

Climate Change: Apocalyptic Prognosis and Reality

V.S. Bondar¹, A.V. Fursa², M.Ya. Gumentyk¹, I.V. Svystunova³

¹*Institute of Bioenergy Crops and Sugar Beet of NAAS, 25 Klinichna St., Kyiv, 03141, E-mail: hmy@ukr.net*

²*National University of Life and Environmental Sciences of Ukraine, 15 Heroiv Oborony st., Kyiv, 03041, E-mail: fursa61@ukr.net*

³*National University of Life and Environmental Sciences of Ukraine, 13 Heroiv Oborony st Kiev, 03041, E-mail: irinasv@ukr.net*

Received: 10.05.2020. Accepted: 10.06.2020

Purpose: The purpose is to clarify the concept of "climate" and to reveal the essence of its modern changes, as well as the role of real processes and factors that cause warming in their cause-effect relationships.

Methods: The following research methods have been used: induction and deduction – for the formulation of the corresponding paradigm, taking into account the achievements of domestic and foreign scientists; systematic analysis – in determining existing ideas and hypotheses on climate; synthesis – to define concepts and forecasts on this topic; expert estimates - for the study of global temperatures and abnormal precipitation; statistical – for processing data on the influence of a number of factors on climate change; forecasting – according to indicators of air temperature, precipitation and other climatic elements.

Results: It is established that the catastrophic consequences of climate warming on planet Earth in the scientific community and civil society are clearly exaggerated. Especially in providing exclusivity to the anthropogenic impact on climate change in such manifestations as an increase in population, reduction of cultivated areas, the disappearance of forests, the spread of deserts, as well as air pollution and even "loss of the genetic basis of the plant and animal world", etc., which has a negative psychological effect on people in anticipation of apocalyptic consequences. At the same time, the centuries-old regularity of regular cyclic alternation of warm and cold periods in the history of the Earth caused by a change in the activity of the Sun under the influence of a galactic magnetic field, orbital cycles of the planets and the gravitational component of the Universe is not sufficiently taken into account. The position on the exclusive role of CO₂ in creating the greenhouse effect is controversial, whereas it is the result of the combined action of not only CO₂, but mainly water vapor, methane, nitrous oxide, sulfur hexachlorides, aerosols, which occupy 1% of the volume, and CO₂ only 0.035%. In addition, increasing CO₂ concentrations do not necessarily lead to warming (mid-twentieth century). This applies to the «destruction» of the ozone layer. The fact of atmospheric pollution by emissions of volcanoes, ingredients of natural metabolic processes of biological and chemical origin in the ocean and on land, endogenous processes inside the Earth, etc., is also underestimated. A number of climatologists have proved that the current "global warming" is residual from the last spike in solar activity, formed due to a decrease in negative winter temperatures over the past 40-50 years, and should change with another cooling with a minimum in 2065.

Conclusions: The causes of climate warming in recent decades, mainly associated with the activities of the Sun, ocean, land and atmosphere, are substantiated; the concept of "climate" has been improved, the forecast of its changes in the near future is substantiated - until 2065. The fallacy of the statement about the effect of overpopulation of the planet Earth on food shortages, the controversy of the hypothesis about the exclusive role of CO₂, the fallacy of the statements about the role of the Earth's internal heat in climate change, water shortage are proved, etc

Keywords: Climate; Global warming; Anthropogenic and cosmological factors; Cyclicity of climate change; The role of the sun; Atmosphere; Ocean; Land

Introduction

There is a heated debate in the scientific community about the definition of the concept of "climate", as well as changes and processes that have taken place with it in recent decades. Some authors call the fact of rapid warming a sharp "climate change", others - "global warming", the third - "global climate change", "increasing weather anomalies", "extreme weather conditions", etc. The very concept of climate is also interpreted ambiguously, mostly as a "weather regime in a certain area", which is far from the case. Domestic and foreign mass media are marked by special frivolity, pessimism and panic predictions of catastrophes and apocalypse on the Earth.

