

**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 **misinformed** 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.

*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 [4], has failed to tell the truth

25 by not considering or even mentioning the climate-affecting tropospheric particulate  
26 geoengineering that has been ongoing for decades and which has become a near-daily,  
27 near-global activity (Figure 1). The failure to take into consideration the ongoing tropospheric  
28 particulate geoengineering compromises IPCC evaluations as well as the published work of  
29 numerous climate scientists, and calls into question whether or not political motivations are  
30 involved. [5].  
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33 **Figure 1.** Geoengineering particulate trails with photographers' permission. Clockwise from  
34 upper left: Soddy-Daisy, Tennessee, USA (David Tulis); Reiat, Switzerland (Rogerio  
35 Camboim SA); Warrington, Cheshire, UK (Catherine Singleton); Alderney, UK looking  
36 toward France (Neil Howard); Luxembourg (Paul Berg); New York, New York, USA  
37 (Mementosis)  
38

39 There are concerted efforts to deceive the scientific community and the public into believing  
40 that particulate trails, such as shown in Figure 1 are ice-crystal 'contrails' from the moisture  
41 vapor in jet exhaust [6,7]. The U. S. Air Force produced Document AFD-0561013-001 to  
42 deceive the public about the aerial spraying, a section, entitled *The Chemtrail Hoax*, states:  
43 "There is no such thing as a 'Chemtrail' [a term some use to describe the aerial spraying] ...  
44 *Contrails [ice crystals from aircraft exhaust moisture] are safe and are a natural*  
45 *phenomenon. They pose no health hazard of any kind" [7].*

46  
47 Retired U. S. Air Force Brig. General Charles Jones reportedly issued in part the following  
48 statement concerning observed trails in the sky [8]: "When people look up into the blue and  
49 see white trails paralleling and crisscrossing high in the sky little do they know that they are  
50 not seeing aircraft engine contrails, but instead they are witnessing a manmade climate  
51 engineering crisis facing all air breathing humans and animals on planet Earth... Toxic  
52 atmospheric aerosols [are] used to alter weather patterns, creating droughts in some  
53 regions, deluges and floods in other locations and even extreme cold under other  
54 conditions...."

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56 Concerned citizens have taken numerous photographs showing that the particulate trails  
57 observed are physically inconsistent with being ice-crystal contrails [9-11]. Figure 2 shows  
58 both the typically white trails, like those in Figure 1, which are consistent with coal fly ash  
59 [10-13] and show much scattered light, and black trails, likely produced by carbon black (BC)  
60 which absorbs light much more efficiently with far less scatter. Ice crystal contrails are never  
61 black. One of us (JMH) witnessed white trails beneath the cloud cover over Frankfurt,  
62 Germany, and black trails above the clouds, presumably to be out of sight.  
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66 **Figure 2.** Both white and black particulate trails above Danby, Vermont, an impossible  
67 combination for alleged ice-crystal 'contrails'.  
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70 For more than three billion years, as long as life has existed on Earth, the surface of our  
71 planet has maintained a remarkably stable state of thermal equilibrium through the  
72 aggregate-effect of numerous natural processes, despite being bombarded by potentially  
73 variable solar radiation from above [14,15] and potentially variable planetary energy sources  
74 from below, including georeactor nuclear fission energy [16-19] and stored protoplanetary  
75 compression energy [20-22]. Decades ago, considering the ever-increasing scale of human  
76 activity, it might have been prudent to engage in open scientific debates and discussions to  
77 ascertain with reasonable certainty the nature and extent that human activities might be  
78 altering those natural processes. But, such objective, open inquiry never occurred.

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80 Instead, in 1988 the IPCC was established, and in concert with various other governmental  
81 entities, such as the U. S. National Aeronautics and Space Administration (NASA), and  
82 presumably driven by political and/or financial motives [23], the IPCC convinced numerous  
83 political leaders that greenhouse gases, notably fossil-fuel produced carbon dioxide [CO<sub>2</sub>],  
84 were trapping heat that otherwise should have been released to space [4]. As the Cold War  
85 ended, climate change, also known as global warming, became the new global enemy.

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87 The science promulgated by the IPCC and the climate science community is seriously  
88 flawed, not only by its failure to consider all factors affecting climate (notably ongoing covert  
89 geoengineering), but also by the application of a seriously flawed investigatory-methodology  
90 that includes the use of assumption-based computational models that typically begin with a  
91 known end-result that is attained by cherry-picking data and parameters [24]. Computational  
92 models, sometimes called simulations, are computer programs subject to the well-known  
93 dictum “garbage in, garbage out” [25].

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95 As the noted atmospheric chemist and inventor of the electron capture detector James  
96 Lovelock noted [26]: “*Gradually the world of science has evolved to the dangerous point  
97 where model-building has precedence over observation and measurement, especially in  
98 Earth and life sciences. In certain ways modeling by scientists has become a threat to the  
99 foundation on which science has stood: the acceptance that nature is always the final arbiter  
100 and that a hypothesis must always be tested by experiment and observation in the real  
101 world.*”

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103 Generally, to maintain stable surface temperatures over time, all of the heat received from  
104 the sun [14,15], as well as the heat brought to the surface from deep-Earth heat-sources [16-  
105 22], must be released to space. The climate science community treats global warming  
106 solely as a radiation-balance issue. Toward that end they define an artificial construct  
107 “radiative forcing” or “climate forcing” in units of Wm<sup>-2</sup> relative to 1750 Wm<sup>-2</sup> as a means to  
108 represent the departure from zero-net radiation balance [27], which they presume is caused  
109 primarily by anthropogenic carbon dioxide and other greenhouse gases. While that approach  
110 provides a common means to express computer model results, it also leads to an incomplete  
111 understanding of all of the factors that affect Earth’s surface temperature, as we disclose in  
112 this review.

