Analele Universităţii din Oradea – Seria Geografie Tom **XX**, no. **2/2010** (**December**), pp. **204-216**
ISSN **1221-1273**, E-ISSN **2065-3409** Article no. **202107-474**

PROGNOSES AND SCENARIOS FOR THE GLOBAL WARMING

Sigismund DUMA
"*Traian*" Ecologic University Deva,
16 1 Decembrie St., Hunedoara, Romania; e-mail :universit_ecologica_traian_deva@yahoo.com

Abstract: Global warming is a reality commonly accepted by most scientists. Nevertheless, there are people who deny such problem exists and most of them are political leaders. The global warming we are facing nowadays is the first in history caused by the intervention of the anthropic factor which will either act in order to slow down this phenomenon, or shall have to withdraw from the forces he himself has „created”.

Key words: Global warming; causes, consequences (risks), scenarios and prognoses

* * * * * *

SHORT HISTORY OF THE CLIMATE CHANGES

Today’s earth climate is change oriented, the same way it has been in the course of time. The latest prognoses lead to the conclusion that the change will take place faster and faster and the temperature will reach the highest point in the history of human society.

During the last 1,000 years two other major climate fluctuations were identified. They were described as the Medieval Climate Optimum, around 1200 and the Little Ice Age which affected the period between the 16th and 19th century (figure 1) (Roberts, 2002).

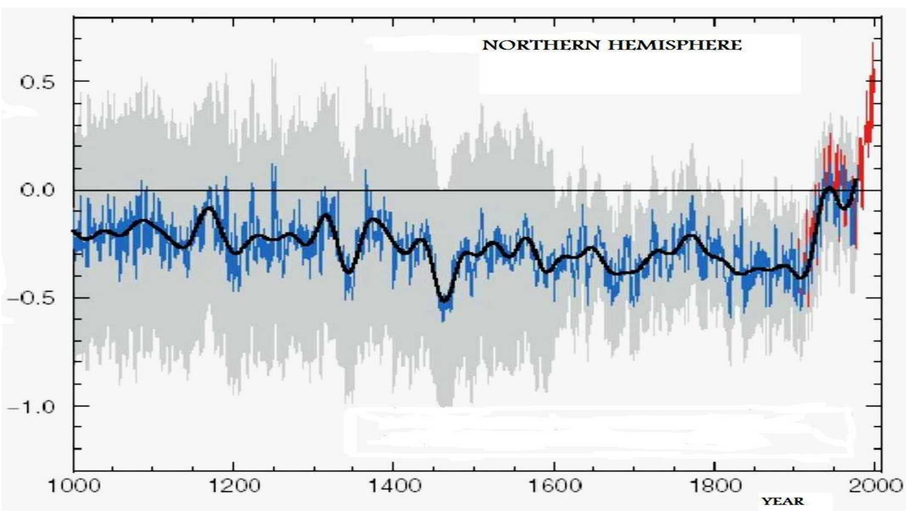

Figure 1. Temperature variations on Terra in the last millennium
(source: IPCC., 2001a.)

The medieval global warming lasted in Europe between 1100 and 1230 A.D. This would explain the Viking expansion in the North Atlantic in the 11th and 12th centuries, as well as the extension of vine plantations towards the North, as it happened in The United Kingdom. The average annual temperature is estimated to have increased with 0.4-0.8ºC in The United Kingdom and with 1ºC in Scandinavia (Lamb, 1982).

The Little Medieval Glaciation manifested through a decrease of the average annual temperature with over 0.5ºC around 1570 and the lowest point was around 1650-1750, mostly in Europe, when the Thames could be crossed on an ice bridge (Thompson et al., 1986).

Short term minimums were registered around 1350 and 1450 and short term maximums around 1570 and 1770.

Both the Medieval Climate Optimum and the Little Medieval Glaciation, as well as the short term minimums and the maximums were caused by orbital variations which have also provoked a variation of the solar energy emissions (Berger, 1992). Other authors, such as Eddy I.A., (1976), believe that the above mentioned climate changes were provoked by the variation of the energy emission from the Sun, influenced by the activity of the Sun stains.

CAUSES OF GLOBAL WARMING NOWADAYS

The climate, on a planetary scale, is influenced by society, mostly in connection to the chemical composition of the atmosphere, the presence of carbon being determinant for the processes that take place in the atmosphere. The carbon concentration has been modified almost permanently in accordance with the the evolution of the Earth, namely with life on Earth and mostly with the technical progress of society.

Theoretic understanding of the interaction between gases and radiation was made possible by the quantum theory. The observation that certain gases absorb caloric radiation constituted a remarkable breakthrough, both theoretically and practically. This made possible a correct understanding of climate variations in the course of Terra’s history, directly connecting them to the surplus or low content of CO_2 from the atmosphere. The glaciations correspond to a low level of carbon dioxide in atmosphere and the warm periods, including those with coal accumulations such as the Carboniferous period, had a high CO_2 content level.

In 1995 the carbon dioxide concentration reached 360 ppm, the highest value in the last 150,000 years, much higher than the concentration reached when fossil fuels started to be used (260 ppm), with an increase of 38 %, while in 2005 the concentration was over 375 ppm (Brown, 2006) (figure 2)

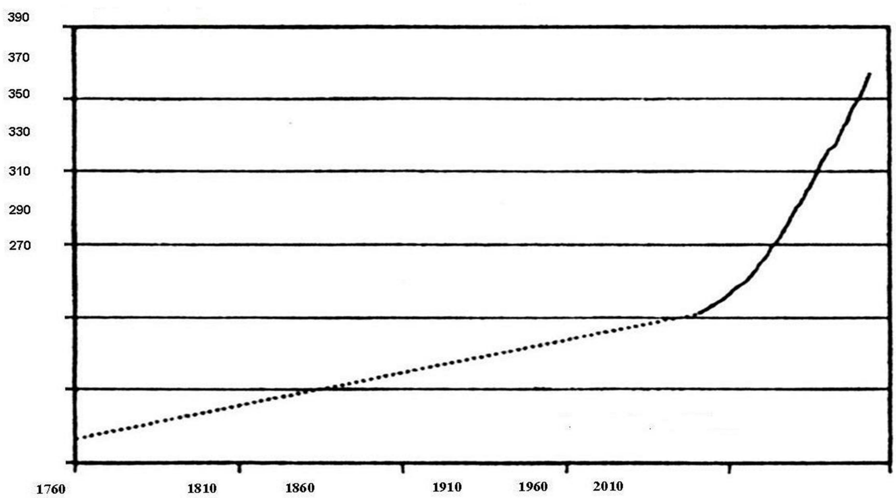

Figure 2. Global concentration of carbon dioxide in the atmosphere during 1760-2004 (according to Brown, 2006)

A double concentration of CO_2, in comparison to the pre-industrial period, would produce major changes in the climate, with dramatic effects upon the living organisms on Earth and mostly upon human society.

