A sense of climatological proportion

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I
The Myth of Scientific Consensus - Politicization of Science

The U.S. president repealed the Paris climate accords, which is embarrassing, although not so much because the planet is now somehow more at risk of immediate incineration, but rather because slamming the door in the world community's face suggests a lack of good manners. While the accords should not have been signed hastily by his predecessor and other managers of world affairs in the first place, they are so innocuous that virtually all countries on the planet signed them.

Ironically, the Ambassador to the United Nations, Nikki Haley, said soon after the announcement of the repeal that the president "*believes the climate is changing*" and the United States "*has to be responsible*" for the environment. She alleged in an interview on CNN's "State of the Union": "*President Trump believes the climate is changing and he believes pollutants are part of the equation*". Beside the fact that the customary culprit, carbon dioxide, is anything but a pollutant, it is hard to comprehend how the president could have one educated opinion or another about the subject, he who is admittedly learning his trade as he goes along, a modus operandi that should probably be applied with benefit to the airline industry, with septuagenarian novice pilots learning how to fly while carrying 300 passengers in the cabin. The president has 300 million passengers, and no active co-pilot.

Notwithstanding the presidential erring, it seems a large part of otherwise perfectly respectable newspapers spend quite some time claiming that the end of the world is near, since temperatures are said to increase one or two degrees, when in fact their priority should be set on denouncing the easily proven immorality of the current government, not on siding with one opinion or the other about a scientific matter they seem not to understand, incurring in the process the very tangible risk of losing all credibility if perchance facts proved different. They will argue of course that 97% of climate scientists are on their side, a number that has long been debunked and is anyhow so high it should have triggered their suspicion. Apart from the rigged election of ruthless dictatorships, such an outstanding majority is never reached in any election or opinion poll, be it about religion (would 97% of scientists agree on the existence of God, or on his non-existence, or on which religion is the true religion), or about biology and the theory of evolution, or about the quantity of carbon dioxide held underground, or in sea water, or the prediction of storms and hurricanes, or the spread of epidemics, or the choice of a president, etc. The sheer magnitude of the 97% majority should have set off the alarm bells, and should have been an indication that something was probably wrong with an opinion that is certainly sensational but not unequivocally correct from a scientific standpoint, as we will endeavor to show in this paper.

At any rate, the historian of science will confirm that in the matter of scientific truth the majority opinion is quite irrelevant.

The Paris accords are voluntary, which means signatories are not obligated to act, this being the reason why China and India, among others, signed the accords so readily, although it is more than probable that they will not do much to reduce their emissions, not because of any dislike for renewable energies, but because those are considerably more expensive than burning coal or natural gas. To give one example, if the U.S. decided to go all renewable in its generation of electricity, the capital expenditure would be of the order of $6 trillion, $20,000 per person, child and adult alike (and the esthetic visual damage would be quite massive: imagine the coasts of New England, the Gulf of Mexico, and California, lined up with hundreds of thousands of wind farms, and the plains of the United States covered with highly reflective material). Even if the U.S. accepted such a huge financial sacrifice, the likelihood that poor countries (per capita) would follow suit is abysmally low. Among such countries are China, India, and most of Asia, Africa, or South America.

Paradoxically, while there should be indeed a consensus that there is nothing political in the current climate issue, since it is supposed to be based on science only, it appears that the issue is in fact mostly political, and even a moral dispute, with progressives and conservatives giving credence, quite vehemently, to opinions that are diametrical opposites, for reasons equally unfounded and unscientific. When dealing about an issue they do not fully comprehend, the public seem to rely mostly on what they call their common sense, which is no better than their gut feeling, or a wild guess. Furthermore, it seems they tend to adopt the opinions of commentators they pre-approved or pre-vetted for reasons foreign to the very issue in consideration, which they will not try to understand personally from facts and logic only, preferring instead to leave the matter entirely to the pool of subjectively pre-selected interpreters of their own choice, as if no one could argue over how many angels can dance on the head of a pin but doctors of theology. It appears the public are also reluctant to have such issues debated publicly between the advocates of each theory, although they would surely object strongly if the crowning of champion athletes was decided only on statistical merits and on the vehemence employed in disparaging their opponents, instead of in a direct confrontation in a public arena.

II
The Fallacy of Climate Permanence

There is no reason for climate to go unchanged, in view of the past geological and climatological vagaries. I see through my windows mountains that were once plains at the bottom of the ocean, and the valley where I sit was once buried under 1,500 meters of ice. That was 17,000 years ago, a very thin slice of the history of Earth, not exceeding three parts in one million. At the time, the Alpine glaciers (*see link*) could have spread over an area of between 150,000 and 200,000 square kilometers. Since then glaciers have not been expanding (otherwise I wouldn't be sitting here), they have been retreating, at a rate of about one tenth of a meter of thickness per year, 10 meters in length lost each year, on average. Since written history started mentioning the glaciers, 2,000 years ago, these have been fluctuating, but, for the time being, have retreated overall. It would have been surprising if after 17,000 years of continuous retreat the withdrawal had been reversed just when the glaciers had been pushed all the way to the highest summits. What is left is probably less than 2% of 1% of the original surface area and about one millionth of the original ice volume.

