecular Bond



The Continuum of Electromagnetic Radiation

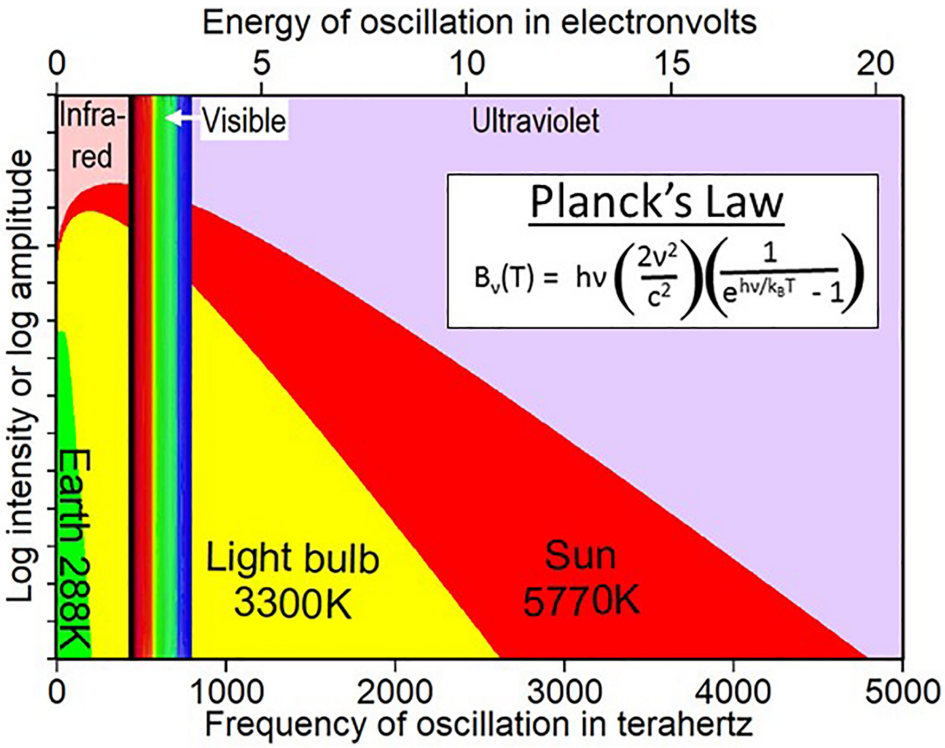


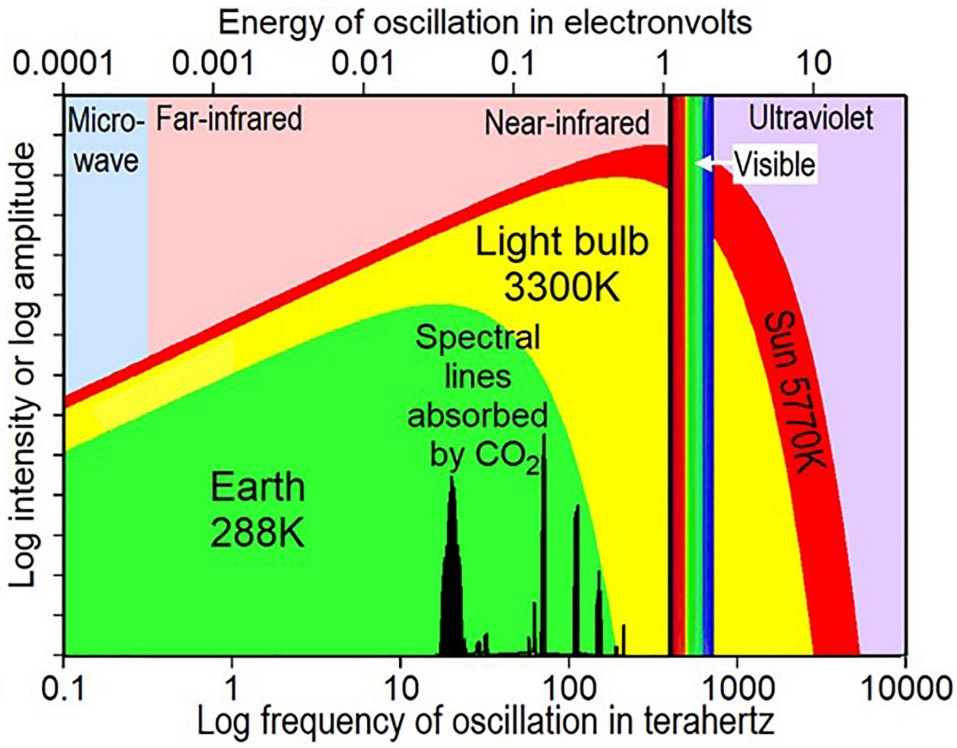
4. Temperature is the result of this broad spectrum of oscillations

