Review Article

Geophysical Consequences of Tropospheric Particulate Heating: Yet Further Evidence that Global Warming is Caused by Particulate Pollution, Not Carbon Dioxide

ABSTRACT

The climate science community and the United Nations' Intergovernmental Panel on Climate Change have misled world governments by failing to acknowledge tropospheric particulate geoengineering that has been ongoing with ever-increasing duration and intensity for decades, and by treating global warming solely as a radiation-balance issue, which has resulted in a seriously incomplete understanding of the fundamental factors that affect Earth's surface temperature. Here we review the consequences of tropospheric particulate heating by absorption of short- and long-wave solar radiation and long-wave radiation from Earth's surface. Generally, black carbon absorbs light over the entire solar spectrum; brown carbon absorbs near-UV wavelengths and, to a lesser extent, visible light; iron oxides are good absorbers, the most efficient being magnetite. Pyrogenic coal fly ash, both from coal burning and from tropospheric jet-spraying geoengineering (for military purposes and/or climate engineering), contains carbon and iron oxides, hematite and magnetite. The recently published climate-science paradigm shift, namely, that the main cause of global warming is not carbon dioxide heat retention, but particulate pollution that *absorbs radiation, heats the troposphere, and reduces the efficiency of atmospheric-convective heat removal from Earth's surface*. In addition to the World War II data, three other independent lines of supporting evidence are reviewed: (1) Passage overhead of the Mt. St. Helens volcanic plume; (2) radiosonde and aethalometer investigations of Talukdar et al.; and, (3) convection suppression over the tropical North Atlantic caused by the Saharan-blown dust. The risks associated with the placement of aerosol particulates into the stratosphere, whether lofted naturally, inadvertently, or deliberately as proposed for solar radiation management, poses grave risks, including the destruction of atmospheric ozone. To solve global warming humanity must: (1) Abruptly halt tropospheric particulate geoengineering; (2) trap particulate emissions from coal-fired industrial furnaces (especially in India and China) and from vehicle exhaust; and, (3) reduce particulate-forming fuel additives.

Comment [P1]: Please dilute the word 'misled', this is too harsh in an academic journal article. Your opinion is good from your own point of view. The UN before arriving at the conclusion had some research supporting the claims. Neither your view nor UN view is misleading the world, there is a meeting point now or in the future.

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Keywords: Aerosol particulate heating, aerosol particulates, geoengineering, climate change, atmospheric convection, coal fly ash, particulate pollution, global warming

1. INTRODUCTION

The idea that our planet is experiencing global warming due to anthropogenic carbon dioxide and other greenhouse gases has been hammered into public consciousness for three decades. There are good reasons to believe that political motives are driving much of the scientific work of the climate science community and the United Nations' Intergovernmental Panel on Climate Change (IPCC) [1]. Real science, unlike politics, is all about telling the truth, truth that is securely anchored to the properties of matter and energy (radiation) [2,3]. However, the climate science community, including the IPCC, has failed to tell the truth by not considering or even mentioning the climate-affecting tropospheric particulate geoengineering that has been ongoing for decades and which has become a near-daily, near-global activity (Figure 1) [4]. The failure to take into consideration the ongoing tropospheric particulate geoengineering compromises IPCC evaluations as well as the published work of numerous climate scientists, and calls into question whether or not political motivations are involved. [5].

Figure 1. Geoengineering particulate trails with photographers' permission. Clockwise from upper left: Soddy-Daisy, Tennessee, USA (David Tulis); Reiat, Switzerland (Rogerio Camboim SA); Warrington, Cheshire, UK (Catherine Singleton); Alderney, UK looking toward France (Neil Howard); Luxembourg (Paul Berg); New York, New York, USA (Mementosis)

For more than three billion years, as long as life has existed on Earth, the surface of our planet has maintained a remarkably stable state of thermal equilibrium through the aggregate-effect of numerous natural processes, despite being bombarded by potentially variable solar radiation from above [6,7] and potentially variable planetary energy sources from below, including georeactor nuclear fission energy [8-11] and stored protoplanetary compression energy [12-14]. Decades ago, considering the ever-increasing scale of human activity, it might have been prudent to engage in open scientific debates and discussions to ascertain with reasonable certainty the nature and extent that human activities might be altering those natural processes. But, such objective, open inquiry never occurred.

Instead, in 1988 the IPCC was established, and in concert with various other governmental entities, such as the U. S. National Aeronautics and Space Administration (NASA), and presumably driven by political and/or financial motives [15], the IPCC convinced numerous political leaders that greenhouse gases, notably fossil-fuel produced carbon dioxide [CO_2], were trapping heat that otherwise should have been released to space [4]. As the Cold War ended, climate change, also known as global warming, became the new global enemy.

The science promulgated by the IPCC and the climate science community is seriously flawed, not only by its failure to consider all factors affecting climate (notably ongoing covert geoengineering), but also by the application of a seriously flawed investigatory-methodology that includes the use of assumption-based computational models that typically begin with a known end-result that is attained by cherry-picking data and parameters [16]. Computational models, sometimes called simulations, are computer programs subject to the well-known dictum "*garbage in, garbage out*" [17].

As the noted atmospheric chemist and inventor of the electron capture detector James Lovelock noted [18]: "*Gradually the world of science has evolved to the dangerous point where model-building has precedence over observation and measurement, especially in Earth and life sciences. In certain ways modeling by scientists has become a threat to the foundation on which science has stood: the acceptance that nature is always the final arbiter and that a hypothesis must always be tested by experiment and observation in the real world.*"

Generally, to maintain stable surface temperatures over time, all of the heat received from the sun [6,7], as well as the heat brought to the surface from deep-Earth heat-sources [8-14], must be released to space. The climate science community treats global warming solely as a radiation-balance issue. Toward that end they define an artificial construct "radiative forcing" or "climate forcing" in units of Wm^{-2} relative to 1750 Wm^{-2} as a means to represent the departure from zero-net radiation balance [19], which they presume is caused primarily by anthropogenic carbon dioxide and other greenhouse gases. While that approach provides a common means to express computer model results, it also leads to an incomplete understanding of all of the factors that affect Earth's surface temperature, as we disclose in this review.

