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Review

Simple Modeling of Dynamic Processes of Earth Atmospheric System

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Abstract

In this paper we report generalized mathematical approach to the dynamic of Earth's atmospheric system which is based on the properties of golden section in dynamics. We report that law of functioning of components (ozone depletion chemicals and green house gases) of the system at division of Earth's atmosphere by rules of golden section follows logarithmic dependences, and dynamics of Earths atmospheric system occurs according to hyperbolic dependences

Keywords: Chlorofluorocarbons, Greenhouse gases , Principle of golden section

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INTRODUCTION

Planet Earth is surrounded by layer of gases called Earths Atmosphere (The Earth's Atmosphere Its Physics and Dynamics Saha, Kshudiram, 2008) and is retained by Earths gravity. Some physical, chemical and biological agents called Air pollution (The Earth's Atmosphere Its Physics and Dynamics Saha, Kshudiram, 2008) modify natural characteristics of the atmosphere in an unwanted way. Ozone depletion of Stratosphere (The Earth's Atmosphere Its Physics and Dynamics Saha, Kshudiram, 2008) has long been recognized as threat to ecosystem and human health. Chlorofluorocarbons (CFCs) (The Earth's Atmosphere Its Physics and Dynamics Saha, Kshudiram, 2008) containing atoms of carbon, chlorine, are nontoxic, nonflammable chemicals. They are used as solvents, and as refrigerants in the manufacture of aerosol sprays, blowing agents for foams and packing materials. CFCs react with sunlight in the earth stratosphere to break down the protective ozone layer, a layer of gas that shields the earths surface from damaging UV-B rays (The Earth's Atmosphere Its Physics and Dynamics Saha, Kshudiram, 2008).

From the sun the radiation passes through the atmosphere.Because of its wavelength it is not absorbed "on the way in"After the radiation hits earth it warms the surface.The infrared radiation (Ir) (The Earth's Atmosphere Its Physics and Dynamics Saha, Kshudiram, 2008) that is emitted by the "warm" earth has a longer wavelength than the radiation comming from the sun.

This Ir with a longer wavelength does get absorbed by the CO_2 in the atmosphere (at least a part of it).Our Earth gives off heat. Part of it can't escape to the outer space because it is retained in the atmosphere by the greenhouse gases (GHGs): CO_2, CH_4, water vapour and others This is called as Greenhouse effect Without carbon dioxide and other greenhouse gases, the atmosphere would be much colder than it is now. Carbon Dioxide traps solar radiation. Gases such as carbon dioxide, methane and fluorocarbons contribute to global warming (The Earth's Atmosphere Its Physics and Dynamics Saha, Kshudiram, 2008)

Ozone depletion and global warming are separate problems, though some agents contribute to both.

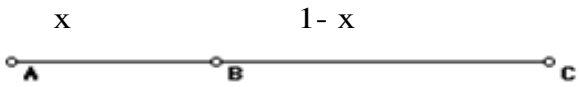

Figure 1. Schematic representation of golden section

Chlorofluorocarbons (CFCs) are the principle cause of ozone deletion, but they also happen to be potent heat-trapping gases. Still, CFCs are responsible for less than 10 percent of total atmospheric warming, far less than the 63 percent contribution of carbon dioxide. Thus, attention paid to CFCs has been on their ozone depletion role. This will change as CFCs are phased out and replaced by hydrochlorofluorocarbons (HCFCs) and hydrofluoro-carbons (HFCs). These chemicals have little or no effect on the ozone layer but are strong heat-trapping gases. As their concentration in the atmosphere is already rising, the likely net effect in the future is that reductions in the CFC-related contribution to global warming will be offset by the presence of HCFCs and HFCs.

.Ozone depletion in the stratosphere and increases in greenhouse gases in the troposphere are both subjects of growing concern among scientists, policymakers, and the public. At the same time, recent data (The Earth's Atmosphere Its Physics and Dynamics Saha, Kshudiram, 2008) show that ozone depletion, greenhouse gases, and climatic change are interconnected.?

Global warming and depletion of ozone in atmosphere are interrelated. In atmospheric system (The Earth's Atmosphere Its Physics and Dynamics Saha, Kshudiram, 2008) In modern conditions research of dynamics of earths atmospheric system is mainly grounded on studying of laws of process of ozone depletion and process of global warming and studying of laws of process of their transition from one condition to another which make these processes of ozone depletion and green house effect.