Planck (1900) developed, by trial and error, an empirical equation, now known as Planck's law, that accurately calculates the observed amplitude of oscillation at every frequency of oscillation in radiation as a function of the temperature of a radiating black body.

The higher the temperature, the higher the amplitude of oscillation at each and every frequency and the higher the frequencies with the greatest amplitudes of oscillation.

The radiation from Sun (red) has distinctly different physical properties from the radiation from Earth (green) or radiation from the tungsten filament of an incandescent light bulb (yellow). The difference is not a single amount, as currently assumed. The difference is a broad continuum of amounts.





5. Even Planck was confused about the energy of radiation

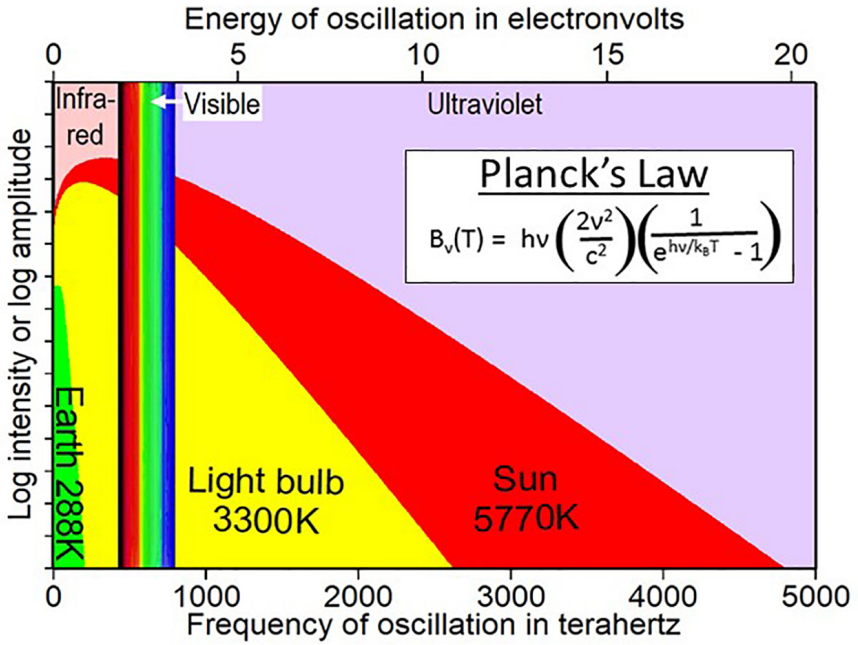
Planck, in formulating his law, postulated that radiant energy (E) equals the Planck constant (h) times frequency (*v*, the Greek letter nu). Planck viewed this simple equation, **E=h*v***, as "a mathematical convenience." He did not stop to realize that frequency or wavelength is plotted on the x-axis and therefore energy (E), which is a function of frequency, must be an alternate x-axis.

