

Global climate change, its consequences and ways to solve the problem

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Abstract. Today, the issues of global warming and significant climate change are extremely relevant. They are discussed not only by scientists and politicians, but also by ordinary citizens. It must be understood that this problem really deserves extensive attention. Numerous studies have long confirmed that warming does have an impact on the environment, even at the regional level. If we leave some thoughts about extrapolation in the future, then the usually cited facts on local effects are easily verified by local residents, to a greater extent when it comes to melting permafrost or warm winters. In addition, biospheric effects relating to individual organisms are observed by all of us at the household level and therefore do not raise questions. In the modern world, the climate is changing under the influence of natural and anthropogenic factors. It seems to us that every person should want to preserve the natural conditions in which we live. Within the framework of this article, it is proposed to consider in more detail how this can be done.

1 Introduction

Global climate change today is one of the most acute problems of the world economy and politics. 97% of scientists agree that the problem exists, and that it has worsened in the last 20 years during the industrial revolution, which led to massive emissions of harmful substances into the atmosphere, water and soil.

In my work, I want to show how the impact of global warming on the world is manifested, what methods exist to combat this problem. In the beginning, I would like to form an idea about the main causes of global warming. The factors of influence of global warming on the world will also be listed [1].

2 Causes of climate change

Today, scientists consider Earth's climate change as a global problem of mankind. The climate on Earth is changing and it is impossible to refute.

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The natural causes of climate change on Earth include the influence of the Sun. Solar radiation unevenly heats the surface of our planet (more strongly in the equatorial region), so winds and sea currents are formed. If solar activity is increased, then geomagnetic storms and warming occur.

The following natural causes of climatic transformations include shifts of the planetary planet, volcanic eruptions, movements of continental and oceanic plates, changes in the geomagnetic field. One interesting fact has been noticed about volcanism: one powerful volcanic eruption is followed by a sharp cooling in this area for several years. Although volcanic eruptions are rare, on a scale of a few years they can play a major role in climate cooling and the extinction or preservation of entire species [2].

It is no secret that for quite a long time, the continents move with the help of tectonic plates. Thus, new seas and oceans are created, mountains collapse or grow: a surface is created, where the climate is subsequently formed. For example, the Ice Age, which occurred about 3 million years ago and went down in history, extended the movement of the North and South African plates. As a result of their collision, the Isthmus of Panama was formed. Perhaps he prevented the mixing of the waters of the two oceans (Atlantic and Pacific), because of which, presumably, the glaciation period lasted longer. These factors have always contributed to cyclical fluctuations.

Anthropogenic factors, those associated with human activities, have been added to the natural causes of climate change. These include, for example, the greenhouse effect. Since the beginning of the 21st century, its impact on the planet has exceeded the influence of solar radiation by 8 times in intensity [3].

Here are other additional problems affecting the climate and the environment that man thoughtlessly creates:

1. Fuel combustion. The amount of CO₂ (carbon dioxide) has increased by 10-15% over the past hundred years, and 400 billion tons of carbon dioxide have been released due to fuel combustion alone. The higher the CO₂ content, the less heat the Earth dissipates. Ice cores extracted from wells at the Vostok and Mirny stations (Figure 1) in Antarctica showed that the carbon dioxide content in the atmosphere is growing, which causes warming and an increase in the temperature contrast of the weather.



Fig. 1. Antarctica.

2. Aerosols. They can be isolated from natural and anthropogenic sources. Aerosols can lead to droughts in some regions, and to a significant deterioration in weather conditions in the form of snowfall, rain and temperature decrease in others. They also influence the formation and growth of clouds.
3. Cement industry. Cement production is an intense source of CO₂ emissions, and therefore responsible for approximately 2.5% of CO₂ emissions from industrial processes (energy and industrial sectors).
4. Land use. Irrigation, deforestation and agriculture are fundamentally changing the environment. Changes in land use can influence climate by changing the properties of the earth's surface, which is not only a direct source of heat in the troposphere, but also one of the main sources of atmospheric water vapor. It is not surprising that a change in the characteristics of the earth's surface can change the thermodynamic and dynamic characteristics of the atmosphere and thus lead to various adverse climatic processes. Land use can influence the characteristics of the regional climate system, such as temperature, precipitation, evapotranspiration.
5. Cattle breeding. Although the relationship between livestock production and climate change is not visible at first, it does exist. According to 2015 data, 85% of the forest in the Amazon is cut down for pasture and farmland to grow soybeans, which are often used as animal feed. Growing meat for human consumption requires the use of large resources. It is expected that by 2050 the world population will increase to 9 billion people. This means that in order to feed the population with meat, meat production must increase, and with it the amount of greenhouse gases (about 46-50%) that adversely affect the environment [4].