A first estimate leads to the conclusion that the greenhouse effect is mostly influenced by the presence of carbon dioxide in the atmosphere; other elements are: Methane (CH_4), nitrogen oxide (N_2O) (figure 3), as well as other gases: hydroflourcarbides (HFC), perfluorcarbides (PFC), sulphur hexafluoride (SF_6), ozone and water vapours. These gases are transparent to thermal radiations of the land and water surfaces, so that an increased concentration, mostly of CO_2, results in a surplus of thermal energy on the land surface, accompanied by temperature increase.

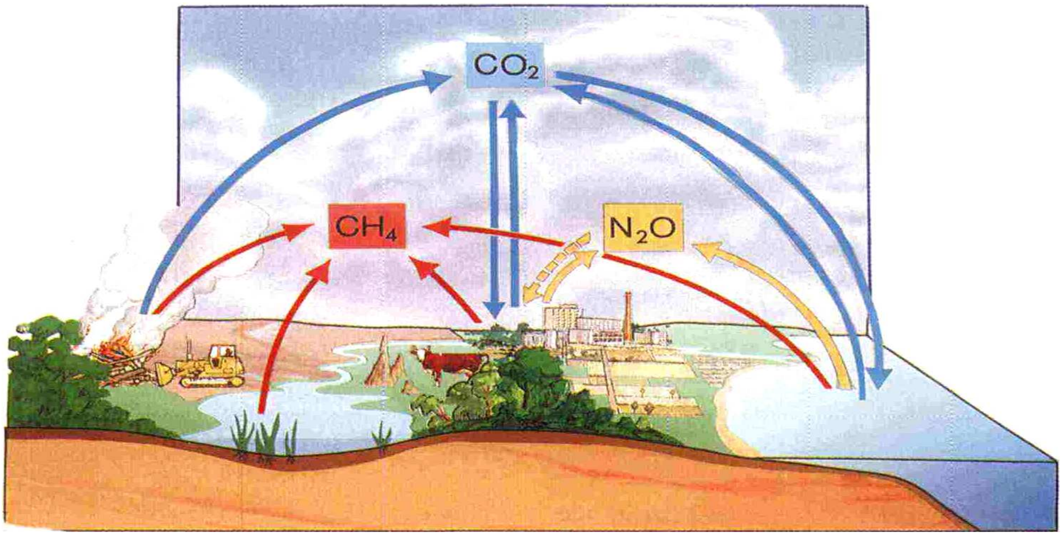

Figure 3. Greenhouse effect gas emissions
(source: Global Change research in the Netherlands, 2001, quoted by Bălteanu and Șerban, 2005)

The heat surplus accumulated in the atmosphere due to the greenhouse effect is estimated to be equivalent to the quantity of heat generated by 300,000 atomic centrals (Bright, 1997).

The carbon dioxide resulted from the burning of fossil fuels rapidly accumulates in the atmosphere; the quantity of CO_2 has constantly grown during the last decades, amounting in 2000 to over 6.3 billion tons. A higher concentration of CO_2 in the atmosphere has not been recorded in the last 420,000 years, not even in the last 20 million years (Steffen et al., 2004).

According to the scenarios regarding energy consumption in the future, the annual emissions of carbon dioxide resulting from the burning of fossil fuels will reach between 10 and 30 billion tons of carbon in 2030, to which are added 170 billion tons accumulated since the beginning of the Industrial Revolution (Washington, Mehl, 1989).

The carbon emissions level varies from one country to another. According to the data released by ONU in 2003, the world leader is USA with a „production" of over 5,500 million metric tons, representing 40 % from the emissions of the industrialized countries and 21 % from the world emissions, followed by China with over 2,850 million metric tons, Russian Federation with 145 million metric tons, Japan with 1,160 million metric tons and India with 1,100 million metric tons. Far behind the „leader" are Germany with over 790 million metric tons, The United Kingdom with 550 million metric tons, Canada with 440 million metric tons and Italy with 430 million metric tons.

The order changes when we speak about carbon emissions/inhabitant, but the „leader", USA, remains the same with 19.7 t/inhabitant, followed by Australia with 18.2t/inhabitant, Canada 14.4 t/inhabitant and Saudi Arabia with 11.7 t/inhabitant.

The analysis of the data above leads to the conclusion that the greatest economic and military power of the world is the greatest polluter of the Blue Planet. China and India have a large population which needs to be energetically „fed" as well; Russia wastes fossil fuels because it has important resources and Japan has a powerful petrochemical and steel industry in its ports, so it needs large quantities of coke and is, consequently, a great energy consumer. West European countries that are far behind the „leader" traditionally have a strong industry which naturally „produces" carbon dioxide (CO_2).

Australia and Canada are among the leaders in CO_2 "production"/inhabitant because they have a strong industry and small population. Saudi Arabia has large oil refining facilities, most of them belonging to American companies, while the country's population is rather small.

Among the countries with the lowest quantities of CO_2 emissions are: Slovenia (14 mil. metric tons), Ireland (40 mil. metric tons), Sweden (47 mil. metric tons), Denmark (50 mil. metric tons), Portugal (60 mil. metric tons), Israel (61 mil. metric tons), Austria (62 mil. metric tons) and Romania (80 mil. metric tons).

The concentration of other gases producing greenhouse effect has also increased mostly during the last century. According to IPCC (2001a) methane (CH_4) grew from 800 ppm in 1,900 to 1,750 ppm in 2000, and the radiative forcing factor grew from 0.05 to 0.5 Wm-2 in the same interval. Most of the methane is thought to come from the rice plantations in China and South-Eastern Asia. Nitrogen oxide (N_2O) concentration grew from 270 ppm in 1900 to 313 ppm in 2000 - a 16 % increase (IPCC., 2001a).

