

Research Article

GLOBAL WARMING. HUMAN ACTIVITY OR NATURAL PHENOMENON

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Abstract

Famous European scientists such as J. Fourier [1], L. Agassiz [2], J. Tyndal [3] and many more raised their concern about climatic changes since Earth's temperature, at that time, was rising. These concerns prompted a number of other prominent scientists, de Saussure, R. Bunsen, Max Pettenkoffer, Albert Kroch (Nobel Prize 1920) and Otto Warburg (Nobel Prize 1931) to send air balloons equipped with special devices in the Lower Atmosphere to trap the air and measure the atmospheric CO₂ concentrations. For 151 years, 90000 measurements in 138 locations in 4 continents were carried out showing atmospheric CO₂ concentrations to vary from 290 ppm to 450 ppm (1820) with mean concentration for the 19th century of 322 ppm. This prompted S. Arrhenius, in 1866, to correlate the increase of atmospheric CO₂ with the rise of temperature. The temperature increase since 1850, that is after the Little Ice Age, is +0,75^oC (0,44^oC/100 years) with the following fluctuations: a) from 1850 to 1940 temperature increased by +0,60^oC. b) from 1940 to 1980 temperature decreased by – 0,2^oC. c) from 1980 to 1998 temperature increased by +0,35^oC and d) since 1998 no temperature increase has been reported.

Atmospheric CO₂ increase does not follow temperature increase. Sometimes it coincides, 1980 to 1998, sometimes not, 1999-2003, and sometimes deviates substantially, 2004-2008. This behavior indicates that the continuous and increasing use of hydrocarbons cannot be connected with the erratic temperature behavior. Therefore it seems that atmospheric CO₂ concentrations are not the driving force behind climatic changes but there are other extraterrestrial drivers such as sunspots.

Keywords: climatic changes, atmospheric CO₂, mean Annual Temperatures, Observatory, Sun spot number

1. Introduction

Climatic changes and their causes have been put forward by the United Nations administration, public media and various environmental groups in order to show that there is an unprecedented temperature increase due to high atmospheric CO₂ levels. The latter is derived from human activities. As a result of these activities ice caps will melt, resulting in the rise of sea water. These statements create a phobia which leads to hysteria. We do not deny the existence of a serious environmental problem but the use of fear to achieve any goal does not suit serious scientists.

2. Main Subject

Climatic changes have been the subject of concern since the middle of the 18th century (Martin, Wikipedia 2009, Ice Age). Since then a great number of scientists tried to resolve the causes which promote such a behavior. Fourier, in 1782 with his work of “Theorie Analytique de la Chaleur” and Luis Agassiz in 1840 with his work of “Etudes sur les Glaciers” as well as in 1847 with “System Glacier” prompted famous scientists such as de Saussure, Robert Bunsen, Max Pettenkofer, Albert Kroch (Nobel Prize 1920) and Otto Warburg (Nobel Prize 1931) to send air balloons in the atmosphere for 151 years (1810 - 1961) equipped with special devices in order to trap and subsequently measure atmospheric CO₂. 90000 measurements were carried out at 138 locations in 4 continents [4], Figure 1.

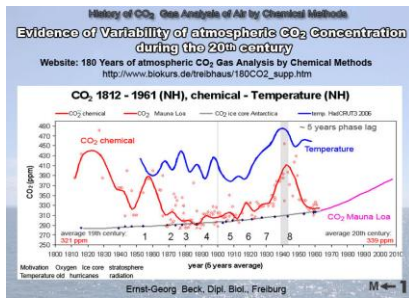


Fig.1. Evidence of variability of atmospheric CO₂ concentration during the 20th century in the Northern Hemisphere [4].