Moreover, in instances there is a lack of understanding of fundamental processes that are crucial to the problem of understanding the maintenance of Earth's surface temperature. For example, many climate scientists (falsely) believe that particulate aerosols, including black carbon (BC), cool the Earth's surface [20-28] or are uncertain whether aerosols cool or heat the Earth [29,30]. For example, Ramanathan and Carmichael [31] state: "...*black carbon has opposing effects of adding energy to the atmosphere and reducing it at the surface*." Similarly, Andreae, Jones and Cox [20] state: "*Atmospheric aerosols counteract the warming effects of anthropogenic greenhouse gases by an uncertain, but potentially large, amount*."

Uncertainty as to whether aerosols result in cooling or warming hinders the ability to project future climate changes [32,33] and even hinders the ability to understand the fundamental factors responsible for maintaining surface temperatures in a range that makes life possible.

Science progresses by questioning the correctness of popular paradigms, and through tedious efforts to place seemingly independent observations into a logical order in the mind so that causal relationships become evident and new understanding emerges [2]. In a series of publications we disclosed a fundamentally different understanding of the main cause of global warming [1,34-37]. The main cause of anthropogenic global warming is not carbon dioxide heat retention, but particulate pollution that heats the troposphere and reduces the efficiency of atmospheric-convective heat removal from Earth's surface [1,34-37].

Rather than making grand, detailed, computational-models based upon the poorly understood complexities of climate science, a preferred approach, we suggest it is more fruitful to better understand the behavior of several specific factors that affect Earth's climate. Toward that end, we review evidence related to the behavior and climate consequences of tropospheric particulate heating.

2. TROPOSPHERIC PARTICULATE HEATING

Solid and/or liquid particles, typically ≤ 10 µm across, in the troposphere originate from a variety of sources including moisture condensation [38], incomplete biomass burning, combustion of fossil fuels, volcanic eruptions, wind-blown road debris, sand, sea salt, biogenic material [39] and, significantly, pyrogenic coal fly ash from unfiltered industrial exhaust [40-43] and geoengineering applications [44-50]. Tropospheric particulates have short atmospheric residence times ranging from days to a few weeks, but nevertheless have direct climate effects through their absorbing solar radiation and radiation from Earth's surface, as well as indirect effects on cloud formation and associated microphysics [51-54].

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When a light photon interacts with particulate matter, it is either reflected (scattered) or absorbed. Considerable efforts have been expended to obtain reflectance spectral data [55] because of their importance in remote imaging technology. Regrettably, there is a dearth of absorption spectral data as the climate science community has been slow to appreciate its importance. Recently, however, measurements of particulate-matter absorption spectra are beginning to be made and, although limited, for example, in spectral-wavelength, it is possible to make accurate non-quantitative generalizations.

Aerosol particles interact with solar radiation by scattering (i.e. reflecting) or absorbing the radiation, both long-wave and short-wave. They become heated and subsequently transfer that heat to the atmosphere through molecular collisions [56,57]. The contribution of black carbon to atmospheric heating is widely recognized [31,56]. However, virtually all aerosol particles absorb solar radiation to some extent, including those that have a high proclivity to scatter radiation [58,59]. Quantifying aerosol absorption/scattering presents considerable uncertainties for many reasons including, for example, variations in particle size, surface topography, chemical/mineral composition, surface coatings, as well as differences in and lack of knowledge of relevant absorption spectra [60,61].

Most particulates found in the troposphere absorb solar energy to some extent from one or more portions of the wavelength spectrum [62-68]. As Hunt noted [69]: "*A dispersion of small absorbing particles forms an ideal system to collect radiant energy, transform it to heat, and efficiently transfer the heat to a surrounding fluid.... If the characteristic absorption length for light passing through the material comprising the particles is greater than the particle diameter, the entire volume of the particles is active as the absorber. When the particles* *have absorbed the sunlight and their temperature begins to rise they quickly give up this heat to the surrounding gas....*"

The one generalization that can now be made is that virtually all tropospheric aerosol particulates, including cloud droplets and their particulate components, absorb short- and long-wave solar radiation, and absorb long-wave radiation from Earth's surface, thus becoming heated. Moreover, aerosols can modify cloud properties and suppress rainfall [70-73]. As Tao et al. [74] note: "*Aerosols, and especially their effect on clouds and precipitation, are one of the key components of the climate system and the hydrological cycle. Yet the aerosol effect on clouds and precipitation remains poorly known.*"

Whereas the methodology utilized by the IPCC and climate science community has focused primarily on the problem of sun-Earth radiation balance and departures therefrom, our focus has been on *understanding the processes involved in the disposition of absorbed heat, notably the consequences of particulate pollution on atmospheric convection*, which we submit, is a primary mechanism for maintaining Earth's habitable surface temperature [1,34-37].

2.1 Role of Carbon and Iron in Aerosol Heating

Dark-colored particulates are efficient absorbers of solar radiation of which black carbon (BC), e.g. soot, absorbs light over the entire solar spectrum; brown carbon, e.g. soil humus, on the other hand, absorbs near-UV wavelengths and, to a lesser extent, visible light [75]. Carbon surface deposits on non-carbonaceous aerosols can enhance their solar radiation heat potential [76].

Iron is usually found in anthropogenic carbonaceous particles [77]. Iron-oxide minerals, although somewhat less efficient solar radiation absorbers than carbon, nevertheless are dominate among mineral radiation-absorbers. Alfaro et al. [78] measured light absorption in samples of desert dust at two wavelengths, 325 nm (ultraviolet) and 660 nm (red light). They found that for carbon-free desert dust, iron oxide was by far the greatest light absorbing substance with the amount of absorption being a linear function of iron oxide content. They further found that the absorption at 325 nm is about 6 times greater than at 660 nm. In addition, Liu et al. [79] employed an "*airborne laser-induced incandescence instrument*" to measure the hematite content of the Saharan dust layer which is known to be heated by solar radiation [80,81].