In North America the retreat of the glaciers (*see link*) was as spectacular. To put the event in perspective and provide some sort of a timeline, it seems Earth might have formed about 5 billion years ago, and some say even earlier, the Primary or Paleozoic Era started 540 million years ago, the Secondary or Mesozoic Era 250 million years ago, the Tertiary or Cenozoic Era 65 million years ago, and the Quaternary Period, a substrate of the Tertiary, or Pleistocene/Holocene Epochs, 2.5 million years ago. Near the end of Earth's history, a mere 18,000 years ago (a time as short as one second in three days), North American glaciers covered 17.3 million square kilometers. Around 12,500 years ago, just when the first humans are thought to have started their migration from Asia to the Americas, ice had probably retreated to 14.3 million square kilometers. By 10,000 years ago ice covered 9.4 million square kilometers, by 5,000 years ago probably 2.2 million square kilometers, 1,000 years ago 2.1 million square kilometers, and 50 years ago 2.0 million square kilometers, including Greenland.

Either the glaciers remain at their current position, or they continue retreating, or they start expanding. From geological history we can infer that the glaciers and icecaps will not stay put, nothing ever remaining static. They will therefore retreat or expand. A serious expansion would be concomitant with a dramatic drop in temperature and the invasion of ice upon heavily populated valleys and plains. If the ongoing trend continues, however, the glaciers will finally disappear. At the current rate that would be consummated within a few to several millennia.

Deglaciation of North America appears to have started 15,000 years ago (*see link*), when the passage of Earth at perihelion last coincided with the northern summer solstice, and there is little reason for deglaciation not to slowly continue.

Incidentally, for the sake of trying to keep a sense of proportion, the laws of thermodynamics show that in the absence of any other source of heat, if all of the terrestrial atmosphere were dedicated uniquely to the melting of the Greenland glaciers, their total removal would require theoretically the prior heating of the whole atmosphere around the globe from its current average temperature of -25 C (-13 F) to +145 C (+293 F). Upon completion of the melting, the average air temperature would be 0 C (32 F). Likewise, the removal of all of the Antarctic icecap would require the prior heating of the entire atmosphere to +2,100 C (+3,800 F). The figures are provided for the sake of proportion only, and assume the absence of liquid water on earth before the melting, since the oceans would limit in effect any theoretical rise of temperature to 100 C (212 F). In reality, any melting would occur because of direct heating from the sun, with global temperatures being a consequence of the melting process, not the cause.

However, as the ice melts temperatures are kept stable, but after all the icecaps have melted the temperatures would increase to the levels mentioned above if there were no liquid water to limit the rise, which the observation of our sister planet, Venus, tends to contradict: with her atmosphere 50 times denser than ours and twice as thick, composed almost entirely of carbon dioxide, as opposed to our meagre 0.04%, and devoid of any liquid water, Venus's average ground temperature is thought to be 462 C (864 F) only. Despite Venus being closer to the sun, Earth and Venus receive amounts of heat on their surface that are quite similar, because of the higher reflectivity, or albedo, of Venus' atmosphere.

It took 9,000 years for ice to retreat from perhaps 50 million square kilometers worldwide to around 12, and 6,000 years to retreat from 12 million square kilometers to the current 10, or so. If no reversal of deglaciation occurred, at the latter rate it would take 30,000 years to complete the melting of all the remaining ice, and, if the former accelerated rate were somehow reinstated, 2,400. By this earlier occurrence, if population growth rates remained hypothetically the same as current, the population of Earth would have reached 200 billion, and by the later date, 2,600 billion. To put things in perspective, the former population would ingest and discharge through eating and breathing twice the carbon released from fossil fuels today, and the latter 30 times as much. The figure is 0.08 currently. Clearly, and whatever happens in between to limit or not the population explosion, by then the world will be quite different from anything we are able to imagine today, and at any rate even the most imaginative science fiction writers were never capable of foreseeing what was coming our way in a much more stable world.

