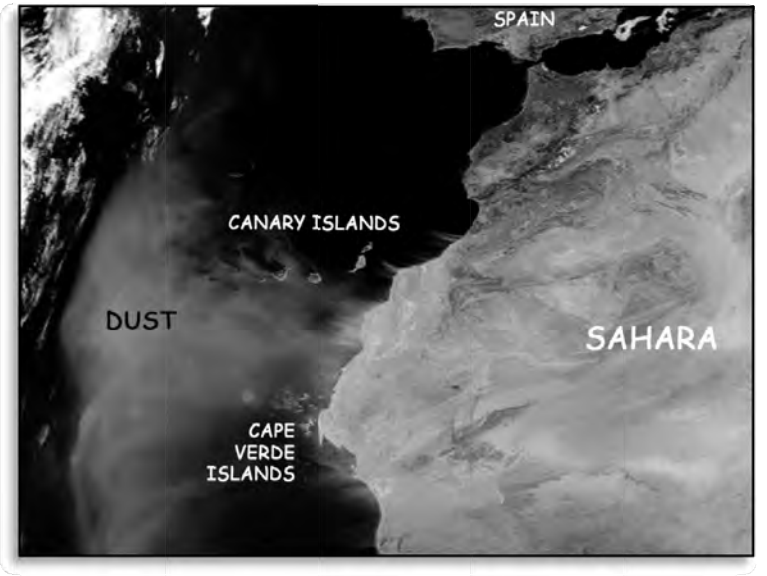


Dust blowing off of the Sahara out over the Atlantic Ocean reflects sunlight back out into space. Also, the iron in the dust serves to fertilize the plankton in the surface waters of the ocean, thus taking more CO_2 out of the air and producing more oxygen.

William H. Calvin, GLOBAL FEVER (University of Chicago Press, 2008)

9

That Pale Blue Sky

One surprise in recent years has been the effect of all of our modern pollution on cooling things. It has long been known that aerosols—sulfates and ash from power plants, smoke from fires, also dust and even sea salt—would reflect sunlight. Some light scatters down, making the sky a pale blue and the sunsets redder.

Some aerosols such as soot also absorb light. That means they warm the atmosphere while shading the surface. When you warm the atmosphere, you reduce cloudiness, allowing more sunlight through to warm the surface.

Until recently, no one realized the size of the cooling effect for aerosols from fossil fuels, what is now called global dimming. They turn out to have masked about a third of the twentieth century greenhouse warming—meaning that the CO_2 situation is even more serious than we thought a few years ago.

About two-thirds of the sunlight reaching the Earth is retained as heat. The rest bounces back out into space. Sand reflects a lot (it has "high albedo" in science-speak) but as rainfall improves and things turn into green grass and dark forests, less and less is bounced out. The tropical ocean bounces only about 10 percent. This means that when sea ice melts in the summer, you go from bouncing most of the sun's rays to absorbing most of them. You can see something similar when a blacktop driveway is covered by snow and then a small patch is cleared. The uncovered black patch heats up and melts the adjacent snow, soon clearing the entire driveway if it doesn't snow again and temperature remains near freezing.

Convert a desert into a suburb, and all of those dark parking lots and roofs now convert sunlight into heat (the urban "heat island" effect has repeatedly been trotted out by the disinformation propagandists to claim that global warning was a measurement artifact, even though it has long been clear that tundra and oceans have warmed up too).

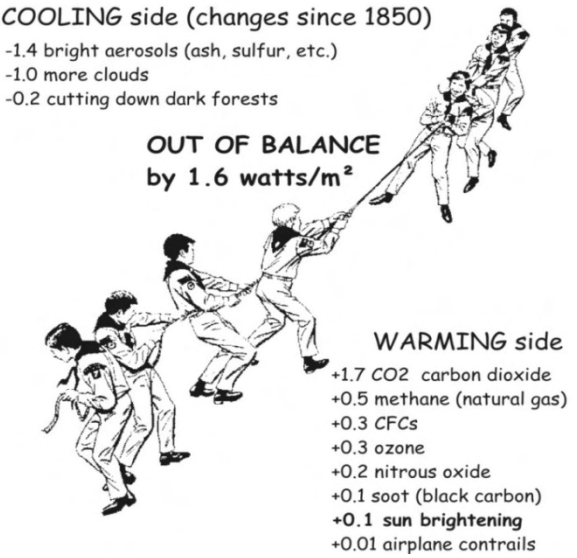
When you irrigate the desert, you are incidentally warming the rest of the Earth in two ways: increasing the heat absorbed with the darker surface, and making the air more humid (and so a better greenhouse blanket).