These measurements led S. Arrhenius [5] to formulate the “Theory of Global warming by greenhouse gases the so called Green House Effect”. This theory states that if the atmospheric CO₂ levels increase by 2,5 to 3 times, presumably 900 ppm to 1200 ppm, temperatures in Northern and Southern Poles will increase by 8⁰C to 9⁰C . In tantrum with these developments, Quaternary Geology was developed in all universities and Geological services to solve the advance (Glacial Periods) and retreat (Interglacial Periods) of Ice Fields from the continents. All these scientific work has never been acknowledged by the scientists working for the United Nations because in 1820 the atmospheric CO₂ concentration was quite high, 450 ppm, and the temperature was +0,5⁰C higher than the optimum temperature of 15⁰C, in the meteorological stations of Rome and Milan, Italy, and Le Bourget, Paris, France. High atmospheric CO₂ concentrations, 390 ppm, were recorded in 1860 with Mean Annual Temperature of Earth’s surface – 0,3⁰C , [6] and 390 ppm in 1940 with Mean Annual Temperature of Earth’s surface +0,10C above the optimum temperature of 15⁰C, [6], Figures 1 and 9. It is more than obvious that since hydrocarbons were not in use during these times, acknowledging the existence of these data would contradict the belief that the increase of atmospheric CO₂ does not have any correlation neither with the hydrocarbons nor with the temperature fluctuations. Moreover, these measurements were in conflict with the proxy measurements that UN scientists were carrying out in air bubbles confined in ice cores from North and South Poles. The deviations were close to 50%. As a result, research work on climatic changes which started over 260 years ago had to be ignored. Climatic changes, according to UN scientists started after 1988, something that was adopted, lightheartedly, by the politicians and the environmental groups.

Another aspect which have been ignored is that in the Quaternary during each Interglacial Period, which lasted over 20000 years, temperatures ranged from +0,5⁰C to 2,5⁰C, Eemian Period, above the today’s Optimum Temperature of 15⁰C without complete ice cap melting of neither North or South Poles. And this is known because the temperatures were recorded in samples taken from the ice cores. The same thing was repeated 3 times during the Holocene, that is in the last 13000 years.

Finally one wonders if atmospheric CO₂ concentrations measured in the air bubbles enclosed in the ice cores reflect paleoatmospheric CO₂ concentrations. Besides the deviation from what was measured by the European scientists one questions the following: How come with an increase of +0,35⁰C (15,35⁰C) above the Mean Annual Temperature of Earth's surface the recorded atmospheric CO₂ concentration to be measured at 385 ppm at Mauna Loa Observatory, and with temperatures during the Eemian Period of +2,5⁰C (17,5⁰C) the recorded by the UN scientists paleoatmospheric CO₂ concentrations to be measured at 285 ppm . Either there is no correlation between CO₂ concentration and temperature, which is correct, or paleoatmospheric CO₂ concentrations as measured in the air bubbles enclosed in ice cores are wrong, which is also correct.

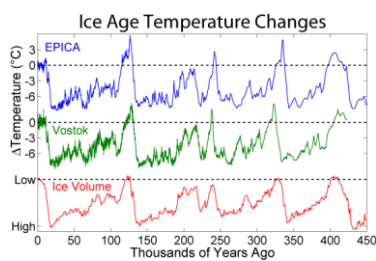


Fig.2.Climatic changes as documented from Vosto-1 icecore data [7], and EPICA ice core data, EPICA, 2004, for the last 450000 years. Worth noticing is the rise of temperature well above the today's one during the long interglacial periods without the complete melting of the ice caps.

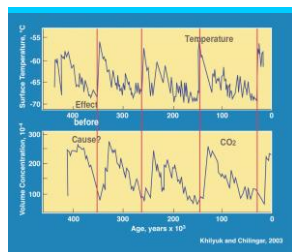


Fig. 3. Time lag between maximum temperatures and atmospheric CO₂ concentration during the Quaternary.[8].