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114 Moreover, in instances there is a lack of understanding of fundamental processes that are  
115 crucial to the problem of understanding the maintenance of Earth’s surface temperature. For  
116 example, many climate scientists (falsely) believe that particulate aerosols, including black  
117 carbon (BC), cool the Earth’s surface [28-36] or are uncertain whether aerosols cool or heat  
118 the Earth [37,38]. For example, Ramanathan and Carmichael [39] state: “...*black carbon has  
119 opposing effects of adding energy to the atmosphere and reducing it at the surface.*”  
120 Similarly, Andreae, Jones and Cox [28] state: “*Atmospheric aerosols counteract the warming  
121 effects of anthropogenic greenhouse gases by an uncertain, but potentially large, amount.*”

122  
123 Uncertainty as to whether aerosols result in cooling or warming hinders the ability to project  
124 future climate changes [40,41] and even hinders the ability to understand the fundamental  
125 factors responsible for maintaining surface temperatures in a range that makes life possible.  
126 Science progresses by questioning the correctness of popular paradigms, and through  
127 tedious efforts to place seemingly independent observations into a logical order in the mind  
128 so that causal relationships become evident and new understanding emerges [2]. In a series  
129 of publications we disclosed a fundamentally different understanding of the main cause of  
130 global warming [1,42-45]. The main cause of anthropogenic global warming is not carbon  
131 dioxide heat retention, but particulate pollution that heats the troposphere and reduces the  
132 efficiency of atmospheric-convective heat removal from Earth's surface [1,42-45].  
133

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

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142 Solid and/or liquid particles, typically  $\leq 10 \mu\text{m}$  across, in the troposphere originate from a  
143 variety of sources including moisture condensation [46], incomplete biomass burning,  
144 combustion of fossil fuels, volcanic eruptions, wind-blown road debris, sand, sea salt,  
145 biogenic material [47] and, significantly, pyrogenic coal fly ash from unfiltered industrial  
146 exhaust [48-51] and geoengineering applications [10-13,52-54]. Tropospheric particulates  
147 have short atmospheric residence times ranging from days to a few weeks, but nevertheless  
148 have direct climate effects through their absorbing solar radiation and radiation from Earth's  
149 surface, as well as indirect effects on cloud formation and associated microphysics [55-58].  
150

151 When a light photon interacts with particulate matter, it is either reflected (scattered) or  
152 absorbed. Considerable efforts have been expended to obtain reflectance spectral data [59]  
153 because of their importance in remote imaging technology. Regrettably, there is a dearth of  
154 absorption spectral data as the climate science community has been slow to appreciate its  
155 importance. Recently, however, measurements of particulate-matter absorption spectra are  
156 beginning to be made and, although limited, for example, in spectral-wavelength, it is  
157 possible to make accurate non-quantitative generalizations.  
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159 Aerosol particles interact with solar radiation by scattering (i.e. reflecting) or absorbing the  
160 radiation, both long-wave and short-wave. They become heated and subsequently transfer  
161 that heat to the atmosphere through molecular collisions [60,61]. The contribution of black  
162 carbon to atmospheric heating is widely recognized [39,60]. However, virtually all aerosol  
163 particles absorb solar radiation to some extent, including those that have a high proclivity to  
164 scatter radiation [62,63]. Quantifying aerosol absorption/scattering presents considerable  
165 uncertainties for many reasons including, for example, variations in particle size, surface  
166 topography, chemical/mineral composition, surface coatings, as well as differences in and  
167 lack of knowledge of relevant absorption spectra [64,65].  
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169 Most particulates found in the troposphere absorb solar energy to some extent from one or  
170 more portions of the wavelength spectrum [66-72]. As Hunt noted [73]: "*A dispersion of small  
171 absorbing particles forms an ideal system to collect radiant energy, transform it to heat, and  
172 efficiently transfer the heat to a surrounding fluid.... If the characteristic absorption length for  
173 light passing through the material comprising the particles is greater than the particle  
174 diameter, the entire volume of the particles is active as the absorber. When the particles*



175 *have absorbed the sunlight and their temperature begins to rise they quickly give up this*  
176 *heat to the surrounding gas....”*

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178 The one generalization that can now be made is that virtually all tropospheric aerosol  
179 particulates, including cloud droplets and their aerosol components, absorb short- and long-  
180 wave solar radiation, and absorb long-wave radiation from Earth’s surface, thus becoming  
181 heated. Moreover, aerosols can modify cloud properties and suppress rainfall [74-77]. As  
182 Tao et al. [78] note: “*Aerosols, and especially their effect on clouds and precipitation, are*  
183 *one of the key components of the climate system and the hydrological cycle. Yet the aerosol*  
184 *effect on clouds and precipitation remains poorly known.”*

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186 In one series of experiments, Ramana et al. [79] measured relative heating rates in the  
187 lowest 3 km of the atmosphere using vertically stacked multiple lightweight autonomous  
188 unmanned aerial vehicles and found in that instance that the “*contribution of absorbing*  
189 *aerosols to the heating rate was an order of magnitude larger than the contribution of CO<sub>2</sub>*  
190 *and one-third that of the water vapour.”*

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192 Whereas the methodology utilized by the IPCC and climate science community has focused  
193 primarily on the problem of sun-Earth radiation balance and departures therefrom, our focus  
194 has been on *understanding the processes involved in the disposition of absorbed heat,*  
195 *notably the consequences of particulate pollution on atmospheric convection,* which we  
196 submit, is a primary mechanism for maintaining Earth’s habitable surface temperature [1,42-  
197 45].

