Pol. J. Environ. Stud. Vol. 23, No. 6 (2014), 2321-2325

Short Communication

Polemical Remarks to the Claim that Carbon Dioxide Strengthens the Greenhouse Effect in the Atmosphere

Stanisław Gumuła[1]*, Krzysztof Pytel[2], Małgorzata Piaskowska-Silarska[2]

[1]Department of Power Engineering and Environmental Protection, University of Science and Technology, Mickiewicza 30, 30-059 Kraków, Poland
[2]Institute of Technology, Pedagogical University of Kraków, Podchorążych 2, 30-084 Kraków, Poland

Received: 25 July 2013
Accepted: 24 October 2014

Abstract

The scientific evidence supporting the link between global climate change and human activities began to emerge in the mid-1980s and was an impetus for the establishment in 1988 of the Intergovernmental Panel on Climate Change, which was designed to investigate these relationships. Four years later, i.e. on 9 May 1992, an important international climate agreement was reached. The agreement was the legal framework for global action to counter the adverse effects of climate change (together with its related parties), which was the United Nations Framework Convention on Climate Change (UNFCCC). In the preamble to the convention it was recognized that increases in greenhouse gases caused by human activity enhance the natural greenhouse effect with the result that the average temperature of the Earth's surface and the atmosphere would grow, which may have a negative effect on natural ecosystems and humankind.

The presented paper summarizes important factors that argue for and against the dangers connected with the emission of one of the main greenhouse gases, carbon dioxide. The discussion included radiation absorption characteristic in the atmosphere depending on the temperature and concentration of carbon dioxide, changes in carbon dioxide concentration in the atmosphere, and the relationship between the temperature deviation and the average value of solar activity.

Keywords: carbon dioxide, greenhouse effect, climate change

Introduction

The intergovernmental Panel on Climate Change (IPCC) in subsequent reports says more distinctly that beyond any doubt CO_2 emissions associated with the combustion of fossil fuels strengthens the greenhouse effect in the atmosphere [1, 2]. The consequence of the strengthening of the greenhouse effect is the rise in temperature of the atmosphere and with it, melting glaciers, rising sea levels, weather anomalies, and environmental disasters that degrade the environment, the economy, and infrastructure. These phenomena can be prevented, in the opinion of the IPCC, only through drastic reduction of CO_2 emissions into the atmosphere. This solution is very expensive. It requires huge financial resources and huge amounts of energy, which will involve a significant increase in energy prices. Are these drastic reductions of CO_2 emissions into the atmosphere necessary and will they bring the expected results?

*e-mail: stangum@gmail.com

Carbon Dioxide in the Atmosphere

Carbon dioxide has been in the atmosphere since the beginning of life on Earth. It is a product of metabolism in humans and animals and the building blocks of the Earth's flora assimilated in the process of photosynthesis. It is the same for the world of plants as oxygen is for animals and humans, therefore it must be in the atmosphere. However, if we look at the curve of the concentration of carbon dioxide in the atmosphere over the past two years, (which is available in any encyclopedia), you will see that the balance between the production of carbon dioxide and assimilating it through the world of plants was clearly imbalanced. Power engineering produces more carbon dioxide and there are fewer trees and plants on Earth for its absorption.

The phenomenon of the rapid build-up of CO_2 in the atmosphere began to increase in the mid-19th century as a result of the dynamic development of industry. This is shown in Fig. 1 (a), where we can see the way in which from the beginning of the industrial age to the present time increases the amount of emission of carbon dioxide into the atmosphere and at the same time increasing its concentration in in the atmosphere [3]. That correlation raises no doubts. Simultaneously with that emission and increase in the concentration of carbon dioxide in the atmosphere we can observe the upward tendencies in the temperature of atmospheric air. This is shown in Fig. 1 (b) [4]. Putting together Fig. 1 (a and b) is the basis for a thesis that global warming stems from increase in the concentration of carbon dioxide in the atmosphere.