Thus, a team of intellectuals and scientists that emanate mainly from the positive sciences, they decided to resist to the climate of hysteria that has been created. Characteristic it is the case of astrophysicist Piers Corbyn, [9] author of Long-term Forecast of Solar Activity. This scientist rejects completely the theory that the CO₂ is person in charge for Global Warming and the climatic change and he claims that it exists no element that would announce that the CO₂ increase the temperature. This confirms also the measurements of CO₂ in atmosphere from the most approved station of the world, Mauna Loa Observatory, Hawaii, USA. The measurements show that during the last 50 years, 1958 - 2008, the concentrations of CO₂ in atmosphere were increased from the 315 ppm in 385 ppm, that is to say only 70 ppm, that mean a change in the centesimal composition of atmosphere of 0,007%, a percentage infinitely small. (figure 4 and 5).

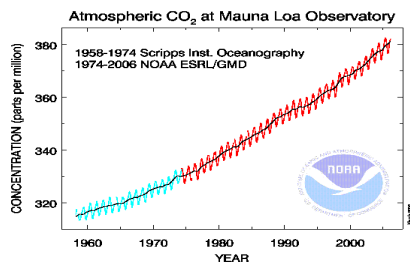


Fig.4. Atmospheric CO₂ concentration from 1958, 315ppm, to 2008, 385 ppm, Atmospheric CO₂ at Mauna Loa Observatory, Hawaii, USA.[10].

It is obvious that the change of centesimal composition of atmosphere at 7 thousandth in the 50 years does not justify the concern and catastrophism that promotes us certain scientists. It is not scientifically acceptable that the increase of atmospheric composition, least from 1 molecule (substantially 0,7 molecules) CO₂ in 10000 molecules of gases that compose atmosphere can cause Global Warming.

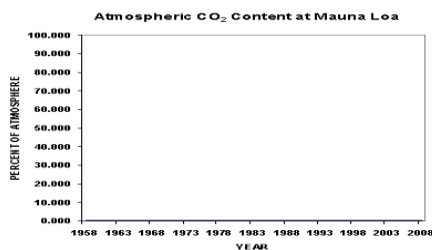


Fig. 5. Atmospheric CO₂ increase during the last 50 years expressed as a percent of the total air composition. It is the, non discernible, blue line in the bottom. It is very indiscernible azure (blue) line in the down part of diagram. The all surface above the azure line him they constitute remainder airy that composes atmosphere [11].

3. The carbon dioxide is a thermostat of the planet?

In the antipode of the opinion that the CO₂ in the atmosphere is the planet's thermostat, we consider in conclusion the following arguments:

1. In the last 50 years, the emissions of CO₂ to the atmosphere are very limited; they do not substantially influence the centesimal composition of atmosphere (figure 5). Thus, any fears for the destruction of the planet, due to the big concentrations of CO₂ in the atmosphere are absolutely groundless.
2. Relation between temperature and CO₂. There is no connection between them. Perhaps they are connected in some complex way, but there is no element establishing that the CO₂ systematically raises the temperature. In reality, since 1998, temperature levels worldwide have fallen (figures 6 and 10).

3. Measurements of CO₂ concentrations in the atmosphere in the last 10 years (1998-2008), conducted by Mauna Loa Observatory (Hawaii, USA), as well as measurements of Average Annual Temperatures of Earth's Surface, UK's Hadley Climate Research Unit, mean Annual Temperatures of Lower Troposphere, NASA, Microwave Sounding Unit (figure 6), show indisputably that there is no relation between CO₂ concentrations in the atmosphere and the mean Annual Temperature of Earth's Surface and the mean Annual Temperature of Lower Troposphere. While the concentrations of CO₂ in the atmosphere went up by 77.8 billion tones compared to 1998-levels, the temperatures not only didn't go up, but from 2006 onwards they have decreased.

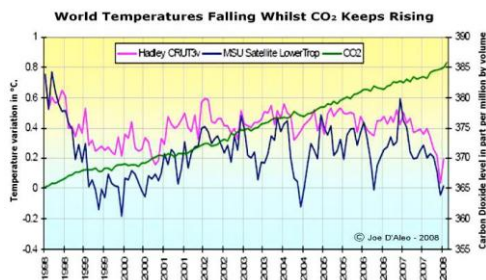


Figure 6. World temperature is falling while atmospheric CO₂ is rising. Data for a) Mean Temperature of Earth's Surface: UK's Hadley Climate Research Unit CRUT3. b) Lower Troposphere Temperature Measurements: NASA's Microwave Sounding Unit (MSU). c) Atmospheric CO₂ concentration: Mauna Loa Observatory, Hawaii, USA. .[12].

