

**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.

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

25 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) [4]. The failure to take into consideration the ongoing
28 tropospheric particulate geoengineering compromises IPCC evaluations as well as the
29 published work of numerous climate scientists, and calls into question whether or not
30 political motivations are involved. [5].



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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)

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

49

50 Instead, in 1988 the IPCC was established, and in concert with various other governmental
51 entities, such as the U. S. National Aeronautics and Space Administration (NASA), and
52 presumably driven by political and/or financial motives [15], the IPCC convinced numerous
53 political leaders that greenhouse gases, notably fossil-fuel produced carbon dioxide [CO₂],
54 were trapping heat that otherwise should have been released to space [4]. As the Cold War
55 ended, climate change, also known as global warming, became the new global enemy.

56

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

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

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

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

92 Uncertainty as to whether aerosols result in cooling or warming hinders the ability to project
93 future climate changes [32,33] and even hinders the ability to understand the fundamental
94 factors responsible for maintaining surface temperatures in a range that makes life possible.
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96 Science progresses by questioning the correctness of popular paradigms, and through
97 tedious efforts to place seemingly independent observations into a logical order in the mind
98 so that causal relationships become evident and new understanding emerges [2]. In a series
99 of publications we disclosed a fundamentally different understanding of the main cause of
100 global warming [1,34-37]. The main cause of anthropogenic global warming is not carbon
101 dioxide heat retention, but particulate pollution that heats the troposphere and reduces the
102 efficiency of atmospheric-convective heat removal from Earth's surface [1,34-37].
103

104 Rather than making grand, detailed, computational-models based upon the poorly
105 understood complexities of climate science, a preferred approach, we suggest it is more
106 fruitful to better understand the behavior of several specific factors that affect Earth's climate.
107 Toward that end, we review evidence related to the behavior and climate consequences of
108 tropospheric particulate heating.
109

110 **2. TROPOSPHERIC PARTICULATE HEATING**

111

112 Solid and/or liquid particles, typically $\leq 10 \mu\text{m}$ across, in the troposphere originate from a
113 variety of sources including moisture condensation [38], incomplete biomass burning,
114 combustion of fossil fuels, volcanic eruptions, wind-blown road debris, sand, sea salt,
115 biogenic material [39] and, significantly, pyrogenic coal fly ash from unfiltered industrial
116 exhaust [40-43] and geoengineering applications [44-50]. Tropospheric particulates have
117 short atmospheric residence times ranging from days to a few weeks, but nevertheless have
118 direct climate effects through their absorbing solar radiation and radiation from Earth's
119 surface, as well as indirect effects on cloud formation and associated microphysics [51-54].
120

121 When a light photon interacts with particulate matter, it is either reflected (scattered) or
122 absorbed. Considerable efforts have been expended to obtain reflectance spectral data [55]
123 because of their importance in remote imaging technology. Regrettably, there is a dearth of
124 absorption spectral data as the climate science community has been slow to appreciate its
125 importance. Recently, however, measurements of particulate-matter absorption spectra are
126 beginning to be made and, although limited, for example, in spectral-wavelength, it is
127 possible to make accurate non-quantitative generalizations.
128

129 Aerosol particles interact with solar radiation by scattering (i.e. reflecting) or absorbing the
130 radiation, both long-wave and short-wave. They become heated and subsequently transfer
131 that heat to the atmosphere through molecular collisions [56,57]. The contribution of black
132 carbon to atmospheric heating is widely recognized [31,56]. However, virtually all aerosol
133 particles absorb solar radiation to some extent, including those that have a high proclivity to
134 scatter radiation [58,59]. Quantifying aerosol absorption/scattering presents considerable
135 uncertainties for many reasons including, for example, variations in particle size, surface
136 topography, chemical/mineral composition, surface coatings, as well as differences in and
137 lack of knowledge of relevant absorption spectra [60,61].
138

139 Most particulates found in the troposphere absorb solar energy to some extent from one or
140 more portions of the wavelength spectrum [62-68]. As Hunt noted [69]: "*A dispersion of small
141 absorbing particles forms an ideal system to collect radiant energy, transform it to heat, and
142 efficiently transfer the heat to a surrounding fluid.... If the characteristic absorption length for
143 light passing through the material comprising the particles is greater than the particle
144 diameter, the entire volume of the particles is active as the absorber. When the particles*

