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ARTICLE

Dual Anthropogenic Origin of Global Warming through GHGs and IR Radiation Emissions from Artificialized Soils

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ABSTRACT

This paper contributes to explain the global warming instead of "giving up" and thinking about passively adapting to climate change or global warming. It makes more sense to tackle what creates the greenhouse effect and contributes to global warming. The greenhouse effect is not only due to GHGs emissions, but also to the excess IR radiation emitted during the day, by artificial surfaces, following the absorption of solar radiation. The phenomenon should be compared to that of radiative forcing well known by climatologists and which makes the link between atmospheric pollution and the density of heat fluxes stopped by the atmosphere inducing global warming. It becomes clear that type an equation here. The surplus CO2 and IR radiation emissions influence global warming, not to mention the direct part of the heat released by the combustion of fossil fuels and even renewable (wood fires, biogas, friction of wind turbine propellers with the air).

1. Introduction

The responsibility for human activities is unequivocal in greenhouse gas emissions and the artificialization of soils. These, mainly due to the construction of roads, pavements, buildings, etc., have serious consequences for the environment [1,2]:

- Decrease in areas constituting carbon sinks .
- Modification of the albedo and therefore the perception of incident solar radiation: the first is reduced and therefore the second is increased in far infrared radiation emissions from artificial surfaces.

Table 1. Coefficient of albedo according to the nature of the surface

Surface	Albedo
Fresh asphalt	0.04
Wom asphalt	0.12
Forest	0.15
Bare soil	0.17
Desrt sand	0.40
New concrete	0.55
Ocean ice	0.60
Fresh snow	0.80

The dual anthropogenic origin of climate change: emission of GHGs and infrared radiation from artificialized

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soils has an issue that must be well understood in order to limit the earth's greenhouse effect and therefore global warming. To do this, it is useful to make the analogy between the greenhouse effect in a solar collector and the terrestrial greenhouse effect.

2. Methodology for Caracterizing the Greenhouse Effect

2.1 Greenhouse Effect Used in a Solar Collector

For those experienced in the field of solar energy [2], the greenhouse effect has always been used to allow solar collectors (water or air) to heat well. Indeed the collector without glazing does not heat too much, it may be used for low temperatures. The glass sensor (single or double) allows higher temperatures to be reached. The secret lies in the selectivity of the glazing which allows solar radiation to pass, the spectrum of which ranges from ultra-violet to near infrared [0.25 - 2.5 µm], and on the other hand is opposed to infrared radiation. Far wavelength that exceeds [4.1 - 41 µm], emitted by the dark surface of the absorber.

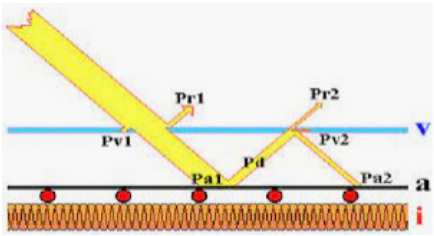


Figure 1. Construction of a double-glazed solar collector. Creation of the greenhouse effect.

Figure 2, the Black-body emission curves from the sun (T = 5780 K) and the earth (T= 290 K), shows the operation of Wien's Law. The two graphs are not to scale.

Indeed for the sun at 6000K, the corresponding average wavelength. λ_{mean} is given by:

$$\lambda_{mean} \frac{2898}{T} = 0.5\ \mu m$$

And the spectrum spreads to

$$0.5.\ \lambda_{mean} \text{ at } 5.\ \lambda_{mean}$$

$_T$hat is to say: [0.25 - 2.5 µm),

For the radiation emitted by the absorber assumed to be at 80 °C for example on average,

$$\lambda_{mean} = 8.2\ \mu m$$

And the spectrum spreads to 0.5. λ_{mean} to 5. $\lambda_{mean,}$ that is to say: [4.1 - 41 µm),

2.2 Terrestrial Greenhouse Effect

The terrestrial greenhouse effect is necessary for life on earth, however it is increased as a result of global anthropogenic emissions. These emissions concern not only GHGs but also infrared radiation emitted by artificial surfaces [4-14]. This contributes to global warming, further accentuated by the heat released by the combustion of fossil fuels, which moreover generate the greatest amount of greenhouse gases.