Industrial activities, the use of fuel in internal combustion engines, the production of fertilizers, animal raising etc. are all important anthropic sources of N_2O.

In order to significantly reduce the greenhouse effect and to bring the climate close to normal, the carbon emissions from the atmosphere must be reduced to about 20 % from the present level, which is to about 1-2 billion tons annually. In this respect, in the Kyoto Protocol, at the UNO Convention on climate changes, issued on the 11th of December 1997 and signed by 141 states, it was agreed that the gas emissions that have a greenhouse effect should be reduced with an average of 5 % until 2012 in comparison to the levels in 1990. The percents vary from 0 % for France and The Russian Federation, 6 % for Japan and Canada, an 8 % average for the European Union – 6.5 % for Italy, 12.5 % for UK, 15 % for Spain and 21 % for Germany. No reduced levels were established for France, because most of its electric energy is produced by atomic and hydroelectric power plants, so the CO_2 emissions are relatively low.

Russia needn't reduce its emissions, since it has huge green spaces (the taiga) which process a large part of the CO_2 emissions; at the same time, Russia is the main supplier of methane for most European countries. Romania has also signed the protocol on the 31st of January 2001. We should also mention that USA and Australia haven't signed the protocol, as they considered it might affect their economic development.

Most authors consider that global warming is mostly due to CO_2 and other gas emissions, which, when in excess, produce the greenhouse effect, but at the same time due to the massive deforestations. It is anyway hard to estimate to what extent each factor contributes. But undoubtedly, a 23 % larger green space would significantly reduce the greenhouse effect (Roberts, 2002).

The annual rhythm of deforestations is 1.8-2 % in the tropical areas. In 1989 only, 142,200 km^2 from the tropical forests have been cut - the equivalent of Austria, Belgium and Switzerland's surface together (Furley, 2002). The graphic representation (figure 4) is indicative of the dramatic situation of the rainforests whose surface has been drastically reduced. In Western Africa, in countries like Nigeria and The Ivory Coast, these forests have almost disappeared and only 1 % of them remained in Madagascar. Large surfaces of rainforests have disappeared in Myanmar, Vietnam, The Philippines, Indonesia and Thailand – in Asia, Mozambique, Nigeria, Malawi, Lesotho – in Africa (Alves, 1991).

The annual rhythm of deforestations is 1.8-2 % in the tropical areas. In 1989 only, 142,200 km^2 from the tropical forests have been cut - the equivalent of Austria, Belgium and Switzerland's

surface together (Furley, 2002). The graphic representation (figure 4) is indicative of the dramatic situation of the rainforests whose surface has been drastically reduced. In Western Africa, in countries like Nigeria and The Ivory Coast, these forests have almost disappeared and only 1 % of them remained in Madagascar. Large surfaces of rainforests have disappeared in Myanmar, Vietnam, The Philippines, Indonesia and Thailand – in Asia, Mozambique, Nigeria, Malawi, Lesotho – in Africa (Alves, 1991).

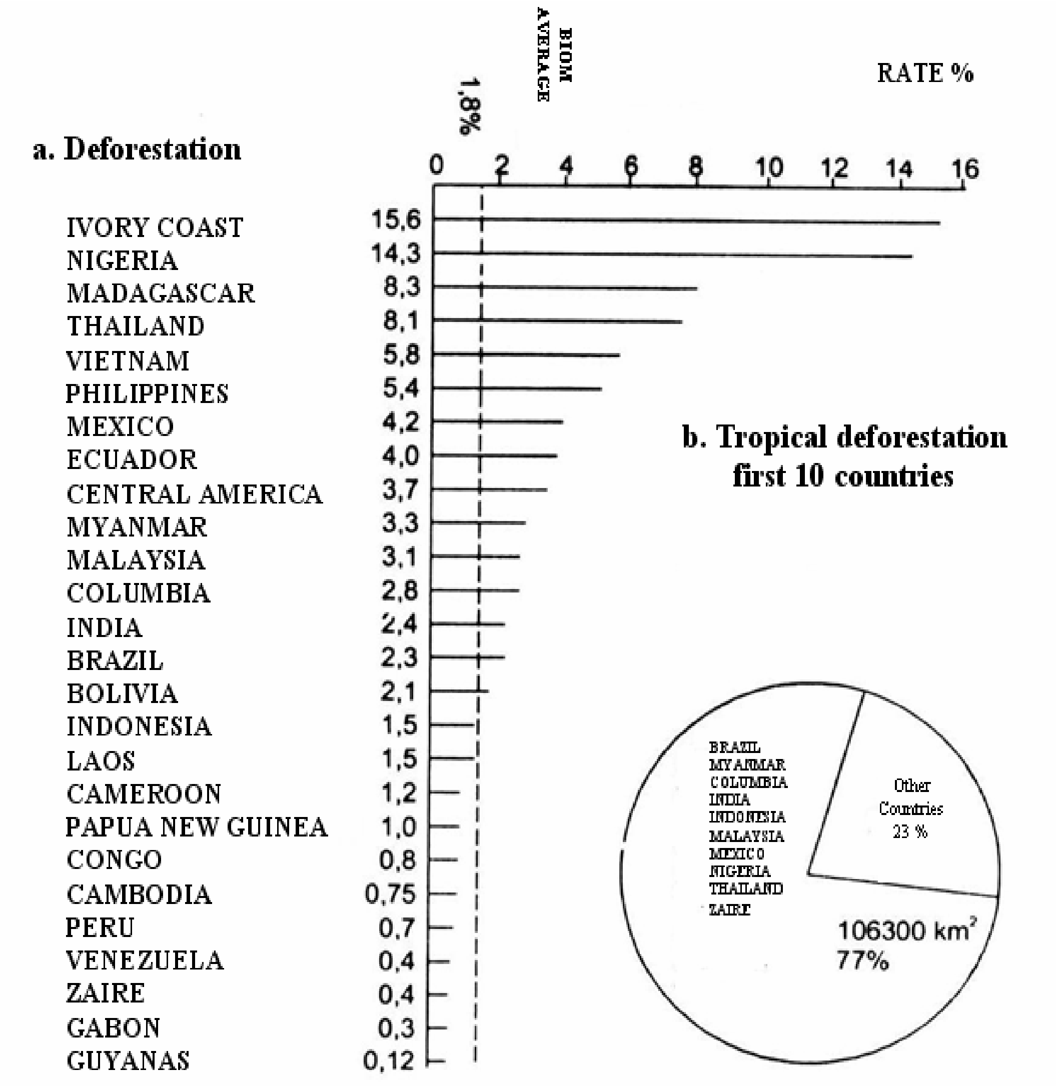

Figure 4. Tropical deforestation a). loss rate in various countries. b). total loss of rainforests (according to Roberts, 2002).

