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CONSEQUENCES OF GLOBAL WARMING ON EARTH

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Annotatsiya: Ushbu ilmiy maqolada global iqlim o‘zgarishlari va ularning Yer yuzidagi tabiiy, ekologik hamda ijtimoiy-iqtisodiy tizimlarga ko‘rsatgan ta’siri keng qamrovda tahlil etiladi. Iqlim o‘zgarishi hozirgi davrda insoniyat duch kelayotgan eng dolzarb global muammolardan biri hisoblanadi. Atmosfera haroratining izchil ko‘tarilishi, qutb va tog‘ muzliklarining tez sur’atlarda erishi, dengiz sathining ko‘tarilishi, cho‘llanish, suv resurslarining kamayishi va ekstremal ob-havo hodisalarining ko‘payishi — bularning barchasi iqlim inqirozining yaqqol namoyon bo‘layotgan jihatlaridir.

Maqolada xalqaro tashkilotlar (Jahon Meteorologiya Tashkiloti, BMT Iqlim O‘zgarishi bo‘yicha Ekspertlar Guruhi – IPCC) ma’lumotlari, zamonaviy statistik tahlillar va prognoz modellaridan keng foydalanilgan. Shuningdek, iqlim o‘zgarishlariga qarshi kurashish va unga moslashish bo‘yicha ilg‘or xalqaro tajribalar, innovatsion texnologiyalar, yashil energetika, barqaror rivojlanish strategiyalari va milliy darajadagi chora-tadbirlar ham muhokama qilingan.

Mazkur ilmiy maqola iqlim o‘zgarishlarining murakkab oqibatlarini chuqur anglash, ularning oldini olish bo‘yicha samarali yechimlar ishlab chiqish hamda atrof-muhit barqarorligini ta’minlash yo‘lida ilmiy asoslangan yondashuvlarni ilgari surishga xizmat qiladi.

Kalit so‘zlar: parnik effekti, Orol dengizi, ozon qavati, dunyo okeani, GFDL-AQSH suyuqliklar geofizik dinamikasi.

Currently, the most pressing natural problem is global warming. The natural mechanisms that support and accelerate this process have already been set in motion. Unfortunately, civilization has been slow to respond actively to this challenge. Observational data from regional climate studies indicate that rising temperatures are having a significant impact on biological and physical systems across many parts of the world.

In polar and mountainous regions, the retreat of permanent glaciers and the acceleration of their melting have been observed. Since the late 1960s, snow cover has decreased by approximately 10%, and the duration of ice cover on lakes and rivers has shortened by around two weeks. Since the 1950s, in the Northern Hemisphere, the extent of sea ice during spring and summer has decreased by 15%, leading to a 40% reduction in the thickness of Antarctic sea ice during these

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seasons.

Over the past century, global sea levels have risen by approximately 20 cm. Scientists attribute this mainly to the melting of polar glaciers and the thermal expansion of seawater caused by global warming. According to available data, during the 20th century, precipitation in mid- and high-latitude regions of the Northern Hemisphere increased by 0.5–10% per decade, while subtropical regions experienced a 0.3% decrease per decade. In some areas, the number of intense and extreme precipitation events has increased.

Global warming has accelerated desertification processes in arid regions. More than 110 countries in Asia, Africa, and South America are at risk of desertification. Annually, desertification causes economic losses exceeding USD 50 billion. Climate change has also contributed to the expansion of highly saline soils and increased evaporation. For example, in the Aral Sea region, soil evaporation has increased by 20% compared to the 1950s.

It is important to note that climate change manifests not only in the rise of average air temperatures but also, primarily, in the increased frequency and intensity of extreme weather events: heatwaves, droughts, floods, sudden temperature spikes and severe frost, landslides, strong winds, and other phenomena.

Hot air increasingly covers the planet year by year, with frequent repetitions, and the number of extreme weather events continues to grow steadily. The climate is becoming more continental and arid. Collected data indicate that agricultural crop yields in various regions of the Earth are already subject to extreme variability.

Global warming is expected to further increase the intensity and frequency of extreme weather events. In Central Asia, systematic studies of climate change began in the 1980s. In Tashkent, the air temperature has risen by 1.2°C over the past 100 years (Figure 1).