METHODOLOGY

Golden Section Using In Earths Atmosphere System

We are interested in modeling of Earth's Atmosphere which is divided in two parts.1.ozone depleting chemicals (CFCs) 2, green house gases (GHGs). Ozone depleting chemical ie CFCs are denoted by (x) and GHGs are denoted by (1-x). x and 1-x bears a ratio which is not simple 1:1 but it bears a ratio which recreates mathematics of common principle of golden section (Golden ratio – Wikipedia http://en.wikipedia.org/ wiki/Golden_ratio)

The mathematical static model of above mentioned process is of such kind where;

$x = x /1-x$ (1)

and in dynamics it may be represented as a composition of two hyperbolic functions (Golden ratio – Wikipedia http://en.wikipedia.org/wiki/Golden_ratio)

$y = 1/x$ (2)

$y = x /1-x = -1 + ((1/ (1-x))$ (3)

which are produced graphically on Figure 2.

Earth Atmospheric System Dynamics

It is a known fact that the property of golden section is researched mostly in statics (Golden ratio – Wikipedia http://en.wikipedia.org/wiki/Golden_ratio). In this paper we look into dynamics of Earth Atmospheric System containing ozone depletion chemicals and green house gases as their two components following golden section. In figure 1, we consider that the coordinate of a point B on line segment AC, depends on 1. size of line segment 2. Time 3. Other factors governing distribution of (whole) Earth Atmosphere in two parts .

Since we are interested at research of dynamics of Earth atmosphere at division of the (whole) Earth Atmosphere, therefore we must consider length of segment AC not as constant, but a system that is changing with time. If function represented by equation (2) and equation (3) meet the requirement of speed of division of the whole line segment AC into two parts in golden section. we can have differential equations representing the Earth Atmospheric System

$dy/dx = 1/x$ (4a)

$dy/dx = x/1-x$ (4b)

by integrating the above two equations we derive laws of system functioning for any new components

$$y = \int dx/x$$

$$=\ln|x| + \ln B = \ln| Bx |$$ (5)

and

$$y = \int xdx/ 1-x = -\int (x-1+1)\, dx \,/\, x-1$$

$$= -\int dx - \int d(x-1)/x- 1$$

$$= -(x + \ln|x-1 | + \ln C)$$

$$= -x - \ln|C(x-1) |$$ (6)

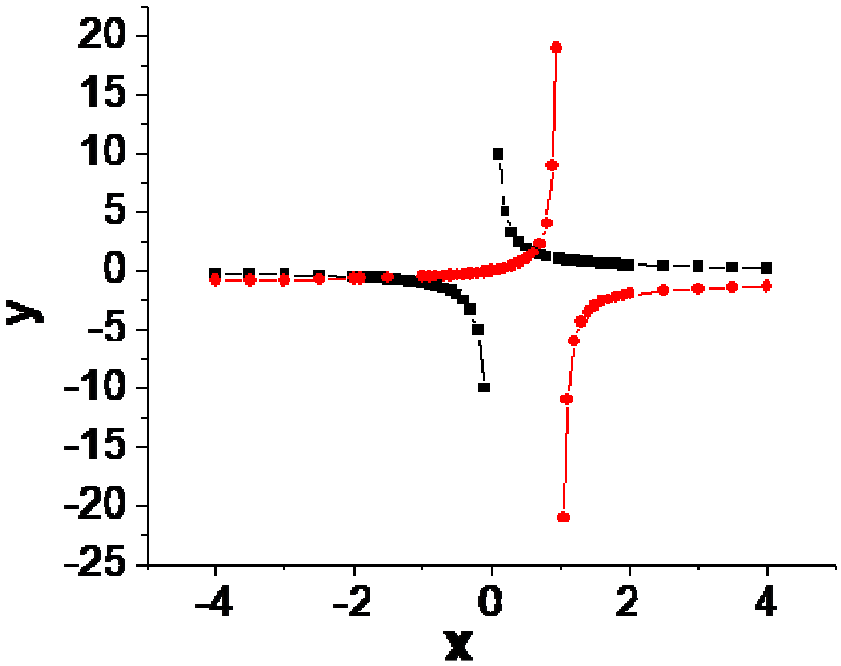

Figure 2. Graphical representation black y =1/x and red y = x /(1-x) respectively, where x = amount of CFCs, 1- x = amount of GHGs