Global horrors and disaster expectations have a negative impact not only on uneducated people, but also on a number of scientists, who also predict cataclysms in the near future. They are alarmed not so much about global warming as about "the increase in the population of the planet Earth; ... Lowering the groundwater level; reduction of sown areas...; reduction of areas and deterioration of forest structure; the spread of deserts in large areas "and even" significant losses of the genetic basis of flora and fauna "(Chizhevskiy, 1973).

Of course, there are rational grains in a number of such statements, but not all of them can be called "catastrophic changes in the environment." A number of fears are simply inappropriate. For example, it is obvious that the growth of the population on Earth

(from 1970 to 2016) from 3.7 billion to 7.5 billion (Naselenie) not only did not negatively affect its food supply, but was accompanied by an increase in consumption per 1 person. If in 1970 298 kg of grain per capita was produced, in 2016 - already 348 kg. Gross grain consumption increased during this period from 1080 million tons to 2569 million tons per year (World Food Situation, 2018). In 2017/18 MY the supply of grain on the world market was 3330.8 million tons, or about 427 kg per capita people. The number of hungry people has significantly decreased over the last ten years (World Data Atlas, 2018). Instead, more than 2 billion people are overweight. The amount of food that humanity now produces can feed about 14 billion people. For some reason, it does not take into account the fact that population growth in recent decades has slowed significantly from 19.3% for the period 1970-1980 to 12.0% for the period 2007-2017 and will continue to decline, and agricultural yields crops and their gross production sometimes increases at times, the sown area of which not only does not decrease, but also expands, especially under crops such as wheat and corn. In general, the area of arable land in the world increased from 1.37 billion hectares in 1961 to 1.53 billion hectares in 2009 (FAO, 2012; World Data Atlas, 2018). The world area from which wheat grain was harvested increased from 204.2 million hectares in 1961 to 221.3 million hectares in 2014, and the harvest for this period of time - from 1.09 t/ha to 3.32 tons/ha, gross harvest - from 222.4 million tons to 733.5 million tons. The area under corn in the United States increased from 23.2 million hectares in 1970 to 33.6 million hectares in 2014 in China - from 15.8 million hectares to 37.2 million hectares, in Brazil - from 9.9 to 15.4 million hectares, in Ukraine - up to 6 million hectares, even in France - from 1.5 million hectares to 1.8 million hectares (World Data Atlas, 2018). Advanced technologies have put on the agenda the problem of removing areas from agricultural use and transferring them to forests in order to restore the natural environment. However, the FAO report predicts that by 2050 the area of world arable land should be increased by another 146 million hectares (FAO, 2012). Something similar is happening with the explanation of the problem of air pollution, the role of the greenhouse effect and ozone holes.

A significant number of researchers believe that the main cause of air pollution and the creation of the greenhouse effect is exclusively the human factor, which leads to excessive concentrations of exhaust gases and CO₂ in the air. To a large extent this is true, but the air pollutant is not only man but also the volcanic activity of the planet Earth, whose share in these processes is quite significant, as well as natural metabolic processes of biological and chemical origin, both in the ocean and on land, endogenous processes in the interior of the Earth.

It should be noted that the greenhouse effect is not only negative for humanity, but also purely positive. If it were not, the temperature on the globe would be -18°C and the possibility of life would be almost no .. However, it is obvious that in recent decades (since the end of XX century) the greenhouse effect has increased significantly. However, in this case, not everything is so clear. The combustion of organic compounds releases into the atmosphere not only CO₂, but a significant mass of heated water vapor, which is the main greenhouse gas on Earth, and the number of emissions exceeds carbon emissions by an order of magnitude, in addition there are emissions of CH₄ and other ingredients.

Equally ambiguous and exaggerated is the problem of the "disappearance of the ozone layer" of the planet and the threat of burning all life on Earth from infrared radiation from the sun. It is known that the ozone layer in the Antarctic region in winter at low temperatures and heavy clouds is really reduced, and in summer returns to normal. That is, this phenomenon is natural and, obviously, has always been, even when there was no humanity.

