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Anthropogenic Heat Flux Will Affect Global Warming

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Abstract

Examination of 420,000 years old ice cores shows a close relation between temperature increase and CO_2-concentration increase. During the industrial era a new energy component appears, Anthropogenic Heat Flux, and a part of that energy will accumulate in Earth climate system and become an essential part of global warming.

Keywords

Global Warming, Anthropogenic Heat Flux, Earth Climate System

1. Introduction

The common opinion is that increasing CO_2-concentration in the atmosphere is the main reason for increasing mean global temperature [1] [2] [3] [4], and the Anthropogenic Heat Flux (AHF) will not cause global warming, but there are reports saying AHF must be considered [5] and there are reports saying heating from CO_2 is much less than expected [6]. To find out the relation between increasing CO_2-concentration and increasing temperature historical data will be analysed, mainly from ice core examination. An important question will be whether a part of AHF will accumulate in Earth climate system and thus become a reason for global warming.

2. Relation between Increasing CO_2-Concentration and Increasing Temperature

Information of temperature and CO_2-koncentration in air from Vostok ice core examination [7] [8] and other similar examinations are important for understanding of global warming. In the Vostok ice core examination a period of 420,000 years from now has been analysed with high resolution.

As can be seen from **Figure 1** maximum temperature and maximum CO_2-concentration occurs at −325,000, −240,000, −125,000 years from now. Time for minimum temperatures and minimum CO_2-concentration are timepoints when temperature and CO_2-concentration start to increase towards the following maximum point. ΔT is the difference between maximum and minimum values for temperture and ΔCO_2 is the difference between maximum and minimum values for CO_2-concentration.

The relation $\Delta T/\Delta CO_2$ is close to 0.12 ˚C/ppm for the three periods including maximum points for temperature and CO_2-concentration during 420,000 years (**Table 1**). This relation is very clear.

If this relation is applied to actual time, from 1970 until today, when the CO_2-concentration has increased from 320 to 420 ppm according to the Keeling curve [9] and the global surface temperature has increased 1.0˚C according to NASA GISS [10], there will be two different ways to use the relation $\Delta T/\Delta CO_2$ = 0.12.

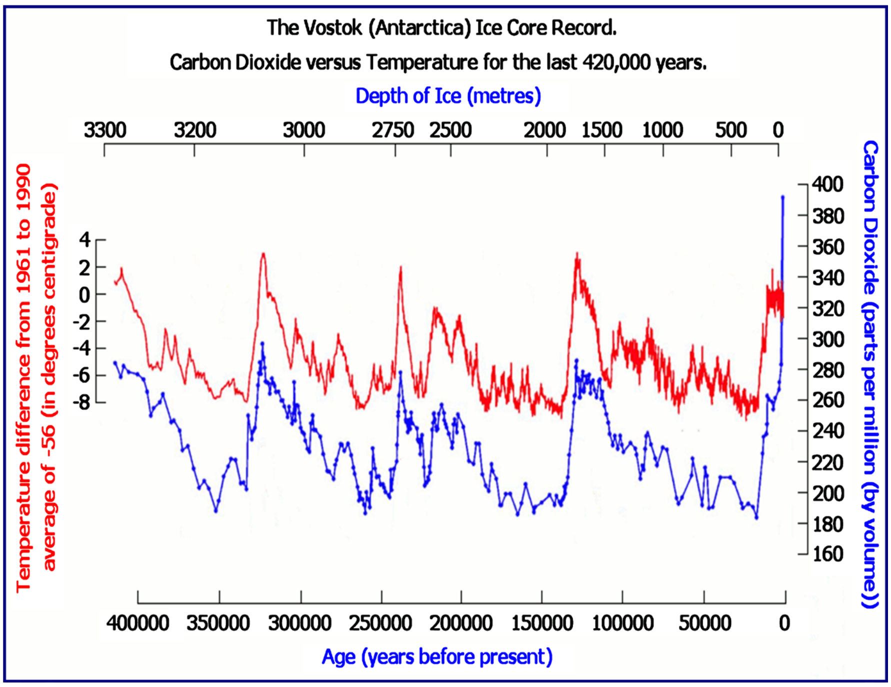

Figure 1. Vostok ice core record.

Table 1. Relation between ΔT and ΔCO_2.

Time for minimum temperature CO_2		Time for maximum temperature CO_2		ΔT (C)	ΔCO_2 (ppm)	$\Delta T/\Delta CO_2$
−330,000	−350,000	−325,000	−325,000	11	100	0.11
−260,000	−260,000	−240,000	−240,000	10	85	0.12
−140,000	−150,000	−125,000	−125,000	12	100	0.12
		Mean value				0.12

1) increasing CO_2-concentration will increase temperature;

2) increasing temperature will increase CO_2-concentration.