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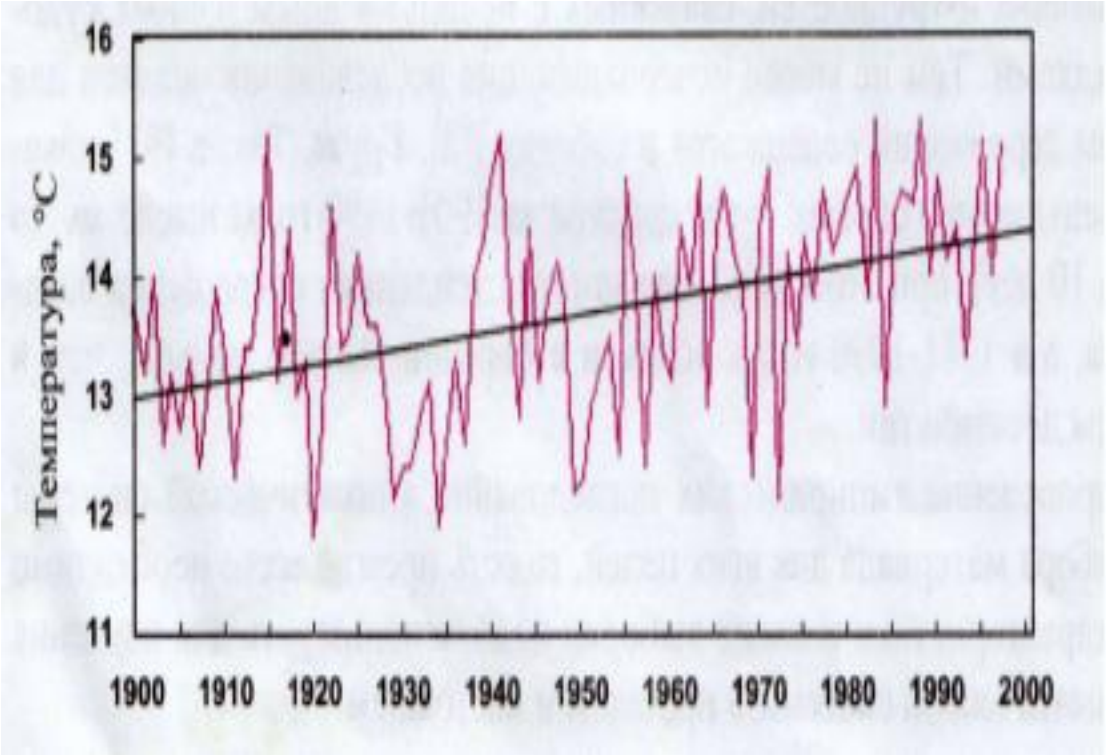

Figure 1. Changes in Annual Average Air Temperature in Tashkent

Ongoing global climate change is having a significant impact on the climate conditions and water resources of the Central Asian region. Global climate change is expected to further increase the occurrence of extreme weather conditions, including prolonged droughts and periods of high temperatures. During droughts, precipitation decreases, and summer air temperatures become extremely high.

Rising air temperatures lead to increased evaporation and reduced river water levels. In the plains of Central Asia, higher temperatures accelerate evaporation, which in turn speeds up soil drying. Analysis of the intensification of desertification in Central Asia indicates that these changes are affecting all components of ecosystems.

Meteorological observations of climate dynamics in Uzbekistan confirm that the region is experiencing a consistent warming trend.

Figure 2.