Matsui et al. [42] discussed the relative importance of anthropogenic combustion iron and iron from mineral dust in aerosol heating, and noted that "*magnetite* [Fe_3O_4] *is the most efficient short-wave absorber among iron oxides in the atmosphere*." Moteki et al. [43] found that the majority of aerosol iron oxide particles in East Asian continental atmospheric outflows are anthropogenic aggregated magnetite nanoparticles that, in addition to carbonaceous aerosols, are significant contributors to short-wave atmospheric heating. Recent results indicate that the atmospheric burden of anthropogenic iron of pyrogenic origin is 8 times greater than previous estimates [42].

Yoshida et al. [82] note that there is a strong correlation between anthropogenic FeOx and BC particles in the East Asian continental outflow of anthropogenic origin. That is not surprising as pyrogenic coal fly ash, in addition to containing magnetite and other iron-oxides, contains carbon particles [83]. For a set of UK coal fly ash (CFA) samples, the hematite [Fe_2O_3] range was determined as 2.5 – 8.6 wt.%, the magnetite [Fe_3O_4] range as 0.8 – 4.1 wt.% [84]. The carbon content of coal fly ash by one estimate is 2 – 5 wt.% under optimum conditions, and 20 wt.% under non-optimum conditions [85]. Another investigation found the carbon content range of coal fly ash to be 2.7 – 14.5 wt.% [86]. One thing is clear from these data: Aerosolized coal fly ash efficiently absorbs solar radiation and heats the troposphere.

2.2 Role of Forest Fires in Aerosol Heating

The smoke and ash from forest fires uplifted into the troposphere comprises one class of aerosol particulates that contains black carbon, brown carbon and iron oxides [66,87]. Iron oxides in the ash from forest fires can be converted at high temperatures to magnetite [Fe_3O_4] which is an even more efficient absorber of solar radiation [65]. The effect of forest-fire originated brown carbon aerosols on atmospheric heating likely has been underestimated [88]. Since 1999 there has been a four-fold increase in the particulates arising from forest fires in the United States [89], which to some extent appears to be one consequence of the now near-daily, near global aerosol particulate geoengineering [49]; corresponding increases have been noted worldwide [90-92]. In addition, fire increases surface heat, and reduces water-evaporation by damaging the canopy [93]. Moreover, forest fires have an "*immediate and profound impact*" on snow disappearance, earlier springtime melt, and lower summer stream flows [89].

2.3 Role of Coal Fly Ash in Aerosol Heating

As the aerial spraying, like that shown in Figure 1, became a near-daily activity in San Diego (USA), one of us (JMH) began a series of investigations aimed at determining the nature and composition of the aerosolized particulates being sprayed. Initially, comparison of Internet-posted 3-element rainwater analyses with corresponding laboratory water-extract analyses of a likely potential aerosol provided the first scientific forensic evidence that the main particulate-substance being jet-sprayed was consistent with the leaching-behavior of coal fly ash (CFA) [44]. Subsequently, comparing 11 similarly-extracted elements validated that forensic finding [48]. Additional consistency was demonstrated by comparing CFA analyses to 14 elements measured in air-filter trapped outdoor aerosol particles [46], and to 23 elements measured in aerosol particles brought down during a snowfall and released upon snow-melting [47,48].

Burning coal concentrates the harmful elements in the ash [94]. The heavy ash that is formed settles beneath the burner. The light ash, called coal fly ash (CFA), forms by condensing and accumulating in the hot gases above the burners. Coal fly ash escapes into the atmosphere from smokestacks in India and China, but is usually trapped and sequestered in Western nations [95,96].

The annual global production of CFA in 2013 was estimated to be 600 million metric tons [97]. Coal fly ash is a cheap waste product that requires little additional processing for use as a jet-sprayed aerosol since its particles form in sizes ranging from 0.01 – 50 µm in diameter [98]. Except for its serious harm to human and environmental health [48,49,99-106], CFA is an ideal particulate for heating the troposphere through absorption of short-wave and long-wave radiation as CFA contains substantial quantities of the iron oxides, hematite and magnetite, as well as carbon [83-86].

3. DIURNAL TEMPERATURE RANGE

The diurnal temperature range (DTR), the daily high temperature minus nightly low temperature, ($T_{max} – T_{min}$), when tracked over time provides a measure of climate change that is model-independent. Moreover, greenhouse gases' effects on long-wave radiation are equivalent during both day and night, and thus affect T_{max} and T_{min} equally. DTR data are therefore essentially independent of the direct radiative consequence of greenhouse gases [4,107]. Furthermore, greenhouse gases are transparent to incoming solar radiation [108]. Although the reduction in T_{max} can be explained by sunlight being absorbed or scattered by particulates or by clouds, the increase in T_{min} is *inexplicable within the current IPCC understanding of climate science* [4] which is dominated by radiation-balance considerations. Diurnal temperature range (DTR) data are typically presented as averages over suitable increments of time for a large geographic area. Figure 2 from Qu et al. [109] presents yearly DTR, T_{max} and T_{min} mean values over the continental USA throughout most of the 20th century and up to 2010.