III
Carbon Realism

On Earth, atmospheric carbon dioxide is extremely tenuous, and represents only 0.04% of the content of the atmosphere. Making reference to Venus again, since some commentators refer to her to support the theory of severe carbon dioxide induced heating, Earth's atmosphere is 50 times less dense than Venus', and half as thick. Carbon dioxide represents 96.5% of Venus' atmosphere, and there is 165,000 times more carbon dioxide in Venus' atmosphere than in Earth's. In Earth's atmosphere, carbon represents only 6% of 1% of 1% of what it is on Venus, or 6 parts per million. What is thought to be true for Venus can hardly be extrapolated for Earth.

Carbon is present in our atmosphere, the oceans, on the surface of earth, and underground.

In the atmosphere, carbon is at a concentration, expressed as mass, of 0.016% (1.6% of one percent). That's 1.59 kg of carbon per square meter of Earth surface. The rest of the atmosphere consists of nitrogen (7,532 kg per square meter), oxygen (2,310 kg), argon (128 kg), water vapor (25 kg), and traces of other gases. The concentration of carbon in the atmosphere is so tenuous that its measurement poses serious challenges. For comparison, at sea level there is less than 0.2 grams of carbon per cubic meter of air, while air has a mass of 1,225 grams per cubic meter at 15 C (59 F); on a hot humid summer day there would be more than 30 grams of water vapor per cubic meter, 150 times as much as carbon.

It is certainly worthwhile noting that a backwards estimate of the mass of carbon per square meter on Earth shows that although it was slightly less than today about 20 million years ago, it has been otherwise consistently higher since the Neoproterozoic Era 650 million years ago, reaching at times 40 kg per sq. m, its average value being 21 kg per sq. m, or 13 times as much as today.

Beside Venus, carbon is also present in the atmospheres of other planets, except Mercury, which has virtually no atmosphere. For the sake of proportion, Venus' atmosphere contains about 200,000 times as much carbon as Earth's per unit of planet mass, Mars 75 times as much (despite Mars' tenuous atmosphere density being only 0.6% of that of Earth), Jupiter 10,000 times, Saturn 20,000 times, Uranus 100,000 times, and Neptune 50,000 times as much as Earth's per unit of planet mass, despite the latter four planets containing only traces of carbon in their atmospheres.

On Earth, carbon is also present on the ground, in the biomass. Although it is not easy to figure out the exact mass of biomass on earth, the compilation of all available material returns a value between around 1,500 and 2,000 billion metric tons of carbon. Per unit of earth surface area, that's about 3,600 grams per square meter, about 2,700 grams of it vegetal, the rest mostly bacterial.

There is also carbon dissolved as carbon dioxide in the oceans, and carbon contained in oceanic carbonates. Reduced to the unit of earth surface it is thought to be of the order of 87 kg per square meter.

The soil also holds a significant quantity of carbon, which is thought to be possibly as much as 4,600 grams per square meter.

It is not easy, or even possible, to calculate how much carbon the planet holds underground, but it is probable that the total content is between two tenth of a thousandth and one thousandth of earth's mass. Per unit of earth surface area, that would be of the order of between 2,000 and 10,000 metric tons per square meter, a large part of it in the form of carbonates.

There is also carbon trapped underground in fossil fuels, to the tune of possibly 3.25 kg per square meter, including oil, natural gas, coal, and methane hydrates. Some estimates reach even 45 kg per square meter.

To summarize, the quantities of carbon present above ground, on the ground, in the water, and underground are as follows:

- Atmosphere: 1.59 kg per square meter in the form of carbon dioxide
- Ground surface: 3.6 kg per square meter in the form of biomass, animal and vegetal
- Soil: 4.6 kg per square meter, according to some authors
- Oceans: 87 kg per square meter, as carbon dioxide and carbonates
- Fossil fuels: 3.25 kg per square meter, and up to 45 kg according to some sources, in the form of hydrocarbons
- Underground: up to 10,000,000 kg per square meter, a large part of it in the form of carbonates

It does not seem carbon was present in earth's material originally, and all of Earth's carbon must have migrated from the atmosphere down. For reference, the dense atmosphere of Venus, the planet closest to Earth, consists mostly of carbon dioxide, to the tune of 275,000 kg of carbon per square meter. One scenario would be that carbon arrived repeatedly to Earth from the impact of external planetary objects. About 30 to 40 Venus events would explain the current quantity of terrestrial carbon.

All the sources of carbon listed above must interact with each other: atmospheric carbon gets fixed in vegetal biomass, the largest part of which in turn is either consumed by animal life or decays, a process that returns carbon to the atmosphere, but another part gets in the ground, first in the soil and later as hydrocarbons, mostly natural gas at first, while part of it is burned either naturally or artificially with the subsequent release of carbon back to the atmosphere; carbon dioxide is released from the oceans when temperature increases and gets dissolved in the oceans when temperature decreases; and carbon dioxide is also transferred from the atmosphere to the oceans and vice-versa at constant temperature, depending on atmospheric partial pressure; hydrocarbons are either released naturally to the atmosphere through oil and gas seeps, or are extracted and burned artificially, and some are either trapped in gas hydrates laying at the bottom of the oceans or in the permafrost, or on the contrary are naturally released, depending on conditions of temperature and pressure; underground carbonates are recirculated through tectonic and volcanic activity, with the release of carbon compounds; and surface carbonates are weathered with the release of carbon to either the atmosphere or surface water.