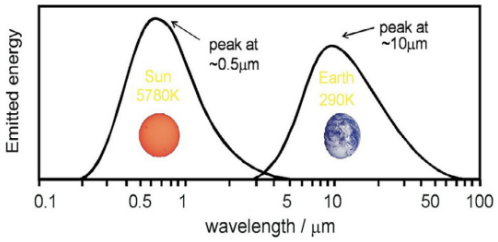


Figure 2. Solar and terrestrial radiative spectrum [3].

2.2.1 Greenhouse Gases

There are many greenhouse gases, more than forty have been identified by the Intergovernmental Panel on Climate Change (IPCC), including

- o water vapor (H_2O),
- o carbon dioxide (CO_2),
- o methane (CH_4),
- o ozone (O_3),
- o nitrous oxide (N_2O),
- o hydrofluorocarbons (HFCs),
- o perfluorocarbons (PFCs),
- o sulfur hexafluoride (SF6).

The proportions of anthropogenic greenhouse gases emitted by human activities are as Table 2 .

Table 2. Proportion and origin of GHGs

Gaz	Origin	Proportion
Carbon dioxyde (CO2)	• Combustion of fossil fuels (petroleum, coal), • Combustion of biomass.	70 %
Nitrous oxide (N2O)	• Agricultural activities, • Combustion of biomass and chemicals such as nitric acid.	14 %
Méthane (CH4)	• Agriculture (rice fields, livestock), • Production et distribution of gaz and oil, • Coal mining, • Combustion of petrolium and coal, • Landfills.	12 %
Fluorinated gazes (HFC, PFC, SF6)	• Refrigeration Systems, • Aerosols and insulating foams, • Semiconductors industry. Fluorating gases have a heating power 1,300 to 24,000 times that of carbon dioxide and have a very long service life. This is why they represent a real danger despite the modest share they represent in total GHG emissions	4 %

2.2.2 Contribution of Each Gas to the Greenhouse Effect

Different gases do not all contribute to the greenhouse effect at the same level. Indeed, some have a greater heating power than others and / or a longer lifespan. The contribution to the greenhouse effect of each gas is measured by the global warming potential (GWP).

The GWP is an indicator which groups together the added effects of the 6 gases contributing to the greenhouse effect which are currently taken into account by the Kyoto Protocol. It takes into account the radiative power returned by each gas to the ground (we speak of "radiative forcing"), accumulated over a period of 100 years.

This indicator is calculated using the respective GWP of the six gases considered. These GWPs are determined relative to that of CO_2, which is set at one [15].

Table 3. Global warming potential for GHGs

GHG	Relative GWP
Carbon dioxyde (CO2)	1
Methane (CH4)	21
Nitrous oxide (N2O)	310
Perfluorocarbons (PFC)	6 500 at 9 200 (depending on the molecules considered)
Hydrofluorocarbons (HFC)	140 at 11 700
Sulfur hexafluoride (SF6)	23 900

So,

• if we emit 1 kg of methane into the atmosphere, we will produce the same effect, over a century, as if we had emitted 21 kg of carbon dioxide;

• if we emit 1 kg of sulfur hexafluoride into the atmosphere, we will produce the same effect, over a century, as if we had emitted 23900 kg of carbon dioxide.

Not every gas contributes the same way to the GWP (global warming power or potential). In 2007, the contribution of GHGs to the PRG was established in metropolitan France as follows:

Table 4. Contribution of GHGs to the PRG

GHS	Contribution to GWP
Carbon dioxyde (CO2)	69.5 %
Méthane (CH4)	12.1 %
Nitrous oxide (N2O)	14.8 %
Fluorinated gases (HFC, PFC, SF6)	3.6 %

Source: CITEPA - Substances relatives à l'accroissement de l'effet de serre - Mai 2009.

In addition, greenhouse gas emissions are measured in carbon equivalent. The carbon equivalent of a gas is calculated from its GWP:

• by definition, 1 kg of CO_2 is equal to 0.2727 kg of carbon equivalent, ie the weight of carbon alone in the compound "carbon dioxide",

• for the other gases, the carbon equivalent is worth: relative GWP x 0.2727 (Table 5).

Table 5. Carbon equivalent of GHGs

GHGs	Carbon equivalent per kg emitted
Carbon dioxyde (CO_2)	0,273
Methane (CH_4)	5,73
Nitrous oxide (N_2O)	84,55
Perfluorocarbons (PFC)	1 772,73 à 2 372,73
Hydrofluorocarbons (HFC)	38,2 à 3 190,9
Sulfure Hexafluoride (SF_6)	6 518,2

Scientifically speaking, regarding global warming, we speak of the concept of radiative forcing, but commonly in public language of the greenhouse effect, which is half incorrect, because, during the day, an agricultural greenhouse heats up too much in the spring due to radiative forcing. In order to lower the temperature, it suffices to create a current of air when opening the doors.