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## 199 **2.1 Role of Carbon and Iron in Aerosol Heating**

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201 Dark-colored particulates are efficient absorbers of solar radiation of which black carbon  
202 (BC), e.g. soot, absorbs light over the entire solar spectrum; brown carbon, e.g. soil humus,  
203 on the other hand, absorbs near-UV wavelengths and, to a lesser extent, visible light [80].  
204 Carbon surface deposits on non-carbonaceous aerosols can enhance their solar radiation  
205 heat potential [81].

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207 Iron is usually found in anthropogenic carbonaceous particles [82]. Iron-oxide minerals,  
208 although somewhat less efficient solar radiation absorbers than carbon, nevertheless are  
209 dominant among mineral radiation-absorbers. Alfaro et al. [83] measured light absorption in  
210 samples of desert dust at two wavelengths, 325 nm (ultraviolet) and 660 nm (red light). *They*  
211 *found for mineral dust from Niger, Tunisia, and China, sampled near their source and thus*  
212 *devoid of anthropogenic carbon contamination, iron-oxide was by far the greatest light*  
213 *absorbing substance with the amount of absorption being a linear function of iron oxide*  
214 *content.* They further found that the absorption at 325 nm is about 6 times greater than at  
215 660 nm. In addition, Liu et al. [84] employed an “*airborne laser-induced incandescence*  
216 *instrument*” to measure the hematite content of the Saharan dust layer which is known to be  
217 heated by solar radiation [85,86].

218

219 Matsui et al. [50] discussed the relative importance of anthropogenic combustion iron and  
220 iron from mineral dust in aerosol heating, and noted that “*magnetite [Fe<sub>3</sub>O<sub>4</sub>] is the most*  
221 *efficient short-wave absorber among iron oxides in the atmosphere.”* Moteki et al. [51] found  
222 that the majority of aerosol iron oxide particles in East Asian continental atmospheric  
223 outflows are anthropogenic aggregated magnetite nanoparticles that, in addition to  
224 carbonaceous aerosols, are significant contributors to short-wave atmospheric heating.  
225 Recent results indicate that the atmospheric burden of anthropogenic iron of pyrogenic origin  
226 is 8 times greater than previous estimates [50].

227

228 Yoshida et al. [87] note that there is a strong correlation between anthropogenic FeOx and  
229 BC particles in the East Asian continental outflow of anthropogenic origin. That is not  
230 surprising as pyrogenic coal fly ash, in addition to containing magnetite and other iron-  
231 oxides, contains carbon particles [88]. For a set of UK coal fly ash (CFA) samples, the  
232 hematite [Fe<sub>2</sub>O<sub>3</sub>] range was determined as 2.5 – 8.6 wt.%, the magnetite [Fe<sub>3</sub>O<sub>4</sub>] range as  
233 0.8 – 4.1 wt.% [89]. The carbon content of coal fly ash by one estimate is 2 – 5 wt.% under  
234 optimum conditions, and 20 wt.% under non-optimum conditions [90]. Another investigation  
235 found the carbon content range of coal fly ash to be 2.7 – 14.5 wt.% [91]. One thing is clear  
236 from these data: Aerosolized coal fly ash efficiently absorbs solar radiation and heats the  
237 troposphere.  
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## 239 **2.2 Role of Forest Fires in Aerosol Heating**

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241 The smoke and ash from forest fires uplifted into the troposphere comprises one class of  
242 aerosol particulates that contains black carbon, brown carbon and iron oxides [70,92]. Iron  
243 oxides in the ash from forest fires can be converted at high temperatures to magnetite  
244 [Fe<sub>3</sub>O<sub>4</sub>] which is an even more efficient absorber of solar radiation [69]. The effect of forest-  
245 fire originated brown carbon aerosols on atmospheric heating likely has been  
246 underestimated [93]. Since 1999 there has been a four-fold increase in the particulates  
247 arising from forest fires in the United States [94], which to some extent appears to be one  
248 consequence of the now near-daily, near global aerosol particulate geoengineering [11];  
249 corresponding increases have been noted worldwide [95-97]. In addition, fire increases  
250 surface heat, and reduces water-evaporation by damaging the canopy [98]. Moreover, forest  
251 fires have an “*immediate and profound impact*” on snow disappearance, earlier springtime  
252 melt, and lower summer stream flows [94].  
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## 254 **2.3 Role of Coal Fly Ash in Aerosol Heating**

