Greenhouse Warming Theory Is Not Physically Possible

Observed warming throughout Earth history is explained clearly and in detail by depletion of the ozone layer allowing more solar ultraviolet-B thermal energy to reach Earth

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Clear, unambiguous observations of Nature show that greenhouse warming theory is based on a fundamental misunderstanding in physics about what heat is physically and how heat flows through matter, air, and space.

Heat is what a body of matter must absorb to become warmer and must lose to become cooler. Heat, as shown below, is a broad spectrum of thermal energies, most of which are not absorbed by greenhouse gases.

Furthermore, heat is well known to flow spontaneously only from warmer bodies of matter to cooler bodies of matter where the flux of heat that flows decreases to zero as the difference in temperature decreases to zero. It is physically impossible, therefore, for heat radiated by Earth to flow back to the planet's surface, making Earth warmer in any of the ways assumed in greenhouse warming theory. A body of matter cannot physically be warmed by its own radiation; otherwise bodies, under the right conditions, could spontaneously heat up, providing an endless supply of free thermal energy.

Earth can only be warmed by absorbing radiation from a much hotter body, of which Sun is the only example in our solar system. It turns out that average global temperatures are determined primarily by how efficiently different frequencies of solar radiation penetrate Earth's atmosphere.

A fundamental misunderstanding about heat

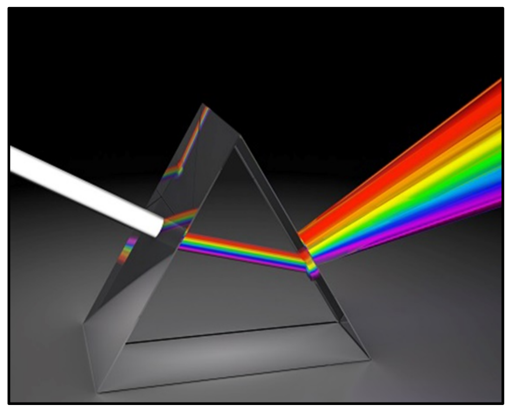
The roots of this misunderstanding are deep, extending back to the 1700s—at least a century before scientists began to understand the atomic and molecular nature of matter. Physicists at that time had no idea what thermal energy in matter was physically. They simply thought of thermal energy as some generic thing contained within matter as they would think of a liquid contained in a tank. The more of this generic thermal energy absorbed, the hotter the matter was assumed to become. Thus, they thought of heat as an <u>amount</u> of some undefined thing called thermal energy flowing per second across a surface ultimately in units of watts per square meter.

Thinking of thermal energy only as an amount has been a reasonable approximation, even today, when the temperatures of the bodies of matter involved are similar. For greenhouse warming theory, however, this thinking breaks down catastrophically because Sun, which clearly warms Earth, is twenty times hotter than Earth.

Climate scientists currently assume that thermal energy radiated by Sun is the same physical thing as thermal energy radiated by Earth except Sun radiates a much greater amount of it. Yet today we observe clearly that the physical properties of radiation from Sun are significantly different from the physical properties of radiation from Earth. Solar radiation, even in small amounts, includes visible light and ultraviolet radiation, which causes sunburn, skin cancer, cataracts, and mutations of DNA. Radiation from Earth, on the other hand, does not include visible light and cannot cause any of these chemical changes no matter how great the amount. Thus, contrary to current thinking in terms of simple amount, the physical properties of radiation from Sun are actually distinctly different from the physical properties of radiation from Earth.

The physical properties of heat

Visible light has two main physical properties: frequency of oscillation, which is equivalent to color, and amplitude of oscillation, which is equivalent to intensity or brightness of that color. Visible light, in fact, contains a whole spectrum of colors that we see in a rainbow or when white light is passed through a prism, ranging from different shades of red, to orange, to yellow, to green, to blue, to violet.



