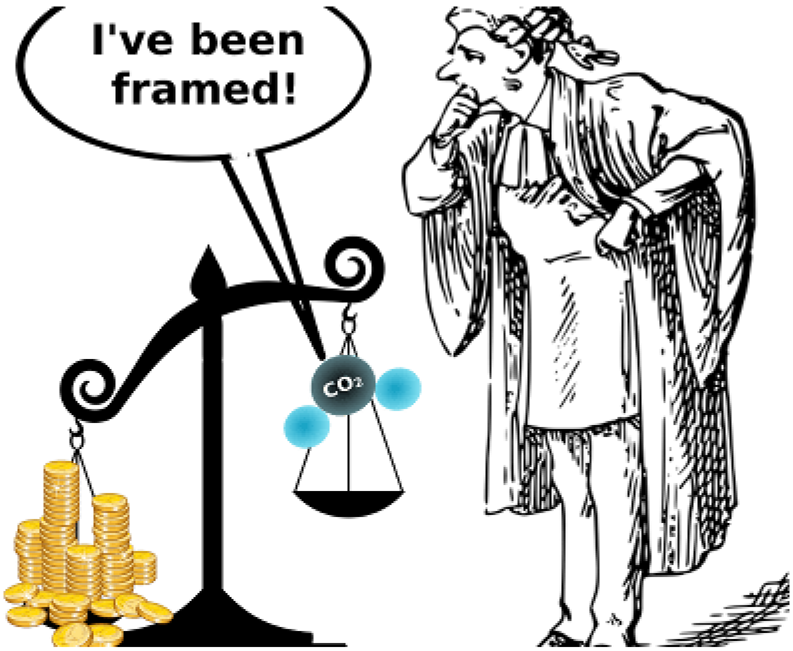
An Atmospheric Greenhouse Effect Cannot Exist So What Does Carbon Dioxide in the Atmosphere Really Do?



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H_20 (water vapor,) CO_2 (carbon dioxide), and CH4 (methane) and some other very minor trace gases are so-called "greenhouse gases" because they absorb infrared energy. Water vapor is by far the largest of these so called greenhouse gases. However, be careful to avoid the common misunderstanding that the earth and its atmosphere behave like a garden greenhouse; that is not true. Greenhouses are closed systems except to incoming energy. Earth is an open system, open to receive energy, as well receive gases and other matter from space and also open to transmit energy, gases and matter back into space. A greenhouse is a poor analogy for earth's climate.

Infrared or IR emission occurs in 360 degrees after a collision event with a water vapor molecule or CO_2 molecule. Half of that emission will be downward, but only 1/360th will be vertically downward. Half of the radiation emitted is directed away from the earth's surface, half towards earth's surface. If that water molecule or CO_2 molecule is close to the surface, the IR emission from the molecule could reach the water or soil. There is no wave guide or other physical phenomena to direct the radiation one way or another.

Flux is the total power incident upon a unit surface area, usually specified in terms such as Watts per square meter per Steradian. Intensity is the flux arriving at a surface area from a source spot of light along a specified angle and direction. Intensity (or radiance) does not decrease with distance. Total flux is the integration of all intensities, those intensities having been weighted for the angle of incidence of the radiation (cosine of the angle). Flux density decreases by the square of the distance from the source.

The amount of downward-directed IR is only half of the IR intensity which was absorbed by that molecule. The IR radiation which was absorbed by the gas molecule probably came from the surface. There can be no absorption at the surface of the down-dwelling instantaneous pulse of IR radiation emitted from a CO_2 or water vapor molecule because the molecules at the surface are radiating at higher intensity and higher flux density than the incoming IR light from the gas molecules. Molecules on the surface are incapable of absorbing IR energy at the lower intensity and lower flux density emitted by the gas molecules. The instantaneous down-dwelling pulse of IR radiation from the gas molecule will either transmit transparently through the surface molecules (and be then be transmitted, reflected/scattered or absorbed by molecules further below the surface), or be reflected/scattered by the surface molecules (albedo) back into the air, most likely the latter because of the efficiency of conduction of heat in water and solids.

These optical interactions with matter are happening nearly instantly. And it is necessary to distinguish between solids, liquids and gases at the surface, as well as the intensity and flux of the IR radiation, and other complex variables. Radiation is absorbed, reflected/scattered or transmitted and the sum of these 3 must be 100%. Absorptivity, reflectivity and transmissivity depend on the direction or angle of incidence of the incoming radiation. If the molecule or surface absorbs IR radiation, then its reflectivity and transmissivity must be low, and vice-versa.

