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Earth's Ices Melting: And if the Greenhouse Effect of Anthropogenic CO₂ is not the (Only) Cause?

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Abstract: The all-sided information provided by greenhouse gas experts is disturbing. Future ocean level and atmosphere temperature raises are assigned to an increase of "greenhouse effect" due to the surplus of carbon dioxide (CO₂) of anthropogenic origin. Reducing the fossil sources of CO₂ is therefore the recommended solution. However, the related dogma is subject to polemics. As an alternative, the present approach is based on the exploitation of twelve facts and not on assumptions and calculations. It is shown that a minimal estimate of the global thermal energy consumed in 2018 (0.1 Zj) and the estimated heat necessary to melt the ices said disappeared during the same year (0.08 Zj) are comparable. This observation suggested that the greenhouse effect of fossil CO₂ is not necessary to explain the disappearance of ices. The discussion shows that taking into account the generally neglected anthropogenic heat and the ice↔liquid↔vapor↔liquid phase-transfer equilibria of water may explain the discrepancy observed between the rather small variations in average atmospheric and oceanic temperatures and the considerable ices melt. It is shown that the increases of total energy, of anthropogenic heat and of melted ices exhibited the same trends over the 2000-2018 period of time. A few years should be enough to confirm or invalidate these trends. In case of confirmation, replacing the fossil sources of energy by other sources to limit climate changes may turn to be ineffective if these new sources supply equivalent amounts of heat. It is the controls of population and of its bulimia in energies that will have to be promoted.

Keywords: Chemistry, Climate change, Fossil sources of energy, Anthropogenic thermal energy, Greenhouse effect, Ices melt, Phase transition, Phase equilibria

1. Introduction

As a neophyte in climate change prediction, the chemist I am is puzzled by the information that is disseminated by greenhouse gas experts and revived at every turn by the media, politicians, environmentalists and various associations. What do we hear? "Climate changes are caused by an increase in the natural "greenhouse effect" due to an increase of carbon dioxide and to some other atmospheric greenhouse gases (methane from herbivorous animals and from natural gas, and even nitrous oxide N₂O of whipped cream). These increases are said causing planet heating via infrared radiations and are all related to human activity. Decreasing the sources of anthropogenic CO₂ is thus the systematically and universally recommended solution.

However, there seem to be arguments against the surplus of greenhouse effect evaluated on the basis of questionable hypotheses and calculations [Coleman (2000); Richard (2017)]. Some opponents to the greenhouse effects (climate-skeptic) contest predictions based on hypotheses and calculations. Others emphasize the absence of correlation between the present small atmosphere and ocean temperature increases and the relatively important ices melt, or oppose fundamentals of infrared electromagnetic waves with molecules [Tower of Reason (2018)].

From what I know about the absorption of visible and ultraviolet electromagnetic waves by the atoms and electrons of chemical functional groups present in organic molecules, I was unable to find flaws in the argument of the latter contribution relative to the limits of CO₂ radiative heating effects. In general, what are missing in these critical arguments are consideration to conductive effects related to heat exchanges by inter-matter conduction, and alternatives to the “greenhouse effect dogma.

Let's forget polemics and religion-like arguments to try an alternative based on facts.

1.1 The facts

1) It is becoming more and more evident, especially over the past decade that glaciers are regressing, permafrost is melting and the polar ice caps are decreasing, all in acceleration [Rignot (2019)].

2) The natural greenhouse effect is largely dominated by the atmospheric water vapor major in quantity and efficiency compared to the small increase in CO₂ actually measured;

3) The annual temperature variations of the oceans and the atmosphere in the hemispheres are mainly dependent on the Sun through the capture of its thermal energy and its irregular cyclic emissions.

4) When two media are brought into contact with each other, the hottest transfer heat to the coldest and the temperatures of both change in opposite directions, except if the transfer is dominated by interphase equilibrium ;

5) Anthropogenic sources of heat include animal and human metabolisms, combustion of oil-based products, natural gas and biomass, activity of nuclear and thermal power plants, and machines using electricity;

6) All sources of energy are not equivalent. When burned in the presence of atmospheric oxygen (O₂) coal (C) generates hot carbon oxides (CO and CO₂) but no primary hot water vapor. In contrast, the combustion of hydrocarbon sources composed of carbon and hydrogen (oil, peat, lignin, natural gas, wood, and even animal and human metabolisms) generates CO₂ plus water vapor both generally hotter than the atmosphere. In all cases, atmospheric oxygen is consumed. There is indeed a slight decrease in its proportion in the air and in the oceans over the years [Keeling (current)]. As for the production of electrical energy by nuclear power plants and by renewable resources, it does not generate CO₂ but it generates heat immediately during the production and later on during the exploitation of electricity (electric radiators, TVs, lightings, smartphones, etc., all heat). Even electric trains and cars give off heat. So all sources of heat and not just fossil fuels disperse heat into the atmosphere and more generally into the environment;