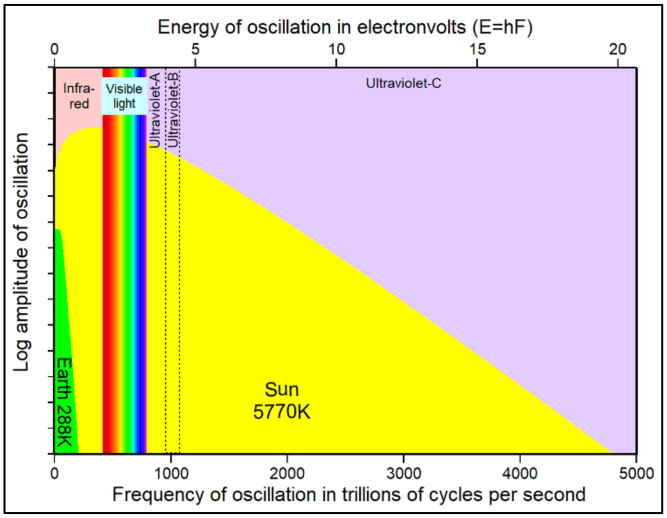
*A **prism** disperses white light into its frequency components.*

Thermal radiation, the radiation from a body of matter caused by its temperature, is well known to be the electromagnetic spectrum ranging from extremely low frequency radio signals oscillating at a few cycles per second, to microwaves, to infrared radiation, to visible light oscillating at hundreds of trillions of cycles per second, to ultraviolet radiation, to X-rays, to gamma rays oscillating at nearly one billion trillion cycles per second.

All these frequencies of oscillation are always present simultaneously in matter, air and space, but depending on the temperature of the emitting body, the amplitude of oscillation at each frequency of oscillation ranges from insignificant to dominant. In other words, these amplitudes of oscillation increase, especially at high frequencies, with increasing temperature of the radiating body of matter.

By the late 1800s, many physicists were measuring the physical properties of radiation. In 1900, Max Planck, one of the fathers of modern physics, developed, by trial and error, an equation, now known as Planck's law, that accurately calculates all observations of the distribution of frequencies of oscillation and their amplitudes of oscillation as a function of the temperature of the radiating body.

Oscillation of what? By the late 1800s, the atomic revolution in science was underway with the discovery of electrons in 1897 and the nucleus of atoms in 1909. Physicists and chemists began to understand the structure of atoms and that matter consists of atoms bonded together into molecules. These bonds are not rigid. In the 20th century, it became clear that thermal energy within matter consists of the simultaneous oscillation of all of these bonds holding matter together. Each bond oscillates between forces of repulsion as atoms get too close and forces of attraction as atoms get farther apart.



***Planck's law** is an equation derived by experiment that calculates the observed amplitude of oscillation at each frequency of oscillation for radiation from a body of matter at a given absolute temperature in units of kelvin. The hotter the body, the higher the amplitude of oscillation at each and every frequency of oscillation and the higher the frequencies with major amplitudes. Note that the frequencies emitted by Earth (green) are a tiny subset of the frequencies emitted by Sun (yellow).*

Planck's law shows that the higher the temperature of the body, the greater the amplitude of oscillation at each frequency of oscillation and the greater the frequencies of oscillation that have the greatest amplitudes of oscillation. Furthermore, the greater the amplitude of oscillation, the greater the average length of the bond and, therefore, the greater the volume of the matter. Most materials are observed to expand when they are heated.

The physical properties of transferred heat, therefore, vary significantly with the temperature of the radiating body. Heat radiated by the very hot Sun (yellow in the figure) contains much higher frequencies of oscillation and much higher amplitudes of oscillation at each and every frequency of oscillation than heat radiated by the much cooler Earth (green).

It is these much higher frequencies of oscillation in the ultraviolet-B range that cause sunburn, skin cancer, cataracts, and even mutations—chemical reactions that cannot be caused by any amount of infrared radiation from Earth. In this way, the average temperature of Earth's surface is determined by how efficiently these much higher frequencies of oscillation penetrate Earth's atmosphere.