Bouncing so much sunlight back out into space via aerosols ought to have cooled the Earth considerably, just as it does for several years after a major volcanic eruption. That it didn't cool shows that the greenhouse warming has

been even larger than we'd realized—that particle pollution has been cancelling part of the warming from the invisible pollution, CO_2.

Economic problems can shut down many of the power plants (as happened in Russia in the 1990s). Remember leads and lags: the particles wash out of the atmosphere in weeks but the CO_2 is only removed on a timescale of centuries. The world could suffer a heat wave following a more widespread economic crash.

Unfortunately, the pollution is also busy changing regional climates and it is feared that it may trigger major droughts in Asia and Africa, even burn off the Amazon. None of the climate mechanisms that we identify turn out to be as one-dimensional or cause-and-effect as we initially suppose.



William H. Calvin, GLOBAL FEVER (University of Chicago Press, 2008)

When the most knowledgeable people about a subject start getting worried that big changes are going to happen, I tentatively side with them, not the neighbor who—emboldened by an ExxonMobil disinformation campaign aimed at providing sound bites for the coffee break—denies it all, despite knowing little about the subject.

I'm sure that it is only a matter of time before a disinformation campaign starts trying to sell you on the notion that pollution is good for you, that it is countering the greenhouse warming.

Just don't inhale.

> Supposing a currently envisioned low probability but high consequence outcome really started to unfold in the decades ahead (for example, 5°C warming in this century) which I would characterize as having potential catastrophic implications for ecosystems . . . Under such a scenario, we would simply have to practice geo-engineering . . .
>
> —climate scientist Stephen Schneider, 1996

There are some schemes for managing the sunlight reaching the Earth, though none can be a complete solution. There is a clever proposal for placing a satellite at the L1 point, where the earth's gravity balances out the sun's gravity and so a satellite might stay put with minimal corrections. Attach a big sunshade to it and you might be able to diminish the sunshine reaching the earth by a few percent.

A high haze around the earth that enhances the amount of sunlight that gets bounced out is another way of

tweaking the earth's energy balance. It's even "natural." The Mount Pinatubo eruption in June 1991, cooled the earth's surface by about 0.5°C during the following year with all the sulfur compounds that it injected into the upper atmosphere.

Paul Crutzen, the atmospheric chemist who won the Nobel Prize for his analysis of the ozone hole created by refrigerator gases, has considered the use of sulfur to make the upper atmosphere reflect some sunlight back into space and thus cool the planet in an emergency.

The chemistry for the stratospheric-sulfur strategy is about the same as for the sulfuric acid generated by burning coal which causes acid rain. It currently leads to a half million premature deaths every year. But the stratospheric-sulfur strategy is not, as some newspapers have proclaimed, going to bring back acid rain. (The same

mistake was made about ozone: it's bad down here but good high up.)

His proposal involves bypassing the weather of the lower atmosphere and using balloons or airplanes to distribute the sulfur in the stratosphere. It would stay there for several years, rather than washing out in a week as it does from coal plant emissions. So the amount needed for enhancing global dimming is only a few percent of the sulfur already being added by burning coal. But there's nothing special about using sulfur; a white powder such as diatomaceous earth would also serve.

If the planet's [reflection back into space] dropped by just a tenth from today's [30 percent] level, to 27 percent, the effect would be comparable to a fivefold increase in atmospheric concentrations of carbon dioxide.