The concentration of carbon dioxide affects the energy supply of the atmosphere; a first order approximation gives: The variation of the radiative forcing is:

DF = 5.35 {\displaystyle \Delta F=5.35\times \ln {C \over C_{0}}}

where C is the CO_2 concentration in parts per million by volume, ppm (v) or ppmv, and CO a reference concentration, for example, 280 ppm (v) for the CO_2 concentration at the threshold of the industrial age. ΔF is the change in radiative forcing in watts per square meter (Figure 3).

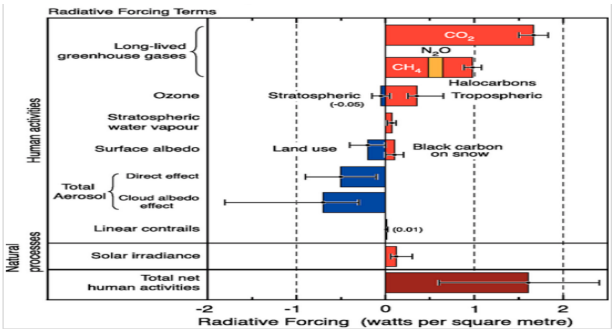


Figure 3. Radiative forcing of climate between 1750 and 2005 [16]

2.3 The Artificialization of Soils

This concerns roads, cities (building, urban expansion, etc.). Due to the fact that these soils can no longer absorb and store carbon dioxide, can no longer absorb rainwater, these soils will see:

- their reduced albedo (reflection coefficient of incident

sunlight) because their dark calor

- their increased absorption of solar radiation

- their increased infrared radiation emissions (this radiation will be returned to the earth by the atmosphere, all the more polluted causing greenhouse phenomenon by radiative forcing, and inducing the global warming.

The "protective mantle" that is our atmosphere is fragile: its way of filtering the sun's rays and conserving the earth's heat totally depends on the gases therein. For millions of years, it was essentially made of air (a mixture of nitrogen, oxygen, etc.). But, by adding more and more molecules, human beings have changed this balance enormously over the past sixty years.

Among these molecules, those called "greenhouse gases" are those which tend to heat the surface of the Earth by modifying its atmosphere. Greenhouse gases are molecules that absorb some of the infrared that the Earth's surface emits [17]. They thus prevent this heat from returning to space, as in a greenhouse which lets in the heat of the sun, but keeps it behind its windows. The main greenhouse gases are water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3) and several gases containing fluorine (such as CFCs and sulfur hexafluoride SF_6). By disturbing our atmosphere, these gases therefore cause overheating of the air and the surface of the Earth, but also a whole procession of disturbances of the movements of air in the atmosphere. This is called climate change. And it is high time to go back: for now, the enormous amounts of greenhouse gases that humans send into the atmosphere are partly "absorbed" by the oceans, but they are on the verge of indigestion.

3. Results and Discussion by Recapitulating

Table 6 recapitulates the effects of the actions of the man on the global warming and this by: 1) the gas emissions for purpose of greenhouse, but also by 2) the atificialision of the grounds which modify their albedo and thus the absorption of the solar radiation and thus their reheating and consequently their infrared emissions which is a fondamental component with the GHGs to cause the global warming. Finally one shows modification 3) due to heat released by the combustion of any type of combustible fossil or renewable [18]. Is it also allowed (finally?) to evoke the absorptive heat of the solar radiation by all the artificialized surfaces and become darker that what they were naturally.