What is thermal energy physically?

In 1900, Planck was able to write his law by postulating that thermal energy (E) equals a constant (h) times frequency (F), where E=hF. This simple equation says that thermal energy is physically identical to frequency of oscillation times a scaling constant (h, the Planck constant), which simply changes the units of measure from cycles per second to energy measured in either joules or electronvolts.

In 1905, Albert Einstein used this equation, E=hF, to describe the photoelectric effect where light, with a color above some minimum frequency in the blue to violet color range, is observed to release electrons from a fresh, unoxidized, metallic surface. In this usage, E is the minimum level of energy, the minimum frequency of oscillation, required to break the bond holding an electron to a molecule of some specific metal. Atmospheric chemists similarly use this equation, E=hF, to specify the minimum level of energy, the minimum frequency of oscillation, required to break a chemical bond that is holding together, for example, the two atoms of an oxygen molecule. Einstein visualized E as a discrete number, an amount of energy, a quantum of energy, a particle of light, which soon became known as a photon. Einstein's concept of a "light quantum" in 1905, led to the development of modern quantum physics and modern particle physics.

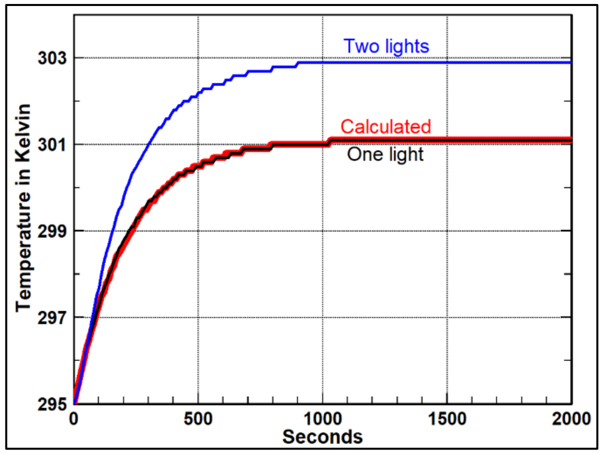
This simple equation, E=hF, however, contains a most surprising and inconvenient truth. When applied to heat, frequency (F) is the electromagnetic spectrum, well-known to be a spectrum of frequencies of thermal oscillations, as described above. A constant (h) times a spectrum of frequencies of oscillation must equal a spectrum of energies of oscillation. Thermal energy E, therefore, is not a quantum, a photon, or a particle—it is a spectrum of energies where each frequency of oscillation has a different energy of oscillation—the higher the frequency, the higher the energy of oscillation. Each frequency is the frequency of oscillation of a single physical oscillator, which is a single degree of freedom of motion of a single bond. Each oscillator is oscillating at a specific frequency, which is a specific level of energy (E=hF). Energy is not limited to be an integer multiple of some basic quantum value of energy as assumed in quantum physics. An individual discrete energy can be any value. Thermal energy is the spectrum of all discrete energies of all degrees of freedom of motion of all physically discrete bonds oscillating simultaneously.

In summary, Planck's law calculates, based on the temperature of the radiating body of matter, the observed amplitude of oscillation at each frequency of oscillation throughout the whole electromagnetic spectrum. Thermal energy at each frequency of oscillation is the same physical thing as the frequency of oscillation. Heat, however, that which must be absorbed to increase the temperature of a body of matter, is the difference between the Planck curve for the final temperature minus the Planck curve for the starting temperature. Heat, therefore, is a spectrum of values of the difference in amplitudes of oscillation at each frequency of oscillation. A body of matter is heated by absorbing radiation that contains greater amplitudes of oscillation at each frequency of oscillation throughout the whole electromagnetic spectrum that is being radiated. This radiation, this heat, can, at best, raise the temperature of the absorbing body only as high as the temperature of the radiating body.