Einstein, while explaining the photoelectric effect in 1905, called **E=h*v*** a "light quantum." E=h*v* became known at the Planck-Einstein relation which is integral to quantum mechanics because it is thought to define the energy of a photon.

But v is a portion of the continuum of electromagnetic radiation. A continuum times a constant must be a continuum. Therefore, **E=h*v* is the definition of a continuum, not the definition of a photon.**

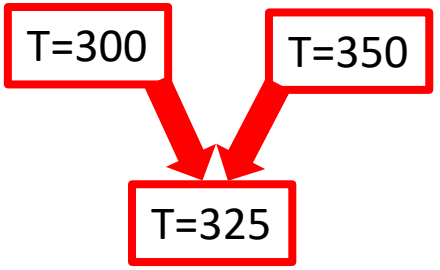
Planck plotted energy on the y-axis because physicists, at the time, thought they were measuring intensity in watts per square meter because their sensors produced watts of electricity.

To get total energy, Planck integrated as a function of frequency, and we still integrate today . But it makes no physical sense to integrate, to add together, different frequencies of oscillation. All frequencies **co-exist** and cannot interact in any way in air and space.



6. Direct observations of Nature—what is physically happening

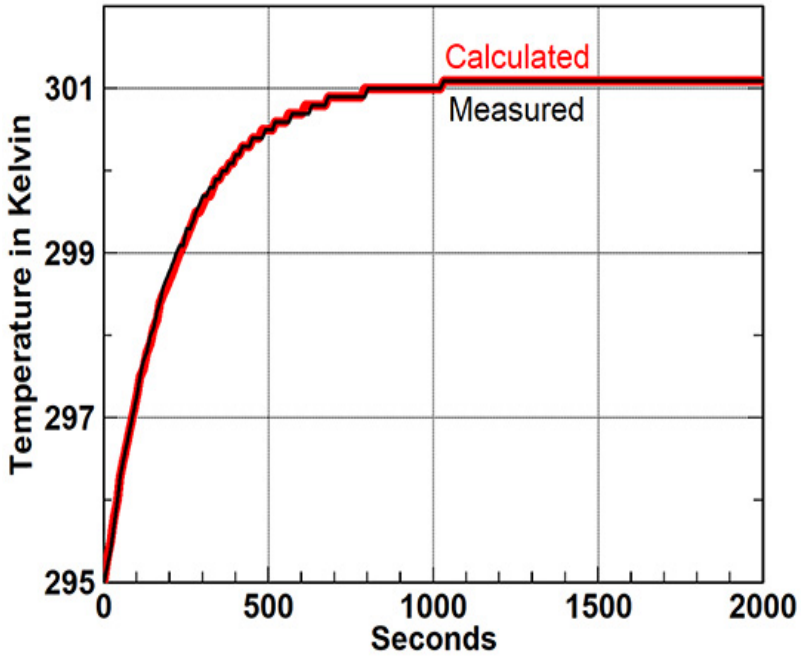
The closest thing to truth in Science is a quality observation of what is physically happening in Nature.



If you take two identical pieces of matter at different temperatures and join them together by conduction or by radiation, the resulting temperature, assuming no other losses, is the average of the initial temperatures: $T=(T_1 + T_2)/2 = 325K$.

If you shine a light on a black piece of metal, the temperature of the metal will rise in a distinctively asymptotic manner shown by the black line. The temperature of the metal rises quickly at first when the difference in temperatures is large, but then more and more slowly as the difference in temperatures approaches zero.

Thus the rise in temperature per unit time is proportional to the average of the current temperature and the ultimate temperature: $T=\text{constant}*(T_{current} + T_{ultimate})/2$, shown by the red calculated line. The flux of heat decreases with time in this distinctively asymptotic manner.



All curves of warming and of cooling similarly approach the ultimate temperature asymptotically.

Heat is observed to flow in a way that temperatures are averaged with time. The amount of heat flowing is not additive as currently assumed, it decreases as the difference in temperatures decreases.