By the way, the increase in CO₂ content in the atmosphere, which is interpreted as a purely negative phenomenon, has a positive side, namely - a certain increase in crop yields. The interpretations of the concepts "global warming", "global climate change", "changes in modern climatic conditions" and the reasons that cause such changes are ambiguous. For some reason, it is based on factors that lie on the surface and are not decisive, in particular, such as summer heat, rising average annual temperatures in some regions, increasing weather anomalies - tropical rains, tornadoes, melting glaciers, vortices, cyclones, which also different geographical points are opposite and do not express the essence and concept of climate.

The purpose of research is to clarify the concept of "climate" in its current changes, as well as real processes and factors that cause significant warming in their causal relationships and development.

Materials and Methods

To formulate the appropriate paradigm used the work of domestic and foreign scientists - climatologists, meteorological observations of the Hydrometeorological Center of Ukraine, documents of authoritative international organizations and quorums on this issue - the Kyoto Protocol, the Paris Agreement of 195 countries to abandon the use of fossil fuels until 2050. Numerous publications on this topic in the media, historical information on climate change in past eras, specific indicators of hydration meteorological centers of Ukraine on air temperature, precipitation and other climate elements in terms of regions of Ukraine and meteorological observations of research and breeding stations of the Institute of Bioenergy Crops and Sugar Beets.

The main research methods were the analysis of existing ideas and hypotheses and the synthesis of concepts and forecasts on climate, expert assessments - on global temperatures and abnormal precipitation; statistical - to process data on the impact of anthropogenic factors on climate change; forecasting - on indicators of air temperature, precipitation and other climate elements.

In presenting the material, preference was given to the works of prominent climatologists - A.L. Chizhevsky, AG Гамбурцева, В.П. Кеппен, B.P. Alisova, LS Berg and others, official documents of international organizations on this issue.

Results of the research

As a result of comparing different interpretations of the concept of "climate", the authors consider the most appropriate and correct formulation:

Climate in general (from the Greek climate (Κλίμα), Ukrainian - sun, slope, Russian - slope) - is the angle between the vertical rays of the sun at the equator and the rays on a certain horizontal surface of the Earth, which determines it along with other factors perennial (several decades in a row) weather regime.

The main provisions of the paradigm for the formation of climate in general and its changes in modern conditions are as follows.

1. Climate-forming factors

Which by minor deviations, are recognized and treated equally by almost all researchers, are:

- astronomical - the luminosity of the Sun, the size and mass of the Earth, the angle of the axis of rotation to the plane of the orbit, the speed of rotation, the density of matter in outer space;
- geographical - latitude, composition and mass of the atmosphere, altitude above sea level, distribution of land and sea, ocean currents, soil, vegetation, snow and ice cover;
- the influence of solar radiation, which depends on the size of the planet and the distance from the sun;

- circulation of the atmosphere in the form of large-scale wind movements, which include trade winds and monsoons, due to cyclones and anticyclones;
- the Earth's hydrosphere, first of all the oceans, precipitation.

In general, we can say that the global climate on Earth is a set of states through which the atmosphere - hydrosphere - land - cryosphere - biosphere for a number of decades.

The interaction of these factors is well described in the special and mass literature and there is no need to repeat it in detail, except for some principles, which are inadequately interpreted by some researchers. In particular, it is argued that "internal heat of the earth together with external is decisive in climate formation" (Panasiuk, 2015). And this is far from the case. 99.96% of the global source of thermal energy on Earth is the Sun.

The total flux of solar radiation passing through a single site perpendicular to the flux of rays at a distance of one astronomical unit from the Sun outside the Earth's atmosphere is called the solar constant (Soniachna, 2019). Light travels from the Sun to the Earth in 8 minutes. 20 sec. At a distance of 149597870700 m. This is an astronomical unit. In the upper atmosphere, every 1 m² perpendicular to the sun's rays receives 1365 W ± 3.4% of solar energy; 31% of it is reflected back into space, the rest spent on maintaining atmospheric and ocean currents and to provide energy to almost all biological processes on Earth. The ocean, on the other hand, absorbs 88% of the rays, and reflects the rest and transmits it to the atmosphere. The amount of internal heat of the Earth is only 0.04% of all thermal energy coming to the earth's surface, and refers to the energy coming from the sun as 1: 2500. Only not understanding this fact can explain the appearance in some articles of such an incorrect question as "what is the sphere of warming, the planet itself or the air?", The answer to which is easy to find in a geography textbook for 6th grade (Pestushko, 2014). The balance of solar heat on the planet Earth has long been calculated and published (Teplovy, 2019).