Heat flows by resonance

Heat is observed to flow spontaneously through matter, through air, and through space from higher temperature to lower temperature. How can a spectrum of frequencies flow? The only option I know of is by resonance.

Resonance is a widely observed physical process whereby two discrete physical oscillators, oscillating at nearly identical frequencies, average their amplitudes of oscillation. In the simplest case, one-half the difference in amplitude of oscillation moves from the higher amplitude oscillator to the lower amplitude oscillator. From Planck's law, this means at each frequency of oscillation that some amplitude of oscillation moves from the higher temperature oscillator to the lower temperature oscillator, in effect averaging the two amplitudes. When resonance occurs simultaneously across all frequencies of oscillation, the two temperatures of two similar bodies are averaged, as typically observed. The greater the difference in temperature, the greater the amount of amplitude that flows at each frequency. Heat is the flow of this broad spectrum of amplitudes. The greater the difference in temperature, the greater the flow of heat, the greater the flux of heat, which is also typically observed.



The rate of warming, the rate heat flows, decreases with decreasing difference in temperature forming an asymptotic curve. The black line shows temperature increase of a small black object caused by radiation from a light bulb. The blue line shows similar warming caused by two identical light bulbs. The red line shows the temperature calculated by adding 4.6% times the ending temperature minus the existing temperature at each 10-second interval.

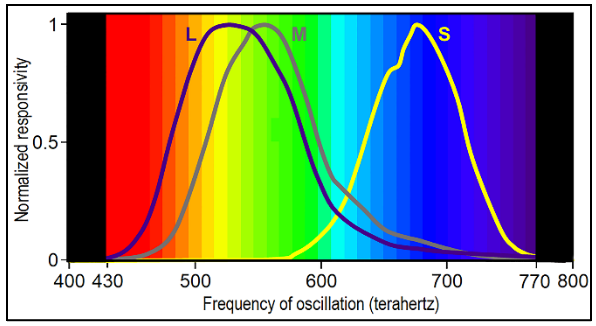
Resonance can occur by the physical touching of two oscillators and thus by conduction, but it is also observed to occur across air and space by electromagnetic communication. A radio station radiates (broadcasts) at a specific frequency. We tune a radio receiver to resonate at that specific frequency, thereby receiving a signal with most amplitude just from that single transmitter.

Electromagnetic communication is made possible by the observation that an oscillating electric charge induces what we think of as an oscillating electric field. This oscillating electric field then induces an oscillating magnetic field. The oscillating magnetic field then induces an oscillating electric field, and so on, providing a way for resonance to occur. We still have much to learn about the detailed physics of electromagnetic communication—about precisely how resonance occurs.

Resonance is all around us

We all hear by resonance. The frequencies of sounds in air resonate with tiny hairs in our inner ear, sending signals to our brain that let us differentiate all the different frequencies. Similarly, a tuning fork in air resonates when an identical tuning fork oscillates nearby.

We all experience resonance when pushing a child on a swing. If we push at the same frequency as the swing is moving, the swing will go higher and higher.



Three different types of cone cells in our eyes (L, M, and S) respond differently when resonating with different colors.

We all see via resonance. When sunlight shines on a green leaf, for example, most frequencies of radiation are absorbed by the leaf, but the green frequencies are, in effect, reflected. Well, actually the color-forming bonds resonate with the light source at the frequencies of their natural color green. These color-forming oscillators then resonate with three different cells in the cones of our eyes (L, M, and S), each of which have a different amplitude response to frequency. Our brain can then differentiate ten million different colors just from these three amplitude responses in the same way that the color of a pixel on your RGB computer screen is determined by three different shades of Red, Green, and Blue primary colors.

For the propagation of heat, resonance is occurring at each and every frequency simultaneously. On a cold, clear night, bonds oscillating on the surface of Earth resonate with much colder bonds in deep space, leading to the transfer of a great deal of heat. When a cloud is present, often heated by the Sun, the difference in temperature with Earth is much smaller, so that much less heat is transferred.