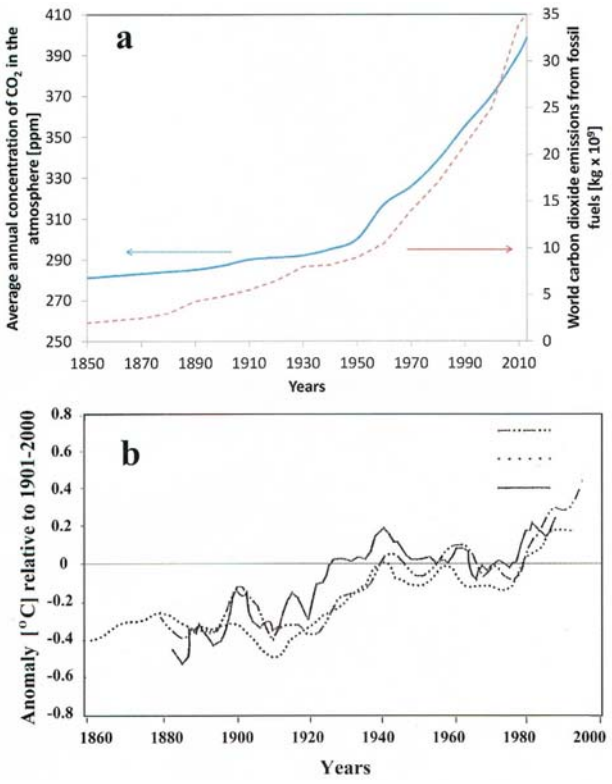

Fig. 1. a) World carbon dioxide emissions from fossil fuels and average annual concentration of CO_2 in the atmosphere (1850-2012), b) and anomaly [ºC] relative to 1991-2000 (in years 1860-2000). Curves represent three independent measurements.

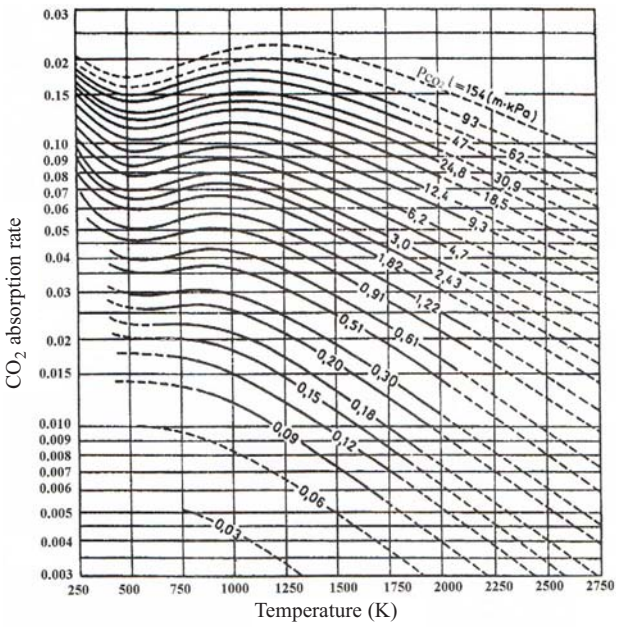

Fig. 2. Dependence of CO_2 absorption on temperature and on product of its layer thickness and partial pressure.

Factors Affecting the State of the Atmosphere

The statement that it is the increase in carbon dioxide concentration that greatly enhances the greenhouse effect in the atmosphere raises serious doubts. Fig. 2 shows the characteristic defining the relationship between absorbency of carbon dioxide and its temperature and thus the atmospheric temperature [5]. In this figure the parameter of the family of curves is the product of layer thickness of carbon dioxide and its partial pressure. The increasing in CO_2 concentration in the graph corresponds to higher and higher lying curves, which is the upward trend absorbency. The interpretation of these characteristic is not so clear. If we consider the temperature range in which the atmospheric temperature changed and thus the temperature of the Earth's absorbing radiation of CO_2, the absorbency of this gas increases as well. The increase absorbency triggers an increase in the temperature, but temperature rise entails a drastically reduced absorbency (scale on the vertical axis is exponential), the weakening of the greenhouse effect. The phenomenon of atmospheric temperature rise due to the increase of CO_2 concentration is therefore a self-locking feature. This fact puts into question the theory of rapid strengthening of the greenhouse effect by increasing the concentration of CO_2 in the atmosphere.

Another fact which makes doubtful whether a significant strengthening of the greenhouse effect by increasing the concentration of CO_2 in the atmosphere is the relationship shown in Figs. 3a and 3b, presenting the recent change in temperature of the atmosphere [6, 7]. There we can see the deviations from the average temperature, which are

much higher than those observed during the last two years. These changes are not associated with synchronized changes in the CO_2 concentration.

The thesis of a strong correlation of atmospheric temperature increases and rising concentration of CO_2 in the atmosphere also questions the relationship shown in Fig. 3c [8]. It shows that the process of air temperature deviation from the average value is closely related to the length of the cycle of solar activity.

There are the arguments stating that CO_2 emissions into the atmosphere and increase of its concentration in the atmosphere is not the main culprit of air temperature anomalies in the Earth's surface environment.

