CLIMATE CHANGES IN THE PAST MILLENIUM

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Abstract

The study analyzes the „global modifications" as a result of the interconnected action of phenomena signalled on Earth, such as: global warming, climate modifications; reduction of the ozone layer; deforestation; reduction of resources; reduction of biodiversity; desertification; environmental pollution; demographic changes, as well as other relevant modifications, caused by other factors that render difficult finding solutions. All these being approached from the perspective of their effect on humans.

Key words: ecologic crisis, global modifications, reduction of the Ozone layer, reduction of biodiversity, environment pollution.

INTRODUCTION

At the beginning of the XXI century, we are facing rapid modifications on the globe. Modern technologies of preservation of energy and resources, more rapid circulation at the level of present communications may represent only few of the modifications which changed the world in better, but not all of these are beneficial for the environment (3). The Earth is dominated by human activity, activity which transformed the surface of the planet, appearing new risk factors. Among these, we can mention: approximately 30% increase in the CO_2 concentration from the atmosphere, approximately one quarter of the species of birds from the Earth have disappeared, half of the sweet water being used in human activity; this lead to the so-called „water crisis"(2).

The human activity has affected the planet's climate, modifying the whole biosphere. These modifications without precedent in history affect the heath and future of all alive organisms. Some environmental problems are local, others have global implications, but all of them represent the result of the decisions of millions of people, or the result of the action of a small group of people with decision power in a state, government, industrial corporations, so on. (6).

MATERIAL AND METHOD

The analysis of the „ecological crisis" with possibilities to reduce it, from the IPCC's perspective, as well as the analysis of reasons of optimism in this field (16). The environmental issues and their consequences on alive

organisms have extended, becoming a threat to survival. We are facing a full ecological crisis, crisis which requires an international approach of the environmental issue. The „biocapacity" of the Earth exceeds today with 25% the capacity to support the needs of human kind, thus this crisis is manifested in three directions (8): - in the multiplication 4 times of the globe's population in the XXth century, from 1,6 billions in 1900 to 6,4 billions in 2000; - in the development of dangerous technologies and their export in the 3rd world countries, poor countries, which lead to the deterioration of their environment due to the lack of instruments for the environmental control; - the replacement of natural products with synthetic, toxic ones, which accumulated in the environment's biosystem. The result of the interconnected action of of a few phenomena signalled on Earth are presented in this paper.

Global warming. The phenomenon is signalled starting with the end of the '80s. The green house effect is based on ascertaining the fact that, in time, some gases from the atmosphere absorb the calorific radiation sent out on the surface of the Earth, the gas by interaction with the calorific radiation are heated and resend the heat in all directions. A part of this rows over the atmosphere, contributing to its additional heating. The increase of concentration of these gases determines the heating of the Earth's surface, creating the „green house effect" (Fig. 1).

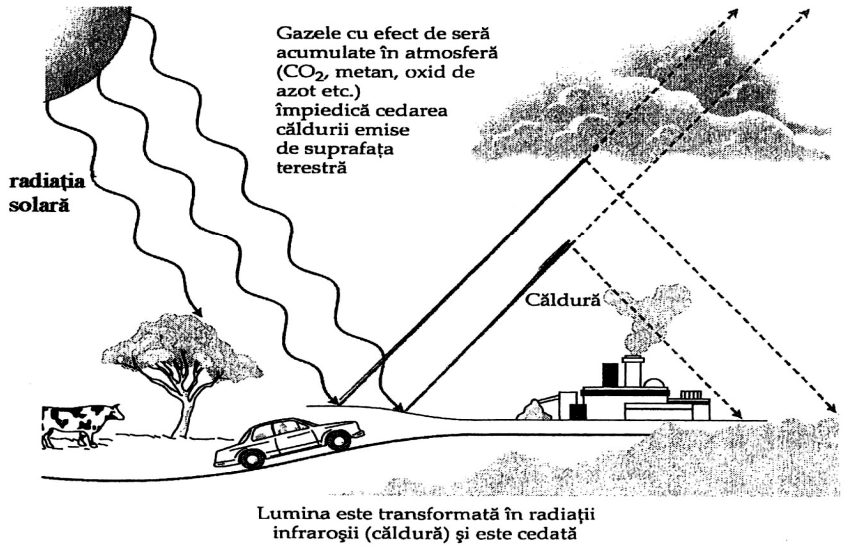

Fig. 1. Green house effect (after *Gates, D.M.,* 1993)