In Haiti, once a tropical paradise almost entirely covered in forests, they can be found now only on 2 % of the territory. Erosions have taken their place and some authors think that this country „is suiciding ” ecologically and politically (Brown, 2006).

Parts from the rainforests in Brazil, D.R.Congo and Indonesia, still untouched, have been saved only because they are situated in isolated, inaccessible places which made them economically inefficient, and not as a consequence of responsible management.

Apart from the fact that deforestations reduce the capacity of processing CO_2 from the atmosphere through photosynthesis, they favour a general increase of the albedo[1] which triggers the increase of air and ground temperature, of the speed and frequency of winds (Bora, for instance, was not known on the Adriatic shores in Antiquity), the decrease of potential evapor-transpiration and of precipitations. Deforestations lead to the increase of the albedo with about 10 %, reduce the ruggedness of the land and increase the value of leakage. High albedo increases the desertification, reducing precipitations with 2-4 % for each 1 % increase of the albedo (Rowntree, 1991).

Forest and savanna fires, apart from the direct negative effects, add CO_2 in the atmosphere, producing sudden convections followed by local showers which sometimes have disastrous consequences (ex. Western USA, Mediterranean forests in Greece, Spain, Corsica and Provence-France, Australia etc.). To all these, we must add the increase of temperature due to extension of urban areas which in hot summers turn into genuine energetic stoves and the fires at pits and gas pipes, as it happened in the Persic Gulf, mostly in Iraq.

ESTIMATE OF THE GLOBAL WARMING

If we take into consideration the direct connection between the solar energy emitted and air temperature, we shall notice nowadays the tendency towards climate cooling. Nevertheless, the global climate heads towards warming, consequent to the surplus of greenhouse gas in the atmosphere, particularly carbon dioxide, and to massive deforestation.

Studies on global temperatures carried out by the British Weather Service and Goddard Institute for Space Studies in New York (belonging to NASA), using networks of thermometers on land and sea surface, confirmed the global warming represented in figure 5.

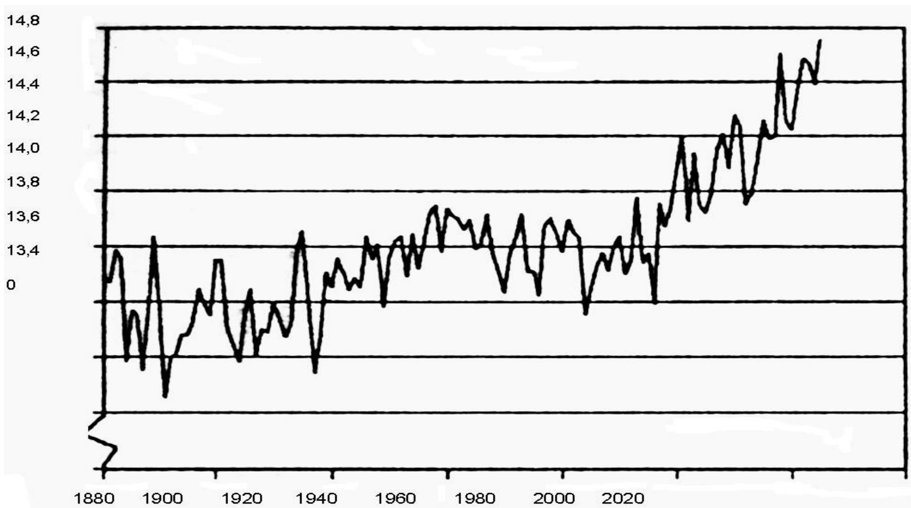

Figure 5. Global average temperature during 1880-2005 (according to Brown, R.L., 2006).

During the last 120 years global temperature increased with 0.7-0.8ºC. Six out of the seven years– the hottest in the last hundred - belong to the ninth decade and 2002 was a record for the entire planet. In Europe the record year was 2003 when 49,000 people died because of the heat, out of which 18,000 in France and 14,800 in Italy (Brown, 2006). 2007 also was a very warm year and hotter years are undoubtedly going to follow.

Computer simulations made by UNO experts estimated an increase of the global temperature with 1.4ºC until 2010 and with 5.8 C until 2100 (Brown, 2006).

[1] albedo – measurement which characterizes the capacity of an object to reflect light, equal to the ratio multiplied with 100 between the intensity of light, diffusely radiated by the surface of the object and the intensity of the light cast on the object.

Global warming will certainly have temporal discontinuities, with stagnation or decrease periods, space differences depending on the hemispheres, continents or even geographic areas on the same continent, ocean or sea.

In fact, spatial discontinuity of global warming was obvious until now in the two hemispheres which haven't warmed identically, as represented in figure 6.

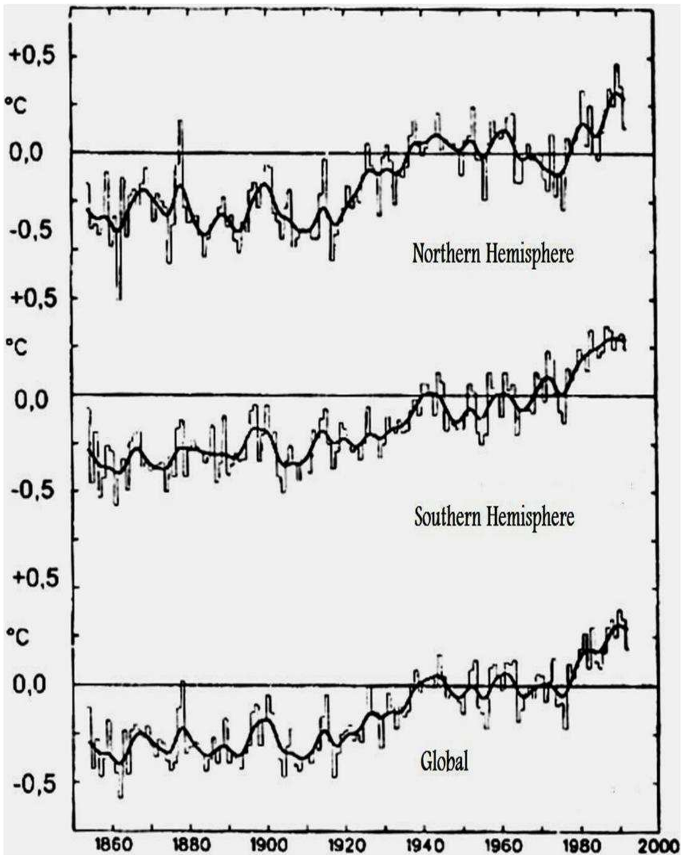

Figure 6. Average annual air temperature during 1854-1992, at global and hemispheric level.
The thin lines are treated with Gaussian filter in order to eliminate variations smaller then 10 years.
All the values are exceptions to the 1951-1980 average. Both continental and marine data are included
(Source: Jones, P.D., Climatic Research Unit, 2002)