A water vapor molecule close to the earth's surface probably absorbed IR radiation which was radiated a moment before from a much larger surface area on earth. The IR radiation flux from the large nearly planar surface was dense, emitting toward a tiny spot, the gas molecule. Shortly after that absorption event, the water vapor molecule had a collision, and instantly after that collision half of the IR radiation was re-radiated by the water vapor molecule in 360 degrees. Half of the flux and intensity which was initially absorbed was now radiated away from the surface of the earth and the other half re-radiated back toward the surface of the earth. The angle of incidence the IR re-radiation returning to earth's surface has been widened significantly, so therefore the intensity of the radiation received at any angle and direction as well as the flux density has been significantly diminished. The frequency/wavelength absorbed by the gas molecule is almost identical to the frequency/wavelength emitted by the gas molecule. In other words, the less intense down-dwelling radiation from the gas molecule cannot be absorbed by the surface from which more intense radiation emitted only a moment before and is probably still emitting. The down-dwelling radiation is most probably reflected/scattered from the surface since conduction and convection efficiently distribute heat/vibrations within solids and liquids, and since the down-dwelling flux and intensity are at least 50% less than the up-dwelling radiation. The down-dwelling radiation is a pulse; the up-dwelling radiation is a continuing flux. The down-dwelling IR radiation is reflected/scattered by the surface back into the air. At each successive absorption-collision-emission sequence, flux and intensity are diminished.

The highly touted ability of so-called "greenhouse gases" to "trap" radiation only lasts for the instant of time between collisions, and after each successive absorption-collision-emission sequence a diminishing flux and intensity of IR energy is incident upon earth's surface. So-called "greenhouse gases" delayed cooling of the earth's surface, essentially functioning as a temporary insulator.

On the other hand, if the earth surface is cold, then the water vapor or CO_2 molecule probably absorbed IR radiation from another nearby water vapor or CO_2 molecule. (Incoming IR radiation from the sun which might be reflected by earth's surface (albedo) is not at the required frequencies/wavelengths to be absorbed by water vapor or CO_2.) Since those CO_2 and water vapor molecules are pulses of IR light radiating in 360 degrees, and since these molecules are relatively rare gas molecules, there is a relatively long distance between these absorbing molecules, therefore then these CO_2 and water vapor molecules are only absorbing very small flux of IR energy before they collide with a N_2 or an O_2 molecule and re-emit that IR energy in lower intensity and flux in 360 degrees.

So, also in the case of a cold earth surface, the highly touted ability of so-called “greenhouse gases” to “trap” radiation only lasts for the instant of time between collisions, and at each successive absorption-collision-emission a diminishing flux and intensity is incident upon earth’s surface or any gas molecules with available bands. If the earth’s cold surface is opaque, it will absorb the diminished IR flux resulting in slight warming of the colder surface. If the cold surface is reflective, e.g. covered with fresh snow or ice, then the IR flux is reflected/scattered back into the air but at reduced intensity and flux density. Thus, the net result is that so-called “greenhouse gases” have delayed cooling of the earth’s surface, essentially functioning as a temporary insulator.

Down-dwelling radiation from a water vapor or CO_2 molecule could be absorbed by certain these same gas molecules, but the probability distribution is that those nearby gas molecules have already absorbed their quanta of IR radiation from the same IR source, the near continuous and more intense, higher flux IR radiation from the earth’s surface. If the energy bands of nearby CO_2 and water vapor molecules are already occupied, then IR radiation will be transmitted transparently through those nearby molecules.

Summarizing so far, most of the IR absorbed by so-called “greenhouse gases” is radiated away from the surface. The down-dwelling half of the radiative flux from these gases may make multiple trips to the surface and back into the air with diminishing flux and intensity at each trip. The net sum of the fluxes results in a delay of cooing of the surface.

IR radiation itself is not heat (nor temperature increase). Heat is generated upon collisions of mass, more collisions = higher temperature = higher gas pressure, or higher conduction and convection in a liquid or solid where the molecules are in physical or ionic contact. Heat is also created after IR radiation is absorbed by molecules causing increased frequency of the internal kinetic vibrations of the atoms in molecules and while in that elevated energy state those excited molecules collide with or are in physical contact with a surface; in such a collision, the potential energy of one molecule can be translated into kinetic motion of the molecules on the solid surface or in the liquid matrix. In the same way but in reverse, a molecule colliding with a high temperature (rapidly vibrating) surface has its vector motion accelerated (higher temperature) after the collision.

Absorption and emission events by themselves are not thermal events. Photons have no mass and no friction. Sunlight is not hot and radiation up-dwelling from earth's surface is not heat. The relative vector motion and collision of molecules is what we measure and perceive as heat. A visible light source shining onto your hand does not warm your hand even though visible light is higher energy than IR light. IR light shining onto your hand feels warm because the IR frequencies/wavelengths match frequencies/wavelengths in molecules in your skin and excites those molecules to higher frequency vibrations, which we perceive and measure as increased temperature.