3 Consequences of global warming

When talking about global climate change, everyone suspects a frightening reality - global warming. No matter how many people fear this word, the facts prove it. If states do not start to seriously deal with the problem of environmental protection, by 2100 the temperature on the planet may rise by 3.7-4.8 °C. Climatologists warn: irreversible consequences for the environment will come already with a warming of more than 2 °C.

The melting of age-old ice indicates global warming. Greenland annually loses 250-300 million tons of ice (Figure 2). A bare darker surface of water or land will heat up even faster.



Fig. 2. Areas covered by Arctic ice during the winters of 1979 (left) and 2003 (right). Space images were taken at the same time of the year.

Due to the melting of ice sheets, as well as due to the expansion of sea water, the level of the World Ocean will continue to rise (it is already rising by about 3 mm annually, and by the end of the 21st century it may rise by 0.3–0.6 m or more).

In 2021, extreme weather conditions have been noticed. Such countries as Canada, South America, Iran, Afghanistan, Pakistan, Turkey suffered from severe drought. A drought has been going on in East Africa for about 40 years [5]. Record temperatures have been recorded in some parts of the world. These places include: California's Death Valley (54.4 degrees), British Columbia (46.6 degrees) and Sicily (48.8 degrees).

Residents of Western Europe are faced with severe floods. Numerous human casualties and financial losses were suffered by Germany, the Henan province in China, and the southeastern United States.

Natural ecosystems suffer no less. They are vulnerable. By the end of this century, 20 to 90% of coastal wetlands and about 70 to 90% of coral reefs could disappear [6].

Based on the first nine months of 2021, the last seven years are on track to be the warmest on record, according to the preliminary WMO State of the Global Climate Report 2021, based on data from the first nine months of 2021 (Figure 3).

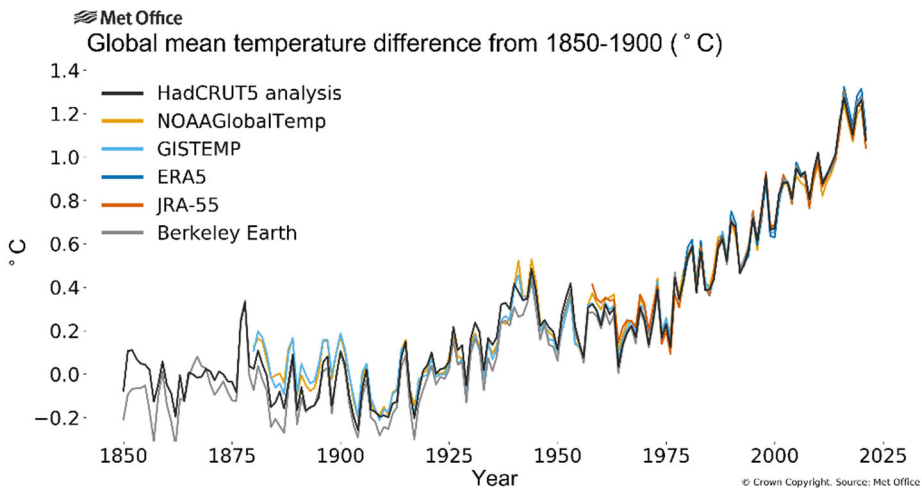


Fig. 3. Global annual mean temperature difference relative to pre-industrial conditions (1850–1900) for six global temperature datasets.

If it is not possible to stop the increase in the temperature of the planet, then:

1. Natural disasters will begin. Climate zones will shift, and the weather will change dramatically. There will be frequent extreme floods, droughts, rainfall and fires.
2. Some countries may become uninhabitable. By 2100, due to high humidity and high average temperatures, it will be impossible to live in some areas of the Earth. The following countries are at particular risk: Saudi Arabia, Qatar, the United Arab Emirates, etc.
3. Different types of plants and animals will begin to die en masse. According to scientists' forecasts, up to 30-40% of ecosystems and living beings are threatened with extinction, because their habitat will change much faster than they will adapt to it.
4. There will be hunger. The warming will negatively affect crop yields. This will be especially noticeable in underdeveloped countries (Latin America, Asia, Africa). By 2080, the number of hungry people could increase by 600 million people.

5. The level of the World Ocean will rise. As UN analysts warn, millions of people on the coast could die from private floods. The following countries fall into the risk zone: Bangladesh, Maldives, the Netherlands, etc. Some territories in Russia, Italy, the USA, and Germany may be sunk.
6. People will get sick more often. Increasing rainfall, water borne diseases will probably spread like malaria. If the Earth becomes warmer, then people may develop skin cancer, allergies, as well as problems with breathing, heart, etc.
7. The seasons will become longer or shorter. It is likely that spring will come 10 months earlier than in the past.
8. There will be a violation of the food chain. Birds will fly south earlier, animals will hibernate longer.
9. The population of the planet will decrease (75%). Half of the world's population will die from natural disasters, and 25% from diseases.
10. Air quality will deteriorate. The consequences are dirty air and smog (Figure 4).