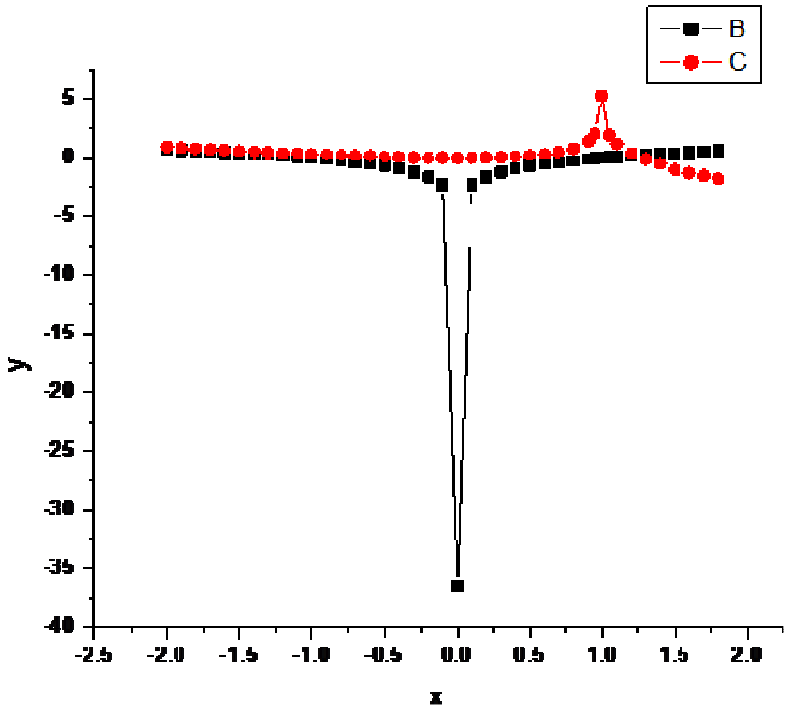

Figure 3. Graphic representation of laws of functioning of elements 1 /x and x/ (1-x) of system in dynamics blac k y =ln|x |,red = - x- ln| (x-1) |

where B and C are constants of integration. If B = C, Figure 3 shows the graphic representation of these two functions.

Inspection of Equation (5) and (6) it is clear that functioning of components of system (CFCs and GHGs) is carried under laws of logarithmic increase and

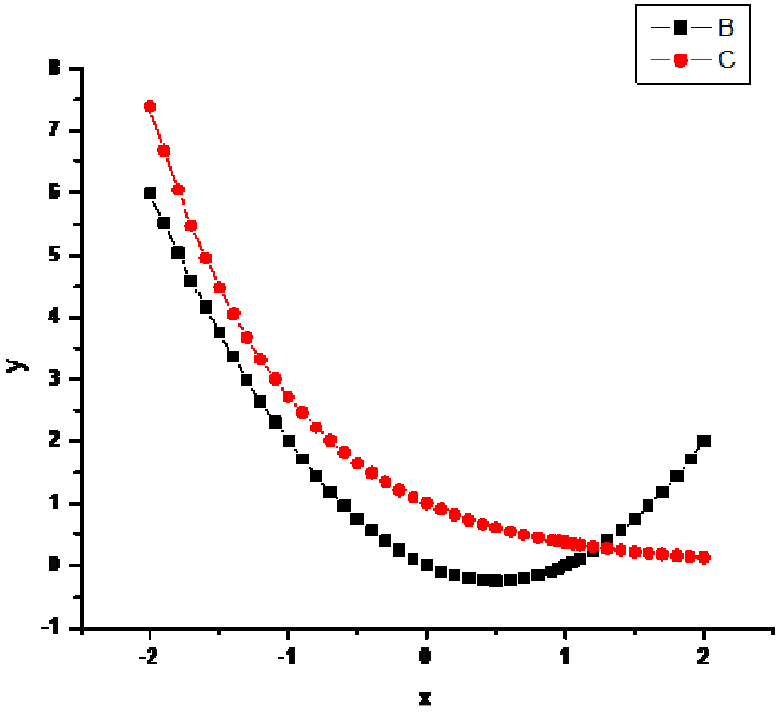

Figure 4. Graphic representation showing Static composition of parabolic(black $y = x^2 - x$) and exponential dependences (red $y = e^{(-x)}$)