Carbon dioxide is the main culprit of global warming in the atmosphere. Even the greatest defenders of the thesis that the largest source of atmospheric anomalies is the increase in carbon dioxide concentration admit that the main culprit of global warming in the atmosphere is water vapor. According to different models of the phenomena occurring in the atmosphere, water vapor is responsible for 65 to 95% of the greenhouse effect in the atmosphere.

It should be underlined that only part of CO_2 emitted to the atmosphere has an anthropogenic origin, so it comes from the phenomena on which humans have an influence. Simultaneously, in the atmosphere there are other greenhouse gases whose concentration in the atmosphere is much smaller than CO_2, but are of much higher radiation absorption coefficient than CO_2. The most important of these are methane, nitrous oxide and halo hydrocarbons (compounds of fluorine, chlorine, and bromine).

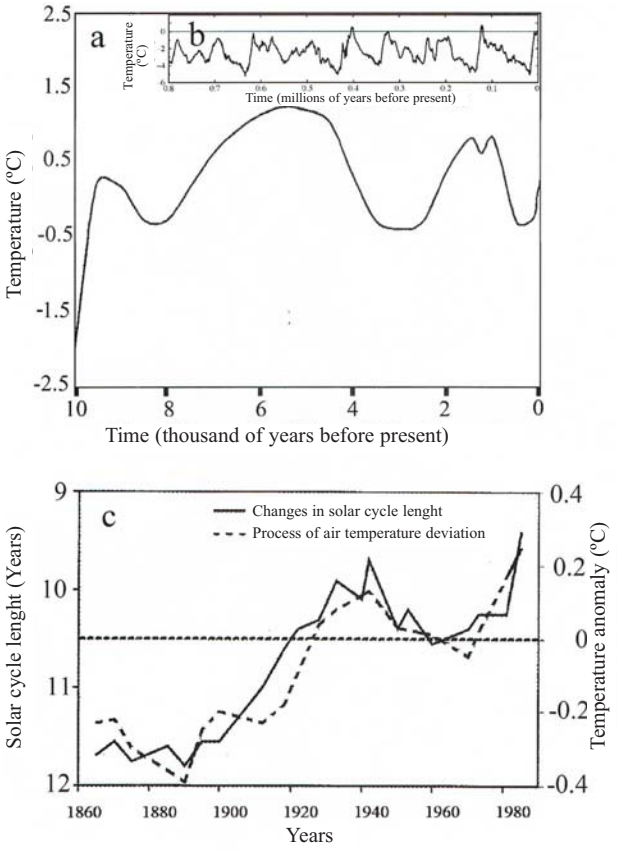

Fig. 3. a) Anomaly [ºC] relative to 1901-2000 in last 10,000 years, b) 800,000 years, and c) changes in solar cycle length versus change in Northern Hemisphere air temperature.

Carbon dioxide of no anthropogenic origin along with small amounts of these greenhouse gases are involved in the formation of the greenhouse effect in the atmosphere, similar to the effect of carbon dioxide derived from anthropogenic origin. Past climate changes have been on Earth much higher than today. The example is the Ice Age in Europe. For instance, the biblical flood can be used as a drastic weather anomaly.

Discussion

The significant contribution of CO_2 in warming the Earth's climate is reported in a number of publications, although some scientists believe that there are a lot of components that affect climate change. The last decades were a time of citing examples of a broader spectrum of issues related to environmental aspects. In the 21st century, humanity facing a number of difficulties, including population growth, depletion of natural resources, increase in environmental pollution, and much more deserves special attention in the environmental context [9]. Moreover, climate changes are expected. Support for climate forecasts are predictions of climate changes taking into account socio-economic development of the world. The scenarios indicate changes in GHG concentrations, an atmospheric temperature increase of no more than 7ºC, and a sea level rise of no more than 0.6 m [10]. The above-mentioned environmental issues help in meeting the elements influencing the greenhouse effect and they are important elements in the controversy about the role of CO_2 in the formation of global warming. Difficulties arise in selecting the method that would be most effective for showing clearly the most important element affecting the dynamics of the greenhouse effect. A well known group of dozens of greenhouse gases includes: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorinated compounds, fluorinated ethers, perfluoropolyethers, hydrocarbons, and other compounds [11]. They differ in terms of global warming potential, which determines the impact on the greenhouse warming of each gas, and its value depends on the ability to absorb infrared radiation, the wavelength range where absorption occurs and lifetime in the atmosphere and more [11]. Furthermore, according to IPCC reports, carbon dioxide is the largest contributor, accounting for more than ¾ of greenhouse gas emissions among a wide range of greenhouse gasses.