4. Relation of Temperature to Solar Activity

The fundamental periodicity of changes in temperature corresponds to the 22-year magnetic cycle of the Sun (figure 7). The current 22-year cycle has reached its peak in the years 2002 and 2003, while we currently observe a decreasing trend (figure 8). In 2002 and 2003, the fluctuating mean temperature reached its peak, which coincides with the phase of the natural 22-year cycle. Thus, we can conclude that mean global temperatures don't increase; in the last 10 years, up to 2002, there has been however a climax of the natural cycle, which is connected with the magnetic 22-year cycle of the Sun.

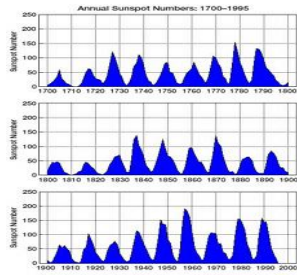


Fig.7. Sun spot number variations from 1700 AD to 1995 AD.[13].

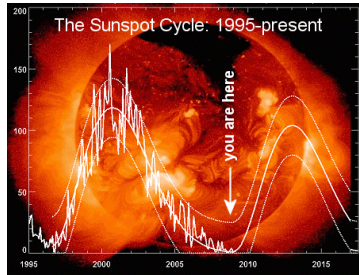


Fig. 8. Eleven (11) year sunspot cycle from 1995 to present. The fluctuation of sunspot numbers is characteristic.[14].

5. Research Method.

According to our research: CO₂ temperature and consumed quantity of hydrocarbons, are observed the followings.

1. From 1850 until today, that is to say for 158 years, the mean Annual Temperatures of the Earth's Surface amounted to + 0.7⁰C , (Figure 10). Results from the famous Climatic Research Unit of the University of East Anglia.

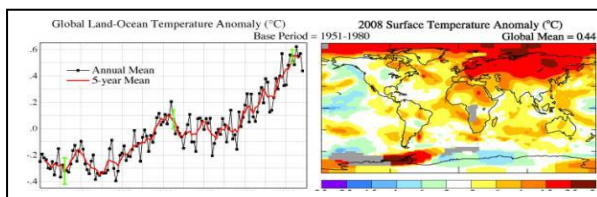


Fig. 9. Left: Mean global-mean anomalies. Right: Global map of surface temperature anomalies for 2008. (Credit: NASA GISS).[15].

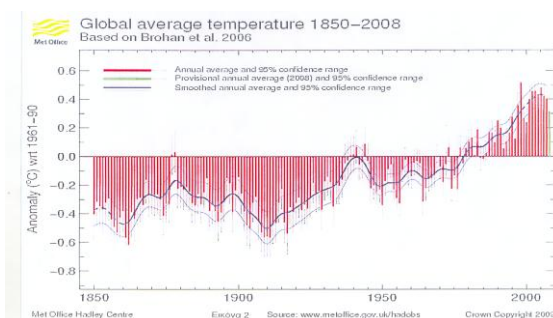


Fig. 10. Global temperature record 1850-2008.[16].

2. From 1910 until 1940, that is to say for 30 years, Mean Annual Temperatures of the Earth's Surface increased by $+ 0.6^{\circ}\text{C}$ even though we have only consumed up to the 8% of the total consumed quantity of hydrocarbons, (Figure 10 and 11).

3. From 1940 until 1975, that is to say for 35 years, Mean Annual Temperatures of the Earth's Surface decreased by $+ 0.2^{\circ}\text{C}$ though we have consumed only 40% of the total consumed quantity of hydrocarbons.

4. From 1975 until 1998, that is to say for 23 years, Mean Annual Temperatures of the Earth's Surface increased by $+ 0.4^{\circ}\text{C}$, (Figure 10 and 11), even though we have consumed up to 38% of the total consumed quantity of hydrocarbons.