145 *have absorbed the sunlight and their temperature begins to rise they quickly give up this*
146 *heat to the surrounding gas....”*
147

148 The one generalization that can now be made is that virtually all tropospheric aerosol
149 particulates, including cloud droplets and their particulate components, absorb short- and
150 long-wave solar radiation, and absorb long-wave radiation from Earth’s surface, thus
151 becoming heated. Moreover, aerosols can modify cloud properties and suppress rainfall [70-
152 73]. As Tao et al. [74] note: “*Aerosols, and especially their effect on clouds and precipitation,*
153 *are one of the key components of the climate system and the hydrological cycle. Yet the*
154 *aerosol effect on clouds and precipitation remains poorly known.”*
155

156 Whereas the methodology utilized by the IPCC and climate science community has focused
157 primarily on the problem of sun-Earth radiation balance and departures therefrom, our focus
158 has been on *understanding the processes involved in the disposition of absorbed heat,*
159 *notably the consequences of particulate pollution on atmospheric convection,* which we
160 submit, is a primary mechanism for maintaining Earth’s habitable surface temperature [1,34-
161 37].
162

163 **2.1 Role of Carbon and Iron in Aerosol Heating**

164

165 Dark-colored particulates are efficient absorbers of solar radiation of which black carbon
166 (BC), e.g. soot, absorbs light over the entire solar spectrum; brown carbon, e.g. soil humus,
167 on the other hand, absorbs near-UV wavelengths and, to a lesser extent, visible light [75].
168 Carbon surface deposits on non-carbonaceous aerosols can enhance their solar radiation
169 heat potential [76].
170

171 Iron is usually found in anthropogenic carbonaceous particles [77]. Iron-oxide minerals,
172 although somewhat less efficient solar radiation absorbers than carbon, nevertheless are
173 dominate among mineral radiation-absorbers. Alfaro et al. [78] measured light absorption in
174 samples of desert dust at two wavelengths, 325 nm (ultraviolet) and 660 nm (red light). They
175 found that for carbon-free desert dust, iron oxide was by far the greatest light absorbing
176 substance with the amount of absorption being a linear function of iron oxide content. They
177 further found that the absorption at 325 nm is about 6 times greater than at 660 nm. In
178 addition, Liu et al. [79] employed an “*airborne laser-induced incandescence instrument*” to
179 measure the hematite content of the Saharan dust layer which is known to be heated by
180 solar radiation [80,81].
181

182 Matsui et al. [42] discussed the relative importance of anthropogenic combustion iron and
183 iron from mineral dust in aerosol heating, and noted that “*magnetite [Fe₃O₄] is the most*
184 *efficient short-wave absorber among iron oxides in the atmosphere.”* Moteki et al. [43] found
185 that the majority of aerosol iron oxide particles in East Asian continental atmospheric
186 outflows are anthropogenic aggregated magnetite nanoparticles that, in addition to
187 carbonaceous aerosols, are significant contributors to short-wave atmospheric heating.
188 Recent results indicate that the atmospheric burden of anthropogenic iron of pyrogenic origin
189 is 8 times greater than previous estimates [42].
190

191 Yoshida et al. [82] note that there is a strong correlation between anthropogenic FeOx and
192 BC particles in the East Asian continental outflow of anthropogenic origin. That is not
193 surprising as pyrogenic coal fly ash, in addition to containing magnetite and other iron-
194 oxides, contains carbon particles [83]. For a set of UK coal fly ash (CFA) samples, the
195 hematite [Fe₂O₃] range was determined as 2.5 – 8.6 wt.%, the magnetite [Fe₃O₄] range as
196 0.8 – 4.1 wt.% [84]. The carbon content of coal fly ash by one estimate is 2 – 5 wt.% under
197 optimum conditions, and 20 wt.% under non-optimum conditions [85]. Another investigation

198 found the carbon content range of coal fly ash to be 2.7 – 14.5 wt.% [86]. One thing is clear
199 from these data: Aerosolized coal fly ash efficiently absorbs solar radiation and heats the
200 troposphere.