Without the green house effect, the temperature of the surface of the ground would vary from 500^0C in the sunny days to 40^0C during the night and during nebulosity. Today, approximately 6 billion Gt. of CO_2 are annually eliminated into the troposphere, the concentration grew with approximately 1,5 ppm/an (0,4%/an), so a general increase of 25% in the past century. The combustion is responsible of approximately 80%, the rest of the percentage are due to deforestation. The increase of concentration of gas will lead to the increase of average temperature in the first half of the XXth century with approximately $0,5^0$C, and around the year 2100 with 20^0C *(*16*).* The most familiar dates for the average monthly temperatures are those registered by C.E.T. (Central England Temperature) which show that the multiannual average in the past 30 years is higher with approximately $0,5^0$ C than the average of the past 330 years. This warming occurred in the past years is more obvious for the winter than for the summer, and from these dates there is a record year for temperature, the year 1990, when the annual average reached $10,6^0$ C.

The numerical modelling of the global climate is supported by the laws of physics and has as basis the principle of pyramid. The pyramid illustrates the position of various models, position which emphasizes the complexity of the three primary processes and the interaction between them. The modified pyramid has an empty basis, the interaction between the primary processes missing, and, once we approach the top, these processes become more powerful (11), (fig. 2).

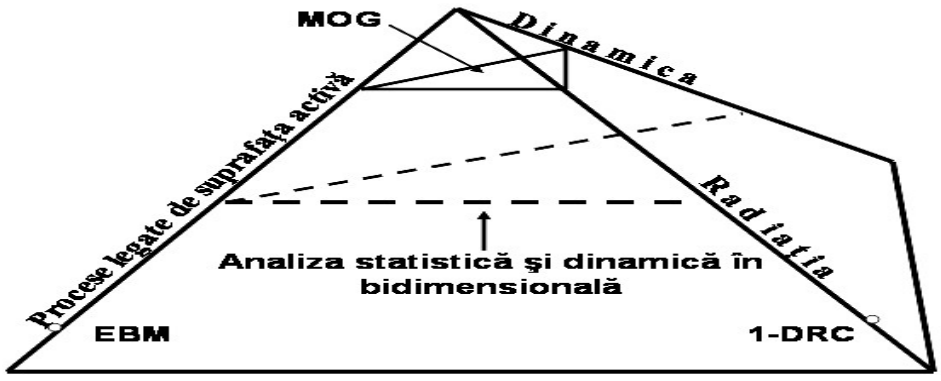

Fig. 2. Pyramid of climate change
(after *Shine, R.P., Henderson – Sellers, A.,* 1983)

Reduction of the Ozone layer. The Ozone is the gas concentrated in the atmosphere at an altitude of 15.000- 45.000 m, with the role of filter and protector of the biosphere to the action of lethal UV radiations. The major

effect of the atmosphere pollution is felt on the modification of the Ozone layer. The Oxygen's photochemistry may represent the cause of formation, but also of the destruction of the Ozone; we have to take into account the implications that the polluting agents and gases with the shape of traces had in the Ozone's survey. During the summer of 1985, in the South Hemisphere a „hole" in the Ozone layer over the Antarctica was noticed. From 1990, the phenomenon was noticed also in the Northern Hemisphere, over Siberia and in the East of North Africa. Until now, the reduction of the Ozone layer is estimated at approximately 3-4% from the atmospherical Ozone and it grows from one year to another (14).

The decrease of content of Ozone in the atmosphere on the global flux of the ultraviolet radiation, as well as on the movements of the spectrum of these waves, to smaller lengths (a reduction of 5 – 10% of the Ozone quantity may lead to an average increase of the ultraviolet radiations with 10 – 20%). If the increase would take place in the field of wave length of 28 – 320 μm, their biological effects would lead to the disorder of the whole planetary ecosystem.

Deforestation. The woods occupied approximately 70% from the surface of the Planet's dry land. Nowadays, we are far from this situation (for example, India lost 2/3 from its woods from 1990 until today, and the USA around 90% starting with the year 1620). With the help of satellites, the annual losses of woods were proved, renouncing to the essential nutrients of the Earth, disturbing water cycles and nourishing elements, impoverishing the soil's fertility reducing agricultural productivity, thus favouring the floods (1).