In the last century there have been periods when only the Northern Hemisphere got warmer (1911-1930), or only the Southern one (1950-1970), but we must certainly notice that after 1990 the warming was faster in both hemispheres (Jones, 2002).

The temperature increase will not be equally distributed on the surface of the Earth, as it will be higher above the land compared to the seas and oceans and higher at high latitudes compared to the equatorial area. The land regions in the Northern hemisphere, at North latitudes, will suffer the greatest temperature increase. The temperature increase in the Southern Hemisphere will be more significant in the extreme Southern zones and in the subtropical regions it will be more significant in the oceanic regions which will turn into real „steam boilers" (Henderson-Sellers, 2002). Significant temperature increase is estimated in Central USA, Central Asia and Central Europe; the Southern and Western parts of Romania will suffer an important temperature increase. Areas like Siberia and North Canada will become suitable for agriculture and habitable and may even be „taken over" by Asian populations characterized by demographic surplus.

CONSEQUENCES AND PROGNOSES OF GLOBAL WARMING NOWADAYS

Even if a precise and detailed prognosis of the climate changes is not possible, we are able to estimate that the global warming will influence all the natural and anthropic components of environment. Among the consequences of global warming these will be the most important ones:

- partial or total melting of the ice cap (figure 7) in Antarctica and Greenland , of ice in the Arctic Ocean and of mountain glaciers which will lead to the increase in the level of the Planetary Ocean and to the loss of an important quantity of fresh water resources. Many streams and rivers will have smaller flows and this will affect alimentation, be it hydro-energetic, with drinking or industrial water, including irrigation water. Land surfaces without ice will have a higher albedo and this will influence the increase of air temperature.

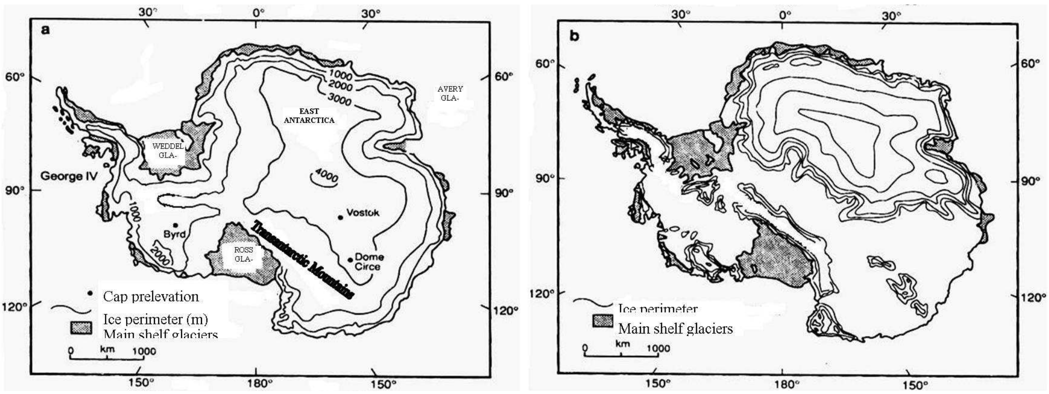

Figure 7. a) Topography of the Antarctic ice cap nowadays. b) Former East – Antarctic ice cap reconstituted according to marine fossils in the Sirius clay blocks from the Transantarctic Mountains (according to Webb et all., 1984).

- the rising of the Planetary Ocean level with minimum 367 cm (Hoffman et al., 1986) and maximum de 65 m (Tooley, 2002) and an average commonly agreed by most authors is 6m. The consequences will be dramatic for the lower coast regions and deltas where more than half of the world population lives. Many shore plains, including the Dutch polders and the deltas of the large rivers (Gange, Brahmaputra, Mekong, Irrawaddy, Nile, Niger, Danube, Rhon, Pad, Mississippi etc.) will disappear under water. Ports such as: Shanghai, New Orleans, Venice, Bangkok etc, and some mega buildings like "Palm Jumeirah" in Dubai, will have the same fate. The seawalls and fjords will suffer falls that can lead to tsunamis.

- the accelerated dynamics of tectonic plates caused by ice-isostasy and the hydro-stasy on other plates will cause an intensification of volcanoes activity and of earthquakes. (Fairbanks, R.G., 1989). Earthquakes will be more frequent and of greater magnitude both in the already active area such as the Pacific Belt of Fire and in areas of relative stability. Among the volcanoes that may have important eruptions we should mention: St. Helen, Yellowstone National Park, Kilauea and Maunaloa (Hawaii) in USA, Pinatubo in the Philippines, Krakatoa and Tambora in Indonezia, Cotopacxi in Ecuador, Tongariro in New Zealand etc. Both earthquakes and mega-eruptions will be followed by powerful tsunamis.

- perturbation of sea tides and winds . The tides will change their route due to temperature changes and chemistry (salinity) of oceans, in other words due to the cooling and lower salinity near the Poles and warming and decrease of salinity in the tropical and subtropical areas. The most affected tides will be The Golf-Stream, Kuroshio and Oiashio, in South Atlantic and the tides from the South of the Indian Ocean. The intensifying of El Niño and La Niña phenomena will also constitute a perturbing factor for sea waters. Temperature changes on land, seas and oceans will produce atmospheric pressure changes which will be followed by modifications of the winds routes –West winds, Polar winds, Alizes and Katabatic (gravity) winds (Duma, 2006).