The first case will give an expected temperature increase of 12˚C but temperature increase is only 1.0˚C, fortunately, so there is no support for this case.

The second case will give an expected increase of CO_2-concentration 8 ppm but the increase is in fact 100 ppm, so there is no support for this case either. The experience from 420,000 years will not explain the situation we have today. The reason for this is an important difference compared to 420,000 years before. Now we are several billions of people using our cars, heating our buildings, working in industries using fossil energy for production. Figure 1 demonstrate that $\Delta T/\Delta CO_2 = 0.12$ applied for 420,000 years but that is not the case now. We know that using fossil energy will bring CO_2 to the athmospere but if $\Delta T/\Delta CO_2 = 0.12$ not will apply now, why global warming?

3. Anthropogenic Heat Fux

Using fossil energy will also release heat to the Earth climate system. A part of that energy will accumulate in the athmospere and that will incresae the global mean temperature. Figures 2-4 demonstrates that process. Figure 2 demonstrates global temperature before the industrial era. When Sun energy is stable, then Earth global mean surface temperature is stable. From day to day the same pattern will be repeated.

Figure 2 represents the normal situation for a stable climate. Temperature will increase $T_0 \rightarrow T_1$ during 12 hours of sunshine, but will go back to T_0 after 12 hours darkness (Table 2). Day 2 will be a repetition of Day 1.

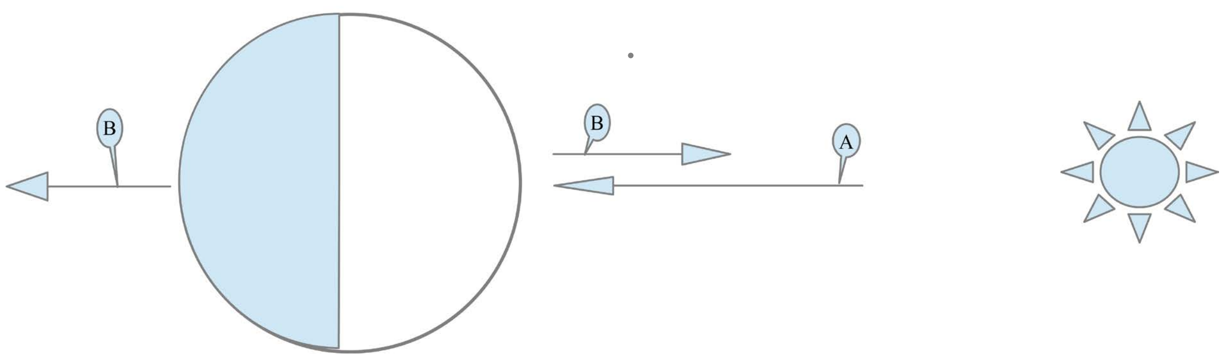

Figure 2. Energy balance and temperature, Sun energy solely.

Table 2. Energy balance and temperature, sun energy solely.

Day 1	Time hours	0	12	24
	Energy balance	0	A − B = B	A − 2B = 0
	Temperature	T_0	T_1	T_0
Day 2	Time hours	0	12	24
	Energy balance	0	A − B = B	A − 2B = 0
	Temperature	T_0	T_1	T_0

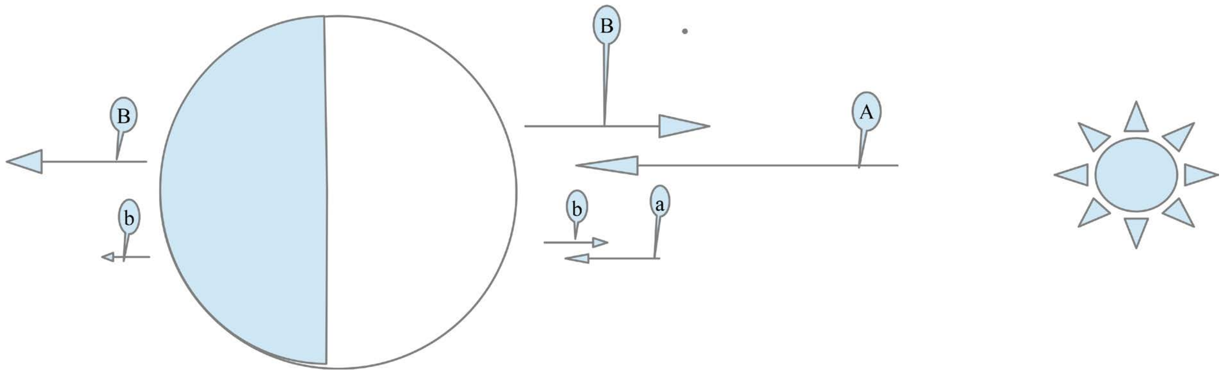

Figure 3. Energy balance and temperature, Sun energy plus energy supplement during 12 hours.