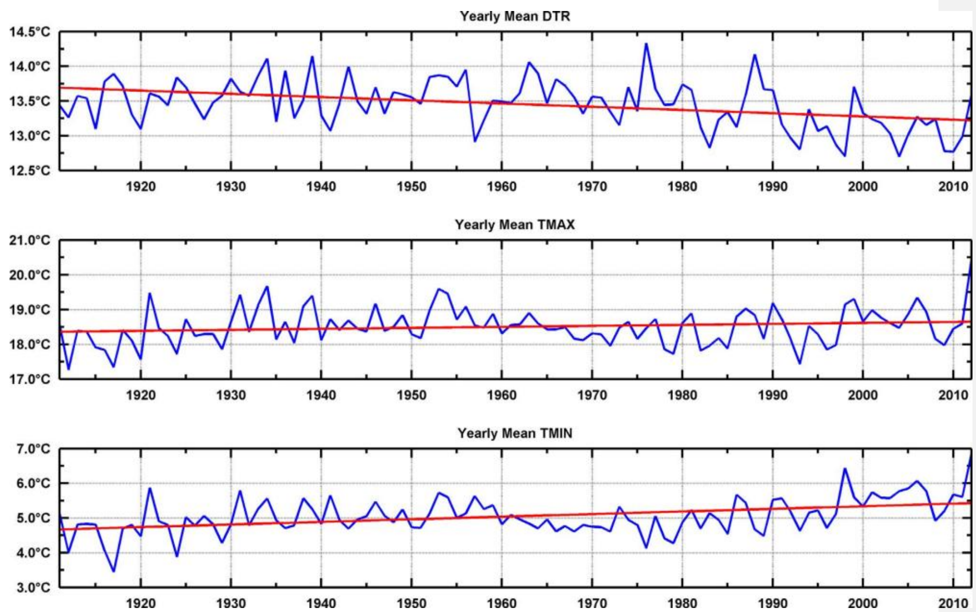

Figure 2. Yearly DTR, T_{max} and T_{min} mean values over the continental USA. The red lines are linear regressions. From [37,109], (http://creativecommons.org/licenses/by-nc-nd/3.0/).

As shown in Figure 2, T_{min} increases at a greater rate than T_{max} causing DTM to decrease over time, a phenomenon that is observed in many similar investigations [110-113] but not all [114]. The reduction in T_{max} can be explained by sunlight being blocked by particulates or by clouds [112], however, the concomitant increase in T_{min} is problematic within the radiation-balance paradigm practiced by the IPCC and climate science community. A good way to make advances in science, in instances such as this, is to ask the question: "*What is wrong with this picture*?" [3].

4. EVIDENCE FROM WORLD WAR II

Gottschalk [115,116] noticed a thermal peak coincident with World War II (WW2) in a global temperature profile image on the front page of the January 19, 2017 *New York Times*. He applied sophisticated curve-fitting techniques to 8 independent global temperature datasets from the U. S. National Oceanic and Atmospheric Administration (NOAA) and demonstrated that the WW2 peak is a robust feature. He concluded that the thermal peak "*is a consequence of human activity during WW2*" [115,116].

The conspicuous aspect of Gottschalk's global-warming results [115], shown by the black curves in Figure 3, is that immediately after WW2 the global warming rapidly subsided. That behavior is inconsistent with CO_2-caused global warming because CO_2 persists in the atmosphere for decades [4,117]. CO_2-caused global warming during WW2 can be further ruled out as Antarctic Law Dome Ice core data during the period 1936-1952 show no significant increase in CO_2 during the war years, 1939-1945 [118]. The evidence thus points to a feature other than CO_2 for the WW2 climate event.

One of us (JMH) realized that WW2 activities injected massive amounts of particulate matter into the troposphere from extensive military industrialization and vast munition detonations, including the demolition of entire cities, and their resulting debris and smoke. The implication is that the aerosolized pollution particulates trapped heat that otherwise should have been returned to space, and thus caused global warming at Earth's surface [34] If particulate pollution caused the sudden rise in temperature, it would have subsided rapidly after hostilities ceased. Rapid cessation of WW2 global warming is thus understandable, since tropospheric pollution-particulates typically fall to ground in days to weeks [51-54,119].

Figure 3, from [34,115], shows relative-value, particulate-pollution proxies added to Gottschalk's figure: Global coal production [120,121]; global crude oil production [121,122]; and, global aviation fuel consumption [121]. Each proxy dataset was normalized to its value at the date 1986, and anchored at 1986 to Gottschalk's boldface, weighted average, relative global warming curve. The particulate-proxies track well with the 8 NOAA global datasets used by Gottschalk [34].

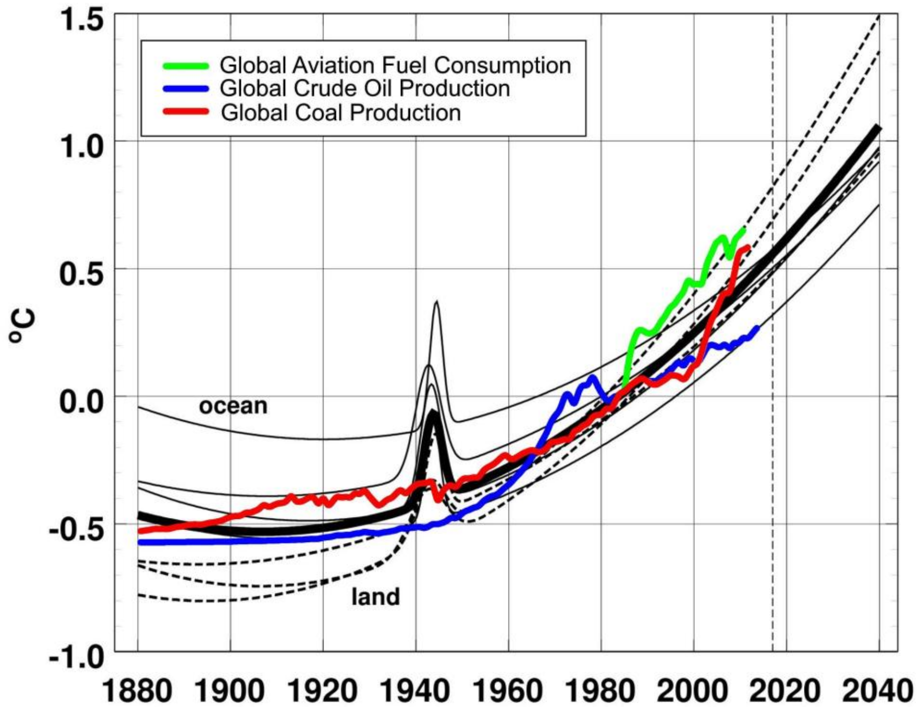

Figure 3. Copy of Gottschalk's fitted curves for eight NOAA data sets showing relative temperature profiles over time [115] to which are added proxies for particulate pollution. Dashed line, land; light line, ocean; bold line, weighted average. From [34].