7) In 1900, the world energy consumption (not primary energy supply which is larger) corresponded to about 1100 megatons of oil equivalent (Mtoe) (coal 480, oil 25, gas 5, and biomass 580). In 1950, the figures were respectively 2158, 955, 505, 153, 545 with the addition of electricity for 29 (total doubled in 50 years). In 2000, the respective figures were 9242, 2116, 3542, 2026, 465, and 1096 which corresponds to a 5 fold increase in 50 years [Encyclopedie-energie]. In 2018, the numbers were: 13865, 3917, 4474, 3360, about 250, about 2000 (i.e., 50 % increase in eight years and 1200 % in 100 years) [Wikipedia 1].

Evaluating the total energy consumption from Mtoe data which depend on the sources is just as approximate as evaluating the greenhouse effect attributed to atmospheric CO₂ [Richard (2017); Wikipedia 2]. Anyhow, based on 13865 Mtoe consumption in 2018 and 1Teo = 4.18x10¹⁰ j (joules) equivalence, it is assessable to about 0.5 Zj or 0.5 x 10²¹ joules of which only 20% (0.1 Zj) are retained to minimize the amount of dissipated anthropogenic heat energy in absence of more precise data. Contributions from previous years are certainly lower but nevertheless cumulative. Where did this huge heat energy go?

8) Although invisible, both the hot combustion gases and the electrically heated air cool more or less quickly by thermal energy transfer to the environment. In general, nothing is seen but the water vapor becomes visible if it is cooled rapidly. In winter, it can be seen from lung exhalation, from the car exhausts at the start or in the upper atmosphere behind planes. It is the same from the evaporators of nuclear plants topped with large clouds;

9) Carbon dioxide and condensed water cooled to ambient temperature are partly integrated into the management of corresponding atmospheric pools. CO₂ is captured by seas, by some alkaline minerals and by plants with regeneration of oxygen (inverted lung) while condensed water is managed by terrestrial absorption, by ice formation, by evaporation ↔ condensation equilibria involved in the formation of clouds and rains, or by reintegration into natural living matter via biochemistry;

10) Chemistry teaches that in a closed world like Earth “nothing is created, nothing is lost, everything is transformed” (even electromagnetic radiations through absorption, transmission and refraction phenomena), whereas physics teaches : a) solid ↔ liquid (ice ↔ water liquid) and liquid ↔ gas (vapor then clouds then rain to close the loop) equilibria consume or generate thermal energy according to the direction they move, and b) such interphase equilibria always evolve at constant temperature, that is to say without temperature change during the energy transfer (the ice in a glass of water melts to bring and maintain the temperature of the water at 0°C but the phenomenon is slow and the temperature of the atmosphere above the glass can be 30° C in summer). In humans and animals, perspiration and evaporation are used to maintain the temperature of the organism fixed (37 ° C for man) and to eliminate the internal or external heating of this organism;

11) On 2019, huge quantities of fossil energy sources (actually solar energy stored in the far past) have already been consumed and transformed in parts as heat, water, CO₂ and biomass. Larger quantities of thermal energy sources are still stored (oil, coal and gas) or are going to be produced (electricity), which will supplement the previous contributions of heat in the lower atmosphere.

What can be said from these facts in relation to climate change? Nothing if the anthropogenic heat energy is neglected or negligible, except call on greenhouse effect to the chagrin of climate-skeptic people. This is what has been done universally although some scientists did pay attention to the role that Anthropogenic Heat Release (AHR) may play. However the effects on the climate were generally considered small relative to the solar heat flux and limited to the regions of production. Some recent studies concluded that AHR is a tiny but important climatic factor that could influence global climate; as such, consideration of its effects should not be restricted to regional climate studies only [Chen (2016); He (2019) and references therein].

Can the anthropogenic thermal energy be really neglected?

If the answer to this question is no, a reason must be found that account for the discrepancy between the rather small effects observed on atmosphere and oceans temperatures and the melting of polar and terrestrial ices now established, for sure, as important and growing.