7. How physically are temperatures averaged?

How does the flow of heat know the ultimate temperature?

Two oscillators oscillating at the same frequency interact via resonance, also known as sympathetic vibration.

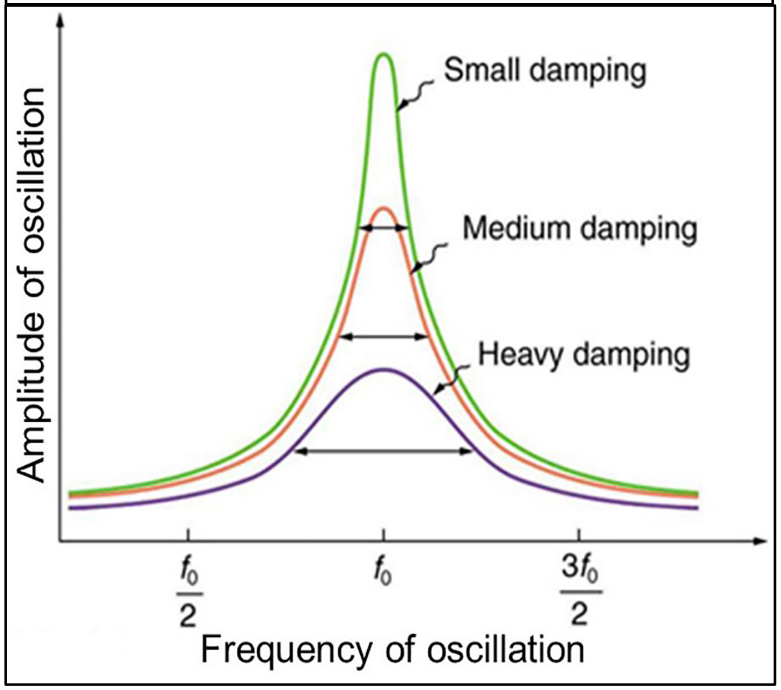
Resonance, under the best of conditions, averages the amplitudes of oscillation, effectively transferring amplitude of oscillation from the transmitter to the receiver.

You experience resonance most clearly when you push a child on a swing. If you push at exactly the same frequency as the swing is swinging, the amplitude of the swing will increase.

You tune your radio receiver to resonate with the frequency of the station you want to listen to.

You hear by resonance when the cilia in your ears resonate with sounds in air.

Resonance increases the amplitude of oscillation at the resonant frequency. For radiation, damping of a frictionless oscillator is essentially zero.



You see visible colors (frequencies of oscillation between 400 and 789 trillion cycles per second) when each oscillator of color resonates with 3 different cells in the cones of your eyes allowing you to differentiate 10 million colors.

Resonance is the way life forms interface with the physical world.