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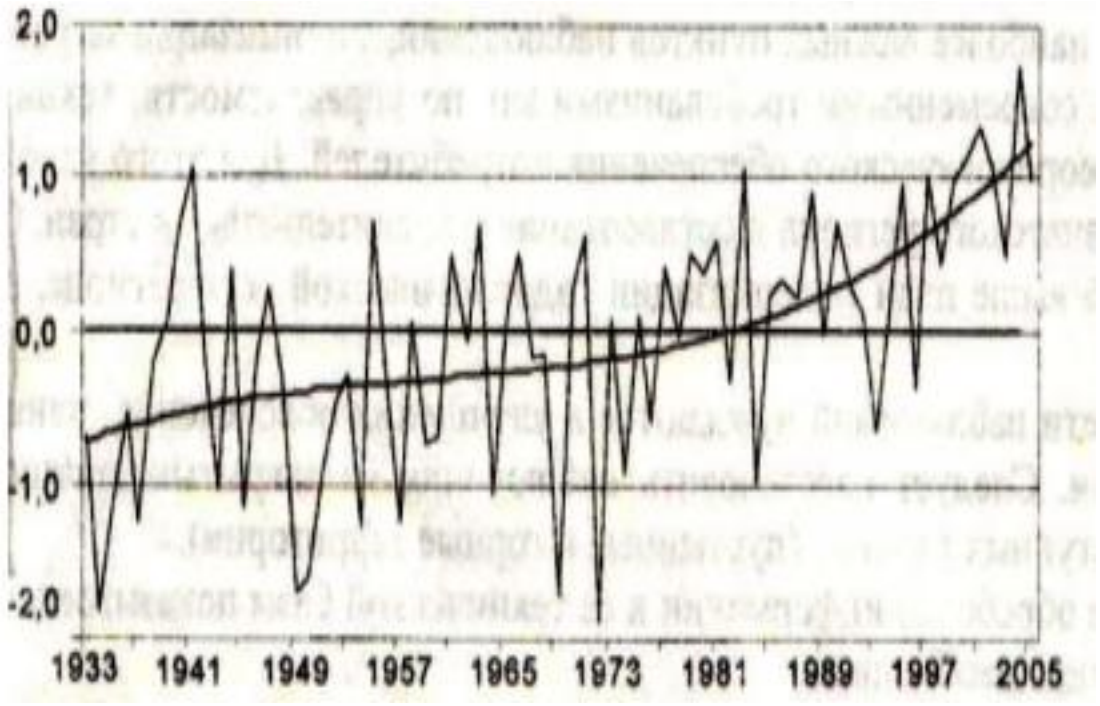

Figure 2. Changes in Air Temperature in the Territory of Uzbekistan
(V.Ye. Chub, 2000) 325

After all evidence proving the reality of global climate warming was published, in 1988, the World Meteorological Organization and the United Nations Environment Programme established the Intergovernmental Panel on Climate Change (IPCC), bringing together prominent geographers and climatologists worldwide. This organization evaluates all scientific research and traditional practical data on global climate change. By its nature, the IPCC is a collaborative effort uniting scientists worldwide, performing the following functions:

- Assessing current knowledge about climate systems and their changes;
- Studying the ecological, economic, and social impacts of climate change;
- Investigating and evaluating vulnerability to climate change and possibilities for adaptation;
- Developing measures to reduce greenhouse gas emissions.

There are many questions regarding climate and its changes, and providing simple answers is difficult. This is because climate is a vast and complex system. Heat, air, and humidity contribute to global circulation, and climate systems can only be understood effectively on a planetary scale, which allows for better comprehension of interactions within these systems.

To date, there is no fully reliable method for predicting climate change; all proposed assessments represent scenarios reflecting the reaction of climate systems to increasing greenhouse gas concentrations. Currently, the assessment of climate change due to anthropogenic influence is

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mostly conducted using analogy principles and empirical-statistical methods. In modeling the physical processes that determine global climate, three-dimensional general circulation models of the atmosphere provide the most reliable support. In recent years, the development of coupled atmosphere-ocean climate models has allowed their extensive use for future climate assessment purposes. Thus, despite existing uncertainties, climate models can be successfully applied to describe both global climate and the climate of specific regions in the future.

The Intergovernmental Panel on Climate Change (IPCC) prepared three assessment reports for the public between 1990 and 2001. The first report, published in 1990, presented scientific evidence confirming climate change. This report had a strong impact on both policymakers and the public, laying the foundation for negotiations on an international climate convention. At the 1992 United Nations Conference in Rio de Janeiro, alongside other documents, the Framework Convention on Climate Change was signed. This convention entered into force in 1993, establishing the general principles and obligations of the participating countries.

The second report was released in 1996 and provided a scientific basis for subsequent actions. In 1997, representatives from over 160 countries gathered in Kyoto, Japan, to determine quantitative commitments for various countries and adopted the Kyoto Protocol. According to this protocol, industrialized countries assumed legal obligations to reduce greenhouse gas emissions.

The report presented evidence of significant climate changes occurring across the Earth and provided projections for the future. The conclusions of the panel are based on data collected from various observations. According to the latest information, warming in the Northern Hemisphere during the 20th century was the strongest in the past 1,000 years. The period from 1990 to 2000 was the warmest decade, with 1998 being the hottest year of the millennium. In particular, climate warming in North America, Northern and Central Asia was quite pronounced, approximately 40% higher than the global average. The duration of frost-free days increased. If carbon dioxide concentrations are not reduced, by 2050 its level will double, causing the global temperature to rise by 0.3°C per decade.