201

202 **2.2 Role of Forest Fires in Aerosol Heating**

203

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

216

217 **2.3 Role of Coal Fly Ash in Aerosol Heating**

218

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

230

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

236

237 The annual global production of CFA in 2013 was estimated to be 600 million metric tons
238 [97]. Coal fly ash is a cheap waste product that requires little additional processing for use as
239 a jet-sprayed aerosol since its particles form in sizes ranging from 0.01 – 50 μm in diameter
240 [98]. Except for its serious harm to human and environmental health [48,49,99-106], CFA is
241 an ideal particulate for heating the troposphere through absorption of short-wave and long-
242 wave radiation as CFA contains substantial quantities of the iron oxides, hematite and
243 magnetite, as well as carbon [83-86].

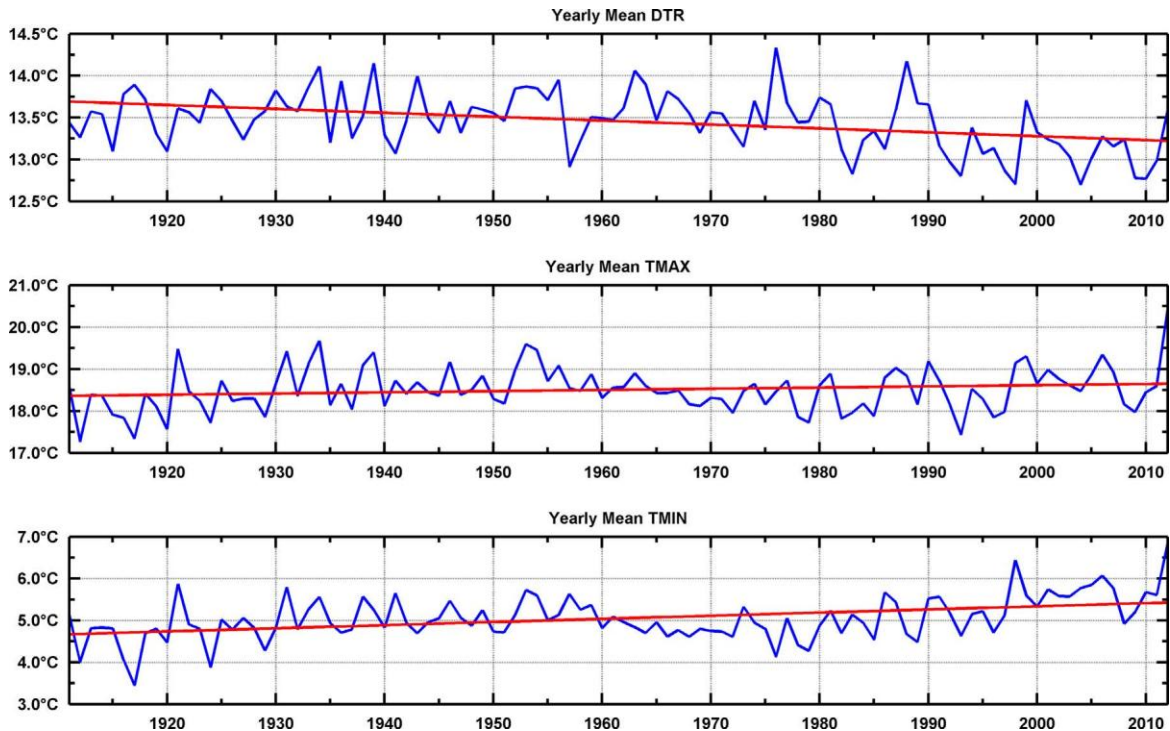
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245 **3. DIURNAL TEMPERATURE RANGE**

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247 The diurnal temperature range (DTR), the daily high temperature minus nightly low
248 temperature, ($T_{\text{max}} - T_{\text{min}}$), when tracked over time provides a measure of climate change
249 that is model-independent. Moreover, greenhouse gases' effects on long-wave radiation are
250 equivalent during both day and night, and thus affect T_{max} and T_{min} equally. DTR data are