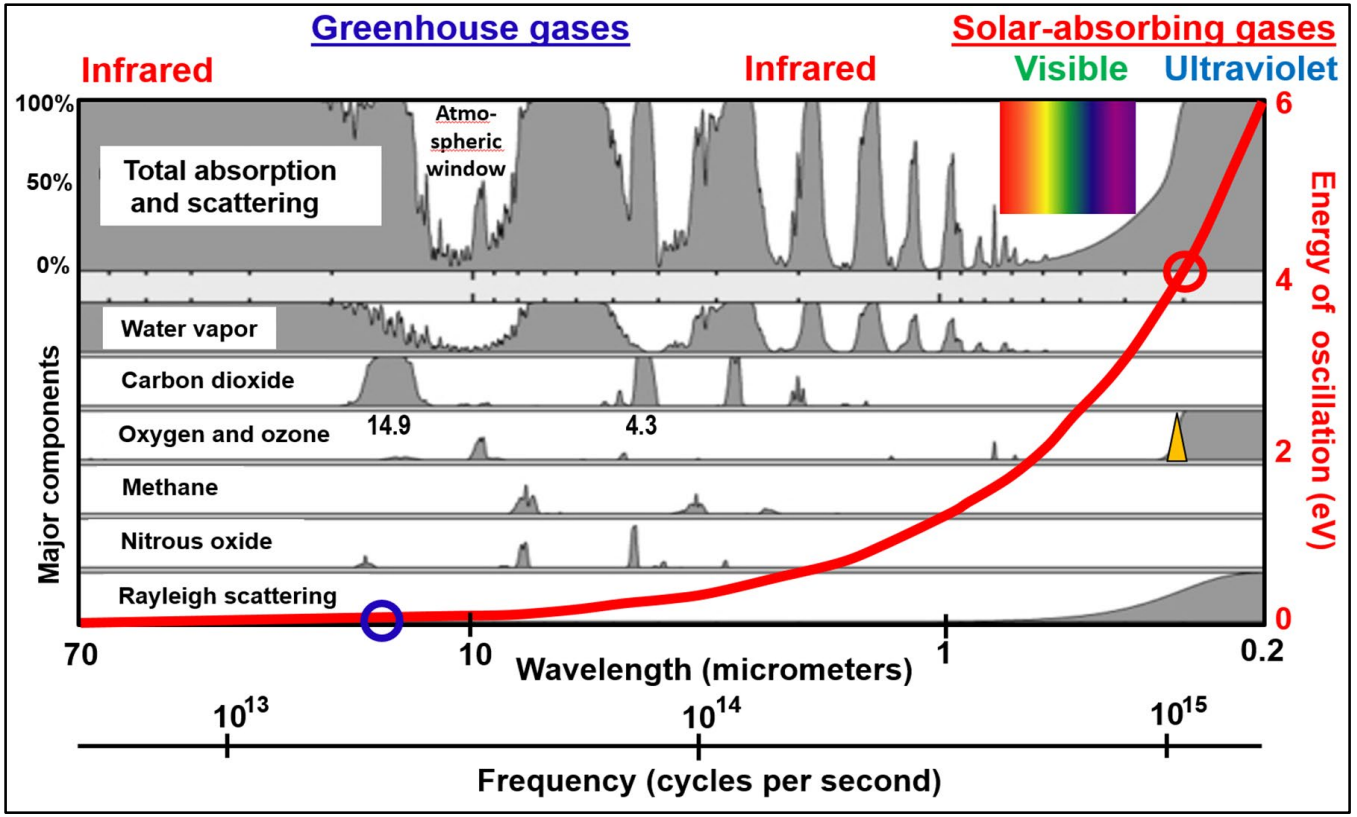
8. Thinking in terms of amount grossly overestimates warming

Climate models integrate across the gray-shaded bands to determine total energy absorbed

Thus the broad 14.9 micrometer peak for carbon dioxide appears to be much more important that the narrow orange band for increased ultraviolet-B reaching Earth when ozone is depleted.

BUT the energy of oscillation of any amount of ultraviolet-B solar radiation (red circle on the red line) is 48 times greater than the energy of oscillation of the 14.9 micrometer infrared peak.

The thermal effect of radiation is a function of the energy of oscillation, not the amount of radiation.



9. Absorbing infrared energy into molecular bonds has never been shown by experiment to raise temperature

Ångström, in 1900, published an experiment in the field and one in the laboratory showing that increasing the concentration of CO_2 in air did not seem to warm the air.