An important factor in climate formation is the Earth's hydrosphere, first of all the oceans, which are 1.5 billion km, or 96.5% of water and which together with the seas occupy 71% of the earth's surface, or 362.24 million km² (Pestushko, 2014).

Another 3% is concentrated in ice and snow, 1.48% underground, and 0.02% in rivers, ponds and lakes. Salt water on the planet - 97%, fresh - 3%. Among the oceans, the largest is the Pacific - 53%, followed by the Atlantic - 23%, the Indian - 21% and the Arctic - 1% (Pestushko, 2014).

The peculiarity of the Earth's hydrosphere is that it retains as much heat as the entire atmosphere. About 9/10 of the thermal energy comes from the ocean into the airspace. The ocean reflects only 8% of solar energy against 30%, which is reflected by the earth's surface. If not, the annual temperature at the equator would be + 33°C, and around the poles - -32°C. But due to the ocean, the movement of air masses, and giant ocean currents, solar energy is distributed more evenly over the earth's surface, and the average annual temperature at the equator is + 26°C, and at the North Pole -16°C in winter and 0°C in summer.

2. Classification of climates

The classical classification of climates by individual characteristics was carried out by W. Keppen; according to the peculiarities of the general circulation of the atmosphere - B.P. Alice and the nature of geographical landscapes - LS Bergom. The most widespread classification was W. Keppen, who identified 6 classes of climate (Naselenie):

1. Tropical climate.
2. Dry climate.
3. Temperate climate.
4. Continental.
5. Polar.
6. Unstable glacier.

For B.P. Alice on Earth there are 7 climatic zones (Klimatychnyi, 2018): 1. Arctic and Antarctic. 2. Subarctic and subantarctic. 3. Moderate. 4. Subtropical. 5. Tropical. 6. Subequatorial. 7. Equatorial.

There is no need to consider the features of each type and subtype of climate, they are described in detail in the literature.

3. Real changes in the Earth's climate, factors and causes that cause them, forecasts.

As evidenced by temperatures over 130 years (1880-2010) (Figure 1) there was an increase on the planet Earth by only 0.6°C, ie an average of 0.0046°C per year, which could be considered insignificant phenomenon, no matter how significant its increase in the period 1980-2010 + 0.016°C per year. In total, the curve of the average annual temperature clearly showed three significant deviations from the mean line; until 1945 - a cold period with a temperature below zero -2-4°C; 1945-1968 - stable - about zero; 1969-2010 - the transition through the base line and a steady increase to + 0.4°C, which continues today.