—atmospheric scientist Veerabhadran Ramanathan

The problems with all such schemes is that they are partial, not addressing the other effects of excess CO_2. If you thought that acid rain was bad for lakes and ponds,

just wait until you see (in chapter 14) what happens to the oceans when the CO_2 concentration in the sea water rises. Acidified ocean is likely to ruin the tiny plankton that sink carbon to the ocean floor, the planet's major mechanism for sinking excess atmospheric carbon for million-year periods.

Still, the engineered high haze should be useful as a tweak as we try to back out of bright pollution without making heat waves worse. Think of such strategies as like the attitude-control thrusters on a spacecraft, which are not suitable for general propulsion but do allow for small-scale tweaks.

The discussions of geo-engineering heard in the science policy community have an air of unreality about them, as they assume some sort of global scientific consensus before deploying anything. I think it more likely that political leaders under pressure to "do something" because of a persistent heat wave will order their power plants to produce more aerosols to achieve local sunscreen, then order planes flying over their territory to use high-sulfur jet fuel, and later order their air force to disperse sulfur in the stratosphere—all without international consensus or scientific wisdom. Done in that fashion, they will probably make things worse.

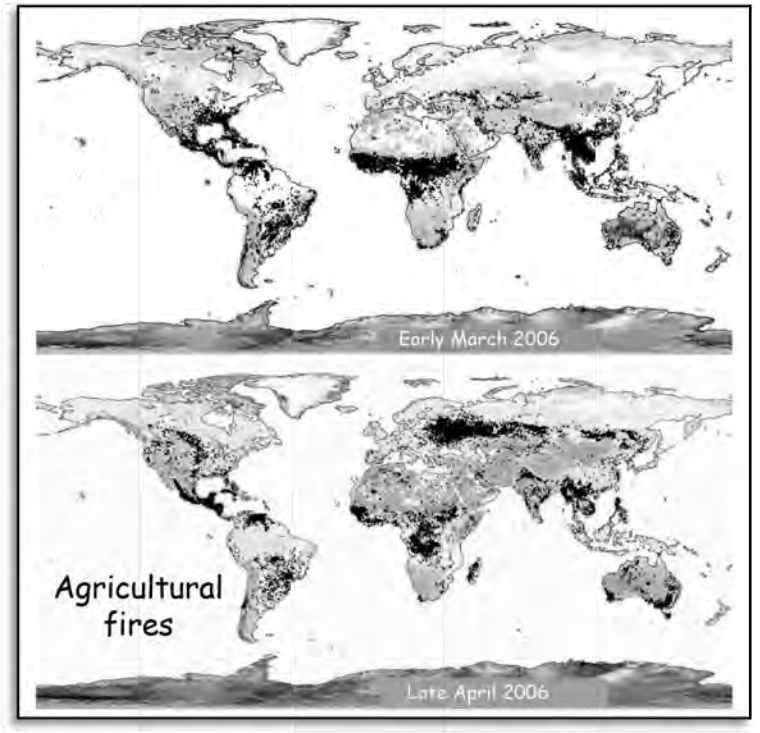
Our dirty-power situation reminds me of that dilemma that pilots face when a stall threatens at a time they aren't very far off the ground—and lack maneuvering room to regain airspeed.

Experts are now saying that we only have a decade to get carbon emissions under control before we start getting into the zone of triggering major droughts and more rapid rise in sea level farther down the line.

We too could lose our maneuvering room and crash.

> Had humans found bromine cheaper or more convenient to use than chlorine [for refrigerator gases], it is quite likely that by the time Paul Crutzen and his colleagues made their discovery [in 1974], we all would have been enduring unprecedented rates of cancer, blindness, and a thousand other ailments; that our food supply would have collapsed; and that our civilization itself would been under intolerable stress.
>
> And we would have had no idea of the cause until it was too late to act.
>
> —biologist Tim Flannery, 2006

Farmers often "clear the land" by setting fires before planting. Satellite monitoring of fires shows how intense the practice has become. Even if the CO_2 is soon reabsorbed by the plant growth, that's a lot of soot constantly circulating to absorb sunlight and warm the air. It also modifies precipitation downwind.



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WILLIAM H. CALVIN

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