The wood is the most productive source of oxygen. 1 hectare of wood produces 3 – 10 times more oxygen than 1 hectare of agricultural crop or than 1 hectare of marine phytoplankton. The importance of woods in recycling of oxygen is represented also by the fact that the forest vegetal production, being harvested by humans, this does not decompose, meanwhile the marine ecosystems are consuming in the decomposition process of the organic substance the highest quantity of produced oxygen (4). In the article „*When the wood issues carbon instead of consuming it*" published in *L'Atlas environnement -Analyses et solution,* from Le Monde diplomatique (18), the authors emphasize the fact that the capacity of forest vegetation to absorb carbon will attain the maximum threshold around the year 2050.

The reduction of biodiversity through the disappearance of new species. Nowadays, there are between 3 and 10 million species in the flora and fauna of the Earth, their diversity is an indicator of the ecological health of the Planet. Until the XXth century, few species were destroyed as a consequence of human activity, but, following this period of time, the

number of destroyed species increased significantly. Some researchers from the field say that daily there are 3 species that disappear, the disappearance process being irreversible and compared by some scientists with „burning a library before its books are read".

It was also mentioned that the extensive use of pesticides for herbs and insects harmful to the crops destroy in the same time a large number of useful species (bees), leading to the death or to the interruption of reproductive capacities of several birds. Controversial studies show that the pesticides affect the number of spermatozoids in humans (9),(17).

The reduction of Earth's resources. In order to survive two resources are highly necessary: - water and food. *The water crisis,* in various parts of the world is associated with various conflicts. In the past 50 years, these conflicts also extended to other regions, their caused being represented by the threats to water's security. In various regions from the Middle East, South Africa, Brazil, South-West of the USA, the water crisis will represent one of the factors which limit the increase of the number of population and the economic development of these regions. The countries in progress have a high rate of increase of the population; the water quantity „per capita" available will decrease irrespective of the institution which created the scenery. The battle for water lasts for thousands of years. But the water issues are different, from a historical period to another, from a geographical area to another, the water needs of the humans today being different (8).

The battle for water is given in order to cover the water needs, as well as against water. Each year, millions of people and large surfaces from many countries are threatened in certain seasons by dangers, generated by the great monsoon rains. The water price in the EU reaches an average of 0,32 Euro/m^3 in Sweden, until 1,70 Euro/m^3 in Germany, France and UK have an average of 1,1 Euro/$m^{3.}$ Such differences are explained by the various density of the population, its needs. Germany has 235 inhabitants/km^2, Sweden 10 times less 1,23 locuitori/km^2 have elevated water sale prices, respectively 1,39 and 1,13 Euro/m^3. The world distribution of water from the point of view of the consumption directions is of 70%, in the field of irrigations, 22% in the industry and energy and merely 8% in the domestic field (16), (fig. 3).

In the ecosphere, the sweet water reserve is limited. From the total of water existent on the globe, 97% is to be found in seas and oceans and only 3% in sweet waters. The sweet water from the ecosphere, although in surplus, is distributed in an unequal manner. In table 1, we are mentioning the water reserve of the Earth (12). The underground reserve is important, but it presents the risk to disappear, as well as the fossil fuels. On the surface of the globe, the water is unequally distributed, as well as the population.

But the salty water occupies a percentage of 95,1%, compared with only 4,9% of sweet water. (fig. 4 the ration between sweet and salty water).

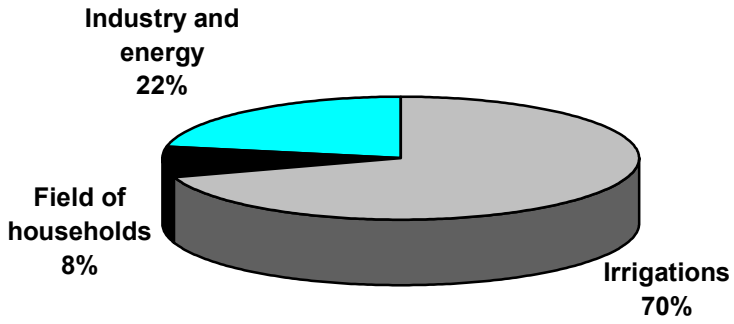

Fig. 3. Worldwide distribution of water in compliance to the consumption directions (after *Lacoste, Y.,* 2003)

Table 1

Water reserve of the Earth (after *Târziu, D.,* 2003)

Reserve from:	Total volume of water in 10^{15}	**%** from total	Resistance in time
Ocean	1.350	97	25.000 years
Glaciers	33	2,4	1.000 10.000 years
Underground waters	8	0,6	1.500 years
Lakes	0,1	< 0,01	17 years
Earth waters	0, 070	< 0,01	1 year
Atmosphere waters	0, 013	< 0,001	8 days
Rivers	0, 0017	0, 0001	16 days
Biomass water	0, 0011	0, 0001	A few hours

