American Meteorological Society Annual Meeting

Abstract Title : (10.6) A Fundamental Breakdown in Communication between Atmospheric Scientists and Physicists Concerning Greenhouse Warming Theory and Some Continuing Problems in Understanding How Air Is Heated

Abstract Type: Oral

Conferences: 19th History Symposium

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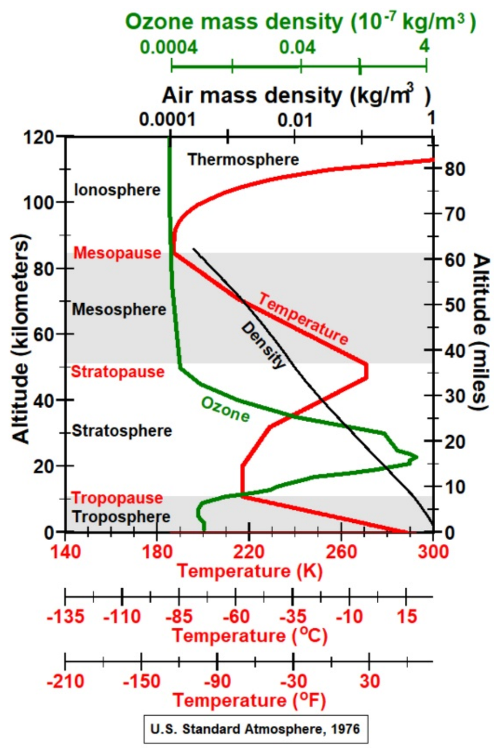
Abstract Schedule:
Date: Thursday, January 14, 2021
Time: 11:05 a.m. - 11:10 a.m.

Abstract Description:

Tyndall (1859), a prominent Irish physicist, documented that gas molecules containing three or more atoms absorb some infrared frequencies radiated by Earth the more atoms, the more bonds, the more frequencies absorbed, the more "potent" the greenhouse gas is calculated to be. Scientists still assume that if these gas molecules absorb thermal energy, they must make air hotter. This is the basis of greenhouse-warming theory first quantified by Arrhenius (1896), a chemist, based on a theory of heat first described by Thompson (1798), a physicist and inventor, long before scientists understood the atomic and molecular nature of matter. Thompson defined heat as a flux, an amount of thermal energy flowing each second through a surface. Thompson assumed the greater the net amount of thermal energy flowing into a body of matter per second, the greater the body's temperature would become. Fourier (1822), described the assumption that Earth would become hotter if it did not lose to space an amount of heat as great as the amount of heat Earth absorbed from Sun. These assumptions form the foundation of greenhouse-warming theory.

But defining heat as a flux, an amount of thermal energy flowing per second, is arithmetic, not physics, because it sidesteps the question of what heat is physically and how it flows. What physically is happening inside a body of matter that gives that body a physical property that we measure as temperature? Today, physicists understand that temperature of matter is caused by the physical oscillation of all the bonds holding matter together and that flux is proportional to difference in temperature. Temperature is the result of a level of thermal energy at the molecular level, not an amount of thermal energy as currently assumed.

Angstrom (1900), a Swedish physicist specializing in absorption of solar radiation by Earth's atmosphere, showed that increases in concentrations of CO_2 do not appear to increase air temperature. He showed that CO_2 absorbs into its bonds less than 16% of the infrared frequencies radiated by Earth. This absorption has no direct effect on air temperature. After publication of Angstrom's paper, most scientists lost interest in greenhouse-warming theory. In 1938, Callendar, a British steam engineer, resurrected greenhouse-warming theory from the trash bin of history but summarily dismissed Angstrom's paper without discussion. ngstrm was the only person trained in physics to question the physics of greenhouse-warming theory in the literature until I became interested around 2010. Angstrom's paper was written in German and is largely unknown to most modern climate scientists. This fundamental breakdown in communication between physicists and climate scientists from a broad spectrum of other scientific disciplines is the primary reason for current misunderstandings.



The second reason is that there are still problems in physics in understanding how thermal radiation is converted to air temperature. In the troposphere, air touching Earth's sun-warmed surface is heated by conduction and rises by convection. The degree of heating from below varies widely as a function of latitude, time of day, clouds, etc. The stratosphere, on the other hand, is heated from above by photo-dissociation. When a molecule of oxygen absorbs solar ultraviolet-C radiation, the molecule is observed to be dissociated the molecular bond breaks. The two oxygen atoms fly apart at high velocity. Temperature of air is well-known to be proportional to the square of the average velocity of all its molecules and atoms. Photo-dissociation converts bond energy immediately and completely into air temperature. The stratosphere is stratified because it is evenly heated by solar radiation from above and because convection is not physically possible since temperatures increase upwards. What makes photo-dissociation so important is that any two atoms of oxygen can collide, reestablishing the molecular bond without changing air temperature. Then the new molecule of oxygen can be photo-dissociated again, raising air temperature, provided sufficient solar ultraviolet-C radiation still exists. By the time sunlight penetrates to the bottom of the stratosphere, all solar ultraviolet-C radiation has been absorbed.

An atom of oxygen and a molecule of oxygen can also collide to form a molecule of ozone. Ozone is photo-dissociated by solar ultraviolet-B radiation, heating the ozone layer in the lower stratosphere. Oxygen atoms and oxygen molecules can then collide again forming a molecule of ozone, which is photo-dissociated again if ultraviolet-B radiation still exists. Normally 97 to 99% of all solar ultraviolet-B radiation is absorbed in the ozone layer before reaching the tropopause. Photo-dissociation is particularly effective at warming air because the increase in temperature is determined primarily by the amount of solar ultraviolet-B radiation available, not by the concentration of ozone molecules. The upper atmosphere is heated by photo-ionization, which is simply photo-dissociation of an electron. The highest energy, highest frequency radiation from Sun breaks the bond between an atom or a molecule and one of its electrons. The pieces fly apart at high velocity, heating the ionosphere.

Earth's surface warmed 0.6ºC from 1970 to 1998 when human-manufactured chlorofluorocarbon gases were observed to deplete the ozone layer and 0.3ºC from 2014 to 2016 when the largest basaltic volcanic eruption since 1783 was observed to deplete the ozone layer. When the ozone layer is depleted, more ultraviolet-B radiation reaches Earth where it is observed to photo-dissociate ground-level ozone pollution, cooling the ozone layer and warming Earth. Major global warming throughout Earth history is contemporaneous with basaltic lava flows covering areas as large as millions of square kilometers the greater the area, the greater the warming. Ozone-depletion theory explains observed global warming in greater detail and far more accurately than greenhouse-warming theory.

But physicists still do not understand the problems with defining heat as a flux, adding fluxes together, thinking of heat as an amount of thermal energy instead of a level of thermal energy, thinking in terms of a balance of fluxes, and the dominant role of photo-dissociation in determining atmospheric temperatures above the tropopause. Current thinking in thermodynamics works acceptably for small differences in temperature typical in most engineering applications but fails catastrophically when Sun is thousands of degrees hotter than Earth. Details at WhyClimateChanges.com.