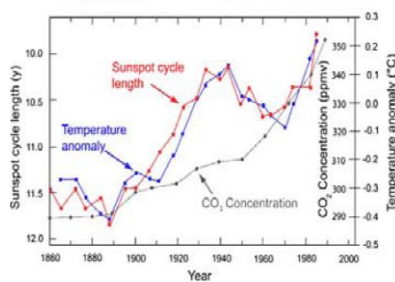


Fig.11. Correlation between sunspot cycle length, temperature anomalies and atmospheric CO_2 concentration.[17].

5. From 1999 until 2007 the Mean Annual Temperatures of Earth's Surface remained constant in $+ 0.4^{\circ}\text{C}$, (figure 12, 13, 14, 15 and 16), even though we have consumed up to 12% of the total, consumed quantity of hydrocarbons.

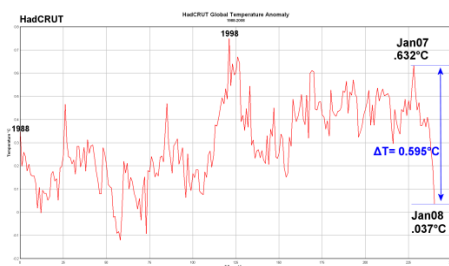


Fig. 12. UK's Hadley Climate Research Unit Temperature anomaly (HadCRUT).[18].

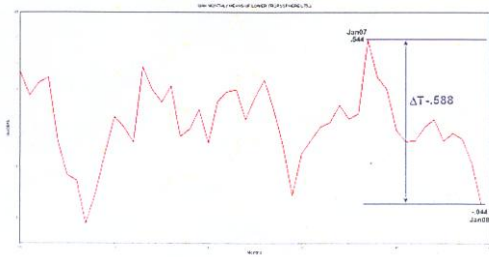


Fig.13 University of Alabama, Huntsville (UAH).[18].

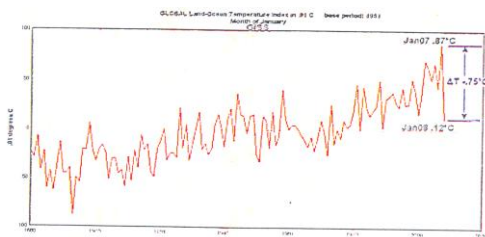


Fig. 14 . UK’s Hadley Climate Research Unit Temperature anomaly (HadCRUT) [18].

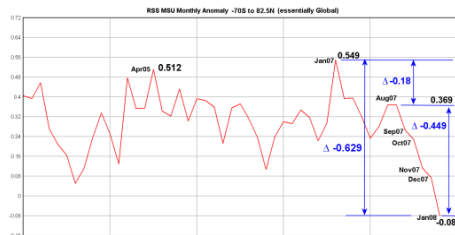


Fig.15 Remote Sensing Systems of Santa Rosa, CA (RSS).[18].

6. From January 2007 until January 2008 the Mean Annual Temperatures of Earth’s Surface cut down at -0.64°C , (Table 1), that is the mean of fall which was recorded by the all stations. Figure 10 (last green bar).

Here is a quick comparison and average of ΔT for all metrics shown above:

Source:	Global ΔT °C
HadCRUT	- 0.595
GISS	- 0.750
UAH	- 0.588
RSS	- 0.629
Average:	- 0.6405°C

For all four metrics the global average ΔT for January 2007 to January 2008 is: -0.6405°C

Table 1. For all four metrics the global average, ΔT for January 2007 to January 2008 is: -0.6405°C . [18].