Of all these interactions, only one of some significance can be quantified reliably: the quantity of carbon extracted as hydrocarbons and burned in the atmosphere with the release of carbon dioxide (minor quantifiable interactions exist, such as the calcination and carbonation of cement, but they probably account for less than 1.5% of the carbon dioxide released from hydrocarbon burning). Some of the other interactions can be estimated, but most of the quantitative interactions between 10,000,000 kg of carbon sources per square meter are absolute unknowns. However, authors seem to contend that all the interactions, except for carbon released through the burning of hydrocarbons and other industrial activities, are strictly balanced, which would be quite surprising.

The current annual release of carbon from hydrocarbon burning is 18 grams per square meter overall, or 0.018 kg. That’s 1.8 parts per billion of terrestrial carbon.

Literature abounds about the carbon cycle, but most authors seem to state that the cycle would be in perfect equilibrium if it weren’t for man’s intervention, and carbon released through the burning of hydrocarbons has nowhere to go but to accumulate in the atmosphere, with half of it going into the oceans, which is surprising since there is no reason why it should. In fact, if it were, there would have been no fossil fuel available anywhere on the planet, and no accumulation of organic carbonates.

The concentration of carbon in the oceans is estimated to be about 30 ppmm (parts per million as mass), mostly in the form of carbonates, and the extra dissolution of half the carbon released through the burning of hydrocarbons would mean an annual concentration increase of 4 ppbm (parts per billion, mass), which is unmeasurable. At the current 380 ppmv concentration of atmospheric carbon dioxide, ocean water has the capacity, even at a temperature as low as 10 C, to dissolve carbon dioxide only at a concentration of 0.25 ppmm carbon.

As it is exceedingly difficult to measure how much hydrocarbons seep naturally every year, how much carbon is fixed or released by methane hydrates, how much is dissolved in or released from the oceans, and how much carbonates are recycled through volcanic activity and weathering, we will leave those interactions unaddressed, although they could be quite significant.

Vegetal biomass consumes and releases carbon. Its average mass is probably around 2.7 kg per square meter (expressed as carbon) and it is thought to grow annually by 335 grams, or 0.335 kg, which represents an overall growth ratio of 12%. Energy-wise, the overall efficiency of this average growth would be only 0.2% of the solar energy hitting earth’s surface. The growth comes from the fixing of atmospheric carbon by the biomass in the photosynthesis process. Part of the growth is consumed by animal life, part will decay under the action of bacteria, both with the release of carbon to the atmosphere, and part will be stored in the soil and eventually underground. We will attempt in the next paragraph to estimate how much is stored.

Various authors state that carbon dioxide concentration in the pre-industrialized atmosphere was 280 parts per million by volume (ppmv), whereas the contemporary concentration is 380 ppmv. The rate at which the atmospheric concentration increases has been well documented since 1960, or at least its moving average, since year to year measurements can vary by as much as 70% on each side of the average value. That rate, per unit of surface area, corresponds currently to 9 grams of carbon per square meter per year, which is almost exactly one half the known release from the burning of hydrocarbons. A legitimate question would be: if 18 grams were released and 9 were left in the atmosphere, where did the balance 9 grams go? Commonly available literature states that the balance goes, quite conveniently, into the oceans, although there is no way to measure or confirm the claim. As mentioned above such a minute increase in average concentration of 4 ppb would be quite invisible. One would have to wait 25 years at current release levels to notice an increase of 0.1 ppm. This rate of absorption in ocean water is only calculated, not measured, and is based on the solubility of carbon dioxide in surface water at 10 degrees C. It does not take into consideration any further transfer of carbon to living organisms or other carbon forms in ocean water, which represent 30 ppm, as opposed to 0.25 ppm of carbon in the form of carbon dioxide. Per square meter of earth surface, carbon contained in the oceans as carbon dioxide represents possibly about 0.75 kg, as opposed to 86 kg in the form of carbonates and 1.59 kg in the atmosphere. The rate of transfer of carbon from the atmosphere to the oceans could be less, but also much more, depending on the rate of transfer from dissolved carbon dioxide to living and then dead organisms, which is unknown.