Resonance is the process in Nature that quantum physicists try to explain as quantum entanglement, where the physical state of something here influences the physical state of something at an arbitrary distance over there with no visible connection between them. Resonance is all around us, it occurs by line of sight, and it is the primary way that living organisms sense the physical world.

The thermal effects of radiation decrease with distance

Frequency of oscillation in radiation and the chemical energy E=hF in radiation are clearly observed not to change with distance, even over galactic distances, except for a small shift when the radiating body is moving relative to the absorbing body—known as the Doppler effect. Amplitude of oscillation in radiation similarly does not change with distance—it only changes through resonance. There is no friction in space to change frequency or amplitude. The heat transferred, however, is observed to decrease with the square of the distance travelled and with decreasing angle of the absorbing surface to the line of sight.

A body of matter looks smaller at a distance because the "size" we see is the solid angle subtended by the distant body at our eye. This solid angle is inversely proportional to the square of the distance. When two bodies are close together, each bond oscillator on the emitting surface resonates with a similar bond oscillator on the absorbing surface. As the bodies move apart, the percent of oscillators on the absorbing surface that resonate, the density of oscillators on the absorbing surface that resonate, decreases proportionally to the square of the distance. In this way, each bond oscillator on the absorbing surface must share by conduction the amplitude of oscillation transferred with an increasing number of bond oscillators that do not resonate with the distant oscillator. There is a similar effect, as the angle of the absorbing surface to the line of sight decreases from ninety degrees to zero.

What is the velocity of light?

For more than 2500 years, natural philosophers and scientists have argued whether electromagnetic radiation, a small subset of which is visible light, travels through space as a wave, a particle, or, in modern physics, via some mixture of both called wave-particle duality. These three alternatives are hard to understand physically. Waves travel by deforming a medium such as water or rock, and physicists have proven that there is no light-conducting medium in space. There are no particles of light as explained above. $E=hF$ is a spectrum, not a quantum. Furthermore, waves and particles are physical things that we can see, while we cannot see light until it is absorbed by matter. Why do we insist on explaining things we cannot see in terms of waves and particles that we can visualize? We cannot see radio signals because each is a specific frequency.

The apparent velocity of light is measured to be a very large value, nearly three hundred thousand kilometers per second. Our current experience with waves and particles makes it hard to conceive of how they could move physically at such a high velocity and how this velocity could be constant. Recognizing that light travels by resonance suggests that what we think of as the constant velocity of light might simply be the very short time it takes for resonance to happen via line of sight from close at hand to galactic distances.

Greenhouse gases absorb some thermal radiation but not heat

Heat is a very broad spectrum of frequencies of oscillation with amplitudes of oscillation described by the Planck's law curve based on the temperature of the radiating body minus the Planck's law curve based on the temperature of the absorbing body. Greenhouse gases, however, are clearly observed to absorb only very small parts of this spectrum. Carbon dioxide, for example, simply absorbs the resonant frequencies of its bonds that make up less than 16% of the frequencies in the spectrum required to constitute the heat radiated by Earth. If you have 16% of a person, you do not have a person. In the same way, greenhouse gases do not absorb heat—they just absorb some oscillatory energy into the molecular bonds, which has no direct effect on air temperature.