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256 As the aerial spraying, like that shown in Figure 1, became a near-daily activity in San Diego  
257 (USA), one of us (JMH) began a series of investigations aimed at determining the nature and  
258 composition of the aerosolized particulates being sprayed. Initially, comparison of Internet-  
259 posted 3-element rainwater analyses with corresponding laboratory water-extract analyses  
260 of a likely potential aerosol provided the first scientific forensic evidence that the main  
261 particulate-substance being jet-sprayed was consistent with the leaching-behavior coal fly  
262 ash (CFA) [52]. Subsequently, comparing 11 similarly-extracted elements validated that  
263 forensic finding [13]. Additional consistency was demonstrated by comparing CFA analyses  
264 to 14 elements measured in air-filter trapped outdoor aerosol particles [10], and to 23  
265 elements measured in aerosol particles brought down during a snowfall and released upon  
266 snow-melting [12,13].  
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268 Burning coal concentrates the harmful elements in the ash [99]. The heavy ash that is  
269 formed settles beneath the burner. The light ash, called coal fly ash (CFA), forms by  
270 condensing and accumulating in the hot gases above the burners. Coal fly ash escapes into  
271 the atmosphere from smokestacks in India and China, but is usually trapped and  
272 sequestered in Western nations [100,101].  
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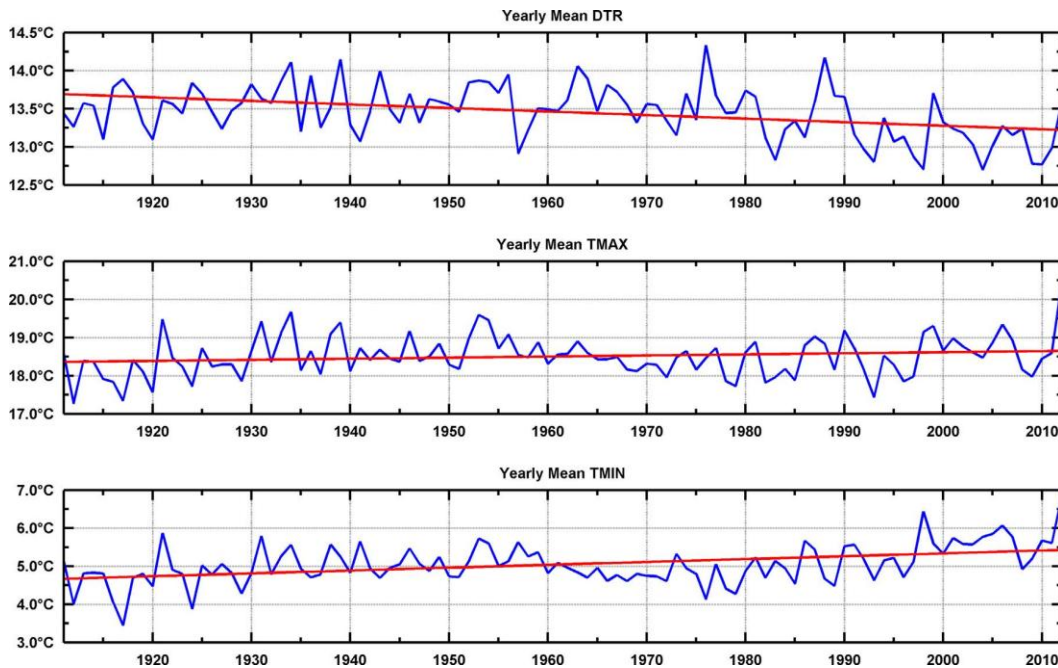
274 The annual global production of CFA in 2013 was estimated to be 600 million metric tons  
275 [102]. Coal fly ash is a cheap waste product that requires little additional processing for use  
276 as a jet-sprayed aerosol since its particles form in sizes ranging from 0.01 – 50 μm in  
277 diameter [103]. Except for its serious harm to human and environmental health [11,13,104-  
278 111], CFA is an ideal particulate for heating the troposphere through absorption of short-  
279 wave and long-wave radiation as CFA contains substantial quantities of the iron oxides,  
280 hematite and magnetite, as well as carbon [88-91].

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### 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 [4,112]. Furthermore, greenhouse gases are transparent to incoming solar radiation [113]. 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 3 from Qu et al. [114] presents yearly DTR,  $T_{\max}$  and  $T_{\min}$  mean values over the continental USA throughout most of the 20<sup>th</sup> century and up to 2010.



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**Figure 3.** Yearly DTR,  $T_{\max}$  and  $T_{\min}$  mean values over the continental USA. The red lines are linear regressions. From [45,114], (<http://creativecommons.org/licenses/by-nc-nd/3.0/>).

As shown in Figure 3,  $T_{\min}$  increases at a greater rate than  $T_{\max}$  causing **DTR** to decrease over time, a phenomenon that is observed in many similar investigations [115-118] but not all [119]. The reduction in  $T_{\max}$  can be explained by sunlight being blocked by particulates or by clouds [117], 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



314 Gottschalk [120,121] noticed a thermal peak coincident with World War II (WW2) in a global  
315 temperature profile image on the front page of the January 19, 2017 *New York Times*. He  
316 applied sophisticated curve-fitting techniques to 8 independent global temperature datasets  
317 from the U. S. National Oceanic and Atmospheric Administration (NOAA) and demonstrated  
318 that the WW2 peak is a robust feature. He concluded that the thermal peak “*is a*  
319 *consequence of human activity during WW2*” [120,121].