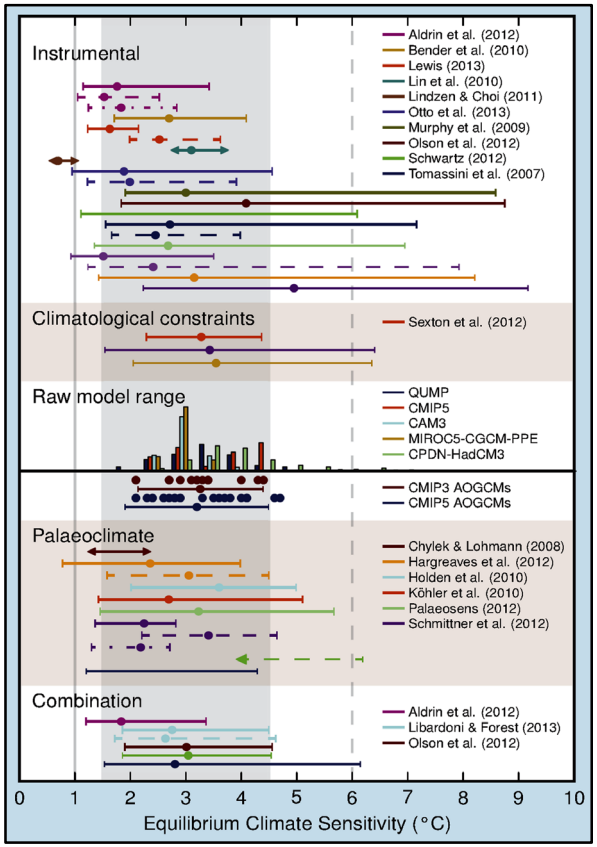
I did an experiment in 2017 exposing a volume of air with a normal concentration of CO_2 and another with >23 times normal to the same source of infrared radiation simultaneously. I could not detect any warming.

The need for an experiment is described at JustProveCO2.com.

I have been offering, since 2015, $10,000 to the first person who can show by experiment that a 15% increase in CO_2, such as that observed from 1970 to 1998, can explain observed warming WhyClimateChanges.com/challenge/.

Because of lack of direct measurements, climate scientists estimate **climate sensitivity** to a doubling of the concentration of CO_2, assuming that all warming observed is caused by greenhouse gases. The values range from 1 to 9°C.

Radiant energy is absorbed into the bonds holding greenhouse gases together. The temperature of a gas, however, is proportional to the average kinetic energy of all gas molecules, which is proportional to the translational velocity squared.



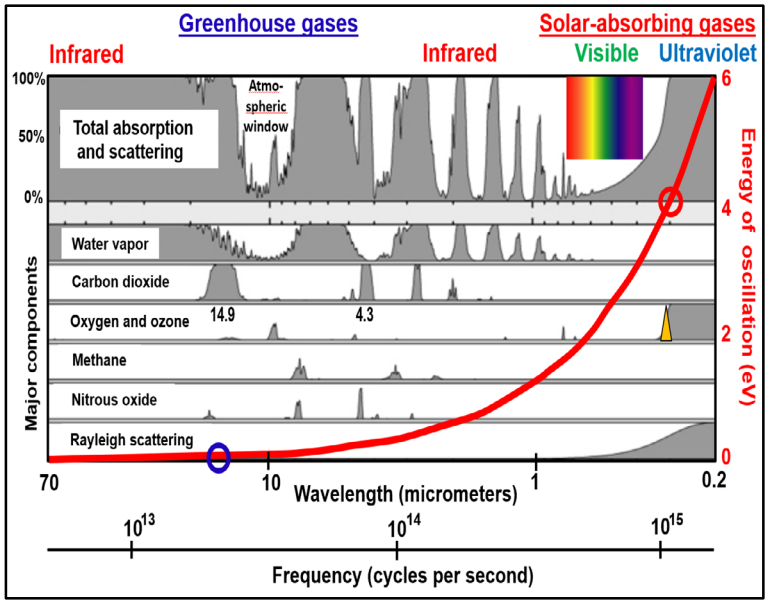
10. Greenhouse gases do not absorb enough heat to explain observed global warming

Heat is what a body of matter must absorb to get warmer or lose to get cooler. Heat is a broad <u>continuum</u> of frequencies of oscillation as shown by Planck's law.