Fig. 4. Sandstorm in the Gaza Strip.

4 Ways to solve the problem

The main cause of modern warming is considered to be the release of greenhouse gases and carbon dioxide into the atmosphere, so the main efforts should be aimed at limiting this mission.

It is also important to reduce the share of fossil energy sources - coal and oil in the global energy balance. The construction of new nuclear power plants, hydroelectric power plants, wind and solar power plants will help reduce emissions into the atmosphere. According to researchers, within 10 years, carbon dioxide emissions should be halved (by 45%).

It is undeniably difficult to refuse air travel. It is worth reading the sad statistics to change your mind about this: only 1 standard transatlantic round-trip flight emits about 1.6 tons of carbon dioxide.

Every inhabitant of the planet can contribute to the prevention of global warming. For example, citizens of any country can use as much natural sunlight as possible, limit or reduce the growth in overall energy consumption, or switch to a green energy supplier. They are also able to plant many trees on their site and monitor the growth of old ones. In order to

personally influence the state of the ecosystem, it is recommended to travel frequently on foot or by bicycle.

And here is another interesting way that will help prevent overheating of the planet - increasing the reflectivity of the Earth. In some countries, the practice of painting the roofs of new houses white is already practiced (Figure 5). This allows a few degrees to reduce the temperature in cities.



Fig. 5. Painting the roof of the house white.

The situation with shopping is no less interesting. The products that the entire population of the Earth buys leave their carbon footprint due to the way they are produced or transported. For example, clothing accounts for 3% of global carbon dioxide emissions. Similar circumstances apply to food products. As a rule, they are sent across the ocean and have more "food miles". Therefore, the best option is to consume locally produced seasonal products.

Having fewer children is also a good idea to contribute to climate change. On average, one person consumes 5 tons of carbon dioxide per year, but each country has different circumstances. Even in one state, there is much more trace from rich people than from people with less income to services and goods.

I would like to note such a concept as a "green" economy. For the first time, its concept was voiced at the London Center for Environmental Economics in 1989. Unfortunately, it has not received universal recognition. Today, when governments are looking for effective ways to get their country out of related (energy, food and financial) crises, the concept of transition to a green economy has been proposed as a means of accelerating the development of frustrated national policies, international cooperation in support of sustainable development. It involves the sustainable development of agriculture, "green" industrial production. Such an economy has a beneficial effect not only on the environment, but also on social and environmental transformation.

5 Conclusion

Climate change and related ecological processes are monitored by the Institutes of Ecological and Climate Research, Biological and Geological Sciences. Their tasks include studying the mechanisms of plant adaptation to climate change and its impact on the soil cover. An example of an organization that specializes in obtaining objective scientific data is the IPCC.

At the end of 2022, the International Economic Forum in Davos on May 22-26 will discuss the mobilization of the efforts of the public and private sectors to achieve the global climate goals for 2030-2050. And at the UN climate summit COP27 in Egypt, it is planned to discuss the report on the state of the global climate (from WMO) for 2021 and the Sixth Assessment Report of the IPCC.

I believe that, taking into account the problems associated with the process of global warming, humanity will be responsible for what surrounds it. I know that nature is not to be trifled with. We all live under the same sky, and in order for our children and future generations to be able to continue to live, it is simply necessary to protect the ecosystem today. Small steps on the path of change to a better life will be a big leap for humanity.

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References

1. Green economy: health United Nations Environmental Program: Green Economy (2021)
2. A. V. Kucherov, O. V. Shibileva, *Young scientist* **4(63)**, 561-563 (2014)
3. N. I. Barkov, R. N. Vostretsov, V. Ya. Lipenkov, A. N. Salamatin, *Arktika i Antarktika* **1(35)**, 82-89 (2002)
4. I. V. Dvoretzkaya, G. M. Kruchenitsky, K. A. Statnikov, *Meteorology and Hydrology* **6**, 19-24 (2020)
5. V. N. Kostyuk, G. L. Smolyan, D. S. Cheshkin, *Information society and the state* **5**, 6-13 (2000)
6. Y. A. Ivanova, A. D. Zakharova, *Bulletin of the Moscow University of the Ministry of Internal Affairs of Russia* **5**, 136-138 (2020)
7. G. G. Nektegyaev, A. I. Borisov, *Moscow economic journal* **11**, 67 (2019)