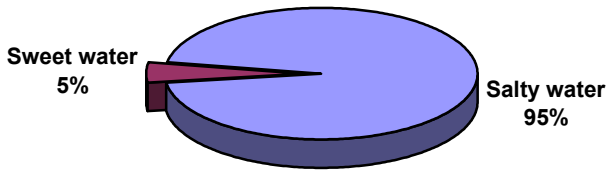

Fig. 4. Renewable water reserves (after *Lacoste, Y.,*2003)

Food crisis. The effects of the El Nino stream (from the end of the ’80s and the beginning of the ’90s) caused the modification of temperature of the oceans, affecting the marine ecology, in several regions, the fish production decreasing, with consequences on the limitation of fish reserves, it insures 20 – 25% from the food needs especially in Asia (15). Another form of reducing the resources is the energy crisis from the industrialized under way countries (China, India), which led to the increase of combustion of inferior coal, to pollution and to an increase of concentration of green house gas, generating variable effects on the health (5).

Desertification. The conversion of agricultural fields into deserts represents a very big issue, the fields for pastures were inadequately used in order to cultivate agricultural species. The tropical forests from Central and South America were eliminated and the clean fields were used as pastures for cows or for the culture of cereals or rice. The cutting of trees in these woods has lead to the interruption of hydrological cycle in the past 10 years the rainfall reduced and the soil’s humidity considerably decreased.

Demographic modifications as well as other relevant modifications cause and other factors make difficult finding a solution. From the demographic point of view, the increase of population and the number of inhabitants on km^2 represents an issue. If at the end of the XIXth century, on the Earth there were 2 billion people, today there are over 6 billion people, and by 2020, it is estimated that 8 billion people will coexist on the Earth. The population is concentrated in the largest cities, for the needs of which the water must be attracted from large distances, existing large consumers of domestic and drinkable water.

Environmental pollution. The pollution has different meanings and can be defined in many ways, a complex definition belonging to the Scientific Committee of the White House, after which the pollution is a defavourable modification of the natural environment, following the

residues coming from human activity and which, through direct or indirect effects alters the life and diversity of alive species (10). The phenomenon is still insufficiently known from the point of view of the capacity to support the ecosystems and the effect of their polluting gas.

The thermal pollution of the atmosphere has an important meteorological meaning, being able to produce severe global climate disturbances if the thermal emissions will exceed 5% from the incidental solar energy to the ground. In agreement with the evolution of world climate and taking into account the violent disturbances in the past years, it is therefore necessary to preserve, by all means possible, the forest ecosystems on the globe, ensuring its necessary viability and stability, reducing its vulnerability by removing the aggressiveness of the polluting agents.

The pollution phenomena are manifesting in two ways. At the beginning, though a green pollution, caused by the invasion of weeds and a brown one, due to the invasion of diseases and pest to sensitive crops, in unfavourable conditions of humidity and heat. The economic loss caused by the brown pollution may sometimes lead to the complete disappearance of crops (during 1991 – 1998, in Romania, due to this, 20.000 ha of trees and 15.000 ha of vine disappeared (2). Another way of manifestation of pollution results from irrational use of pesticides. The pollution affects the vegetation in its vast majority, but the forest is the first component of biosphere affected by atmosphere impurities. In general, the wood species are simultaneously exposed to the mix of polluting agents, their dominant effect being, sometimes, bigger than the individual toxic effect, the mix having synergy effect.

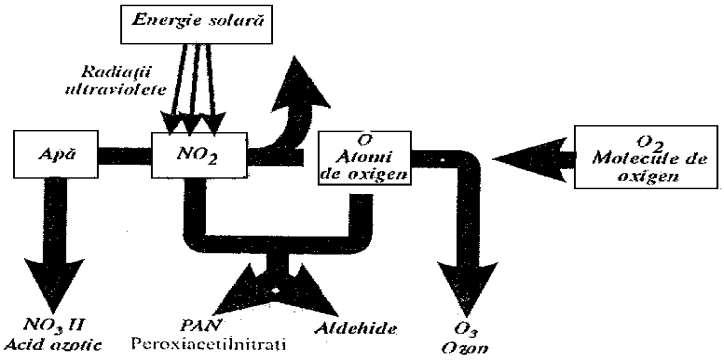

Fig. 5. Formation of photochemical smog (after *Ungureanu I.,* and collaborators, 2003)

Through the interaction of nitrogen oxides (resulting from the use of airplanes) with freons and with other gases which also produce green house effect, the ozone layer is destroyed. Thus, abnormal quantities of ozone

(which exceeds its natural concentration), together with other toxic gases (resulting from burning fuels), determines the formation of photochemical smog (13), (fig. 5).