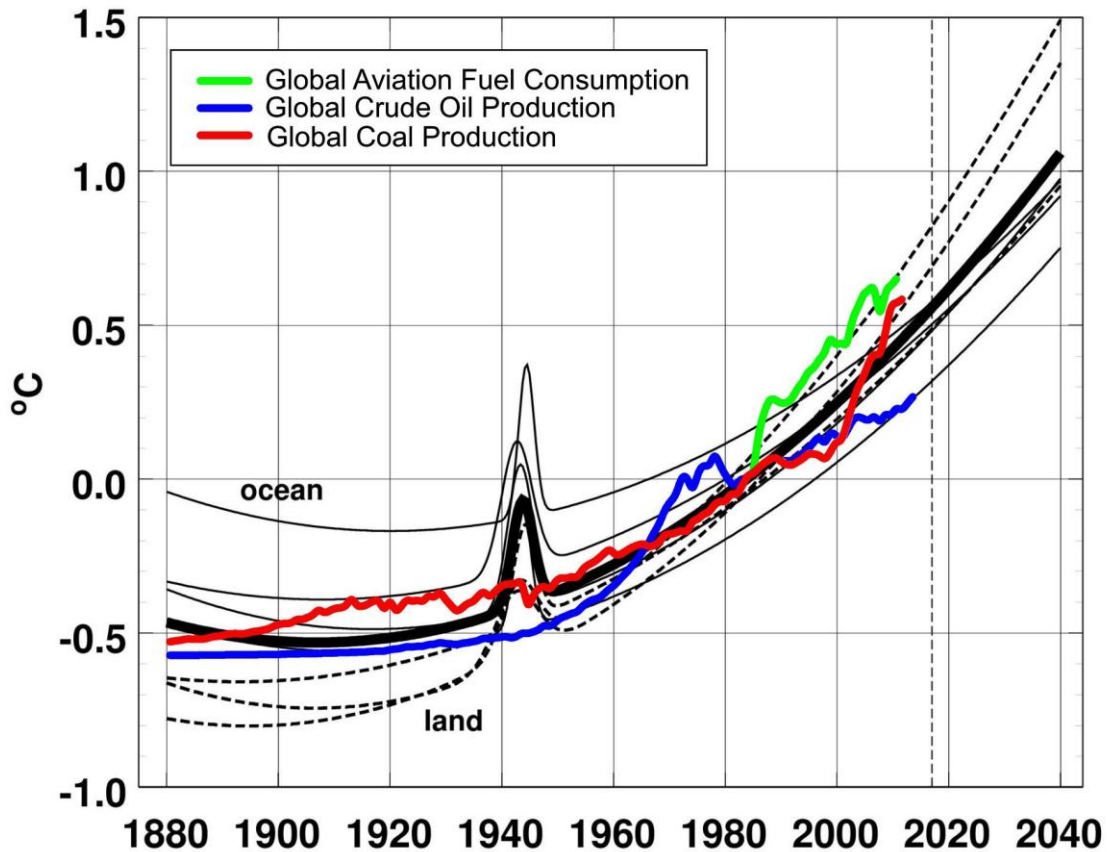
320  
321 The conspicuous aspect of Gottschalk's global-warming results [120], shown by the black  
322 curves in Figure 4, is that immediately after WW2 the global warming rapidly subsided. That  
323 behavior is inconsistent with CO<sub>2</sub>-caused global warming because CO<sub>2</sub> persists in the  
324 atmosphere for decades [4,122]. CO<sub>2</sub>-caused global warming during WW2 can be further  
325 ruled out as Antarctic Law Dome Ice core data during the period 1936-1952 show no  
326 significant increase in CO<sub>2</sub> during the war years, 1939-1945 [123]. The evidence thus points  
327 to a feature other than CO<sub>2</sub> for the WW2 climate event.

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329 One of us (JMH) realized that WW2 activities injected massive amounts of particulate matter  
330 into the troposphere from extensive military industrialization and vast munition detonations,  
331 including the demolition of entire cities, and their resulting debris and smoke. The implication  
332 is that the aerosolized pollution particulates trapped heat that otherwise should have been  
333 returned to space, and thus caused global warming at Earth's surface [42] If particulate  
334 pollution caused the sudden rise in temperature, it would have subsided rapidly after  
335 hostilities ceased. Rapid cessation of WW2 global warming is thus understandable, since  
336 tropospheric pollution-particulates typically fall to ground in days to weeks [55-58,124].

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338 Figure 4, from [42,120], shows relative-value, particulate-pollution proxies added to  
339 Gottschalk's figure: Global coal production [125,126]; global crude oil production [126,127];  
340 and, global aviation fuel consumption [126]. Each proxy dataset was normalized to its value  
341 at the date 1986, and anchored at 1986 to Gottschalk's boldface, weighted average, relative  
342 global warming curve. The particulate-proxies track well with the 8 NOAA global datasets  
343 used by Gottschalk [42].

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**Figure 4.** Copy of Gottschalk’s fitted curves for eight NOAA data sets showing relative temperature profiles over time [120] to which are added proxies for particulate pollution. Dashed line, land; light line, ocean; bold line, weighted average. From [42].

Following the end of WW2 hostilities, wartime aerosol particulates rapidly settled to ground [124], Earth radiated its excess trapped energy, and global warming abruptly subsided for a brief time [42]. Soon, however, post-WW2 industrial growth, initially in Europe and Japan, and later in China, India, and the rest of Asia [128] increased worldwide aerosol particulate pollution and with it concomitant global warming [42]. 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 4, 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.

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## 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*” [129]. 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 [130-133] and of the Earth’s mantle [134,135] continue to be produced, although sustained thermal convection in each instance has been shown to be physically impossible [16] thus necessitating a fundamentally different geoscience paradigm [17,20-22,136-138].