Logically, the contradiction can be assigned to the fact that atmosphere and oceans temperatures depend on the physical equilibria introduced at # 10, at least basically. In the past, the anthropogenic energy was negligible and only the Sun heated the atmosphere with reversible ice melting and atmospheric heating over summers and winters and alternately in the northern and southern hemispheres, greenhouse effects included. Today, anthropogenic heat diffused in the environment complements that of the Sun and is involved in the same processes. As solar energy, anthropogenic heat is managed through the ice ↔ liquid water ↔ water vapor ↔ liquid water (cloudiness, rainfall) equilibria that are theoretical sources of temperature constancy. These interdependent physical equilibria control the thermal energies on Earth by evolution in one direction or the other depending on the amount of negative or positive heat to be managed. Theoretically, the global temperature should remain balanced. However, the Earth is very large and complex and submitted to chaos. What is observed locally are temperature wells and peaks, formations and disappearances of clouds, floods and droughts, etc. Basically, their opposite thermal effects should be strictly balanced through ice melt and formation and through water evaporation from warm ocean to cold upper atmosphere or by condensation inversely. This is not the case because these fluctuations are far from those scientists are used to play with in a laboratory. Global averaging is impossible because of the relative slowness of some equilibria evolutions and turbulences in air and water (low atmospheric pressures (humid air) and high pressures (dry air), high winds, heavy rainfalls, hurricanes, oceanic streams Labrador and Gulf stream, Niño and Niña, summer and winter, etc.). In contrast, solid ices are not dramatically disturbed by turbulences though their fusion depends on them. It is therefore preferable to monitor the annual differential formation-disappearance of ices (in mass and not in surfaces) to try predicting the evolution of the planet climatic environment on the basis of thermodynamic phenomena. Whether the thermal energy to be absorbed comes from an excess of greenhouse effect or from the anthropogenic thermal energy, or from both, the trend is clear: on continuous heating the buffering effect of ice melting will be progressively transferred to the buffering effect of evaporation-condensation transitions involving water.

Anthropogenic energy and disappearance of ices.

An assessment of the thermal energy absorbed by ices melt in 2018 can be made on the basis of an annual mass loss averaged over 6 years, i.e. 240×10^{12} kg [Perthmedia (2018), Shepherd (2018)] and the melting heat of ice, i.e. 333.55×10^3 j per kg [Wikipedia 3, entry : Heat of fusion]. We obtain a value of 8×10^{19} j (0.08 Zj) close to the minimalized thermal energy of anthropogenic origin evaluated as (0.1 Zj) for the same year in # 7. According to this approximation, the 5th of anthropogenic energies consumed in 2018 was enough to cause ices melting without any contribution of the greenhouse effect due to CO₂.

In summary, the preceding analysis leads to attributing the slight increases in air and ocean temperatures detected until now to a control of the anthropogenic thermal energies by the equilibria involving the solid, liquid and vapor water as it is for solar heat. According to this logic, anthropogenic thermal energies transferred by atmosphere and by oceanic water turbulences are sooner or later going to be absorbed by the melting of ices, something which is predominantly observed today. Therefore, oceanic and atmospheric waters act only as

means of heat transfers, the slow rate of which allowing short term temperature variations locally. Since anthropogenic energies are managed by these intermediaries, turbulences that have been handling part of the solar heat supply to Earth (hurricanes, thunderstorms, tornadoes, oceanic movements) should increase in strength and frequency locally without affecting importantly and permanently the present global oceanic and atmospheric temperatures. There already seems to be signs in this direction. So far, the few tenths of a degree Celsius and the few cm raises of atmospheric and oceanic averages, respectively, may be another version of the half-full or half-empty bottle ambiguity, meaning that small increases may be viewed or not as dramatic deviations. This ambiguity fuels the polemics relative to climate evolution. In the far future, when all the ices disappear, the absorption of anthropogenic heat will be supported by the only back and forth evolution of water evaporation-condensation equilibria which will evolve towards the formation of more and thicker clouds. The resulting screen will reflect more and more the Solar energy and thus will cause a surface cooling of the Earth with, at the end of the process, reformation of the ices as it was in the far past. Cumulated anthropogenic energy diffusion will result in shortening the time scale.

If this is the future, what should we do?