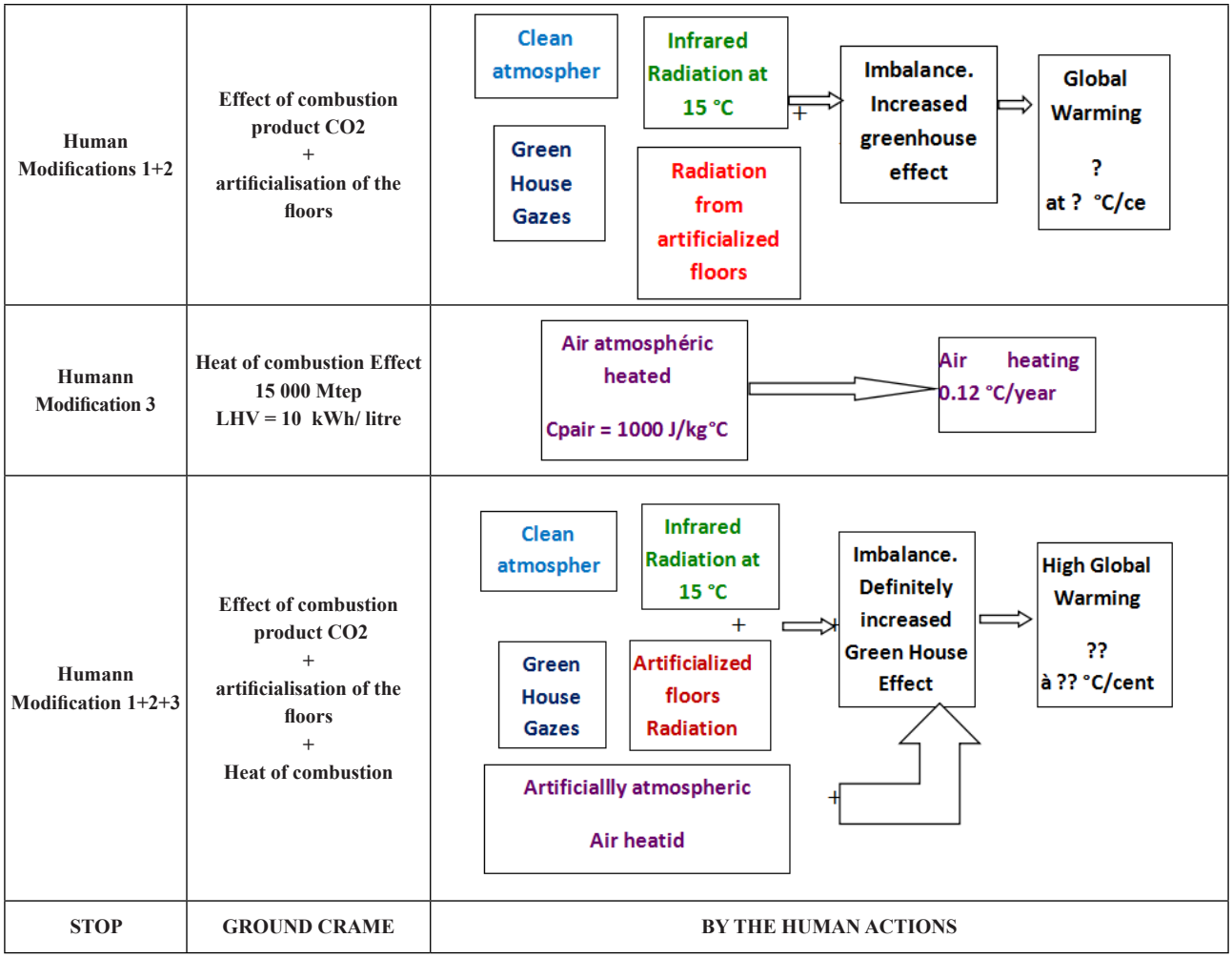
4. Conclusions

The global warming du to the greenhouse effect ca be reduced by reducing the two factors that make it up according to the scientific name: radiative imprisonnement:

- For the factor: imprisonnement, there is a need to reduce the greenhouse gas emissions; and thus is known and evoked by all,

Table 6. Recapitulate

Naturally	**One century ago**	Clean atmospher → Terrestrial infrared radiation at 15 ° C → Desired greenhouse effect for the life on the earth
Humann Modification1	**Effet of combustion product CO2**	Clean atmospher; GHGs 35.10^9 tCO2e → Infrared Radiation at 15 °C → Imbalance. Increase of the Green House Effect → Global warming 2 to
Humann Modification2	**Effect of the artificialisation of the floors**	Clean atmosphere; Infrared Radiation at 15 °C; Radiation from artificialized floors → Imbalance. Increase of the Green House Effect → Global Warming ? at ? °C/centu



- For the factor: radiative, there is a need to reduce or at least limit the expansion of soil artificialisation which mainly concerns cities and roads, which absorb a lot of solar radiation during the day mainly because of their dark color , unlike bare soils.

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