7. If we compare figures 1, 4, 6 and 10, we see clearly that there is not any relation between the increase of Average Annual Temperature of Earth's Surface and atmospheric CO₂

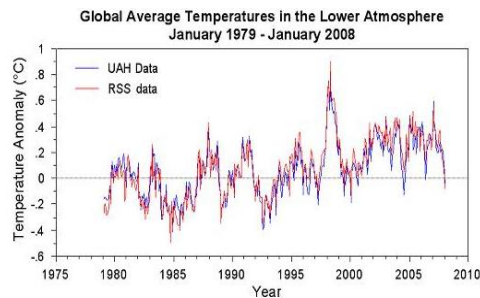


Fig.16. Global average temperature history (January 1979 through January 2008) of the lower troposphere as produced by researchers at the University of Alabama-Huntsville (UAH, blue line) and from Remote Sensing Systems (RSS, red line).[19].

Hence, these narrow-range fluctuations of temperature do not foretell devastating phenomena for the human race, because it is virtually impossible to predict the future long-term development of a system, which is influenced by multiple factors, a system which is complex and mainly chaotic, such as the climate. There is though another reason: in the recent past of the human kind (Paleolithic era, Roman period, Byzantium and Middle Ages), the temperatures oscillated from 0.8 °C to 2.5°C above the Mean Annual Temperature in the year 1980; there has been no ice-melting in the North- and South Pole and human evolution has not been affected in any way (figure 17).

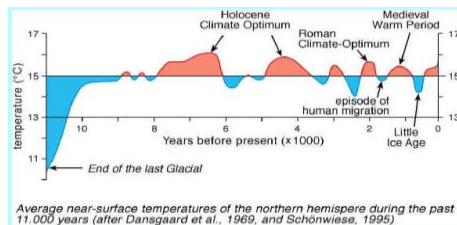


Fig.17. Average near surface temperatures of the northern hemisphere during the past 11000 years. [20], [21].

The big climatic changes (period of glaciation, period of interglacial) (Figure 2 and 3), they are attributed in the orbital system of earth around the sun, circles of Milankovitch, that became scientifically acceptable [22], while the microclimatic changes, inside interglacial era, they are attributed in the elation of not solar blots and the effect of solar winds, roughly 40000 tons/annually, [23], [24]. Sunspots are storms on the sun's surface that are marked by intense magnetic activity and host solar flares and hot gassy ejections from the sun's corona. The number of spots on the sun cycles over time reaches a peak, the so-called Solar Maximum, every 11 years. Solar winds, according to NASA's Marshall Space Flight Center, consist of magnetized plasma flares and in some cases are linked to sunspots. They emanate

from the sun and influence the amount of galactic dust, which may in turn affect atmospheric phenomena on Earth, such as cloud cover.

The big problem that humanity faces today is not the increase of atmospheric CO₂, because this subject disorientates the governments and the entire world from the befalling whirlwind that is the lack of cheap energy raw materials, (figure 18). For this reason, we have to turn ourselves immediately in financing the growth of Renewable Energy Sources, putting in second fate the costliest financing and inquiring programs that are related with the reduction or the capture of emitted CO₂.

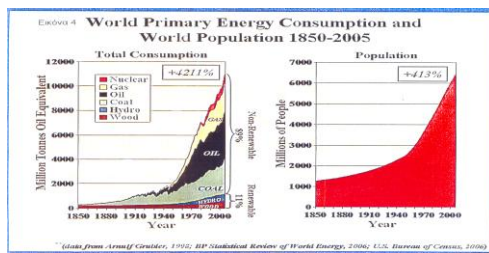


Fig.18. World consumption of primary energy and world increase of population between 1850-2005 [25].

6. Results and Conclusions

1. The climatic changes were the subject of regular research of European scientists from the beginning of 19th century. The ignorance of all the work done and of its full results places huge question marks in the world scientific community that deals during the last 20 years, with the climatic changes.

2. There is not any relation between the concentrations of CO₂ in the atmosphere and the Mean Annual Temperature of Earth's Surface. This appears of course:

a. From the delay of Annual Mean maximum Temperature of Earth's Surface in relation with the highest Concentration of CO₂ in Atmosphere.

b. From the Annual Mean Temperatures of Earth's Surface, UK's Hadley Climate Research Unit, the Mean Annual Temperatures of Low Troposphere, [NASA], Microwave Sounding Unit, and the increase of concentrations of atmospheric CO₂, Mauna Loa Observatory, Hawaii, USA. On a five-year period, while the concentrations of CO₂ in atmosphere are increasing, the temperatures are falling, a fact that outbids the opinion that the hydrocarbons are not the only source of CO₂ in the atmosphere, but also that they do not influence the Mean Annual Temperature of Earth's Surface . This is also confirmed:

g. From the big concentrations of CO₂ in the atmosphere in 1820, 450 ppm, in 1860, 395 ppm and in 1940, 395 ppm, when the use of hydrocarbons was null or too small.