Following the end of WW2 hostilities, wartime aerosol particulates rapidly settled to ground [119], Earth radiated its excess trapped energy, and global warming abruptly subsided for a brief time [34]. Soon, however, post-WW2 industrial growth, initially in Europe and Japan, and later in China, India, and the rest of Asia [123] increased worldwide aerosol particulate pollution and with it concomitant global warming [34]. The rapid non-linear rise in these curves in recent decades presumably has been also accelerated by covert tropospheric aerosol geoengineering operations.

From the evidence shown in Figure 3, there is one inescapable conclusion: Aerosol particulate pollution, not carbon dioxide, is the main cause of anthropogenic global warming. That conclusion is not at all evident if you rely on the "radiation-balance" methodology and parametrized models so widely utilized. The concept that aerosol particulate pollution is the main cause of global warming thus constitutes *a climate-science paradigm shift*.

In the desert cloudy days are usually cooler than non-cloudy days, while cloudy nights are typically warmer than non-cloudy nights. With that observation in mind, we now review the evidence of the principal mechanism responsible for aerosol particulate caused global warming.

5. MECHANISM OF GLOBAL WARMING BY AEROSOLIZED PARTICULATES

Aerosol particulates that become heated and transfer that heat to the surrounding atmosphere have been said to cause "*changes in the atmospheric temperature structure*" [124]. Published scientific papers rarely, if ever, mention of the consequences of such observations on atmospheric convection, and the concomitant surface-heat-transfer reduction that results from "*changes in the atmospheric temperature structure*" [4].

Indeed, convection is perhaps the most misunderstood natural process in Earth science. Hypothetical convection models of the Earth's fluid core [125-128] and of the Earth's mantle [129,130] continue to be produced, although sustained thermal convection in each instance has been shown to be physically impossible [8] thus necessitating a fundamentally different geoscience paradigm [9,12-14,131-133].

Convection in Earth's troposphere is dynamically complex. Computational models, although simplistic, are mathematically complicated [134,135] and typically utilize parametrization-based [136] assumption-simplification solutions of hydrodynamic equations [137,138]. Critical details of the actual physical process of convection may be thus obscured in climate-science models.

Chandrasekhar described convection in the following, easy-to-understand way [139]: *The simplest example of thermally induced convection arises when a horizontal layer of fluid is heated from below and an adverse temperature gradient is maintained. The adjective 'adverse' is used to qualify the prevailing temperature gradient, since, on account of thermal expansion, the fluid at the bottom becomes lighter than the fluid at the top; and this is a top-heavy arrangement which is potentially unstable. Under these circumstances the fluid will try to redistribute itself to redress this weakness in its arrangement. This is how thermal convection originates: It represents the efforts of the fluid to restore to itself some degree of stability.*

To the best of our knowledge, consequences of the *adverse temperature gradient*, described by Chandrasekhar [139] have not been explicitly considered in either solid-Earth or tropospheric convection calculations. A simple classroom-demonstration experiment, however, can provide critical insight for understanding how convection works, applicable to both tropospheric and Earth-core convection [36].

As described recently [37]: *The convection classroom-demonstration experiment was conducted using a 4 liter beaked-beaker, nearly filled with distilled water to which celery seeds were added, and heated on a regulated hot plate. The celery seeds, dragged along by convective motions in the water, served as an indicator of convection. When stable convection was attained, a ceramic tile was placed atop the beaker to retard heat loss, thereby increasing the temperature at the top relative to that at the bottom, thus decreasing the adverse temperature gradient.*

Figure 4, from [36], extracted from the video record [140], shows dramatic reduction in convection after placing the tile atop the beaker. In only 60 seconds the number of celery seeds in motion, driven by convection, decreased markedly, demonstrating the principle that reducing the adverse temperature gradient decreases convection. That result is reasonable as zero adverse temperature gradient by definition is zero thermal convection.