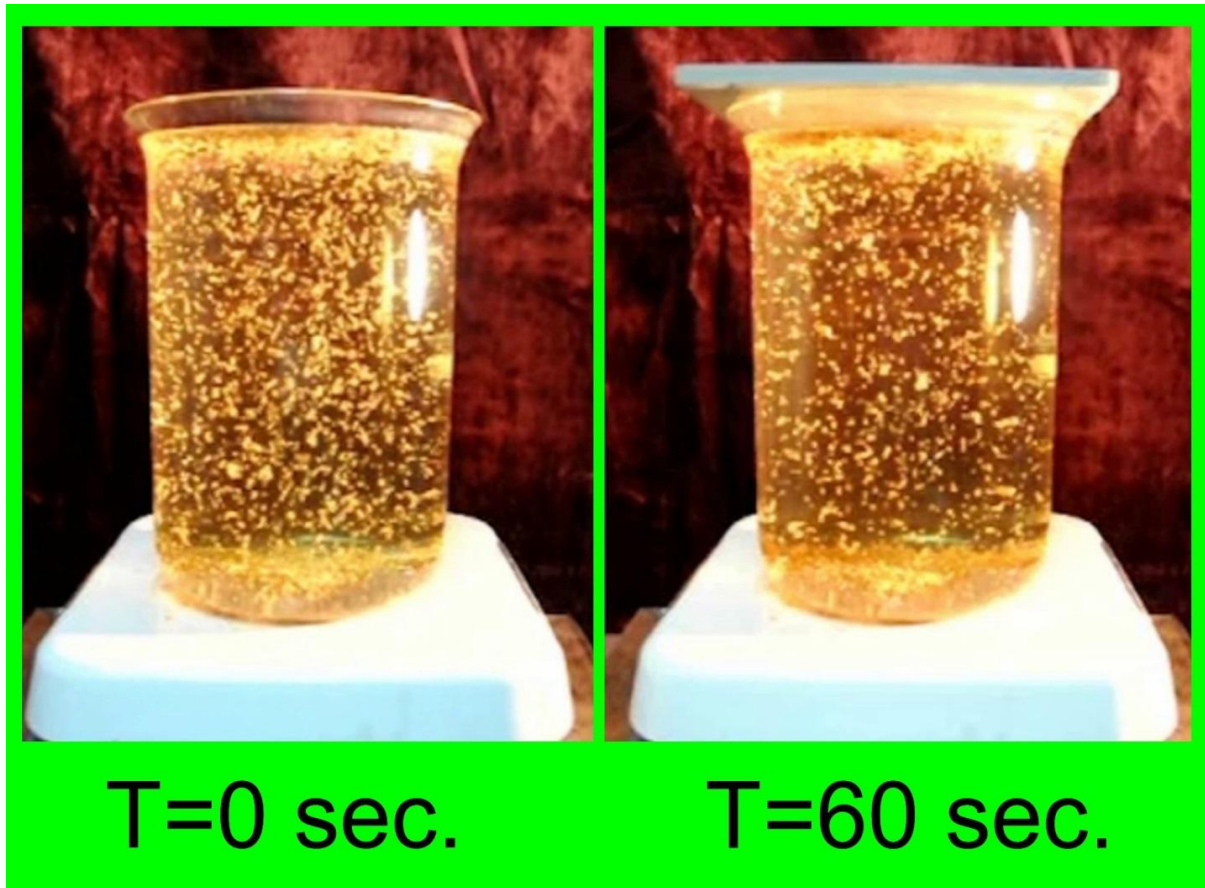
Convection in Earth’s troposphere is dynamically complex. Computational models, although simplistic, are mathematically complicated [139,140] and typically utilize parametrization-based [141] assumption-simplification solutions of hydrodynamic equations [142,143]. Critical details of the actual physical process of convection may be thus obscured in climate-science models.

Chandrasekhar described convection in the following, easy-to-understand way [144]: *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 [144] 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 [44].

As described recently [45]: “*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 5, from [44], extracted from the video record [145], 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.”*



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**Figure 5.** From [44]. 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 [146]. However, the vast WW2 historical record, including film documentation, should leave no doubt that WW2-activity spiked the

445 troposphere with vast amounts of particulate matter. Moreover, the particulate-proxies,  
446 shown in Figure 4, track well with the subsequent global warming record.

447

448 In the case of WW2, global warming was inferred from an understanding of the manner by  
449 which aerosolized particulates affect convection. The diurnal temperature range (DTR) data  
450 (Figure 3), suggest that, although aerosol particulates block some sunlight from reaching  
451 Earth's surface [117], to explain the reduction in  $T_{max}$  another process must account for the  
452 increase in  $T_{min}$ . Data from the Mt. St. Helens 1980 volcanic eruption in Washington State  
453 (USA) [147] demonstrated that a short-term reduction in the adverse temperature gradient  
454 increased the  $T_{min}$  of DTR data and provide an opportunity to assess the consequences of  
455 volcanic particulate injection into the troposphere [148].

456

457 As previously described [45]: *As the volcanic plume passed overhead in the troposphere,*  
458 *daytime temperatures dropped as the sunlight was absorbed and scattered by the*  
459 *particulates; nighttime temperatures, however, increased, and for a few days thereafter*  
460 *remained elevated presumably due to aerosol dust that persisted for a few days before*  
461 *falling to ground [148]. The diurnal temperature range was significantly lessened by the*  
462 *plume, but almost completely recovered within two days [148]. These observations are*  
463 *consistent with (1) the Mt. St. Helens aerosol particulates in the plume absorbing LW*  
464 *radiation and becoming heated in the atmosphere overhead, (2) the transfer of that heat to*  
465 *the surrounding atmosphere by molecular collisions, (3) the lowering of the atmospheric*  
466 *adverse temperature gradient relative to the Earth's surface, (4) the consequent reduction of*  
467 *atmospheric convection, and (5) concomitant reduction of convection-driven surface heat*  
468 *loss, which is evident by the increase in  $T_{min}$  [1,42-44].*

469

470 Because the IPCC and other climate scientists attempt to explain global warming by relying  
471 principally on the role of radiation transport, they are unable to explain the Mt. St. Helens'  
472 data in a logical, causally related manner as indicated, for example, by the following illogical  
473 explanation: "*at night the plume suppressed infrared cooling or produced infrared warming*"  
474 [148].

475

476 By contrast, the Mt. Pinatubo eruption ejected large amounts of material into the  
477 stratosphere, where there is very little convection and little heat transport by convection, and  
478 where particulate matter can remain for months cooling the planet by blocking sunlight and  
479 increasing albedo [149,150].