3. The concentrations of CO₂ in the atmosphere have increased by 70 ppm, during the last fifty-year period, according to the measurements made by Mauna Loa Observatory, Hawaii, USA, that means a change of the atmospheric mixture by 7 mm. This change does not justify the observed increase of the Annual Average Temperature of Earth's Surface by +0,40 °C or +0,30 °C above the 15°C that is the normal Annual Mean Temperature of Earth's Surface.

4. The increase of temperature from the end of Little Ice Age season that lasted from 1350 - 1850 was of the order of + 0,70 °C , with a lot of fluctuations. The rise of temperature was of the order of +0,44 °C /100 years. The rise of Annual Mean Temperature of Earth's Surface by +0,4 °C or +0,3 °C above the 15 °C (the normal Annual Mean Temperature of Earth's Surface), during the last 68 years, and with reducing tendencies during the last 4 years, cannot be considered as something excessive and worrying, because such fluctuations we had noticed from the last Ice Age season (18000 BC till 1850 AD).

5. The increase of Annual Mean Temperature of Earth's Surface should be attributed in the effect of solar blots that create the solar winds. The last ones turn away the incident lactic ashes that are the cause of creation or not of the clouds, depending on the intensity of solar winds. Virtually, the micro-fluctuations of the temperatures are due to the "number 1" greenhouse gas, the water vapors, that its concentration in the atmosphere is 100 times bigger than that of CO₂. Unfortunately, the water vapors are not offered for geopolitical exploitation, neither are they offered for the creation of a stock exchange and a respective emissions market.

6. The micro-fluctuations of the temperatures are not forebode for devastating phenomena for the human gender, because substantially it is impossible to be forecasted, for the next 50 or 100 years, the future development of such a multi-factorial, complicated and mainly chaotic system, as it is the climate.

7.References

1..Fourier, J. 1824."Remarques Générales sur les Températures Du Globe Terrestre et des Espaces Planétaires." *Annales de Chemie et de Physique* 27: 136-67. Translation by Ebeneser Burgess, "General Remarks on the Temperature of the Earth and Outer Space," *American Journal of Science* 32: 1-20. (1837).

2.Agassiz, L.Etude sur les glaciers, Nauchatel. Digital book on Wikisource. en.wikipedia.org/wiki/Louis_Agassiz. (1840).

3. Tyndall, J. "On the Absorption and Radiation of Heat by Gases and Vapours." *Philosophical Magazine* ser. 4, 22: 169-94, 273-85. (1861).