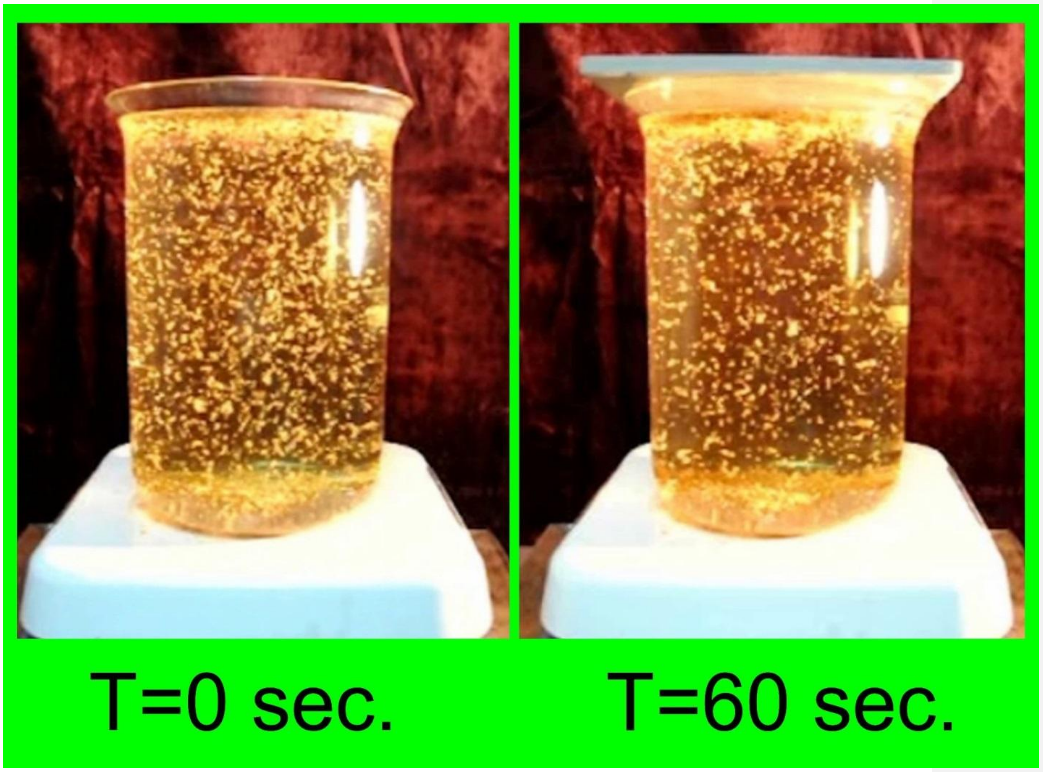

Figure 4. From [36]. A beaker of water on a regulated hot plate with celery seeds pulled along by the fluid convection motions. Placing a ceramic tile atop the beaker a moment after T=0 reduced heat-loss, effectively warming the upper solution's temperature, thus lowering the adverse temperature gradient, and reducing convection, indicated by the decreased number of celery seeds in motion at T=60 sec.

Particulate matter in the troposphere, including the moisture droplets of clouds not only blocks sunlight, but absorbs radiation from both in-coming solar radiation and from out-going terrestrial radiation. The heated particles transfer their heat to the surrounding atmosphere, increasing its temperature and reducing the adverse temperature gradient relative to the surface. The reduction of the adverse temperature gradient, as demonstrated by the above classroom-demonstration, concomitantly reduces convective heat transport from Earth's surface.

6. EVIDENCE OF CONVECTION-DRIVEN SURFACE HEAT LOSS-REDUCTION

The above discussion of the consequences of reduced tropospheric adverse temperature gradient is general, and pertains to global warming, regional warming, and to local warming. In the case of global warming, specific data on aerosol particulates might be available only for quite limited circumstances, such as the case of soot accumulation on museum bird specimens collected during the WW2 era [141]. However, the vast WW2 historical record, including film documentation, should leave no doubt that WW2-activity spiked the troposphere with vast amounts of particulate matter. Moreover, the particulate-proxies, shown in Figure 3, track well with the subsequent global warming record.

In the case of WW2, global warming was inferred from an understanding of the manner by which aerosolized particulates affect convection. The diurnal temperature range (DTR) data (Figure 2), suggest that, although aerosol particulates block some sunlight from reaching Earth's surface [112], to explain the reduction in T_{max} another process must account for the increase in T_{min}. Data from the Mt. St. Helens 1980 volcanic eruption in Washington State (USA) [142] demonstrated that a short-term reduction in the adverse temperature gradient increased the T_{min} of DTR data and provide an opportunity to assess the consequences of volcanic particulate injection into the troposphere [143].

As previously described [37]: *As the volcanic plume passed overhead in the troposphere, daytime temperatures dropped as the sunlight was absorbed and scattered by the particulates; nighttime temperatures, however, increased, and for a few days thereafter remained elevated presumably due to aerosol dust that persisted for a few days before falling to ground [143]. The diurnal temperature range was significantly lessened by the plume, but almost completely recovered within two days [143]. These observations are consistent with (1) the Mt. St. Helens aerosol particulates in the plume absorbing LW radiation and becoming heated in the atmosphere overhead, (2) the transfer of that heat to the surrounding atmosphere by molecular collisions, (3) the lowering of the atmospheric adverse temperature gradient relative to the Earth's surface, (4) the consequent reduction of atmospheric convection, and (5) concomitant reduction of convection-driven surface heat loss, which is evident by the increase in* T_{min} *[1,34-36].*

Because the IPCC and other climate scientists attempt to explain global warming by relying principally on the role of radiation transport, they are unable to explain the Mt. St. Helens' data in a logical, causally related manner as indicated, for example, by the following illogical explanation: "*at night the plume suppressed infrared cooling or produced infrared warming*" [143].

The idea that tropospheric particulates reduce atmospheric convection received further support by the long-duration series of radiosonde and aethalometer investigations undertaken by Talukdar et al. [144]. Their investigations demonstrated that higher amounts of tropospheric black carbon (BC) aerosols can disturb the normal upward movement of moist air by heating up the atmosphere, resulting in a decrease in the atmospheric convection parameters associated with the increase in concentration of BC aerosols.

Convection occurs *throughout the troposphere*, with differing degrees of scale, both geographically and altitudinally, and with various modifications caused by atmospheric circulation and lateral flow. Convection-efficiency in all instances is a function of the prevailing adverse temperature gradient. Aerosolized particulates, heated by solar radiation and/or terrestrial radiation, rapidly transfer that heat to the surrounding atmosphere, which in turn reduces the adverse temperature gradient relative to Earth's surface and, concomitantly, reduces surface heat loss and thereby over time causes increased surface warming [36]. The same particulate-pollution-driven process operates locally, as in the case of urban heat islands [63,145-148], regionally, and globally. Consequently, *particulate pollution, not anthropogenic carbon dioxide, is the likely principal cause of global warming* [1,34-36].

7. CONVECTION-REDUCTION BY SAHARAN-BLOWN SOLAR-HEATED DUST

During summer months, Saharan-blown dust covers an area over the tropical ocean between Africa and the Caribbean about the size of the continental United States [62,80,81]. The dust-layer extends to an altitude of 5-6 km; measurements indicate greater dust density and associated haziness at 3 km than at the surface [81].

The warmth of the upper portion of the Saharan-blown dust layer is a consequence of its origin over the Sahara, but the warmth is maintained by the absorption of solar radiation by the dust [80], which is known to contain radiation-absorbing iron oxide [78,79] that, when incorporated in bodies of water, initiates harmful algae blooms [106,149-151].