- severe climate changes and extreme weather and hydrologic phenomena such as long drought in summer, extremely high temperatures in the temperate zones from the Northern Hemisphere, alternating with a surplus of snow and catastrophic storms in winter. In the USA the tornadoes will be more frequent and intense, most of them at 4-5 on Saffir-Simson scale; tornadoes are expected to form in Europe and Asia as well. Aridization will lead to desertification on large areas from the temperate zones in the Northern Hemisphere and also in the Southern Hemisphere. The deserts will extend towards the areas below the Equator in Africa and Australia and the Indian subcontinent will quasi totally turn into deserts (figure 8). A particularly negative role will have the dust clouds from the desert zones carried away at larger and larger distances (figure 9).

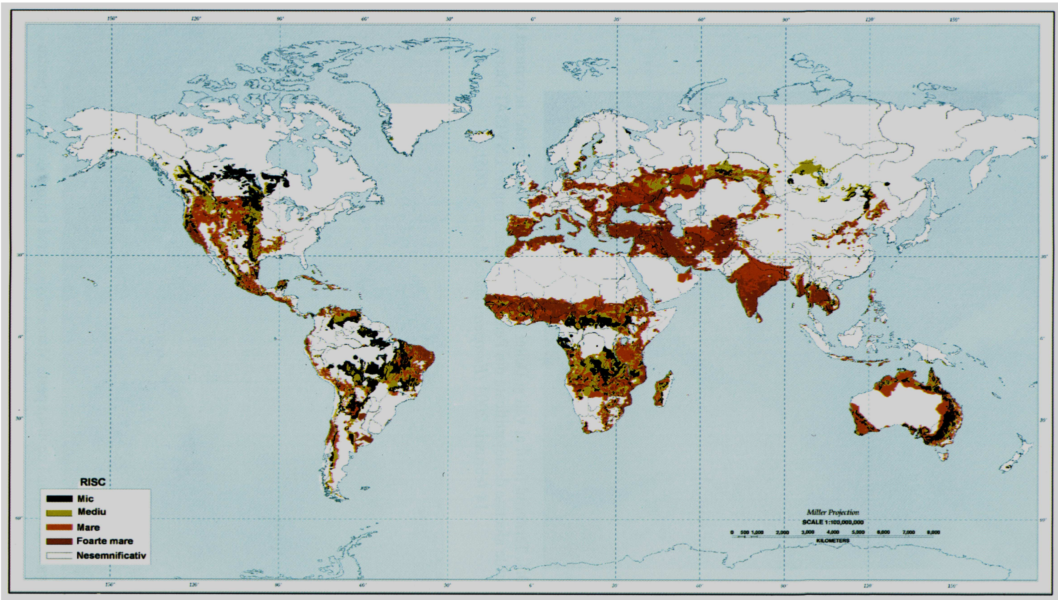

Figure 8. Risk of desertification (source: USDA-NRCS., 1999)

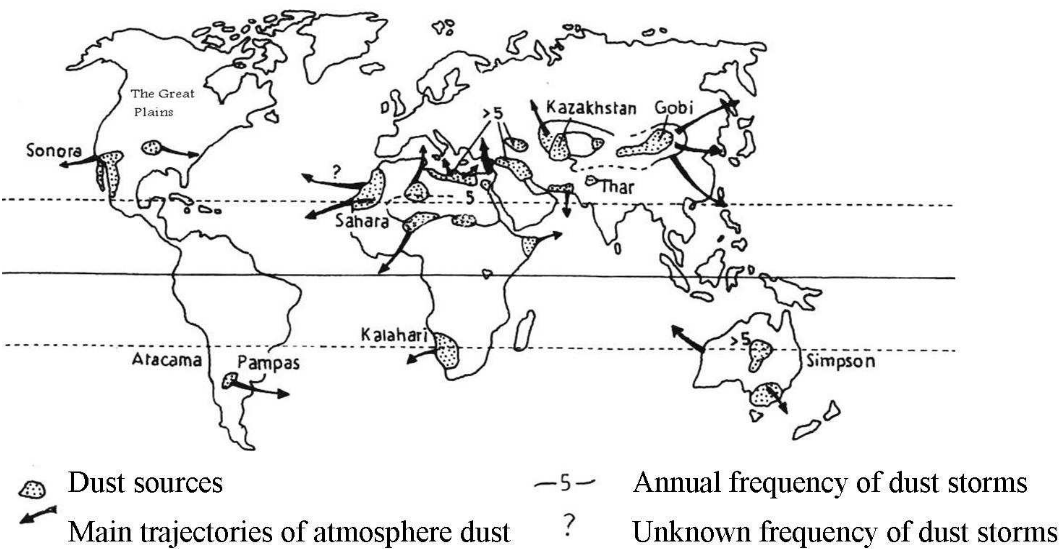

Figure 9. Frequency and directions of dust storms
(source : Bryant, E.A., 1991)

- intensifying of destructive storms (hurricanes and typhoons) both in the area known as „The Hurricane Belt" (figure 10), and beyond, towards the East-African, East-Australian and East-South American shores.

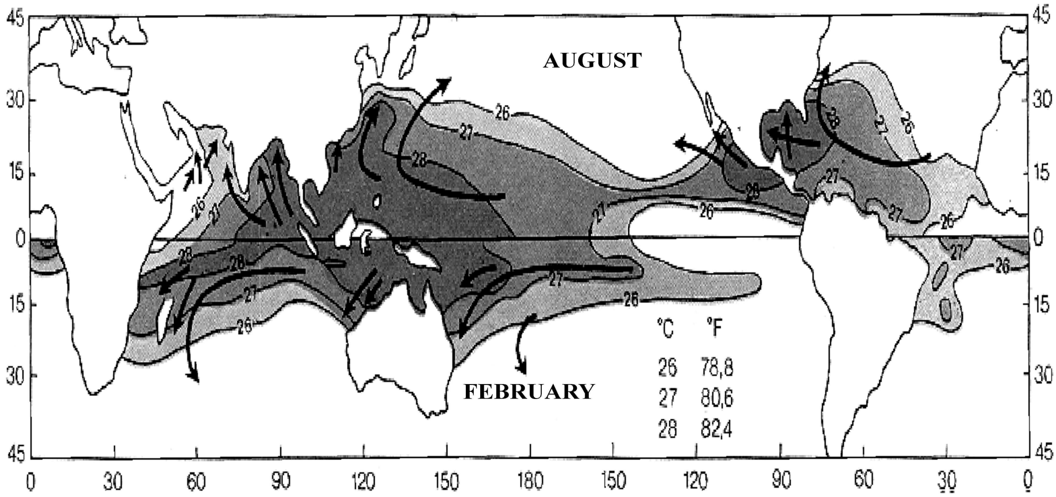

Figure 10. The Hurricanes Belt.Characteristic trajectories of tropical cyclones are connected during summer in that particular hemisphere to temperatures at the sea surface (according Strahler and Strahler, 1974)

In fact, there have been more than 20 hurricanes in the North Atlantic during the last years. Katrina (figure 11), the most devastating one, manifested between 28.08.2005 and 31.08.2005. The damages amounted to 120 billion dollars, there have been 2683 victims, out of which 1383 dead and 1300 missing (Duma, 2006).