251 therefore essentially independent of the direct radiative consequence of greenhouse gases
 252 [4,107]. Furthermore, greenhouse gases are transparent to incoming solar radiation [108].
 253 Although the reduction in T_{max} can be explained by sunlight being absorbed or scattered by
 254 particulates or by clouds, the increase in T_{min} is *inexplicable within the current IPCC*
 255 *understanding of climate science* [4] which is dominated by radiation-balance considerations.
 256 Diurnal temperature range (DTR) data are typically presented as averages over suitable
 257 increments of time for a large geographic area. Figure 2 from Qu et al. [109] presents yearly
 258 DTR, T_{max} and T_{min} mean values over the continental USA throughout most of the 20th
 259 century and up to 2010.
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 262
 263 **Figure 2.** Yearly DTR, T_{max} and T_{min} mean values over the continental USA. The red lines
 264 are linear regressions. From [37,109], (<http://creativecommons.org/licenses/by-nc-nd/3.0/>).
 265

266 As shown in Figure 2, T_{min} increases at a greater rate than T_{max} causing DTR to decrease
 267 over time, a phenomenon that is observed in many similar investigations [110-113] but not
 268 all [114]. The reduction in T_{max} can be explained by sunlight being blocked by particulates or
 269 by clouds [112], however, the concomitant increase in T_{min} is problematic within the
 270 radiation-balance paradigm practiced by the IPCC and climate science community. A good
 271 way to make advances in science, in instances such as this, is to ask the question: “*What is*
 272 *wrong with this picture?*” [3].
 273

274 4. EVIDENCE FROM WORLD WAR II

275
 276 Gottschalk [115,116] noticed a thermal peak coincident with World War II (WW2) in a global
 277 temperature profile image on the front page of the January 19, 2017 *New York Times*. He
 278 applied sophisticated curve-fitting techniques to 8 independent global temperature datasets
 279 from the U. S. National Oceanic and Atmospheric Administration (NOAA) and demonstrated
 280 that the WW2 peak is a robust feature. He concluded that the thermal peak “*is a*
 281 *consequence of human activity during WW2*” [115,116].

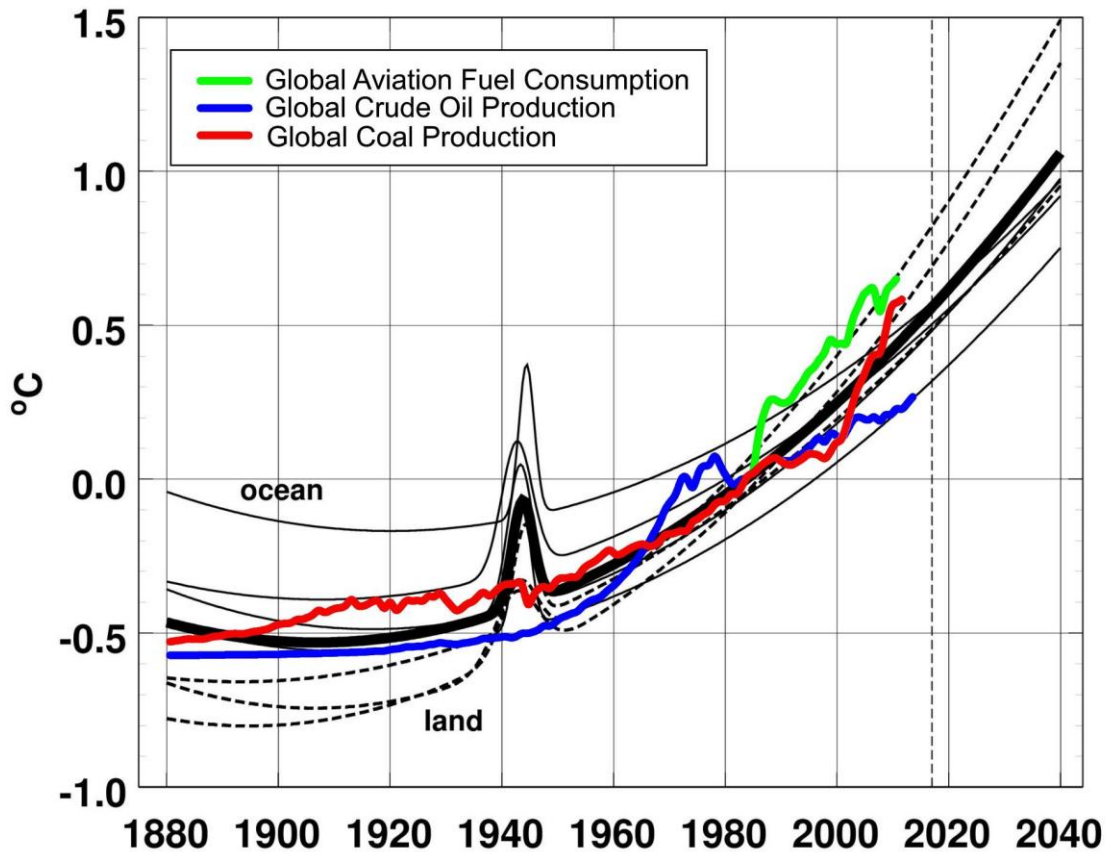
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The conspicuous aspect of Gottschalk's global-warming results [115], shown by the black curves in Figure 3, is that immediately after WW2 the global warming rapidly subsided. That behavior is inconsistent with CO₂-caused global warming because CO₂ persists in the atmosphere for decades [4,117]. CO₂-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 CO₂ during the war years, 1939-1945 [118]. The evidence thus points to a feature other than CO₂ 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].