During the growing emissions of the greenhouse gasses such as methane and nitrogen suboxide, some studies have focused on the examination of the impact of human activity on climate change from a wider perspective. Consideration is given to sectors such as mining, energy, manufacturing, and agriculture. Simultaneously, it is emphasized that each activity constitutes a specific ecosystem, which is a unique part of Earth, used by people for individual purposes. Therefore, it is important to balance reasonably the emissions of greenhouse gases originating from production, pro-

cessing, breeding, and crop cultivation. Simultaneously, it is pointed out that although there is no certainty as to the total effect of anthropogenic origin gases on the greenhouse effect and even reaching the null balance seems impossible, it should be as close to equilibrium as possible [12].

It is known that global warming and increasing concentrations of GHGs in the atmosphere influence the functioning of whole biosphere of Earth [13]. At the same time, the physical characteristic of the atmosphere and vegetation conditions considerably influence the processes of mass and energy exchange between the earth's surface and atmosphere [14, 15]. In the literature global warming is often described as the carbon circulation between the earth and the atmosphere. Some papers point to the wet ecosystems as systems that play an important role in the global carbon balance [16, 17]. You can find examples of wetlands that seem to be particularly sensitive to climate change because of the complexity of both biomass growing and decomposition process, then through the analysis of gas exchange between wetland and the atmosphere could infer a rapid growth of concentrations of gases such as carbon dioxide and methane in the atmosphere [18, 19].

Issues related to global warming may not always predict a hopeless future. Global economic growth and reports of worrying levels of pollution in the environment, in particular the high levels of CO_2 emissions [20], make rational and effective exploitation of fuel and energy sources a key challenge for the coming years. Environmental concerns have focused on the international consensus on reducing emissions of air pollution and the increase in the overall share of energy from renewable sources in order to eliminate potential contamination in the environment [21, 22]. The results of quantitative assessment of carbon dioxide emissions show that lignite is a huge source of pollution. Burning lignite is responsible for high emissions of SO_2, CO_2, and dust emissions. Electricity supplied by the power grid is nearly as toxic to the environment because electricity generation leads to the emission of soot and benzopyrene. As a positive aspect reduction in fossil fuel consumption and aim for energy efficiency use can be identified [20]. Simultaneously, a number of steps have been taken in order to reduce CO_2 emissions into the atmosphere even though there are still controversies concerning the impact of carbon dioxide on climatic processes. Reducing these emissions can be carried out as geological storage of CO_2. The need for CO_2 capture, transport, and storage becomes an obligation for an already designed and under construction, huge coal-fired power plant [23].

Noting these differences in perceptions of potential risks arising from the presence of CO_2 in the atmosphere and taking them into account while actions are being pursued to prevent the negative impacts of the greenhouse gases on the environment, it is necessary for energy, production, and agriculture sectors to create a motivating system for rational use of energy and responsible exploitation of the natural environment and its resources [12] apart from the very significant or minor role of CO_2's impact on the environment, as submitted by some researchers of climate change.

Conclusions

The thesis indicating carbon dioxide as the sole perpetrator of the Earth's temperature increases by enhancing the greenhouse effect raises serious doubts:

- Concentration of carbon dioxide in the formation of the greenhouse effect in the atmosphere is fractional. The main role is played by water vapor.
- Atmospheric temperature fluctuations and deviations from average value over the last few thousand years have been more than now, and were not associated with changes in the concentration of carbon dioxide.
- The concentration of carbon dioxide in the past several hundred years increases monotonically, but in the course of atmospheric temperature changes we can observe periods of up to 20 years of temperature drop.
- There is a strong correlation between the size of air temperature deviation from the average value and the activity of the sun.
- Absorbency of radiation by carbon dioxide increases with the increases of its concentration. The increase in temperature causes an increase in absorbency of CO_2. The temperature increase of CO_2 will affect absorbency. This phenomenon has stabilizing properties.