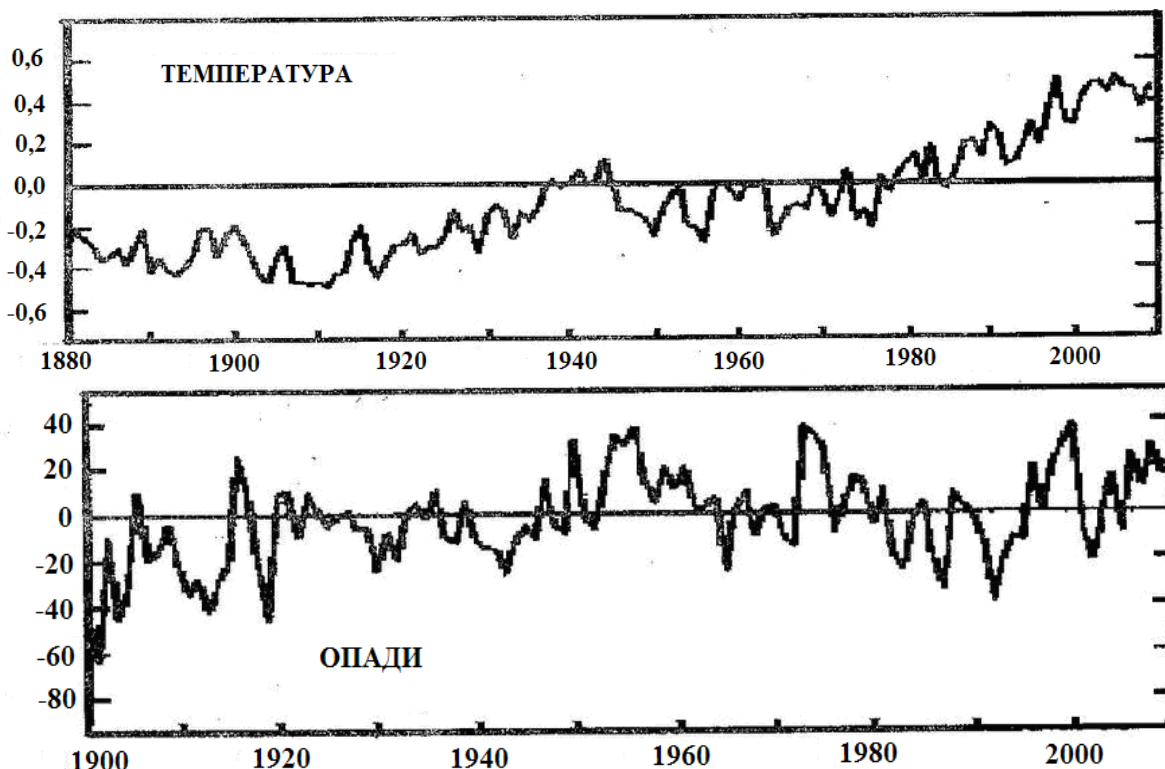


Figure 1. Global temperature and anomalous precipitation for the period 1880-2010. Source: [12].

The main conclusion that follows from these data is that in the last 40-50 years the air temperature on the ground is really rising and this increase is not due to summer heat, as many claim, but due to the reduction of negative temperatures in winter ("warm winters"), which, in turn, is associated with the cyclical nature of sunspots and magnetic processes in the galaxy and the solar system. Thus, the conclusion that this warming is "catastrophic" and irreversible is not scientifically confirmed. On the contrary, the onset of cooling is more likely, which is confirmed by studies of a number of scientists - B.G. Tapасова, A.Г. Tin (Tarasov, 2009), even before (Chizhevsky AL, who studied the laws of solar cycles, their duration and dependence on galactic plasma fluxes in the structures of the magnetic field of the Sun and Earth and the influence of distant planets Pluto, Neptune, Uranus and Saturn on the Sun. Thus, according to the forecasts of these scientists, humanity is waiting until 2070, not "global warming", but another period of low icing (Figure 2).

**Figure 2.** The time course of the average annual global temperature of the Earth's surface layer for the period from 1600 to 2100. Source: [13, p. 8].

Based on a special method, a number of scientists Vitinskiy with the help of Wolf's numbers performed appropriate calculations and concluded that the cycles of solar activity, which account for 80% of the variance, were regular, and identified the main factors influencing it. This is the Sun itself, which interacts with the flows of galactic plasma, which through electromagnetic fields with force lines affect the solar magnetic field, the Moon and the Periods of the orbital cycles of the planets.

They found that the 22-year solar cycle is determined by its passage through two adjacent galactic magnetic fields of opposite polarity and consists of two 11-year cycles of opposite polarity associated with galactic magnetic field structures located along the path of the solar system in the universe. Based on rather complex calculations, a graph of solar activity for 2,500 years (from the birth of Christ to 2,500) was constructed. Its reality is confirmed by historical chronicles, geological artifacts and the memory of people of recent centuries. And the main proof of reality was the indisputable combination of factual data of the Zurich Observatory for 1640-2000 on solar cycles with the estimated (Tarasov, 2009) except for deviations in some cases of the amplitude of activity that indicates incomplete consideration of some important factors. Proven fact is the periodic cycles of significant bursts of solar activity every 496 years under the influence of distant planets Pluto, Neptune, Uranus and Saturn, coinciding with the double rotation of Pluto (248 years), triple - Neptune (164 years), six-year periods of Uranus) and seventeen periods of Saturn (19 years). The introduction of these characteristics into the method of forecasting showed that in the future we will still be cooling (Figure 3).