UNDER PEER



307
308 **Figure 3.** Copy of Gottschalk's fitted curves for eight NOAA data sets showing relative
309 temperature profiles over time [115] to which are added proxies for particulate pollution.
310 Dashed line, land; light line, ocean; bold line, weighted average. From [34].
311

312
313 Following the end of WW2 hostilities, wartime aerosol particulates rapidly settled to ground
314 [119], Earth radiated its excess trapped energy, and global warming abruptly subsided for a
315 brief time [34]. Soon, however, post-WW2 industrial growth, initially in Europe and Japan,
316 and later in China, India, and the rest of Asia [123] increased worldwide aerosol particulate
317 pollution and with it concomitant global warming [34]. The rapid non-linear rise in these
318 curves in recent decades presumably has been also accelerated by covert tropospheric
319 aerosol geoengineering operations.
320

321 From the evidence shown in Figure 3, there is one inescapable conclusion: Aerosol
322 particulate pollution, not carbon dioxide, is the main cause of anthropogenic global warming.
323 That conclusion is not at all evident if you rely on the "radiation-balance" methodology and
324 parametrized models so widely utilized. The concept that aerosol particulate pollution is the
325 main cause of global warming thus constitutes a *climate-science paradigm shift*.
326

327 In the desert cloudy days are usually cooler than non-cloudy days, while cloudy nights are
328 typically warmer than non-cloudy nights. With that observation in mind, we now review the
329 evidence of the principal mechanism responsible for aerosol particulate caused global
330 warming.
331

332 **5. MECHANISM OF GLOBAL WARMING BY AEROSOLIZED PARTICULATES**

333

334 Aerosol particulates that become heated and transfer that heat to the surrounding
335 atmosphere have been said to cause “*changes in the atmospheric temperature structure*”
336 [124]. Published scientific papers rarely, if ever, mention of the consequences of such
337 observations on atmospheric convection, and the concomitant surface-heat-transfer
338 reduction that results from “*changes in the atmospheric temperature structure*” [4].

339

340 Indeed, convection is perhaps the most misunderstood natural process in Earth science.
341 Hypothetical convection models of the Earth’s fluid core [125-128] and of the Earth’s mantle
342 [129,130] continue to be produced, although sustained thermal convection in each instance
343 has been shown to be physically impossible [8] thus necessitating a fundamentally different
344 geoscience paradigm [9,12-14,131-133].