4. Beck, E. G. 180 years of atmospheric CO₂ gas analysis by chemical methods. *Energy and Envir.* v.18 No 2 pp. 259-282. (2007).
5. Arrhenius, S. "On the Influence of Carbonic Acid in the Air Upon the Temperature of the Ground." *Philosophical Magazine* 41: 237-76. (1896).
6. Brohan, P., Kennedy, J.J., Haris I., Tett, S.F.B., Jones, P.D. Uncertainty estimates in regional and global observed temperature changes: A new data set from 1850. *J. Geophys. Res.*, 111 D12106, doi:10.1029/2005 J D 006546. (2006).
7. Petit, J.R., Jouzel, J., Raynaud, D., Barkov, N.I., Barnola, J-M., Basile, I., Benders, M., Chappellaz, J., Davis, M., Delayque, G., Delmotte, M., Kotlyakov, V.M., Legrand, M., Lipenkov, V.Y., Lorius, C., Pépin, L., Ritz, C., Saltzman, E., Stievenard, M. Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica. *Nature* 399: 429-436. (1999).
8. Khilyuk, K. Chillingar G.V., Global warming: are we confusing cause and effect. *Energy Sources*, 25 357-370. (2003).
9. Corbyn P., Do not bet on man made origin of global warming. *Executive Intelligence Review*, June 1, 2007 Review. (2007).
10. Atmospheric CO₂ at Mauna Loa Observatory, Scripps Institute of Oceanography and US Department of Commerce, National Oceanic and Atmospheric Administration, Earth System Research Laboratory, Gas Monitoring Data (NOAA ESRL/GMD). [http://en.wikipedia.org/wiki/File: CO₂-Mauna-Loa .png](http://en.wikipedia.org/wiki/File:CO2-Mauna-Loa.png). [www.jbs.org/jbs-news-feed/4333-fifty-years-of-hot-air-\(2007\)](http://www.jbs.org/jbs-news-feed/4333-fifty-years-of-hot-air-(2007)).
11. www.jbs.org/jbs-news-feed/4333-fifty-years-of-hot-air-
12. [http://icecap.us/images/uploads/Correlation Last Decade pdf.](http://icecap.us/images/uploads/Correlation%20Last%20Decade.pdf)
13. www.ngdc.noaa.gov/stp/SOLAR/SSN/ssn.html.
14. Hathaway, D.. What's is wrong with the Sun? (Nothing). [science.nasa.gov/.../11 Jul. solarcycleupdate.html](http://science.nasa.gov/.../11_Jul_solarcycleupdate.html) . (2008).
15. [giss.nasa.gov.data: http://www.giss.nasa.gov/data/update/gistemp/sectiondata/.](http://giss.nasa.gov/data/update/gistemp/sectiondata/)
16. [http://hadobs.metoffice.com/hadcrut3/diagnostics/global/nh+sh/\).](http://hadobs.metoffice.com/hadcrut3/diagnostics/global/nh+sh/)
17. Friis-Christensen, E. Correlation of sunspot activities with temperature and CO₂ concentration in the atmosphere. (2007).
[http://www.friendsofscience.org/assets/files/documents/NORM20%K%20ROTARY%.](http://www.friendsofscience.org/assets/files/documents/NORM20%K%20ROTARY%)
18. [http://wattsupwiththat.com/2008/02/19/january-2008-4-sources-say-globally-cooler-in-the-past-12-months/.](http://wattsupwiththat.com/2008/02/19/january-2008-4-sources-say-globally-cooler-in-the-past-12-months/)(2008).
19. Global average temperature history (January 1979 through January 2008) of the lower troposphere as produced by researchers at the University of Alabama-Huntsville (UAH, blue

line) and from Remote Sensing Systems (RSS, red line).
<http://www.worldclimatereport.com/index.php/2008/02/07/more-satellite-musings/>.(2008).

20. Dansgaard, W., Johnsen, S.J., Moller J. One thousand centuries of climatic record from the Camp Century on the Greenland Sheet. *Science*, v. 166 (3903),377-381p. (1969).

21. Schonwiese, C., *Klimaänderungen: Daten, Analysen, Prognosen*. Springer, Heidelberg. (1995).

22. Hayes, J., Imbrie, J., Shackleton N. J. Variation in the Earth's Orbit: Pacemaker of the Ice Ages. *Science*, v 194, No. 4270, 1121-1132 pp.(1976).

23. Murad, E., Williams, I. P. *Meteors in the Earth's Atmosphere: Meteoroids and Cosmic Dust and their Interaction with Earth's Upper Atmosphere*. Cambridge Univ. Press 322p. ISBN-13: 9780521804318, ISBN: 10: 0521804310. (2002).

24. Landgraf, M. Galactic dust storm enters Solar System. www.Mewscientist.com/.../dn4021-galactic-dust-storm-enters-solar-system.html. (2003).

25. BP Statistical Review of World Energy,. <http://www.bp.com/productlanding.do?categoryId=6929&contentId=7044622>, 38K, 48p. (2008).