In Figure 3 clearly shows a surge in activity in 2002 (max) and in 2006 - a minimum. Then for 3 years there was no surge of activity until the beginning of 2011, when 4 years later a new solar cycle began, which will last not 12 years as a full one, but only 7 years. In the future, the trend of delaying the start of cycles, reducing their duration and reducing the maximum will increase, respectively, 7 years, 3 years, and only from 2045 will begin the restoration of solar activity, and the gaps between cycles will disappear only from 2065.

3. Forecast by superposition method

From the point of view of energy, the absence of spots and flashes on the Sun is a period of its compression under the action of the proton plasma of the galactic center and a parade of 4 planets, a period of growth of gravitational and magnetic component of full energy, pulsation. electromagnetic vortices and plasma emissions, which cause natural, man-made and social phenomena and cataclysms on earth. The growth of the Earth's gravitational component leads to an increase in the frequency of seismic, volcanic and man-made disasters by an order of magnitude or more (8-12 times), (Sumatran tsunami 2004; Chinese earthquake May 12, 2008; accident at Sayano-Shushinskaya HPP August 17, 2009 etc.).

The period of excess temperature, which began in 1950, according to climatologists, will continue for some time, after which accelerated cooling will begin with a minimum in 2065. Then - the way out of the negative anomaly, which will end by 2105 and begin a new global warming similar to the warming of 1608-1680. Another 500-year (or 496 years) maximum will be reached by 2125 - again, a decrease in global temperature and t. e. to the end of the world.

Climate fluctuations over short periods, even decades, are not global climate change, but weather anomalies. They really only show climate variability, not global change.

Rising temperatures in recent years can be interpreted as a residual phenomenon from previous warming due to the inertia of the process.

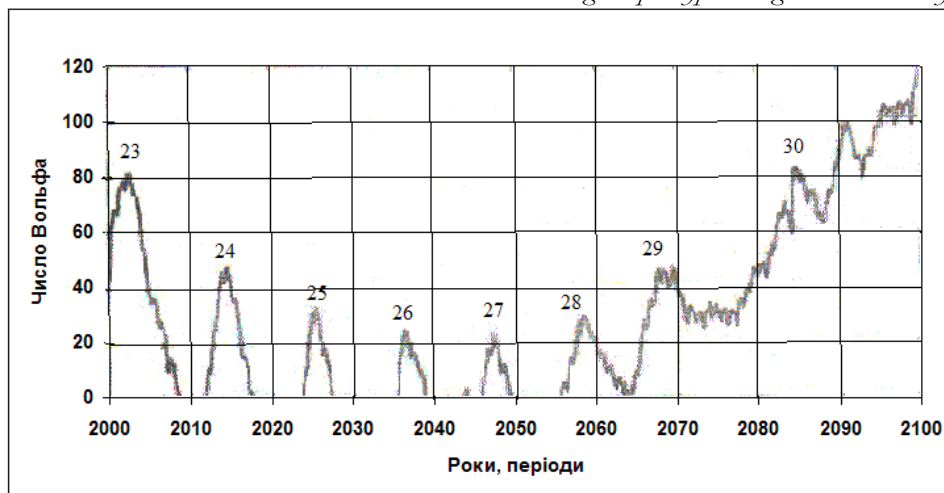


Figure 3. The course of the decrease in the solar constant and the forecast of its recovery for the period 2000-2100 Source: [13, p. 6].

4. Anthropogenic factors influencing climate change

Scientists say that the anthropogenic impact on climate change is indeed due to the following global reasons: increasing concentrations of carbon dioxide and other gases in the atmosphere as a result of emissions from the combustion of fossil fuels, increasing the number of aerosols, forest fires and land use change, excessive deforestation, especially in the tropics, overgrazing, drying of swamps, ocean pollution and other factors.