References

1. PYTEL K., JARACZ K., GUMUŁA S. An impact of chosen construction parameter and operating conditions on the quality of wind turbine energy generation. ICCC 592, **2012**.
2. PYTEL K. Availability and reliability analysis of large wind turbine systems in chosen localizations in Poland. Journal of KONBiN **20**, 29, **2012**.
3. MAŁECKI A. Globalne ocieplenie – kilka niewygodnych prawd. Biuletyn Polskiego Stowarzyszenia Wodoru i Ogniw Paliwowych. Kraków, Wydawnictwo PSWiOP, **2009** [In Polish].
4. KOLENDA Z. Kontrowersje wokół globalnego ocieplenia klimatu, Prace Komisji Zagrożeń Cywilizacyjnych PAU, T. **3**, 125-14, **2000** [In Polish].
5. MIĘTUS M. Współczesne globalne ocieplenie klimatu - przegląd wybranych zagadnień, Biuletyn Polskiego Stowarzyszenia Wodoru i Ogniw Paliwowych, PSWiOP, Kraków **2009** [In Polish].
6. STANLEY S.M. Historia Ziemi, PWN, Warszawa **2002** [In Polish].
7. HANSEN J.E., SATO M. Paleoclimate Implications for human-made climate change. In Climate Change: Inferences from Paleoclimate and Regional Aspects. A. Berger, F. Mesinger, and D. Šijački, Eds. Springer, 21-48, **2012**.
8. LAUT P. Solar activity and terrestrial climate: an analysis of some purported correlations' Journal of atmospheric and solar-terrestrial physics, **65**, 801, **2003**.
9. YANLI Y., JABBAR M.T., ZHOU J-X. Study of nvironmental change detection using Remote Sensing and GIS application: A case study of northern Shaanxi Province, China. Pol. J. Environ. Stud., **21**, (3), 783, **2012**.
10. PYTEL K. Evaluation of energy, environmental and economic characteristics of hybrid wind and solar power systems, VSB-TU Ostrava, **2012**.

11. STEINFELD H., GERBER P., WASSENAAR T. CASTEL V., ROSALES M., DE HAAN C. Livestock's long shadow: environmental issues and options. Food and Agriculture Organization, Rome **2006**.
12. WIĘK A., TKACZ K. Carbon footprint: an ecological Indicator in food production. Pol. J. Environ. Stud., **22**, (1), 53, **2013**.
13. CHOJNICKI B.H., MICHALAK M., KONIECZNA N., OLEJNIK J. Sledge Community (*Caricetum elatea*) carbon dioxide exchange seasonal parameters in a wetland. Pol. J. Environ. Stud., **21**, (3), 579, **2012**.
14. EULENSTEIN F., LEŚNY J., CHOJNICKI B.H., KĘDZIORA A., OLEJNIK J. Analysis of the interrelation between the heat balance structure, type of plant cover and weather conditions. International Agrophysics **19**, (2), 125, **2005**.
15. EULENSTEIN F., URBANIAK M., CHOJNICKI B.H., OLEJNIK J. Influence of plant cover on the share of the soil heat flux In the heat balance of the active surface. International Agrophysics **19**, (1), 31, **2005**.
16. DAWIDSON A., JANSSENS I.A. Temperature sensivity of soil carbon decomposition and feedbacks to climate change. Nature **04514**, 440, **2006**.
17. BYRNE K.A., CHOJNICKI B., CHRISTIANSEN T.R., DRÖSLERM., FREIBAUER A., FRIBORG T., FROLKING S., LINDROTH A., MAILHAMMER J., MALMER N., SELIN P., TURUNEN J., VALENTINI R., ZETTERBERG L. EU peatlands: Current carbon stocks and trace gas fluxes. In CarboEurope-GHG Concerted Action – Synthesis of the European Greenhouse Gas Budget, Viterbo, pp. 1-58, **2004**.
18. DISE N. B. Peatland response to global change. Science 326, 810, **2009**.
19. BRIDGHAM S.D., PASTOR J., DEWEY B., WELTZIN J.F., UPDEGRAFFK Rapid carbon response of peatlands to climate change. Ecology **89**, (11), 3041, **2008**.
20. REDLARSKI G., PIECHOCKI J., DĄBROWSKI M. Reducing air Pollutant emissions from the Residential Sector by switching to alternative energy sources in single-family homes. Pol. J. Environ. Stud. **22**, (1), 197, **2013**.
21. HATZIGEORGIOU E., POLATIDIS H., HARALAM-BOPOULOS D. Energy CO_2 emissions for 1990-2020: A Decomposition Analysis for EU-25 and Greece", Energy Sources. Part A: Recovery, utilization and environmental effects **32**, (20), 1908, **2010**.
22. WANG X., CHEN D., REN Z. Global warming and its implications to emission reduction strategies for residential buildings. Build. Environ. **46**, 871, **2011**.
23. RUSIN A., STOLECKA K. Environmental Hazards Caused by carbon capture and storage (CCS) Technologies. Pol. J. Environ. Stud. **22**, (1), 205, **2013**.
24. HOBLER T. Ruch ciepła i wymienniki, WNT, Warszawa **1998** [In Polish].