480

481 The idea that tropospheric particulates reduce atmospheric convection received further  
482 support by the long-duration series of radiosonde and aethalometer investigations  
483 undertaken by Talukdar et al. [151]. Their investigations demonstrated that higher amounts  
484 of tropospheric black carbon (BC) aerosols can disturb the normal upward movement of  
485 moist air by heating up the atmosphere, resulting in a decrease in the atmospheric  
486 convection parameters associated with the increase in concentration of BC aerosols.

487

488 Convection occurs *throughout the troposphere*, with differing degrees of scale, both  
489 geographically and altitudinally, and with various modifications caused by atmospheric  
490 circulation and lateral flow. Convection-efficiency in all instances is a function of the  
491 prevailing adverse temperature gradient. Aerosolized particulates, heated by solar radiation  
492 and/or terrestrial radiation, rapidly transfer that heat to the surrounding atmosphere, which in  
493 turn reduces the adverse temperature gradient relative to Earth's surface and,  
494 concomitantly, reduces surface heat loss and thereby over time causes increased surface  
495 warming [44]. The same particulate-pollution-driven process operates locally, as in the case  
496 of urban heat islands [67,152-155], regionally, and globally. Consequently, *particulate*



497 *pollution, not anthropogenic carbon dioxide, is the likely principal cause of global warming*  
498 *[1,42-44].*

499

## 500 **7. CONVECTION-REDUCTION BY SAHARAN-BLOWN SOLAR-HEATED DUST**

501

502 During summer months, Saharan-blown dust covers an area over the tropical ocean  
503 between Africa and the Caribbean about the size of the continental United States [66,85,86].  
504 The dust-layer extends to an altitude of 5-6 km; measurements indicate greater dust density  
505 and associated haziness at 3 km than at the surface [86].

506

507 The warmth of the upper portion of the Saharan-blown dust layer is a consequence of its  
508 origin over the Sahara, but the warmth is maintained by the absorption of solar radiation by  
509 the dust [85], which is known to contain radiation-absorbing iron oxide [83,84] that, when  
510 incorporated in bodies of water, initiates harmful algae blooms [111,156-158].

511

512 As noted by Prospero and Carlson [86]: “ ... *the warmth of the Saharan air has a strong*  
513 *suppressive influence on cumulus convection ...*” Dunion and Velden [85] further note: “*This*  
514 *new type of satellite imagery [Geostationary Operational Environmental Satellite (GOES)]*  
515 *reveals that the SAL [Saharan air layer] may play a major role in suppressing TC [tropical*  
516 *cyclone] activity in the North Atlantic. This paper presents documentation of these*  
517 *suppressing characteristics for a number of specific TC-SAL interactions that have occurred*  
518 *during several recent Atlantic hurricane seasons.*” Similarly, Wong and Dessler [159] also  
519 recognize the suppression of convection over the tropical North Atlantic by the Saharan air  
520 layer. The one commonality of these investigations is their failure to recognize the generality  
521 of the reduction of convection-efficiency that occurs as a consequence of reducing the  
522 adverse temperature gradient through aerosol particulate heating [1,42-44].

523

## 524 **8. SURFACE WARMING BY FALLEN AEROSOL PARTICULATES**

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526 Tropospheric aerosol particles, as reviewed above, heat the atmosphere, reduce the  
527 adverse temperature gradient relative to Earth’s surface which suppresses atmospheric  
528 convection and thus reduces surface heat loss and increases global warming [1,42-45].  
529 However, the lifetime of tropospheric particulates is short, typically settling to the surface in  
530 days to weeks [55-58,124]. If the aerosol particulates settle into bodies of water, their iron  
531 components disrupt the natural balance there, causing, for example, harmful algae blooms  
532 [111]. If the aerosol particulates settle on land, they absorb solar radiation and cause  
533 additional global warming [160,161]. If the aerosol particulates settle on snow or ice (Figure  
534 6), they also change the albedo, causing less light to be reflected and more to be absorbed,  
535 further adding to global warming [162,163]. Zhang et al. [164] estimate a 38% albedo  
536 reduction caused by downed aerosol particulates in snow cover on the Tibetan Plateau. As  
537 noted above, forest fires have an “*immediate and profound impact*” on snow disappearance,  
538 earlier springtime melt, and lower summer stream flows [94].

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**Figure 6.** Particulate-coated glacier in Iceland. Courtesy of Daniel Knieper.

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## **9. AEROSOL TRANSPORT OF PARTICULATES INTO THE STRATOSPHERE**

There is ample evidence of tropospheric aerosols in the stratosphere [165]. Various means exist for lofting aerosols from troposphere to stratosphere, including super-cell convection [166] and monsoon anticyclonic transport [167]. Soot aerosol, presumably from airline traffic in flight corridors near 10-12 km altitude, has been observed at up to 20 km altitude [168]. Volcanic ash aerosol was observed at 19 km altitude [169].

Residence time of particulates in the stratosphere is considerably longer than the days to weeks residence time of troposphere aerosols [55-58]. 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 [170].

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'ón [171] and Pinatubo [149].

Table 1 from [104] 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 [165-167].

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**Table 1.** Coal fly ash:  
Range of halogen element compositions [172].

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

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By one recent estimate there have been 2,543 scientific articles published on the subject of solar radiation management geoengineering [173]. 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<sub>2</sub> 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 SRM and other geoengineering schemes, and invariably fail to even mention the ongoing tropospheric geoengineering and its risks to human [12,52,54,106-108,174] and environmental [11,13,104,105,109-111] health.

## 10. REVIEW SUMMARY

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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.

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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.

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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.