Table 3. Energy balance and temperature, Sun energy and small energy supplement.

	Time hours	0	12	24
Day 1	Energy balance	0	A + a − B − b = B + b	A + a − 2B − 2b = 0
	Temperature	T_0	$T_1 + \Delta t$	T_0
	Time hours	0	12	24
Day 2	Energy balance	0	A + a − B − b = B + b	A + a − 2B − 2b = 0
	Temperature	T_0	$T_1 + \Delta t$	T_0

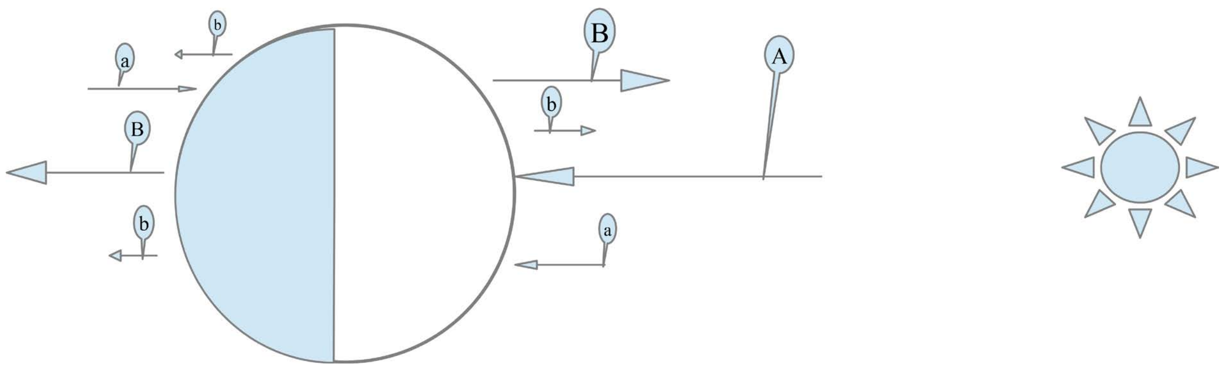

Figure 4. Energy balance and temperature, Sun energy plus energy supplement during 24 hours.

Table 4. Energy balance and temperature, Sun energy and small energy supplement 24 hours.

	Time hours	0	12	24
Day 1	Energy balance	0	A + a − B − b = B + b	A + 2a − 2B − 3b = b
	Temperature	T_0	$T_1 + \Delta t$	$T_0 + \Delta t$
	Time hours	0	12	24
Day 2	Energy balance	b	b + A + a − B − b = B + 2b	b + A + 2a − 2B − 3b = 2b
	Temperature	$T_0+\Delta t$	$T_1 + 2\Delta t$	$T_0 + 2\Delta t$

Figure 3 represents the situation when Sun energy (A) plus a small energy supplement (a) occurs during 12 hours. Temperature will increase to $T_1 + \Delta t$ after 12 hours, but will go back to T_0 after12 hours more (Table 3). Day 2 will be a repetition of Day 1. Mean temperature is still stable.

Figure 4 represents the situation when sun energy (A) and the energy supplement are 2a equally distributed over 24 hours. Temperature will increase after 12 hours during Day 1 to $T_1 + \Delta t$, but after 24 hours Day 1 temperature will be $T_0 + \Delta t$ (**Table 4**).

This temperature will also be the start temperature of Day 2. This means that the energy amount 1b is accumulated in the climate system. After Day 2 accumulated energy is 2b. Every Day with energy amount of 2a introduced in the system will increase accumulated energy with the amount of 1b and temperature of one more step Δt.

4. Conclusion

According to **Figure 4**, 25% of all fossil energy used by mankind will accumulate into the Earth climate system if the energy consumption is fairly equal over 24 hours. Earth surface temperature is not stable, it is increasing continuously. Fossil energy consumption is mainly related to buildings (heating and air condition), transport (cars, airflights etc.) and industrial production. According to BP Statistical Review of World Energy, accumulated world energy consumption 1971-2018, was 3,800,378 TWh and 89% of fossil origin. Then 850,000 TWh is accumulated in the troposphere resulting in a global temperature increase of 0.8˚C which is a major part of the observed global temperature increase.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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