As noted by Prospero and Carlson [81]: "... *the warmth of the Saharan air has a strong suppressive influence on cumulus convection* ...." Dunion and Velden [80] further note: "*This new type of satellite imagery* [Geostationary Operational Environmental Satellite (GOES)] *reveals that the SAL* [Saharan air layer] *may play a major role in suppressing TC* [tropical cyclone] *activity in the North Atlantic. This paper presents documentation of these suppressing characteristics for a number of specific TC-SAL interactions that have occurred during several recent Atlantic hurricane seasons*." Similarly, Wong and Dessler [152] also recognize the suppression of convection over the tropical North Atlantic by the Saharan air layer. The one commonality of these investigations is their failure to recognize the generality of the reduction of convection-efficiency that occurs as a consequence of reducing the adverse temperature gradient through aerosol particulate heating [1,34-36].

8. SURFACE WARMING BY FALLEN AEROSOL PARTICULATES

Tropospheric aerosol particles, as reviewed above, heat the atmosphere, reduce the adverse temperature gradient relative to Earth's surface which suppresses atmospheric convection and thus reduces surface heat loss and increases global warming [1,34-37]. However, the lifetime of tropospheric particulates is short, typically settling to the surface in days to weeks [51-54,119]. If the aerosol particulates settle into bodies of water, their iron components disrupt the natural balance there, causing, for example, harmful algae blooms [106]. If the aerosol particulates settle on land, they absorb solar radiation and cause additional global warming [153,154]. If the aerosol particulates settle on snow or ice (Figure 5), they also change the albedo, causing less light to be reflected and more to be absorbed, further adding to global warming [155,156]. Zhang et al. [157] estimate a 38% albedo reduction caused by downed aerosol particulates in snow cover on the Tibetan Plateau. As noted above, forest fires have an "*immediate and profound impact*" on snow disappearance, earlier springtime melt, and lower summer stream flows [89].

Figure 5. Particulate-coated glacier in Iceland. Courtesy of Daniel Knieper.

9. AEROSOL TRANSPORT OF PARTICULATES INTO THE STRATOSPHERE

There is ample evidence of tropospheric aerosols in the stratosphere [158]. Various means exist for lofting aerosols from troposphere to stratosphere, including super-cell convection [159] and monsoon anticyclonic transport [160]. Soot aerosol, presumably from airline traffic in flight corridors near 10-12 km altitude, has been observed at up to 20 km altitude [161]. Volcanic ash aerosol was observed at 19 km altitude [162].

Residence time of particulates in the stratosphere is considerably longer than the days to weeks residence time of troposphere aerosols [51-54]. For example, the mean residence time for a tungsten-185 tracer injected into the equatorial stratosphere between 18 and 20 km altitude was found to be about 10 months, with most of the transport into the troposphere occurring at middle latitudes [163].

There are inherent risks associated with the placement of aerosol particulates into the stratosphere, whether deliberately, inadvertently, or through natural processes. The current ongoing near-daily, near-global geoengineering heat-trapping activity masks the effects of potential radiation-altering stratospheric aerosols. They also pose a serious threat to atmospheric ozone which protects life from ultraviolet solar radiation. Significant stratospheric ozone destruction was observed following the eruptions of El Chich´on [164]] and Pinatubo [165].

Table 1 from [99] shows the range of halogen compositions of coal fly ash (CFA). Covert geoengineering jet sprays massive quantities of ultra-fine CFA that presumably places vast amounts of chlorine, bromine, fluorine and iodine into the atmosphere all of which can deplete ozone. Other substances in CFA aerosols, including nano-particulates, might also adversely affect atmospheric ozone. Even if placed in the troposphere, some of this material will likely be lofted into the stratosphere [158-160].

Table 1. Coal fly ash:
Range of halogen element compositions [166].

Chlorine μg/g	**Bromine μg/g**	**Fluorine μg/g**	**Iodine μg/g**
13 – 25,000	0.3 – 670	0.4 – 624	0.1 – 200

By one recent estimate there have been 2,543 scientific articles published on the subject of solar radiation management geoengineering [167]. There is something inherently dishonest about geoengineering articles that neither mention nor discuss the effects of tropospheric aerial particulate emplacement done by the military and its various commercial contractors, an activity that has been ongoing for at least two decades [44-50]. These articles also presume future solar radiation management will take place in the stratosphere, not in the troposphere where our weather mostly occurs. As should be evident in this review, academic climate scientists operating under the CO_2 paradigm are unlikely to be able to recognize other causes of global warming. Moreover, many of them appear to be naïve about the catastrophic dangers proposed by solar radiation management and other geoengineering schemes, and invariably fail to even mention the ongoing tropospheric geoengineering and its risks to human [44,47,50,101-103,168] and environmental [48,49,99,100,104-106] health.

NOTE

10. CONCLUSIONS

Planet earth is getting hotter, threatening the integrity of the biosphere. By its refusal to consider the role of the covert tropospheric geoengineering that has been going on for decades, the climate science community, including the IPCC, has systematically failed to tell the truth about global warming.

The IPCC was established in 1988, and in concert with various other governmental entities and without proof, convinced numerous political leaders that fossil-fuel-produced carbon dioxide and other anthropogenic greenhouse gases were trapping heat that otherwise would be released into space. Global warming, also called climate change, became the new global enemy just as the Cold War ended.

The climate science community treats global warming solely as a radiation-balance issue which leads to a radically incomplete understanding of the factors affecting Earth's surface temperature, as disclosed in this review.

- Many climate scientists do not understand the role of tropospheric particulates, whether on balance they warm or cool the Earth.

- In a series of publications we disclosed a climate-science paradigm shift, namely, that the main cause of global warming is not carbon dioxide heat retention, but particulate pollution aerosols that heat the troposphere and reduce the efficiency of atmospheric-convective heat removal from Earth's surface.

Comment [P4]: Can you possibly establish a comparative study of CO_2 causing global warming and particulate heating causing global warming? If there are such studies where the two causative factors have been experimented and compared in order to establish which of the factors contributes the greatest of the global warming it willbe fine. However, the review expresses that particulate heating contributes the greatest effects/causes to global warming. Any comparative study to this expression? I therefore, suggest a review to this comparison if available.