RESULTS AND DISCUSSION

We may ask if the changes in temperature and rainfall quantity which take place at the global level are due to natural phenomena (such as variability of solar activity or the effects of solar explosions) or are the result of the increase of green house effect. The temperature variations in the atmosphere might modify the structure of the troposphere with consequences in changing regional climate and with the modification of ozone concentration, determining increases in temperature on the Earth's surface, effects comparable to those given by the increases of carbon dioxide.

The deforestation, unavoidable phenomenon due to the fact that 60% from the planet's inhabitants use wood for fire, the industry being also a large consumer of wood. The destruction of woods causes global climate changes, reducing the capacity of the Earth to absorb carbon dioxide from the atmosphere. In parallel to land clearings, the heating reduces the humidity, spreading the fires (the conjunction between El Nino and the increase of forest concessions). The fires from 1997 – 1998 lead to radiations of approximately 2,5 Gt. of carbon in the atmosphere, radiations equal to the annual European emissions (14).

Over the centuries, the water quantities which fell were more or less sufficient to cover the needs of agriculture. In the future, the issue of water will become more serious also due to the fact that in the future decades, the climate conditions risk to be modified (on a large part of the globe) by the increase of values of average temperature of the atmosphere. The destruction of species might have lethal consequences for humans, as well as for the other living beings. The climate changes are linked to a demographic explosion (the middle of the XXth century), which shows that the number of the population of the globe tripled, rising the fear that we will not be able to ensure its needs and that, in the future 30 years, the population of the globe will reach 8 billion inhabitants.

The atmosphere pollution might be regarded under three aspects: the role of meteorological factors on the phenomenon, its effect on the planet's chemism and the effects of pollution on the climate.

The cutting of trees in Sahara, which, 3000 years ago, was, at least in part covered with woods, lead rapidly to the conversion into desert. Similar processes took place in other regions on the globe, which has as

consequence the reduction of potential to produce nourishment. A deserted field may become again rich, after several hundreds or thousands of years.

For our temperate climate, flighty and full of unwanted phenomena, we have to practice a forestry and an adequate agriculture, the corresponding means for existent technologies, in order to reduce unfavourable, biological and climate effects of the CO_2 from the atmosphere, possible through some drastic measures, out of which we mention here: the termination of land clearings from forest ecosystems, rational cultivation of all fields (agricultural, forest etc.) and conservation of forest fund still existent on Terra, measures mainly connected to the antropic factor.

CONCLUSIONS

The direct and indirect effects of global warming will be manifested, thus, in several general directions: - *modifications of vegetation,* the appearance of weeds which may become fatal for the ecosystem, in time; - *the increase of the level of seas and oceans* with approximately 50 cm in the year 2050, which might put in danger lots of ecosystems, especially by an increase of salinity; - *weather abnormalities* manifested though tropical rains, storms, tornados, waves of heat, etc. With an impact on the entire biosystem and on all alive mechanisms; - *the appearance of diseases transmitted through vectors,* in some regions of the globe this phenomenon may lead to incidence, prevalence and, possibly, mortality; - *the food safety is threatened*, high temperatures will affect crops in some regions of the world, especially due to modifications of the rainfall regime and the soil's humidity; - *emphasis on the desertification,* due to the „green revolution" which lead to a dramatic increase of the agricultural production, especially in the past 40 years after the second world war; - *withdrawal of alpine glaciers* has as main cause the increase of green house gas concentration, phenomenon noticed for the first time in the XIXth century, leading to the withdrawal of river flows (used in irrigations and as drinkable water), which generated a real "water crisis" with consequences in the limitation of population increase in many regions from the globe.

Our society must adopt a practical attitude in solving the *environmental issues*, instead of the one adopted until now, a reactive attitude, taken each time when a crisis appears. An optimism reason might be the fact that the great majority of alive organisms from Terra are robust, powerful, which many times demonstrated the ability to adapt to a large scale of precarious weather conditions. Mankind enters

into the largest crisis ever encountered, but the man is full of resources and in the best shape, even in crisis moments.

IPCC, in its report from 1995, approached *several options to diminish* these global modifications: non-polluting methods of transportation, reduction of gas emissions of human establishments, preservation of agricultural fields, policies and strategies of management of woods from the Earth, an efficient industry, so on.

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