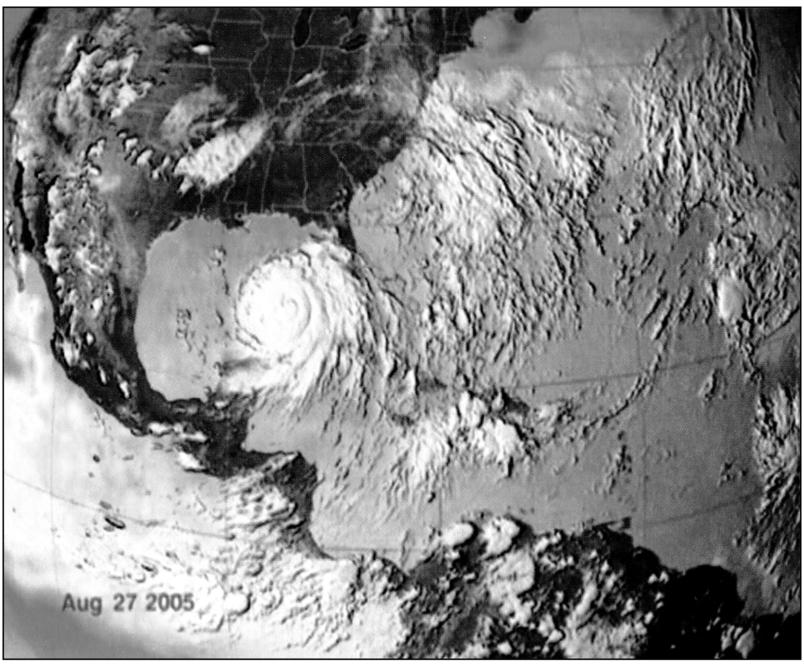

Figure 11. Hurricane Katrina (5th category) entering the Gulf of Mexico (source: NASA., 2005)

Hurricanes may also form in the Mediterranean Sea, as well as tornadoes over the oceans.

- the modification of the geomorphologic processes will partially manifest through a movement towards the Poles and through increased intensity and repercussions. The action zones of the ice morphodynamics will diminish their area, possibly disappearing altogether; instead, there will start cryonival processes which will generate a periglaciary relief overlapping the glaciary one. The permafrost will be strongly affected by defrosting, mud and rocks slides will take place, leading to increased aluvions in the rivers. The cryonival processes will be replaced by geomorphic ones, typical to the temperate area: linear erosion and lamination, sliding, solifluxions etc, and in the now arid temperate zones, specific processes such as wind erosions will take over, provoking dust storms. All these changes will also affect the buildings and the infrastructure, because of the geotechnical parameters modifications.

- A severe destruction of the biodiversity, of agriculture and of human society. The biotic stratum will be seriously affected, certain plant and animal species may disappear. The forests will gradually change their floristic composition and will be replaced by savannas and steppes which, eventually will be replaced by deserts and semi-deserts. The fauna in forests, savannas and steppes will change and most animals will migrate towards places with food and water supplies. The mangroves forests will be covered in water and the corals will be thermally and physiologically affected and eventually disappear. The ocean fish will be severely affected by the disappearance of mangroves and coral reefs and the ocean fish production will diminish. Because of the coral reefs destruction, states such as Tuvalu, Marshall Islands and Maldives will disappear, together with territories from Seychelles, Antigua, Barbuda etc. The fish in the rivers (salmon, trout) will also be affected by the warming of the river water.

The agricultural production will decrease as a consequence of global warming and the plants will need more water for irrigation, while the fresh water reserve will get smaller. The fertilizing effect of CO_2 will be annulled due to the increased temperatures, the photosynthesis will drop to zero and so will pollination. New varieties of plants must be obtained, adapted to high temperatures and with a specific vegetation cycle, corresponding to the new climate conditions. The domestic animals may start displaying symptoms of unspecific diseases, possibly unknown ones, which may trigger serious epidemics.

Beyond the direct effect of thermal stress, human society will suffer from food and water shortage. High temperatures will favour parasites resistance to medicines, reducing the body immunity. In temperate areas will appear diseases like malaria, encephalitis, hemorrhagic fever etc. The unbearable heat will lead to higher costs for air conditioning and food preservation. All these will influence a mass movement of the population towards temperate zones, namely the North in the Boreal Hemisphere and the South in the Austral Hemisphere. The migration phenomenon will be enhanced by the poverty in the third world and will have the features of a humanitarian drama.

It is easily understood that all these environment changes will imminently have an impact upon the entire society, as well as upon its components, so our civilization will face the risk of the most dramatic changes.

Having in view Le Chatelier's Principle[2], we may appreciate that together with the increase of the Planetary Ocean and considering the fact that the depth of the new water mirrors will be relatively small, evaporation will intensify, enhanced by the higher temperatures. Under these circumstances the humidity in the atmosphere grows and the water vapours will speed up the greenhouse effect. With excessive humidity, high temperatures and carbon dioxide in excess, a luxuriant vegetation, including phytoplankton, will appear on the entire planet. A real „Green Explosion" will take place globally, supplying food for the consumers on all the trophic levels. New vegetal and animal species, of remarkable dimensions, may appear.

[2] Le Chatelier 's Principle - Any intervention upon a natural system, operating as a perturbation factor, forces the system to auto-regulate from inside, so that in time, it re-balances and returns to the initial state, or to a state close to the climax

Gradually, the luxuriant vegetation will absorb through photosynthesis the CO_2 surplus in the atmosphere, causing a severe cooling of the climate, possibly to a glaciation level. This cooling will be enhanced by the surplus of water vapours that will turn into clouds absorbing solar energy and triggering a negative feedback. In addition, the clouds with more water will be more opaque (screen clouds), preventing the rays of sun from reaching the earth surface; consequently, the higher troposphere will be warmed, while the lower troposphere will be cooled, again as a negative feedback effect.