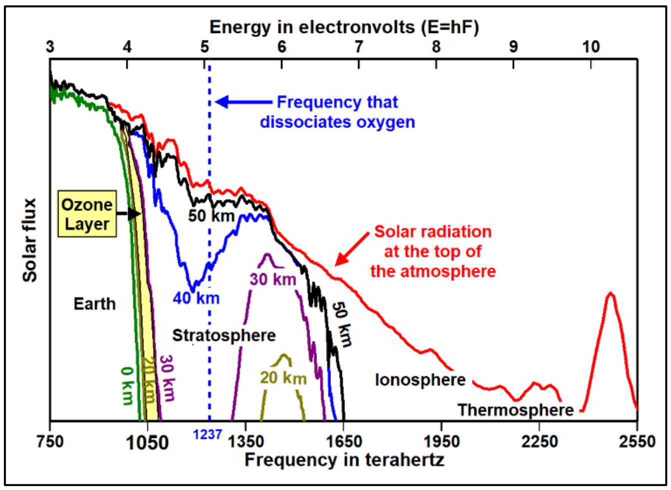
Temperature in air is well-known to be determined by the average kinetic energy of the independent movements of all air molecules travelling and colliding in random directions through space. To convert radiant energy absorbed into the bonds holding the molecule together to air temperature, we must assume that the absorbed oscillatory bond energy is converted through myriads of collisions to kinetic energy of motion of all air molecules. Even if such conversions actually occur efficiently, which they probably do not, the kinetic energy from a single carbon dioxide molecule must still be shared with 2500 other gas molecules because carbon dioxide makes up only 0.04% of air.

Furthermore, Planck's law shows us that the only way that radiation can warm a body of matter, is if the radiation comes from a hotter body that has bonds oscillating at higher amplitudes of oscillation for each and every frequency of oscillation. There is no physical way, without adding heat from a hotter body, for radiation from Earth to have its amplitude of oscillation at every frequency of oscillation increased so that it could warm Earth's surface. Heat cannot flow by resonance from a warm body of matter to a warmer body of matter. Terrestrial radiation does not contain high enough amplitude of oscillation at each and every frequency of oscillation to warm Earth. Greenhouse-warming theory is not physically possible.

Humans most likely caused observed global warming from 1970 to 1998

Solar radiation is well observed to warm Earth every day. Solar radiation, as shown by Planck's law, contains significantly larger amplitudes of oscillation than radiation from Earth at each and every frequency of oscillation.

Ultraviolet-C frequencies of solar radiation are nearly all absorbed in the stratosphere, causing dissociation of oxygen molecules and leading to the formation of ozone molecules. Then ultraviolet-B radiation causes dissociation of ozone molecules in the lower stratosphere in an endless oxygen-ozone cycle that continually forms and destroys the ozone layer every 8.3 days on average. Dissociation causes a molecular bond to come apart, allowing the molecular pieces to fly apart at very high velocity. Dissociation, in this way, converts all energy in the chemical bond directly into kinetic energy of motion, efficiently raising air temperature.



The highest energy solar radiation with frequencies greater than about 1050 terahertz are nearly all absorbed in the atmosphere at altitudes above 20 km.

In this way, the ozone layer protects life on Earth from Sun's hottest, most damaging ultraviolet-C and ultraviolet-B radiation. When the amount of ozone in the ozone layer is decreased, when ozone is depleted, less ultraviolet-B radiation is absorbed in the ozone layer, cooling the ozone layer as observed, and more ultraviolet-B is measured to reach Earth's surface, warming Earth, as observed. Ultraviolet-B radiation penetrates oceans tens of meters, efficiently increasing ocean heat content and sunburning corals.

On land, however, ultraviolet-B radiation is absorbed warming the surface during the daytime, but much of this warmth can be radiated back as infrared radiation at night. In heavily populated areas, however, ground-level ozone pollution is formed in the presence of sunlight by chemical reactions between oxides of nitrogen and volatile organic compounds. When ultraviolet-B radiation dissociates this ground-level ozone pollution, air temperatures rise. This dissociation appears to explain why global warming from 1970 to 1998 was twice as great in the northern hemisphere as in the southern hemisphere because the northern hemisphere contains eighty-eight percent of global population and most air pollution.

Furthermore, ozone depletion is greatest within the Arctic and Antarctic circles, explaining widely observed arctic amplification of global warming and why the greatest warming since 1970 observed anywhere on Earth was along the Antarctic Peninsula. In addition, ozone depletion is greatest during late winter/early spring, raising global minimum average temperatures more than global maximum average temperatures.