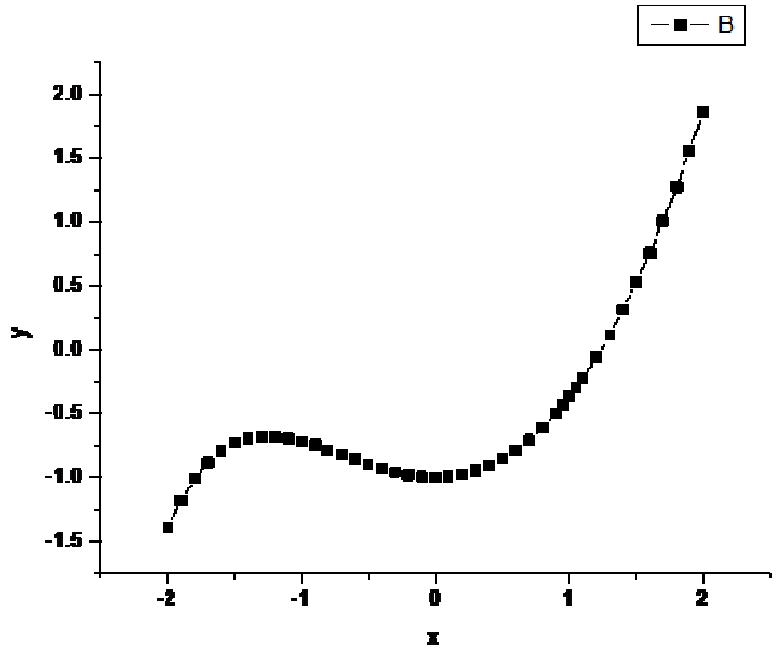

Figure 5. Reproduction of dynamics of Earth Atmospheric System containing CFCs and GHGs as two components showing hyperbolic dependences

recession and the whole Earth Atmospheric system operates under the following law

$$\ln|Bx| = -x - \ln|C(x-1)| \quad (7)$$

Rearranging equation(7) we get the ratio:

$BCx(x-1) = e^{-x}$ (8)
When B = C =1, equation (8) becomes a static composition of parabolic and exponential dependence, which is shown by the following equation
$x^2 - x = e^{-x}$ (9)
Figure 4 graphically represents the earths atmosphere shown by equation (9) Graphic representation showing Static composition of parabolic,
$y = x^2 - x$(black)and exponential dependences (red $y = e^{(-x)}$)and in dynamic form (Sizov et al., 1992) the system will follow the following equation
$y = x^2 - x - e^{-x}$ (10)
graphically it is represented on Figure 5 at small values of –x the difference of parabolic and exponential form increases with increase of -x, at intermediate values of -x, it decreases , but at large values of x , exponential term almost goes to zero and we see that entire dynamic of development of system is predominantly governed by hyperbolic dependences. The entire dynamics of system containing green house gases and chloroflurocarbons is having hyperbolic dependencies. . In other words when CFCs.>> the entire dynamics of of system is having perbolic dependencies. When GHGs>>CFCs dynamics of earths atmosphere is governed by equation (10) shown in Figure 5.
There are two possibilities x>> it means ozone depleting chemicals like chloroflurocarbons ,ie CFCs.>> are present much more in earth atmosphere than green house gases, therefore e^{-x} tends to zero, then dynamic of earth atmosphere is governed by following equation
$y = x^2 - x$
the entire dynamics of system is having parabolic dependencies
When x<< it means whole system contains much more green house gases compare to ozone depleting chemicals or GHGs>>CFCs then dynamics of the system is governed by the following equation (10) and is shown in Figure 5 reduces to
$y = - e^{-x}$
the entire dynamics of of system is having hyperbolic dependence.
when x = 0
above equation (10) gets converted to
y = -1,is shown in Figure 5
when x = 1
equation (10) becomes
y = - (1/ e) ,is shown in Figure 5

CONCLUSION

We conclude that to get the above analytical equation showing generalized results, for the dynamics of the system containing ozone depletion chemicals and green house gases as component it is necessary to research it under following laws
1. Division of the (whole) Earth Atmospheric system into ozone depleting chemical and green house gases may not be on two equal parts, but in other ratio and, in particular,in division by the rules of golden section
2.It is not necessary to consider the sizes of the (whole) Earth atmospheric system as constant or same
3.The law of functioning of components Green house gases and chlorofluorocarbons, at division of the Earths atmosphere by rules of golden section meet the requirement of logarithmic dependence, and dynamics of Earths Atmospheric system occurs according to hyperbolic dependences.
The offered general approach to research of earths atmosphere in functioning of its components assists the improvement of methodology for forming new laws, especially the law governing dynamics of earths atmosphere.

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