Greenhouse gases only absorb very limited bandwidths of infrared radiation as shown shaded grey.

Greenhouse gases only absorb spectral lines within these limited bandwidths as shown below in red for the 14.9 micrometer absorption bandwidth for CO_2.

These are the resonant frequencies of all the modes of oscillation of all the bonds holding the molecule together.

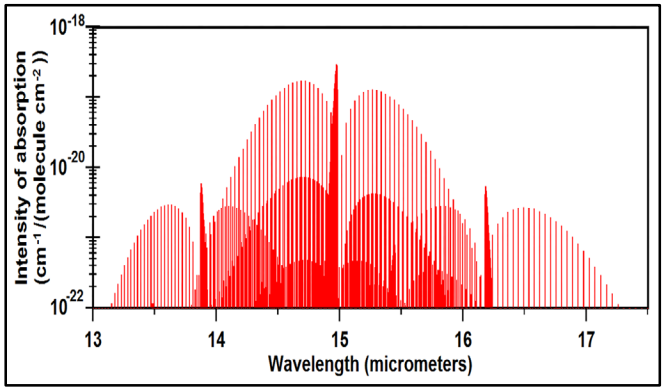


Ångström showed in 1900 that these spectral lines make up less than 16% of infrared radiation from Earth and that total absorption is very little dependent on the concentration of CO_2.

Heat is a continuum. <16% of a continuum <u>is not heat</u> just as <16% of a person is not a person.

Scientists today ignore Ångström's definitive experiments. They simply assume that a gas absorbing infrared energy must get warmer and must somehow slow the cooling of Earth. These assumptions have never been verified by experiment.

Greenhouse gases do not absorb heat. They only absorb limited spectral lines than cannot physically cause heating.



11. What I have been explaining is a fundamentally new way of quantifying radiant heat based on direct observations of how heat is observed to flow in Nature

Current thinking	Physically correct thinking
Heat flows spontaneously only from hot to cold	Heat flows spontaneously only from hot to cold
Heat is an amount, a discrete number of W m^{-2}	Heat in a broad continuum of W m^{-2}
Heat is additive	Heat is averaged, it is "averative"
Amount of heat is integrated over frequency	Makes no physical sense to integrate over frequency
Flux of heat decreases with decreasing temperature	Flux of heat decreases with the difference in decreasing temperature forming asymptotic warming and cooling curves
Physical nature of thermal energy does not need to be defined	Thermal energy in matter is the oscillation of all the bonds holding matter together
Radiation from sun is just like radiation from Earth except there is a whole lot more of it	The physical properties of radiation vary significantly with temperature of a body
Asymptotic heating and cooling curves explained mathematically	Asymptotic heating and cooling curves explained physically

12. Conclusions and Implications

Direct observations of the flow of heat in Nature show unequivocally that temperature and heat in matter are the result of a broad continuum of frequencies of oscillation of all the bonds that hold matter together. Heat cannot be summarized in an amount of Watts per square meter.

Furthermore, flux of thermal energy is proportional to difference in temperature between emitter and absorber.

Temperature and heat are each averative, not additive as currently assumed.

This revolutionary new understanding of thermal energy and other observations show that greenhouse gases do not absorb enough heat to explain observed warming. Greenhouse-warming theory is mistaken.

This is the most unexpected surprise for climate scientists who are convinced that global warming is explained by greenhouse-warming theory.

Recent warming and warming throughout Earth history can be explained far more precisely and in much greater detail by observed depletion of the ozone layer caused by chlorine and bromine gases. One atom of chlorine, under the right atmospheric conditions in the lower stratosphere, can lead to the destruction of 100,000 molecules of ozone, making ozone depletion the Achilles heel of climate warming.

Meanwhile, political leaders worldwide, convinced by the extraordinary consensus among scientists, are beginning to spend tens of billions of dollars to reduce greenhouse-gas emissions. Don’t you think we should re-evaluate the science first?