Humans depleted the ozone layer from 1970 to 1995 by manufacturing chlorofluorocarbon gases (CFCs) used widely for refrigerants, spray-can propellants, solvents, and such. When these CFCs rise into the stratosphere, they are broken down by ultraviolet radiation, releasing chlorine atoms. One atom of chlorine in the ozone layer has been shown by three Nobel laureates to catalyze numerous heterogeneous chemical processes that can destroy more than 100,000 molecules of ozone. Thus, ozone depletion is the Achilles heel of the climate system.

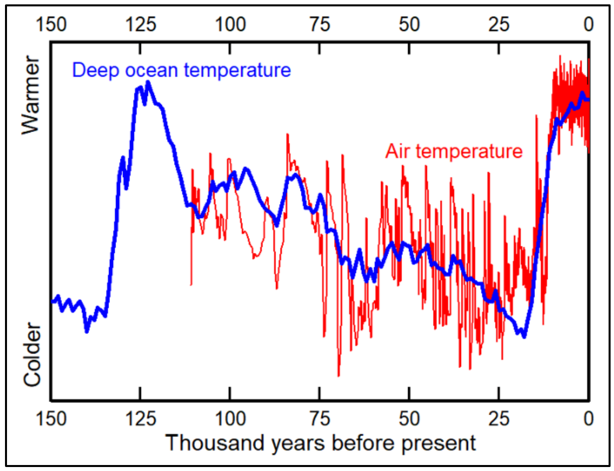
When the Antarctic ozone hole was discovered in 1985, scientists and political leaders moved quickly to pass the United Nations Montreal Protocol on Substances that Deplete the Ozone Layer, which mandated rapid cutback in manufacturing of CFCs. By 1993, the increase in CFCs in the atmosphere stopped. By 1995, the increase in ozone depletion stopped. By 1998, the increase in average global temperature stopped for 16 years. Humans appear to have caused global warming by manufacturing CFCs and humans appear also to have stopped the increase in global warming by limiting CFC production.

CFCs are very stable molecules that remain in the atmosphere for many decades. Ozone depletion, therefore, is not likely to be reduced to 1970 levels for many more decades. This natural decay is slowed by an ongoing black market in CFC gases especially in lesser-developed countries and the recent discovery that insulating-foam-blowing industries in

China are ignoring the Montreal Protocol. As long as ozone remains depleted, increased ultraviolet-B radiation sublimates snow on the surfaces of glaciers and warms the oceans very efficiently.

Volcanic eruptions both cool and warm Earth

Volcanic eruptions also deliver chlorine and bromine gases into the lower stratosphere where they are observed to deplete ozone, causing short-term warming. Big, explosive eruptions, however, also form sulfuric-acid aerosols in the lower stratosphere that reflect and scatter sunlight, causing net global cooling of about one-half degree centigrade for two to four years. This short-term cooling of the whole ocean surface is modeled to reduce ocean temperatures for as long as a century. That is why several major explosive eruptions per century, continuing over tens of thousands of years, are observed to cool oceans incrementally down into ice-age conditions (blue line for deep ocean temperature in the figure).



Average deep ocean temperature (blue) and air temperature in Greenland (red) during the past 150,000 years.

Hot chlorine and bromine gases rising from basaltic lava flows, on the other hand, are observed to cause sudden global warming but form little if any cooling aerosols. Rapid global warming from 2014 to 2016 appears to have been caused by the slow, effusive eruption of the volcano Bárðarbunga in Iceland, which spread basaltic lava over an area of 85 square kilometers within six months, the largest basalt flow since 1783. Extensive basaltic eruptions throughout Earth history, covering hundreds to millions of square kilometers of Earth's surface, are all contemporaneous with periods of major warming—the larger the flow, the longer the eruption lasts, the greater the warming.