In September 1987, the Montreal Protocol on substances that deplete the ozone layer was adopted. The protocol established a comprehensive schedule for gradually reducing the production and use of ozone-depleting substances, as well as measures to regulate their production, export, and import. Currently, global warming caused by the “greenhouse effect” is recognized as a real phenomenon and a matter of global concern. The increasing concentration of carbon dioxide in the atmosphere and the resulting “greenhouse effect” threatens to raise global air temperatures by 3.5–4°C. This leads to the melting of polar ice, rising sea levels, and changes in the continuous movement of air masses and ocean currents.

According to forecasts by French scientists, the United States will be the most severely affected zone. Severe droughts will cover more than half of the country, particularly the states of California, Texas, and Florida. North Africa, as well as the countries of the Near and Middle East, will experience even drier and hotter conditions. By the year 2100, sea levels are projected

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to rise by 1.5 meters, submerging one-third of Bangladesh. The Bahamas in the Caribbean basin and the Maldives archipelago in the Indian Ocean will be flooded. Rapid melting of glaciers in the Himalayas and other mountain ranges in Central Asia will sharply increase the risk of floods in India, Pakistan, and China. This region will also face more frequent typhoons and storms. As noted earlier, ocean levels have already risen by 20 cm. By 2100, sea levels could increase by up to 90 cm compared to present levels. If this scenario occurs, millions of square kilometers of land and millions of people will face significant risks.

According to V.Ye. Chub, due to global warming, by 2030 in Uzbekistan, the boundaries between dry subtropical and temperate climate zones (the southern part of Uzbekistan being subtropical, and the northern part temperate) could shift 150–200 km northward. In mountainous regions, the elevation of climate zones could rise by 150–200 meters. The number of frost-free days is expected to increase by 8–15 days.

To determine expected climate changes in Uzbekistan, the following general circulation models of the atmosphere are used: SSSM-Canada (Canadian Climate Center Model), UKMO (United Kingdom Meteorological Office Model), GFDL (Geophysical Fluid Dynamics Laboratory, USA), and GISS (Goddard Institute for Space Studies, USA). For these models, primary data come from 40 meteorological and hydrological stations in Uzbekistan and its surrounding areas that regularly monitor temperature and precipitation. Most of these stations began instrumental observations in the 1920s.

According to the SSS model, the annual temperature in Uzbekistan is expected to rise by 5.2°C; the UKMO model predicts an increase of +1.0°C; GFDL and GISS models indicate +2.9°C and +1.2°C, respectively (compared to the 1951–1980 baseline). Despite differences between models, all indicate a rising trend in annual average temperature. Precipitation amounts in Uzbekistan and adjacent mountainous areas are expected to increase to varying degrees compared to 1951–1980. Calculations are given for relatively mild, moderate, and very severe greenhouse gas emission scenarios. A moderate scenario assumes a 1% annual increase in CO_2 concentrations. According to V.Ye. Chub, if CO_2 increases by 1% per year in Uzbekistan, by 2030, the average annual temperature could rise by 0.8–3.4°C (compared to 1961–1990). The impact of global warming is particularly strong in the northwestern regions of the country. Its effect decreases slightly toward southern and mountainous areas, with the impact being weaker in high-altitude regions.

Overall, the ongoing climate changes will have significant effects on the agroclimatic resources, water balance, and water resources of the entire Aral Sea basin in the future. In 1992, together with the World Meteorological Organization, UNESCO, and other organizations, the “Global Climate Observing Systems” program was developed. A scientific-technical committee composed of prominent scientists was established, creating a general concept for the priorities and scale of global climate observation systems. The primary task of this organization is to collect and coordinate observational data necessary for predicting seasonal and interannual climate variability and climate change, and to reduce uncertainties in long-term climate

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forecasting.

Conclusion

Climate change is currently one of the most urgent global ecological problems. The increasing concentration of greenhouse gases in the atmosphere is causing a rise in the Earth's average temperature, leading to significant changes in natural systems. The melting of glaciers, rising sea levels, increased frequency of droughts and heavy rainfall, forest fires, and the loss of biodiversity are all direct or indirect consequences of climate change.

These changes negatively affect human health, agricultural productivity, water resources, and the economy. Therefore, it is essential to develop international cooperation, environmental policies, and sustainable development strategies to prevent and adapt to climate change. Only through scientific approaches, innovative technologies, and collective action can this global challenge be effectively addressed.

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