Through backward extrapolation, we can estimate the total quantity of fossil fuels extracted and burned by mankind in the last 150 to 200 years to be of the order of slightly above 1,000 grams of carbon per square meter. We can also estimate, from historical records, that the destruction of natural forests both temperate and tropical, removed as much as 1,950 grams of carbon per square meter, most of which has, by now, been burned or oxidized or reduced by animal life forms, and at one point returned to the atmosphere. It is worth noting that, apparently, twice as much carbon was released along the ages to the atmosphere through deforestation than through hydrocarbon extraction. A total of 2,950 grams was transferred from the biomass and fossil fuel deposits to the environment, most of it during the last 150 to 200 years. The 2,950 grams have not accumulated in the atmosphere and the oceans only, since atmospheric carbon concentration increased during the same period only by 100 ppmv, from 280 to 380 ppmv, or by 418 grams per square meter, to the current 1,590, while through the increase of carbon dioxide pressure the concentration in the oceans can be calculated to have increased from 0.185 to 0.250 ppm, which would correspond to an increase from 0.56 to 0.76 kg per square meter, or 200 grams. In other words, 2,332 grams were stored in another form, either in the oceans or underground. The compounded annual rate of transfer underground would be on average 0.32% of the mass of vegetal biomass, or 2.58% of the natural growth rate of 12%.

This would mean that the existing biomass has the capacity to remove and store 2,700 x 0.32% = 8.5 grams of carbon per square meter annually, while currently the oceans have the capacity to absorb also 8.5 grams as a consequence of the increase of the atmospheric carbon partial pressure. Since the actual increase of atmospheric carbon is 9 grams per year per square meter, the total release is then 26 grams per year, 18 grams of which comes from hydrocarbons, which means that 8 grams come from elsewhere. It so happens that the current tropical forest deforestation rate of more than 125,000 square kilometers annually would result in the release of 8 grams per square meter of carbon, as ultimately all timber felled is burned or consumed by termites and other life forms. However, this convenient enough figure could be different, which would imply the existence of other sources of carbon dioxide release.

If deforestation stopped now, the annual increase of atmospheric carbon would drop from 9 to 5 grams per square meters annually, after accounting for the release from the oceans due to the drop of partial pressure in the atmosphere. More importantly, if deforestation had never occurred, the carbon storage potential from biomass activity would be 15 grams per square meter per year and the increase of atmospheric carbon would drop to 1 or 2 grams per square meter after consumption of fossil fuels. If all hydrocarbon production stopped and deforestation had never occurred, it is probable that about 8 grams of carbon would disappear from the atmosphere every year, until a situation of carbon starvation would exist that would severely limit biomass growth.

Incidentally, it has been proven, and is proven every day, that in the places most subject to tropical forest deforestation the rate of deforestation would be significantly higher without the recourse to fossil fuels, as people in the poorest parts of the world cut down wood for energy, a phenomenon that is spreading again in richer countries whenever the price of energy increases due to market pressure or taxation.

As noted above, it appears, quite ironically, that deforestation is possibly a more prominent cause of the increase of atmospheric carbon concentration than is hydrocarbon extraction.

If carbon released from the combustion of hydrocarbons was exclusively released into the atmosphere and dissolved into the oceans, stabilizing carbon concentration in the atmosphere at the current level of about 380 ppmv would mean halting the consumption of all fossil fuels, since the solubility in water is a function of atmospheric carbon dioxide concentration, not of the amount being released in it. However, this scenario does not consider other unknown sources of carbon release.

Also, whether coincidentally or significantly, if it is assumed that the accumulation of sedimentary organic carbonates started in earnest with the so-called Cambrian Explosion at the beginning of the Paleozoic Era about 550 million years ago, and said accumulation amounts to 10,000 tons of carbon per sq. m., then the average rate of sedimentary deposition is also 18 grams per year, or very conservatively at least 5 grams per year if the total amount of sedimentary carbon is 5,000 tons per sq.m. and the period of sedimentation is extended to 1 billion years since the beginning of the Neoproterozoic Era. Since the rate of sedimentary deposition must be compensated by a more or less equivalent amount entering the system through the atmosphere, then in both cases that amount is of the same order of magnitude as the rates of human induced carbon release, or increase in atmospheric concentration, or rate of accumulation in the soil.

The real issue is probably not that the concentration of atmospheric carbon should increase every year by 9 grams per square meter, but that if all deforestation and burning of fossil fuel stopped today the natural rate of decrease of atmospheric carbon would be about 4 or 5 grams per square meter per year, and, assuming an exponentially diminishing rate due to the increasing starvation of the biomass, within 80 years the concentration of atmospheric carbon dioxide would be lower than eighteenth century levels, and within two centuries half of the atmospheric carbon would have disappeared, with serious negative consequences for biomass growth. If before deforestation and hydrocarbon extraction the concentration of carbon dioxide in the atmosphere was indeed 280 ppmv, its mass would have been 1,170 grams per square meter. At the time, the natural rate of annual depletion through biomass would have been probably 15 grams per square meter. If no other source of permanent carbon release existed, and considering the release from the oceans concomitant with the reduction in carbon dioxide partial pressure, the drop in atmospheric carbon would have been 8 grams per year per square meter at first. An exponentially diminishing decrease would have exhausted 50% of atmospheric carbon dioxide within a century. By now less than 20% or so would subsist, with dire effects on natural biomass growth, a quite ironical paradox.