Among the most important anomalous phenomena in nature is the fact of increasing the concentration of carbon monoxide in the planet's atmosphere, which enhances the greenhouse effect, leading to significant warming.

It is believed that the CO₂ content in the atmosphere may double compared to the beginning of the industrial era, which will increase the Earth's temperature by 2-3°C in temperate latitudes and up to 10°C at the poles, which in turn will cause further melting of glaciers, rising ocean level and other anomalies.

However, not everything is so simple. In a number of decades of the twentieth century, despite the growth of industrial and agricultural production and a 2-fold increase in CO₂, the temperature on Earth not only did not rise, but fell, including in Ukraine. Studies by an intergovernmental group of experts on climate change have assessed the sensitivity of the equilibrium climate to a doubling of CO₂ in the range of 2.0–4.5°C; most likely 3°C. It is believed that the characterization of the greenhouse effect does not take into account the importance of aerosols in the surface layer of the atmosphere, troposphere and stratosphere, which reflect sunlight and can even cause cooling. By the way, an important cause of the greenhouse effect is not only CO₂, but water vapor in the atmosphere; carbon dioxide is in second place. They are followed by methane (CH₄), nitric oxide (N₂O), hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride (SF₆). The concentration of CH₄, more active than CO₂ gas, increased 2.5 times during the industrial period and amounted to 1774 ppm (billion⁻¹), nitrous oxide - by 18%. The latter is indeed a source of some ozone depletion.

Together, anthropogenic sources of methane account for 55-60% of total emissions of chemicals in the atmosphere, or 264-428 million tons per year, natural - 168-260 million tons.

Thus, greenhouse gas emissions are largely caused by the consumption of fossil fuels and humanity must fight this phenomenon in a planned manner. It is aimed at this The Paris Agreement (2015) within the framework of the UN Framework Convention on Climate Change, which was also signed by Ukraine [16].

Conclusions

1. The catastrophic effects of global warming in modern civil society are clearly exaggerated. This does not take into account the centuries-old pattern of regular cyclic alternation of warm and cold periods in the history of the Earth, caused by changes in solar activity under the action of the galactic magnetic field, orbital cycles of planets and the gravitational component of the universe.
2. It is also an exaggeration to claim the predominance and exclusivity of anthropogenic impact on climate change on Earth and underestimation of atmospheric pollution by volcanic emissions, ingredients of natural metabolic processes of biological and chemical origin in the ocean and on land, endogenous processes in the Earth's interior and others.
3. Controversial is the position on the exclusive role of CO₂ concentration in the atmosphere in creating the greenhouse effect, while it is the result of joint action not only CO₂ but also water vapor, methane, nitrous oxide, sulfur hexachlorides, aerosols, which together occupy 1% vol. and CO₂ only 0.035%.
4. Climate change on Earth occurs with a certain frequency and sequence and they are associated primarily with the cyclical activity of the Sun as the only source of energy on Earth. The weather on Earth is essentially shaped by the sun, oceans, land and atmosphere.
5. In addition to space factors, climate-forming factors on Earth are geographical - size, mass of the Earth, orbital angle, speed, eccentricity, ground nutation, as well as latitude, atmospheric composition, altitude, ocean currents, soil, vegetation, snow covers, etc., the circulation of atmosphere and moisture and, of course, the human factor. Their interaction determines the weather on the planet.
6. The current "global warming" is residual from the last surge in solar activity and is due to a decrease in negative winter temperatures for the last 40-50 years, which in the near historical period will be replaced by another cooling with a minimum in 2065. In the future, the transition to another global warming is forecast, the 496-year cycle of which will reach a maximum in 2065.
7. The problem of increasing the level of CO₂ concentration in the atmosphere and its role in creating a "greenhouse effect" should be studied in more depth, because the fact of lower average annual temperatures in the 40s of the twentieth century, with a simultaneous increase in the concentration of CO₂ in the atmosphere finds no scientific explanation.