If the global anthropogenic heat energy does play the role proposed above, replacing the fossil sources by other sources of energy to keep the global energy consumption growing without CO₂ production may appear like a plaster cast on a wooden leg. As a matter of fact, the Earth looks cancerous and the tumor is humanity because of a quasi-exponential growth of population and a bulimia of energy whose negative effects on the planetary balances go get worse if nothing is done. The treatment may be a reduction of the anthropogenic CO₂ that is connected to the demand in energies but it is the origin of the harm (the total anthropogenic heat energy dissipated in the environment) and the excessive demand for energy that have to be treated. To repel the described evolution, the economy will have to be curbed in order to reduce the production of goods and of energy-consuming means needed today to provide remunerative work and to satisfy the lure of profit. Greenhouse effect or not, it appears necessary to act without waiting for Nature to limit the human population and its worship of consumption otherwise increasing anthropogenic heat might lead to humanity disappearance as it may have been for dinosaurs in the past according to the climate theory [Science Daily, (2019)]. Fortunately it is not for soon. In a close future, the buffering effects of ices, ocean water, and atmospheric evaporation-condensation should continue to keep ocean and atmosphere temperatures globally stable even if enhanced local fluctuations are observed. It is probably a matter of centuries but it is better to anticipate. Presently, the growths of global heat consumption, ices melting and anthropogenic heat show similar trends since 2000 (Fig. 1) whereas the atmospheric temperature remained stable between 2000 and 2014 [Berkeley Earth, (2018)].

These trends are not proofs but a few years should be enough to confirm or refute them and thus the role assigned above to thermodynamics and physical phase-transfer equilibria as well, especially if ices melt progresses while sources of anthropogenic CO₂ are driven down.

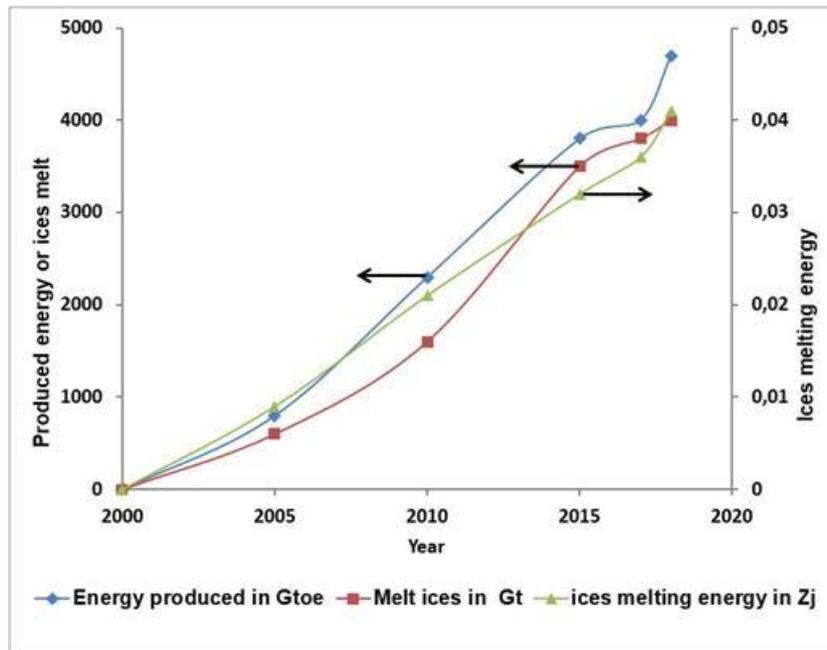


Figure 1: Comparison between the evolutions of the total energy produced (in Gtep), of melted ices (in Gt) and of the heat diffused in the atmosphere (1/5 of the total energy) relative to year 2000 taken as reference (data collected from various internet sources).

Conclusions

The present essay-type contribution based on global data collected via Internet shows that anthropogenic thermal energy produced in 2018, greatly minimized to 20% of the total production of energies, is sufficient to explain the melting of ices said disappeared in the same year. Complementary or alternative to the greenhouse effect of the anthropogenic surplus of CO₂ in the atmosphere, the role heat balancing assigned to the thermodynamic equilibria of water phase transitions led to propose maintenance rather than increase of global oceanic and atmospheric temperatures and suggested increasing of turbulent regulatory mechanisms whose local consequences should worsen in frequency and intensity. Presently the Sun remains master of climate changes on Earth as he did for billions of years independently of CO₂ fluctuations. In the meantime, Earth managed its climate through alternative hot and cold periods. The novelty is that during the last hundred years, Humanity has been freeing increasing parts of the huge heat energy stored on Earth as fossil matters and as radioactive minerals source of electricity. Coming on top of Sun actions on Earth's climate, anthropogenic heat diffusion in the environment might result in scaling down the climate ups and downs evolutions in force for millions of years if it continues to grow year after year.

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