IV
Fictional Woes and Real Perils

If the theory holds that an increase of atmospheric carbon dioxide concentration leads to an overall increase of atmospheric temperature, the melting of subsisting glaciers, and the subsequent rise of ocean levels (although it seems the variations of carbon dioxide concentration follow temperature variations, not the other way around; it is heat that melts ice, not temperature, and temperature usually drops when ice melts if no additional heat is applied), then a decrease of atmospheric carbon dioxide concentration should logically lead to overall cooling, the expansion of glaciers, and the lowering of ocean levels, which would be quite detrimental to the comfort for mankind of places such as northern Europe, Russia, North America, northern Asia, southern Australia, New Zealand, and southern Africa and South America.

The current Quaternary Period is one of the coldest, if not the coldest, in the 4 or 5 billion years of Earth’s history. The coldest was reached 18,000 years ago, when the world population might have been a couple of millions only. The abrupt expansion of mankind coincided with the deglaciation that started 15,000 years ago, and about 6,000 years ago world population had reached perhaps 7 million. Deglaciation continues to this day, but it was precisely at the time most of the glaciers had retreated, 6,000 years ago, that mankind started really blooming, quadrupling to 25 million 4,000 years ago. Two thousand years ago the population might have been already 200 million, and by 2016 it had reached 7,500 million. It seems mankind developed thanks to the global warming that started at the peak of the last glaciation.

Literature contends that carbon dioxide released through the burning of fossil fuels accumulates in the atmosphere and the oceans, without any other outlet. If true, this would mean that the rate of fossil fuel consumption would not influence the eventual concentrations in the atmosphere and the oceans, and whether the resources are used swiftly or slowly, the final concentration would be the same.

Current fossil fuel energy usage is about 31 million metric tons of oil equivalent per day, or 4.2 kg per inhabitant of the planet, per day. For comparison, Americans consume 16.5, Australians 14, and the Dutch 12.5, while the figure is less than 1 for Filipinos and Pakistani. In the future, the poor will endeavor to use more cheap energy, not less, and the poor largely outnumber the rich. It is unlikely that the starved will heed the advice and warnings of the well fed. Short of increasing, not decreasing, global energy consumption, disparity between the starving and the overfed will increase dramatically.

At the current rate of population growth, 2,000 years from now world population would reach 180 billion, theoretically and hypothetically, which would probably prove most unsustainable (although some current estimates predict just the opposite, that population is soon to decrease, with the corresponding woes of an abruptly aging population, a trend which would also probably prove to be most unsustainable). Even a short 100 years in the future the population is likely to be 16 billion, with the increase happening primarily in countries both poor and yearning for energy, and overall fuel consumption will be at least twice, or thrice, that of today, although by that time the resources might be severely depleted. No matter what, it is quite likely that whatever fossil fuel is available will be eventually extracted and burned, and the larger the population and the more atomized independent nationalities become, the less likely overall consumption could be controlled (on the eve of World War I, a dozen polities controlled a world population of less than two billions, either directly or through expatriate proxies; a century later, two hundred different independent governments rule over a population exceeding seven billions. If the trend persists, how many independent nationalities will there be in the future, and how many will be at odds?). Trying to restrict the poorest, who will represent a large majority of the global population, from accessing cheap fossil fuels would widen the gap between the richest nations of the world, some of them boasting currently $175,000 of gross domestic product per capita per year, and the poorest, with only $150, a level of destitution not known in any rich country. We're not addressing here the disparity between the richer and the poorer sections of individual rich countries, where even the poorest are affluent compared to the poor of the Third World.

Any worldwide taxation of fossil fuels in the form of carbon taxes would just exacerbate the process.

Without fossil fuels mankind would chop wood to cook, as it does currently in Third World countries. Within fifty years all the forests on earth would be gone. Of course, part of the populations of rich countries would use solar, wind, and nuclear power, but the not so rich in those countries would do what they do today, heat their houses by burning firewood, until it is banned by law and they become outlaws, although freezing outlaws. Anyway, by then the rich countries would represent quite a small fraction of the world population. By that time atmospheric carbon dioxide concentration could be 2 to 5 times current levels.