345

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

351

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

361

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

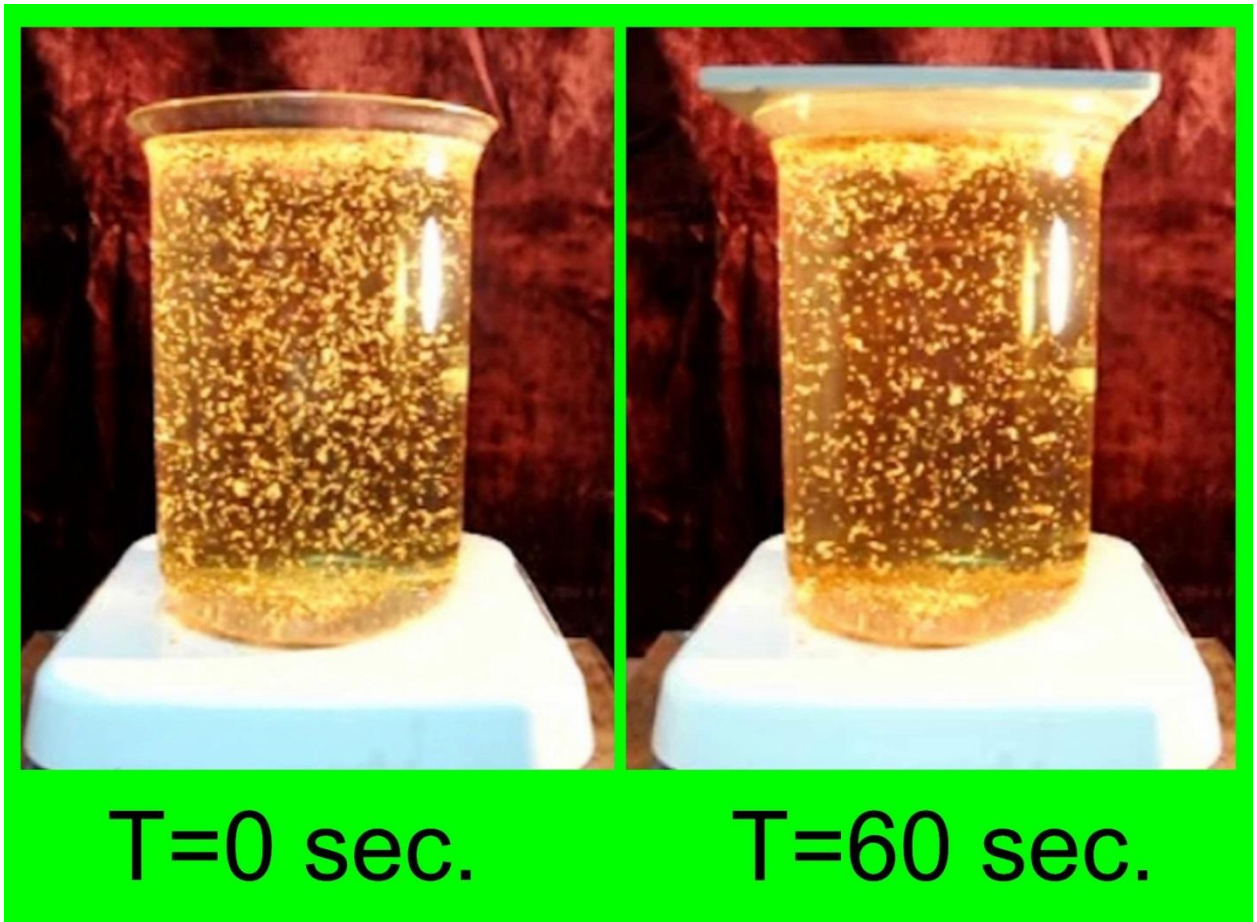
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368 As described recently [37]: *The convection classroom-demonstration experiment was*
369 *conducted using a 4 liter beaked-beaker, nearly filled with distilled water to which celery*
370 *seeds were added, and heated on a regulated hot plate. The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

375

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

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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

406 troposphere with vast amounts of particulate matter. Moreover, the particulate-proxies,
407 shown in Figure 3, track well with the subsequent global warming record.

408

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

417

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

430

431 Because the IPCC and other climate scientists attempt to explain global warming by relying
432 principally on the role of radiation transport, they are unable to explain the Mt. St. Helens'
433 data in a logical, causally related manner as indicated, for example, by the following illogical
434 explanation: "*at night the plume suppressed infrared cooling or produced infrared warming*"
435 [143].