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- 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.
- 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

620 Earth's surface and become heated, thereby making a significant contribution to  
621 global warming and climate change.  
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- 623 • Dark-colored particulates are efficient absorbers of solar radiation of which black  
624 carbon, e.g. soot, absorbs light over the entire solar spectrum.  
625
- 626 • Brown carbon, e.g. humus, absorbs near-UV wavelengths and, to a lesser extent,  
627 visible light.  
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- 629 • Carbon surface deposits on non-carbonaceous aerosols can enhance their solar  
630 radiation heat potential.  
631
- 632 • For carbon-free desert dust, iron oxide is by far the greatest light absorbing  
633 substance with the amount of absorption being a linear function of iron oxide  
634 content.  
635
- 636 • Magnetite is the most efficient short-wave absorber among iron oxides in the  
637 atmosphere.  
638
- 639 • Iron oxides in the ash from forest fires can be converted at high temperatures to  
640 magnetite which enhances the absorption of solar radiation.  
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- 642 • Iron is usually found in anthropogenic carbonaceous particles.  
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- 644 • Iron-oxide minerals, although somewhat less efficient solar radiation absorbers than  
645 carbon, nevertheless are dominate among mineral radiation-absorbers.  
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- 647 • Forest fires have an "*immediate and profound impact*" on snow disappearance,  
648 earlier springtime melt, and lower summer stream flows.  
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- 650 • Pyrogenic coal fly ash (CFA), contains magnetite and other iron-oxides, as well as  
651 carbon particles. Aerosolized CFA efficiently absorbs solar radiation and heats the  
652 troposphere.  
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- 654 • The main particulate-substance being jet-sprayed into the atmosphere is consistent  
655 with coal fly ash (CFA).  
656
- 657 • Although a major threat to human and environmental health, CFA is otherwise an  
658 ideal particulate for heating the troposphere through absorption of short-wave and  
659 long-wave radiation because CFA contains substantial quantities of the iron oxides,  
660 hematite and magnetite, as well as carbon.  
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- 662 • The global warming peak during World War II is understandable as wartime  
663 aerosolized pollution particulates trapped heat that otherwise should have been  
664 returned to space, thus causing global warming at Earth's surface by reducing  
665 atmospheric-convective heat loss.  
666
- 667 • WW2 global warming rapidly subsided after hostilities ceased since tropospheric  
668 pollution-particulates typically fall to ground in days to weeks.  
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- 670 • After 1950 global warming and particulate-proxies increased exponentially.  
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- 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 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 [148].
  - The radiosonde and aethalometer investigations of Talukdar et al. [151] 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 [85,86,159].
  - 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.



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

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

732  
733 The problem of particulate-caused contamination of the biosphere and the runaway global  
734 warming that accompanies it must be addressed immediately if we are to have a viable  
735 future.

## 736 737 **11. CONCLUSIONS**

738  
739 The climate science community and the United Nations' Intergovernmental Panel on Climate  
740 Change (IPCC) have failed to acknowledge tropospheric particulate geoengineering that has  
741 been ongoing with ever-increasing duration and intensity for decades. Ignoring  
742 geoengineering climate altering activities in their climate considerations leads to incorrect  
743 results and, consequently, misinformation to world governments about climate change.

744  
745 The climate science community and the IPCC erred by treating global warming solely as a  
746 radiation-balance issue, which has resulted in a seriously incomplete understanding of the  
747 fundamental factors that affect Earth's surface temperature. Tropospheric particulate heating  
748 by absorption of short- and long-wave solar radiation and long-wave radiation from Earth's  
749 surface results in reducing the adverse temperature gradient relative to Earth's surface and,  
750 consequently, reducing the efficiency of atmospheric-convective surface-heat removal.

751  
752 We recently published a fundamentally new climate-science paradigm shift, namely, that the  
753 main cause of global warming is not carbon dioxide heat retention, but particulate pollution  
754 that *absorbs radiation, heats the troposphere, and reduces the efficiency of atmospheric-*  
755 *convective heat removal from Earth's surface.* In addition to the World War II data, three  
756 additional independent lines of supporting evidence are reviewed: (1) Passage overhead of  
757 the Mt. St. Helens volcanic plume; (2) radiosonde and aethalometer investigations of  
758 Talukdar et al.; and, (3) convection suppression over the tropical North Atlantic caused by  
759 the Saharan-blown dust.

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761 Generally, black carbon aerosols absorb light over the entire solar spectrum; brown carbon  
762 aerosols absorb near-UV wavelengths and, to a lesser extent, visible light. Iron oxides are  
763 good absorbers, the most efficient being magnetite. Pyrogenic coal fly ash, both from coal  
764 burning and from tropospheric jet-spraying geoengineering (for military purposes and/or  
765 climate engineering), contains carbon and iron oxides, hematite and magnetite.

766  
767 The risks associated with the placement of aerosol particulates into the stratosphere,  
768 whether lofted naturally, inadvertently, or deliberately as proposed for solar radiation  
769 management, poses grave risks, including the destruction of atmospheric ozone. To solve  
770 global warming humanity must: (1) Abruptly halt tropospheric particulate geoengineering; (2)  
771 trap particulate emissions from coal-fired industrial furnaces (especially in India and China)  
772 and from vehicle exhaust; and, (3) reduce particulate-forming fuel additives. Greatly reducing  
773 tropospheric aerosol particulates will quickly lead to a reduction in global warming and to an  
774 improvement in public health.

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## **AUTHORS' ETHICAL STATEMENT**

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The authors hold that technical, scientific, medical, and public health representations made in the scientific literature in general, including this particular journal, should be and are truthful and accurate to the greatest extent possible, and should serve to the highest degree possible to protect the health and well-being of humanity and Earth's natural environment.

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## **COMPETING INTERESTS**

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The authors declare no competing interests.

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