For as long as fossil fuels will be available, fossil fuels will be used, particularly in poor countries, and more so when legal barriers are erected against them in the rich countries to serve the needs of the proponents of alternative, but expensive, technologies, with, as a consequence, downward pressure on fossil fuel prices. Fifty years from now, the population of the world will be 12 billion, most of it poor and energy hungry. The rich countries will erect forests of windmills and cover the ground with solar panels, while the poor will endeavor to close the energy gap as fast as they can, using whatever fossil fuel there is, which is preferable to burning forests anyhow. Fossil fuel prices will benefit from restrictions in rich countries, until prices rise again when resources dwindle, if they do. Trying to scare the poor with imminent incineration in order to prevent them from using cheap energy will prove rather difficult.

Furthermore, it is also probable that the Great Carbonaceous Scare will fuel revolt and discontent throughout the Third World because of the legal restrictions it aims to impose on cheap energy universally, and will provide a platform to a new form of populism in places where the attempted carbon policies will be resented as a new form of intellectual colonialism. Meanwhile, the rich countries will have entangled themselves in rules of their own making and will lose their economic advantage, with energy costs inflated at least fivefold compared to the rest of the world.

And what happens in 2517 if and when world population reaches 50 billion? Mankind was apparently not well versed in the art of living at peace when it numbered 1, 2, 3, or 7 billion. Is the planet likely to be more peaceful when mankind numbers 50 billion? Are higher numbers likely to result in fewer conflicts, or rather more? Will mankind be easier to control when its numbers explode? How safe will the world be, considering the probable proliferation of nuclear and other severely destructive weapons soon to be, quite unavoidably, in the hands of rogue political entities?

Shouldn’t the hypothetical woes associated with a slight increase of one minute gas in the atmosphere, the process of which is quite unclear, be the least of all our possible worries? Aren’t they a deadly distraction from considerably more pressing issues? Is a temperature increase of one or two degrees, even if confirmed in the future, likely to destroy the planet, or is it to be beneficial to all places at higher latitudes, rather than detrimental? Will the increase not happen anyhow, irrespective of whether we burn fossil fuels or not, returning in the process minute amounts of carbon to the atmosphere, whence it came in the first place?

The ubiquity of fantasy fiction and horror movies suggests that a large part of the public, if not the largest, relish those genres and somehow feels thrilled when imaginary danger and catastrophe loom. If, in addition, a sense of anthropocentric importance, or Wichtigkeit, can be instilled in the audience, together with a feeling of righteousness at the spectacle of the heroic combat of virtue versus evil, then the show will achieve record popularity. It would seem the danger posed by a tenuous gas, which happens to be the gas of life for vegetal growth and the main dry constituent of animal life (chemistry involving carbon is called ‘organic’), serves well the purpose of nourishing a general but harmless popular scare, to the benefit of opportunistic commercial and political interests. It also provides a convenient rationale for extra taxation. Climatological disasters have been guaranteed since the late 1980s, as a punishment for human induced carbon release, but did not happen: there has been no hurricane to hit the U.S. shores of the Gulf of Mexico for a good solid 8 years since Ike in 2008 (although some will return, perhaps even this year, as in the past), the drought which was promised to scorch California and other western states finally came to an end, with record snowfalls on the Sierras and the Rockies (*see Grand Targhee, Wyoming, on 14 June 2017*), the bleaching of some coral reefs on the Great Barrier, which was thought to be due to an immeasurable acidification of sea water, seems to be explained by slightly dropping sea levels, a consequence of the El Niño–Southern Oscillation climate pattern. It is not only likely, but probably to be hoped, that the deglaciation of the planet will continue, with the continuing slight rise of the oceans, although the phenomenon will take a few to several millennia to complete, until at one point the process will be naturally reversed, and glaciers will start expanding while the oceans start receding, stranding all the great ports of the world and freezing large expanses of Earth. As for the status quo in the current state of affairs, or even nostalgically going back in time a couple of centuries, we know we shouldn't be overly wishful.

If the waters rise, our distant descendants will move inland and build dykes rather than arks. If the waters recede, they'll move seaward.

And while adapting to changing conditions, they will make sure to keep their environment clean, which is rather a totally distinct issue.

At any rate, finding fault in the climatological wickedness of the heathens of Sodom and Gomorrah is not likely to result in their annihilation by fire and brimstone.

V
Incidental remarks

It has been seen above that the annual atmospheric discharge of carbon from fossil fuels is 18 grams per square meter of Earth surface, and it can be easily calculated that the annual consumption of fossil fuels plus all non-fossil energy is of the order of 24 grams per square meter, expressed as crude oil equivalent.

Ultimately, most, if not all, of that energy is released in the form of heat, which is absorbed by the environment. The amount of heat released in such fashion is about 1,000,000 Joules per year per square meter.