436

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

443

444 Convection occurs *throughout the troposphere*, with differing degrees of scale, both
445 geographically and altitudinally, and with various modifications caused by atmospheric
446 circulation and lateral flow. Convection-efficiency in all instances is a function of the
447 prevailing adverse temperature gradient. Aerosolized particulates, heated by solar radiation
448 and/or terrestrial radiation, rapidly transfer that heat to the surrounding atmosphere, which in
449 turn reduces the adverse temperature gradient relative to Earth's surface and,
450 concomitantly, reduces surface heat loss and thereby over time causes increased surface
451 warming [36]. The same particulate-pollution-driven process operates locally, as in the case
452 of urban heat islands [63,145-148], regionally, and globally. Consequently, *particulate*
453 *pollution, not anthropogenic carbon dioxide, is the likely principal cause of global warming*
454 [1,34-36].

455

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

457

458 During summer months, Saharan-blown dust covers an area over the tropical ocean
459 between Africa and the Caribbean about the size of the continental United States [62,80,81].
460 The dust-layer extends to an altitude of 5-6 km; measurements indicate greater dust density
461 and associated haziness at 3 km than at the surface [81].
462

463 The warmth of the upper portion of the Saharan-blown dust layer is a consequence of its
464 origin over the Sahara, but the warmth is maintained by the absorption of solar radiation by
465 the dust [80], which is known to contain radiation-absorbing iron oxide [78,79] that, when
466 incorporated in bodies of water, initiates harmful algae blooms [106,149-151].
467

468 As noted by Prospero and Carlson [81]: "... *the warmth of the Saharan air has a strong*
469 *suppressing influence on cumulus convection*" Dunion and Velden [80] further note: "*This*
470 *new type of satellite imagery [Geostationary Operational Environmental Satellite (GOES)]*
471 *reveals that the SAL [Saharan air layer] may play a major role in suppressing TC [tropical*
472 *cyclone] activity in the North Atlantic. This paper presents documentation of these*
473 *suppressing characteristics for a number of specific TC-SAL interactions that have occurred*
474 *during several recent Atlantic hurricane seasons.*" Similarly, Wong and Dessler [152] also
475 recognize the suppression of convection over the tropical North Atlantic by the Saharan air
476 layer. The one commonality of these investigations is their failure to recognize the generality
477 of the reduction of convection-efficiency that occurs as a consequence of reducing the
478 adverse temperature gradient through aerosol particulate heating [1,34-36].
479

480 **8. SURFACE WARMING BY FALLEN AEROSOL PARTICULATES**

481

482 Tropospheric aerosol particles, as reviewed above, heat the atmosphere, reduce the
483 adverse temperature gradient relative to Earth's surface which suppresses atmospheric
484 convection and thus reduces surface heat loss and increases global warming [1,34-37].
485 However, the lifetime of tropospheric particulates is short, typically settling to the surface in
486 days to weeks [51-54,119]. If the aerosol particulates settle into bodies of water, their iron
487 components disrupt the natural balance there, causing, for example, harmful algae blooms
488 [106]. If the aerosol particulates settle on land, they absorb solar radiation and cause
489 additional global warming [153,154]. If the aerosol particulates settle on snow or ice (Figure
490 5), they also change the albedo, causing less light to be reflected and more to be absorbed,
491 further adding to global warming [155,156]. Zhang et al. [157] estimate a 38% albedo
492 reduction caused by downed aerosol particulates in snow cover on the Tibetan Plateau. As
493 noted above, forest fires have an "*immediate and profound impact*" on snow disappearance,
494 earlier springtime melt, and lower summer stream flows [89].
495
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Figure 5. 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 [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'ón [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

527 adversely affect atmospheric ozone. Even if placed in the troposphere, some of this material
528 will likely be lofted into the stratosphere [158-160].