Extensive basaltic eruptions on land that cause global warming are most common in areas of continental rifting such as Iceland and the East African Rift, while explosive eruptions forming aerosols that cause global cooling are most common above subduction zones where ocean plates and continental plates are converging. The prime example is the "Ring of Fire" formed around the Pacific Ocean today, involving 452 explosive volcanoes. Motions of tectonic plates covering Earth's surface control climate in this way, causing net warming when continental rifting is most frequent and net cooling when subduction is most widespread.

Details in the geologic record document sudden global warming within just a few years followed by slow global cooling over tens of thousands of years in highly erratic sequences often as short as just a few thousand years (red line for air temperature in the figure). This interplay between basaltic lava flows and explosive, aerosol-forming volcanic eruptions explains the geologic record in considerable detail. The largest basaltic eruptions covering millions of square kilometers and erupting over tens of thousands of years, produce the greatest warming, ocean acidification, and mass extinctions. Changes in greenhouse gas concentrations, on the other hand, are unable to explain most of the details of climate change documented throughout the geologic record.

The greenhouse consensus is built on mistaken science

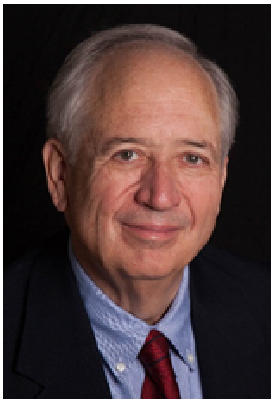
Most climate scientists have worked very hard together for decades to demonstrate consensus behind greenhouse-warming theory so that political leaders would act promptly to reduce greenhouse-gas emissions. Climate scientists have also diligently fought off politically motivated sceptics who fear new government regulations if it is shown that humans can affect climate significantly. Thus, it is easy to understand why the possibility that the science of greenhouse-warming theory could be mistaken is anathema to the scientists, while the possibility that humans manufacturing CFCs could have caused the warming from 1970 to 1998 is anathema to climate sceptics, many of whom are staunchly libertarian.

Unfortunately, most climate scientists, hiding behind "the consensus", refuse to even look at papers that question greenhouse theory. Most leading scientific journals refuse to even send papers our for review that question greenhouse theory. This is not good science. Consensus is the stuff of politics. Debate is the stuff of science. Science evolves. Science is never settled.

What is described in this short document provides, if correct, a revolution in thinking about radiation and heat in thermodynamics, climate science, and quantum physics. What are the chances that I am correct? Everything written here is based on direct observation of Nature. There are no assumptions. Interpretations of these basic observations do not depend on some theory. The closest thing to truth in science is quality observation of Nature.

Physics is about what is physically happening in the world around us. The fundamental goal of science is to understand Nature and how Nature works. We still have a lot to learn from Nature. Science is not done by popular vote. Science is not done by consensus. A major benefit of science is that, over time, it is self-correcting, but only if some scientists have minds open to evaluating new observations and new insights.

As long as climate scientists continue to ignore clear evidence that greenhouse warming theory appears to be mistaken, they are causing those who believe in the value of science for informing sound public policy to squander very large amounts of money and political capital. They are also delaying efforts to minimize ozone depletion that would reduce observed global warming. Warming due to volcanic eruptions recovers within years after the eruptions stop. Warming of the oceans due to CFC gases will continue to increase for many more decades until the ozone layer has recovered to pre-1970 levels. There is much work to be done to speed this recovery. Quality science should be leading the way.



Dr. Peter L. Ward, Dartmouth College 1965 and Columbia University 1970, chaired a White House committee and worked on a Committee for Vice President Al Gore during his 27 years as a research geophysicist and leader at the U.S. Geological Survey. He is a well-published scientist who helped develop and manage a major national research program. Ward has appeared on more than 130 television and radio shows including being featured on Good Morning America. Ward earned two national awards for educating the public about science. He founded the non-profit *Science is Never Settled* to challenge current consensus that he believes has shut down true scientific debate—the life-blood of Science.

He explains, "If Science was settled, we would still believe the Earth was flat."

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