When the high troposphere is warmed, the ice particles in the clouds turn into water particles, the liquid clouds become more numerous and more solar energy will be absorbed. This process will also constitute a negative feedback to the warming of the earth atmosphere, although caloric energy will be released during the first stage when ice turns into liquid form, which will present as a positive feedback.

If we proceed with the above argumentation, the cooling of the global climate may be inevitable, as part of a climate changes cycle. Its dimension, though, cannot be estimated. But if we also consider the general cooling trend from cosmic causes, we may expect it to be a severe phenomenon. At low temperatures the flora and fauna will suffer a genuine ecologic drama, the same with human society. Many plant and animal species will disappear and others will adapt to the new environment conditions. The migration phenomenon will be this time North-South oriented in the Northern Hemisphere and South-North oriented in the Southern Hemisphere and its consequences will be devastating.

More CO_2 and CH_4 will result from the huge quantity of biomass, they will re-charge the atmosphere and the climate will regain its features prior to the global warming So, one of the cycles of climatic changes with an anthropic cause will end.

This scenario may unfold over several decades or centuries. One thing is clear: any beginning has and ending which constitutes a new beginning, resulting that everything goes in cycles, nothing happens without a cause and any intervention upon a natural system dynamically balanced is followed by feedback repercussions whose role is to reinstate a new balance, but at a different time scale.

Certainly, other prognoses and scenarios can be conceived. For example, one centered on the alternation of very hot years of drought with cold and very rainy years, ending in a climate similar to the initial one. Anyway, a prediction in this respect is hard to make. We can only assume certain phenomena will take place and this may be almost totally or partially confirmed. What we know for sure is that the Earth is and will continue to be subject to severe climatic stress with all the consequences implied.

REFERENCES

Allen Ph., (1997), *Earth Surface Processes*, Blackwell Science Ltd. USA;

Alves D., (1991), *Rate of Deforestation in Brazilian Amazon*. Unpublished note to 1991 Global Change Institute, Snowmass, CO July 1991, USA;

Bălteanu D., Şerban, M.; (2005),G*lobal Modifications of the Environment*, C.N.I.Coresi Printing House, Bucureşti. România;

Berger A.L., (1992), *Astronomical Theory of Paleoclimates and the Last Glacial-Interglacial Cycle*, Quaternary Science Reviews. USA;

Bright C., (1997), *On the Ecology of Climate Changes and Global Problems of Mankind*, Tehnic Printing House, Bucureşti. România;

Brown R.L., (2006), *Plan B 2.0 Salvation of a Planet under Pressure and of a Civilization in Danger* , Tehnic Printing House , Bucureşti. România;

Bryant E.A., (1991), *Natural Hazards*, Cambridge University Press., Great Britain;

Duma S. (2006), *Resources and Environmentl*, Univesity Printing House Bucureşti, România;

Eddy J.A., (1976), *The Maunder Minimum*, Science.Washington D.C, USA;

Furley P.A., (2002), *Major Changes of the Environment. Tropical Rainforests: Transformation or Preservation?*, All Printing House Bucureşti. România;

Henderson-Seller A., (2002), *Major Changes of the Environment. Numeric Shaping of Global Climate*, All Printing House, Bucureşti. România;

Hoffman J.S., Wels J.B., Titus J.G., (1986), *Future Global Warming and Sea Level Rise.* In G. Sigbjarnason (ed), Iceland River Symposium Reykjavik: National Energy Authority, Iceland;

Jones P.D., (2002), *The influence of ENSO on Global Temperatures*, Climate Monitor, USA;

Lamb H.H., (1982), *Climate, History and the Modern World*, London: Methuen. Great Britain;

Myers N., (1988), *Tropical Deforestation and Climatic Change*, Environmental Conservation. USA;

Roberts N., (2002), *Major Changes of the Environmenti*, All Printing House Bucureşti. România;

Rountree P.R., (1991), *Climatic Effects of Deforestation*, In HMSO, Climatological and Environmental Effects of Rain Forest Destruction, House of Commons Select Commitee on the Environment, London, Appendix 2. Great Britain

Strahler A.N., Strahler A.H., (1974), *Environmental Geoscience: Interaction between Natural Systems and Man,* Hamilton, Publishing Company, Santa Barbara, California, USA;

Thompson L.G., Mosley-Thompsom E., Dansgaard E., Groote P.M., (1986), *The Little Ice Age as Recorded in the Stratigraphy of the Tropical Quelccaya Ice Cap*. Science, 234, 341, USA;

Tooley M., (2002), *Sea Level and Climate, Major Changes of Environment*, Editura All Educational, Bucureşti. România

Washington W.M., Meehl G.A., (1989), *Climate Sensitivity Due to Increased CO_2 Experiments with a Coupled Atmosphere and Ocean General Circulation Model*, Climate Dynamics, USA;

Webb T., Wigley T.M.L., (1985), *What Past Climates Can Indicate about a Warmer World*. In MacCracken and F.M. Luther (eds), Projecting the Climatic Effects of Increasing Carbon Dioxide, Washington DC: United States Department of Energy, USA;

*** IPCC (2001a), *Climate Change 2001: The Scientific basis, Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change*, Houghton JT, Ding Y.,Griggs DJ., Noguer M., van der Linden PJ., Dai X., Madkell K., Johnson CA (eds), Cambridge University Press, Cambridge and New York, Great Britainand SUA;

*** (2005), *Earth Observatory, National Aeronautics and Space Administration*, (http:earthobservatory.nasa.gov.), NASA, USA;

*** (1999), *Risk of Human Induced Desertification*, US Department of Agriculture, Natural Resources Conservation Service, Soil Survey Division, World Soil Resources, Washington D.C, USA;

*** (2004), *Management Strategies in Agriculture and Forestry for Mitigation of Greenhouse Gas Emissions and Adaptation to Climate Variability and Climate Change*. Technical Note No. 202, WMO-No. 969, Geneva, Switzerland.

Submitted:	Revised:	Accepted:	Published online:
March 9, 2010	September 1, 2010	October 25, 2010	November 26, 2010