Photons/waves at appropriate frequencies/wavelengths excite electrons. The probability and frequency of a negative electric charge being found in a given location around the molecule is increased. Upon absorption, the electrons are bumped from their ground state up to an excited state. The velocity and frequency of the incident photon/wave is converted by the electron shell into higher frequencies of the various characteristic internal kinetic motions of the atoms (which have mass) relative to other atoms in the molecule. The gas molecule which was stretching and bending in various characteristic patterns in its ground state now does those characteristic motions at higher frequency; this is absorption. Then, this elevated vibrational state can be transmitted by collision with another molecule which has similar dipole moments if that molecule is not already excited, after which the first molecule returns to its ground state vibrations. In other words, the elevated vibrational state that results from absorbance of IR radiation does not necessarily result in higher temperature. Higher frequency internal molecular vibration from absorption of radiation is higher potential energy. Heating occurs when the internal motions of the atoms in molecules are translated to kinetic vector motion of the molecules, when atomic motions become molecular motions. This translation occurs in collisions or physical contact between molecules.

An excited molecule can also relax to its ground state vibrations by emitting the IR radiation which it absorbed. Near the surface in the troposphere usually there will be a collision before this relaxation occurs. In the rarified, low pressure, cold, upper atmosphere, about half of this IR radiation can be emitted into outer space from a given molecule in a given emission event.

In certain collisions, such as a water vapor molecule colliding with a nitrogen molecule (which is the most likely occurrence for a water vapor molecule by about an order of magnitude), the excited water vapor molecule will emit IR in 360 degrees – a momentary point of IR light – after the collision, and the vector motion of the water vapor molecule will be accelerated (heated) after the collision with the more massive N_2. Alternatively, the water vapor molecule would also be accelerated (heated) following a collision with an O_2 or CO_2 molecule since these are also more massive molecules than a water vapor molecule. Since O_2 and N_2 are much higher concentration in air than water vapor, and since O_2 and N_2 have no energy bands with which to absorb either vibrations or emitted radiation from water vapor molecules, and since O_2 and N_2 are more massive than water vapor, then the most likely event in this example of probability distribution is post-collision 360-degree IR emission by the water vapor molecule into the surrounding 99% empty space, followed by the water vapor molecule relaxing to its ground state internal vibrations, and a new vector direction and acceleration (temperature) are imparted to the water vapor molecule as determined by the velocity and mass of the two molecules and collision angle of that specific collision event. In other words, the water vapor molecule, which is considered by some to responsible for 95% of so-called “greenhouse gas” warming, is itself warmed (accelerated) by frequent collisions with the far higher concentrations of the more massive N_2 and O_2 molecules in air.

On the other hand, a collision between the more massive CO_2 molecule with either O_2, N_2 or gaseous H_2O will result in acceleration (heating) of the O_2, N_2, or gaseous H_2O. Of course, collisions with CO_2 are rare compared to the probability of collisions among the other gases colliding with each other. Although collisions with CO_2 are relatively rare because CO_2 is a trace gas, increasing the concentration of CO_2 increases the rate of collisions between CO_2 with the other less massive molecules in air. Collisions with CO_2 will result in acceleration (heating) of the other molecule in the collision, but this heating is not due to absorption of IR radiation by CO_2, unless the other molecule happens to be water vapor or CO_2. IR radiation is potential energy held in the excited or elevated internal vibrations of the CO_2 molecule. To transfer that potential energy non-radiatively the CO_2 molecule would need to collide with another molecule with similar dipole configuration (such as another CO_2 molecule or a water vapor molecule) which itself is not already excited; the probability of such a collision is very low.

Note that the absorbance of radiation by a gas is linearly proportional to the concentration of that gas. But, on the other hand, temperature of a gas increases by the log of the concentration of the gas (i.e., the inverse of concentration: 1 divided by the concentration.) In other words, absorption and re-emission of radiation by so-called “greenhouse gases” does occur, but the molecular species of the gas (and thus its mass), as well as its relative concentration versus the other gases in air, and the air pressure, determine the temperature of the air more than the absorption of IR radiation by “greenhouse gases” like water vapor and CO_2. And, the net concentration of “greenhouse gases” is dominantly determined by the temperature of the oceans. Collisions determine air temperature far more than absorption of IR radiation. “Trapping” of IR radiation lasts only fractions of a second between collisions. Net summary: absorption of IR radiation from earth’s surface by “greenhouse gases” results in delayed cooling of the earth’s surface by delaying emission of IR radiation back into outer space. This delayed cooling results in earth being a much more comfortable temperature and place to live. The effects of human-produced CO_2 are too small to measure.