Comment [P5]: This section should be the 'Review Summary' or 'Summary of Review'.

- Most particulates found in the troposphere absorb solar energy to some extent from one or more portions of the wavelength spectrum. Particulate aerosols have direct effects of absorbing radiation as well as indirect effects on the formation, microphysics, and lifetime of clouds.

- The one generalization that can be made about virtually all tropospheric aerosol particulates, including cloud droplets and their aerosol components, is that they absorb short- and long-wave solar radiation and absorb long-wave radiation from Earth's surface and become heated, thereby making a significant contribution to global warming and climate change.

- Dark-colored particulates are efficient absorbers of solar radiation of which black carbon, e.g. soot, absorbs light over the entire solar spectrum.

- Brown carbon, e.g. humus, absorbs near-UV wavelengths and, to a lesser extent, visible light.

- Carbon surface deposits on non-carbonaceous aerosols can enhance their solar radiation heat potential.

- For carbon-free desert dust, iron oxide is by far the greatest light absorbing substance with the amount of absorption being a linear function of iron oxide content.

- Magnetite is the most efficient short-wave absorber among iron oxides in the atmosphere.

- Iron oxides in the ash from forest fires can be converted at high temperatures to magnetite which enhances the absorption of solar radiation.

- Iron is usually found in anthropogenic carbonaceous particles.

- Iron-oxide minerals, although somewhat less efficient solar radiation absorbers than carbon, nevertheless are dominate among mineral radiation-absorbers.

- Forest fires have an "*immediate and profound impact*" on snow disappearance, earlier springtime melt, and lower summer stream flows.

- Pyrogenic coal fly ash (CFA), contains magnetite and other iron-oxides, as well as carbon particles. Aerosolized CFA efficiently absorbs solar radiation and heats the troposphere.

- The main particulate-substance being jet-sprayed into the atmosphere is consistent with coal fly ash (CFA).

- Although a major threat to human and environmental health, CFA is otherwise an ideal particulate for heating the troposphere through absorption of short-wave and long-wave radiation because CFA contains substantial quantities of the iron oxides, hematite and magnetite, as well as carbon.

- The global warming peak during World War II is understandable as wartime aerosolized pollution particulates trapped heat that otherwise should have been returned to space, thus causing global warming at Earth's surface by reducing atmospheric-convective heat loss.

- WW2 global warming rapidly subsided after hostilities ceased since tropospheric pollution-particulates typically fall to ground in days to weeks.

- After 1950 global warming and particulate-proxies increased exponentially.

- Particulate matter in the troposphere, including the moisture droplets of clouds, not only blocks sunlight, but also absorbs in-coming solar radiation and out-going terrestrial radiation. These heated particles transfer that heat to the surrounding atmosphere which reduces the adverse temperature gradient relative to Earth's surface. The reduction of adverse temperature gradient concomitantly reduces convective heat transport from Earth's surface. This is a general concept that applies globally, regionally, and locally.

- The Mt. St. Helens volcanic plume provides one independent line of evidence that supports our contention that the heating of tropospheric aerosols reduces convective heat loss from Earth's surface [143].

- The radiosonde and aethalometer investigations of Talukdar et al. [144] provide a second independent line of evidence that supports our contention that the heating of tropospheric aerosols reduces convective heat loss from Earth's surface.

- Investigations of the suppression of convection over the tropical Atlantic by the summer-blown Saharan-dust provides a third independent line of evidence that supports our contention that the heating of tropospheric aerosols reduces convective heat loss from Earth's surface [80,81,152].

- If aerosol particulates settle into bodies of water, their iron components disrupt the natural balance of such waters, causing, for example, harmful algae blooms.

- If aerosol particulates settle on land, they absorb solar radiation causing additional global warming.

- If aerosol particulates settle on snow or ice, they absorb solar radiation and also change the albedo, causing less light to be reflected and more to be absorbed, further adding to global warming.

- There is ample evidence of tropospheric aerosol transport into the stratosphere, where residence times are measured in months, not days or weeks.

- There are inherent risks associated with the placement of aerosol particulates into the stratosphere, whether deliberately, inadvertently, or through natural processes. The currently ongoing near-daily, near-global geoengineering heat-trapping activity masks the effects of potential radiation-altering stratospheric aerosols, as well as pose a serious threat to atmospheric ozone which protects life from harmful solar ultraviolet radiation.

- Covert geoengineering emplaces massive quantities of ultra-fine CFA that contains chlorine, bromine, fluorine and iodine into the troposphere, some of which may be lofted into the stratosphere, and thus potentially deplete ozone. Other substances in

CFA aerosols, including nano-particulates, are also likely to adversely affect atmospheric ozone.

- Academic climate scientists and the IPCC have a fundamental misunderstanding about what really causes global warming. Moreover, they appear to minimize the grave dangers that would arise from proposed geoengineering schemes like stratospheric aerosol injection.

- More grievously, the complicity of silence among climate scientists and engineers cloaks the covert activity of deliberately poisoning the air we all breathe, and deceives the public about the dire health risks.

Solving the anthropogenic global warming problem is well within the means of current technology, and in principle great strides could be accomplished in a matter of months, due to the short lifetime of tropospheric particulates. What is needed is: (1) Abruptly halting tropospheric particulate geoengineering; (2) trapping particulate emissions from coal-fired industrial furnaces, especially in India and China, and from vehicle exhaust; and, (3) Reducing particulate-forming fuel additives.

The problem of particulate-caused contamination of the biosphere and the runaway global warming that accompanies it must be addressed immediately if we are to have a viable future.

CONCLUSION

Comment [P6]: Please conclude here. The conclusion should be a collection and simplified summarry of all findings or reviews as well as recommendations to the science community.

COMPETING INTERESTS

The authors declare no competing interests.

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Comment [P7]: Please provide the internet link address of the references.Also, check the journal referencing format.

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