If all such heat were absorbed by all of the atmosphere the resulting annual temperature increase would be 0.1 degree C. If only half the atmosphere were concerned the temperature increase would be 0.2 degree C, and so forth.

However, various inter-governmental organizations have consistently declared that the annual atmospheric temperature increase is currently only 0.016 degree C.

One way to reconcile the large discrepancy is naturally to consider that the heat released from burning fossil fuels is absorbed not only by the atmosphere, but also by the superficial terrestrial rocks and ocean water. If both land and oceans absorb equal heat per unit of surface, and considering the respective densities and specific heat capacities of each, then about 10 meters of the oceanic water column and 30 meters of terrestrial rock are affected by such heat absorption, the atmosphere absorbing about 20 % and oceans and terrestrial surface about 40% each.

Whatever heat is not absorbed by air, rocks, and oceans, would be used for water evaporation (although corresponding heat would be restituted in rain), or for melting icecaps and glaciers, although without any atmospheric temperature increase. If no heat was absorbed by air, rocks, and oceans, 0.005% of all existing ice could melt this way every year.

Additionally, assuming, as has been shown above, that the total quantity of carbon released from fossil fuels throughout the ages is of the order of 1,000 grams per square meter, the overall temperature increase would have been 0.016 x 1,000 / 18, or about 1 degree C, excluding the burning of biomass over the ages, not far from the carbon related estimates provided by various inter-governmental organizations.

This being said, and to keep things in perspective, the heat released by the combustion of fossil fuels in any given year is equivalent, solar irradiance-wise, to adding less than 2 seconds to the duration of each day of the year. In other words, it pales in comparison to solar irradiance.

On a different, although related, level, it is tempting to attempt to calculate the probable overall increase of atmospheric temperature if all of the six thousand megatons of TNT-equivalent contained in the twelve thousand or so nuclear warheads known to exist went off simultaneously. By comparison with the immediate and delayed devastations of all sorts inflicted in 1945 on Hiroshima by a relatively small 15 kiloton device, and on Nagasaki by a 20 kiloton device, a considerably greater devastation is to be expected locally if all 12,000 existing devices, each with an average charge of 500 kilotons, went off simultaneously, with peaks of temperature in the thousands of degrees experienced directly at the places of destruction. However, since the energy contained in all existing nuclear devices is tantamount to about 5% of the current annual consumption of fossil fuels plus all non-fossil energy expressed as crude oil equivalent, which is of the order of 24 grams per square meter, the energy contained in all existing nuclear heads is but 1.2 gram per square meter, and the overall increase of atmospheric temperature would be 0.016 x 5% = 0.0008 degree C, hardly Dante's Inferno. Although many, who profess a disproportionate, if not unlimited faith in the grandeur and prowess of their own species, have claimed, quite immodestly, that a nuclear war would transform the planet into a ball of fire, therefore destroying all forms of life on Earth, as much as they may indulge in the fancy of being some modern Prometheus, myths are but myths. Mankind is likely to suffer great damage from such unreasonable self-immolation, and possibly a significant reduction in its numbers, but the planet as a whole and its millions of living species, which together *have a dry mass equivalent to at least 50,000 times that of all mankind, are likely to enjoy a much improved prosperity from the dwindling of mankind's encroachment on their natural habitat. Will some wise animal paraphrase the Bard in the fable of a future Aesop: "A good riddance, at last!"?*

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Notes on sources and references - Argumentum ad hominem

This document does not cite third party sources, on purpose. Pre-internet papers pointed from necessity to specific preselected references, since at the time most technical and scientific information was restrictively circulated and was therefore unavailable but from a limited number of libraries spread out across the planet. As a consequence, locating relevant information was tantamount to finding the proverbial needle in a million haystacks, so pointing to pre-existing references was quite indispensable, although necessarily subjective. In contrast, the age of the internet has not only rendered brick-and-mortar libraries mostly redundant, but it has also caused the selective pointing to pre-sorted information to become intellectually questionable, if not frequently biased.

The author of this study refers throughout this document to encyclopedic knowledge which is widely available across the aptly named World Wide Web. Rather than perhaps misguiding the reader by pre-selecting supporting sources, he invites him or her to critically research and check facts personally.

Likewise, the author of this study does not provide past academic credentials, which he believes would unavoidably skew the reader's objectivity one way or the other. He suggests that this study be read without prejudice, and be appraised only according to the present merits, or lack thereof, of its facts and logic, as opposed to the usual academic custom of prejudging the strength of a study according to the past reputation of its author and the merits of earlier papers, even when those are largely unrelated, if not altogether irrelevant.

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Quiz

The reader might be interested in filling this self-evaluation questionnaire anonymously.