References

- Panasiuk B. Ya. (2015). Hlobalni zminy klimatu ta ekonomika. *Ekonomika APK* [Economika APK], 11, 14–23. [in Ukrainian]
- Naselenie Zemli. URL: <http://countrymeters.info/ru/World> (data obrashcheniya: 25 aprelya 2018). [in Russian]
- World Food Situation. URL: <http://www.fao.org/worldfoodsituation/csdb/en/> (data zvernennia: 25 kvitnia 2018).
- OON: U sviti rizko zroslo kil'kist liudei, yaki poterpaiut vid holodu. URL: <http://www.dw.com/uk/oon/a-40530058> (data zvernennia: 12 kvitnia 2018). [in Ukrainian]
- FAO 2012. Sostoyanie mirovykh zemel'nykh i vodnykh resursov dlya proizvodstva prodovol'stviya i vedeniya sel'skogo khozyaystva. Upravlenie sistemami, nakhodyashchimisya pod ugrozoy. Prodovol'stvennaya i sel'skokhozyaystvennaya organizatsiya Ob"edinennykh Natsiy (Rim) i Izdatel'stvo «Ves' Mir» (Moskva). URL: <http://www.fao.org/docrep/018/i1688r/i1688r.pdf> (data obrashcheniya: 24 aprelya 2018). [in Russian]
- World Data Atlas. World and regional statistics, national data, maps, rankings. URL: <https://knoema.com/atlas> (data zvernennia: 03 kvitnia 2018).
- Soniachna enerhetyka. URL: https://uk.wikipedia.org/wiki/Soniachna_enerhetyka (data zvernennia: 09 kvitnia 2019). [in Ukrainian]
- Pestushko V. Yu., Uvarova H. Sh. (2014). *Heohrafiya* : pidruch. dlia 6-ho kl. Kyiv : Heneza. [in Ukrainian]
- Teplovyi balans Zemli. URL: https://uk.wikipedia.org/wiki/Teplovyi_balans_Zemli (data zvernennia: 08 kvitnia 2019). [in Ukrainian]
- Klasyfikatsiia klimativ Keppena. URL: https://uk.wikipedia.org/wiki/Klasyfikatsiia_klimativ_Keppena (data zvernennia: 17 kvitnia 2018). [in Ukrainian]
- Klimatychnyi poias. URL: https://uk.wikipedia.org/wiki/Klimatychnyi_poias (data zvernennia: 17 kvitnia 2018). [in Ukrainian]
- Kohan F. Kosmichnyi monitorynh klimatu i prohnozuvannia vtrat zerna: hlobalnyi i rehionalnyi pidkhid : doklad na Ukrainському zernovomu konhresi – 2010 (m. Kyiv, 6–8 zhovtnia 2010 r.). [in Ukrainian]
- Tarasov B. G., Olovyannyi A. G. (2009). Prognoz tendentsiy geosfernoy aktivnosti metodom superpozitsii orbital'nykh tsiklov Solntsa v usloviyakh snizheniya solnechnoy postoyannoy. *Vestnik Kuzbasskogo gosudarstvennogo tekhnicheskogo universiteta*, 6, 3–9. [in Russian]
- Chizhevskiy A. L. (1973). *Zemnoe ekho solnechnykh bur'*. Moskva : «Mysl'». [in Russian]
- Vitinskiy Yu. I., Kopetskiy M., Kuklin G. V. (1986). *Statistika pyatnoobrazovatel'noy deyatel'nosti Solntsa*. Moskva : Nauka. [in Russian]
- Paryzka uhoda (2015). URL: [https://uk.wikipedia.org/wiki/Paryzka_uhoda_\(2015\)](https://uk.wikipedia.org/wiki/Paryzka_uhoda_(2015)) (data zvernennia: 27 kvitnia 2019). [in Ukrainian]

Citation:

Bondar, V.S., Fursa, A.V., Gumentyk, M.Ya., Svystunova, I.V. (2020). Climate Change: Apocalyptic Prognosis and Reality. *Ukrainian Journal of Ecology*, 10 (2), 273-278.



This work is licensed under a Creative Commons Attribution 4.0. License