529

530 **Table 1.** Coal fly ash:

531 Range of halogen element compositions [166].

532

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

533

534 By one recent estimate there have been 2,543 scientific articles published on the subject of
535 solar radiation management geoengineering [167]. There is something inherently dishonest
536 about geoengineering articles that neither mention nor discuss the effects of tropospheric
537 aerial particulate emplacement done by the military and its various commercial contractors,
538 an activity that has been ongoing for at least two decades [44-50]. These articles also
539 presume future solar radiation management will take place in the stratosphere, not in the
540 troposphere where our weather mostly occurs. As should be evident in this review, academic
541 climate scientists operating under the CO₂ paradigm are unlikely to be able to recognize
542 other causes of global warming. Moreover, many of them appear to be naïve about the
543 catastrophic dangers proposed by solar radiation management and other geoengineering
544 schemes, and invariably fail to even mention the ongoing tropospheric geoengineering and
545 its risks to human [44,47,50,101-103,168] and environmental [48,49,99,100,104-106] health.

546

547 **10. CONCLUSIONS**

548

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

553

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

559

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

563

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

566

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

571

572 • Most particulates found in the troposphere absorb solar energy to some extent from
573 one or more portions of the wavelength spectrum. Particulate aerosols have direct

574 effects of absorbing radiation as well as indirect effects on the formation,
575 microphysics, and lifetime of clouds.
576
577 • The one generalization that can be made about virtually all tropospheric aerosol
578 particulates, including cloud droplets and their aerosol components, is that they
579 absorb short- and long-wave solar radiation and absorb long-wave radiation from
580 Earth's surface and become heated, thereby making a significant contribution to
581 global warming and climate change.
582
583 • Dark-colored particulates are efficient absorbers of solar radiation of which black
584 carbon, e.g. soot, absorbs light over the entire solar spectrum.
585
586 • Brown carbon, e.g. humus, absorbs near-UV wavelengths and, to a lesser extent,
587 visible light.
588
589 • Carbon surface deposits on non-carbonaceous aerosols can enhance their solar
590 radiation heat potential.
591
592 • For carbon-free desert dust, iron oxide is by far the greatest light absorbing
593 substance with the amount of absorption being a linear function of iron oxide
594 content.
595
596 • Magnetite is the most efficient short-wave absorber among iron oxides in the
597 atmosphere.
598
599 • Iron oxides in the ash from forest fires can be converted at high temperatures to
600 magnetite which enhances the absorption of solar radiation.
601
602 • Iron is usually found in anthropogenic carbonaceous particles.
603
604 • Iron-oxide minerals, although somewhat less efficient solar radiation absorbers than
605 carbon, nevertheless are dominate among mineral radiation-absorbers.
606
607 • Forest fires have an "*immediate and profound impact*" on snow disappearance,
608 earlier springtime melt, and lower summer stream flows.
609
610 • Pyrogenic coal fly ash (CFA), contains magnetite and other iron-oxides, as well as
611 carbon particles. Aerosolized CFA efficiently absorbs solar radiation and heats the
612 troposphere.
613
614 • The main particulate-substance being jet-sprayed into the atmosphere is consistent
615 with coal fly ash (CFA).
616
617 • Although a major threat to human and environmental health, CFA is otherwise an
618 ideal particulate for heating the troposphere through absorption of short-wave and
619 long-wave radiation because CFA contains substantial quantities of the iron oxides,
620 hematite and magnetite, as well as carbon.
621
622 • The global warming peak during World War II is understandable as wartime
623 aerosolized pollution particulates trapped heat that otherwise should have been
624 returned to space, thus causing global warming at Earth's surface by reducing
625 atmospheric-convective heat loss.
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- 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.

- 678 • Academic climate scientists and the IPCC have a fundamental misunderstanding
679 about what really causes global warming. Moreover, they appear to minimize the
680 grave dangers that would arise from proposed geoengineering schemes like
681 stratospheric aerosol injection.
682
- 683 • More grievously, the complicity of silence among climate scientists and engineers
684 cloaks the covert activity of deliberately poisoning the air we all breathe, and
685 deceives the public about the dire health risks.

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

692
693 The problem of particulate-caused contamination of the biosphere and the runaway global
694 warming that accompanies it must be addressed immediately if we are to have a viable
695 future.
696

697 **COMPETING INTERESTS**

698
699 The authors declare no competing interests.
700

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