

Dynamics Of Changes In Rainfall And Soil Moisture Amounts Under Global Climate Change And Its Impact On Biodiversity (In The Example Of Chartok District)

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Abstract

This article analyzes the climate changes observed in Uzbekistan in recent years, their main causes and regional impact. The study examined processes such as temperature increase, uneven distribution of precipitation, increased drought, and the impact of factories on climate change and the increase in waste in our republic. The article highlights the impact of climate change on precipitation and soil moisture, as well as on ecological stability, and discusses its negative impact on biodiversity.

Keywords: Arid, Central Asia, precipitation, Average, Natural, Chartak district, humidity, ozone layer, Freon gases, Cinniguloshlar, industry, anthropogenic, Köppen Geiger

Introduction. In recent years, global climate change has become one of the most significant environmental problems observed in all regions of the Earth. Central Asia, and in particular Uzbekistan, as an arid and semi-arid region, is one of the most sensitive regions to climate change. For example, we can see the northeastern part of the Fergana Valley in the Chartak district of Namangan region.

Uzbekistan has a continental climate due to its location in the interior of the Eurasian continent, far from the oceans and seas. The distinctive features of the continental climate are: the sky is extremely clear and sunny; the temperature is extremely high, the annual precipitation is small, but on the contrary, the potential evaporation is large: summer is long and hot, and winter is somewhat cold for this geographical latitude; the difference in annual and daily temperatures is large. [1.] Uzbekistan is a region located in the center of Central Asia.

We do not have access to the sea and ocean, which creates problems for industrially developed transport. In my opinion, it is good that we are not among the coastal countries, because there are many natural disasters such as floods, tsunamis, tornadoes. However, we are located in a region that is very sensitive to climate change, and this sensitivity not only has a very negative impact on biodiversity, but also causes the extinction of endemic species. In the following figure, we can see the climate change in Central Asia:

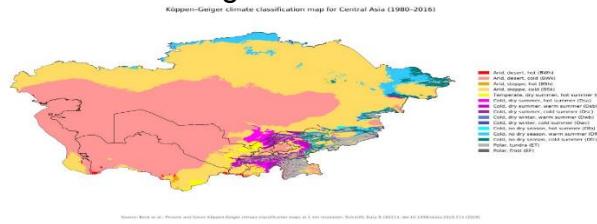


Figure 1. Climate change in Central Asia between 1980 and 2016 (according to the Köppen Geiger system)

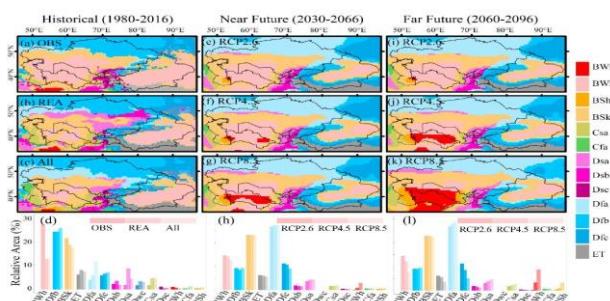


Figure 2. Spatial distribution of climate zones in Central Asia based on the Köppen-Geiger climate classification. (a – c): for the historical period derived from the observational dataset (OBS), the reanalysis dataset (REA), and the ensemble dataset (All). (e – g): estimated climate zones for the near future (2030–2066) under the GCM ensemble RCP2.6, RCP4.5, and RCP8.5 scenarios, respectively. (i – k): estimated climate zones for the far future (2060–2096) under the GCM ensemble RCP2.6, RCP4.5, and RCP8.5 scenarios, respectively. (d, h , i) relative area of each climate type in the total area over the historical period, near, and far future, respectively. Different transparency represents different data sources or representative concentration paths. The color scheme is adopted from Peel et al.

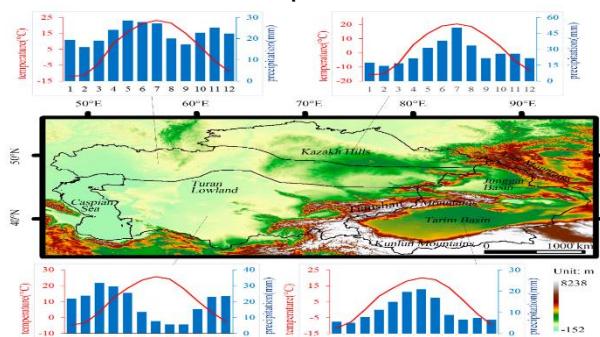


Figure 3. The study area, annual cycle of temperature and precipitation in four subregions of Central Asia. The subregions are indicated by the cluster method [24]. Temperature and precipitation are taken from the Climate Research Unit (CRU) dataset for the period 1980–2016.

Map of the territory of Chartok district, Namangan region, in the northeastern part of the Fergana Valley:

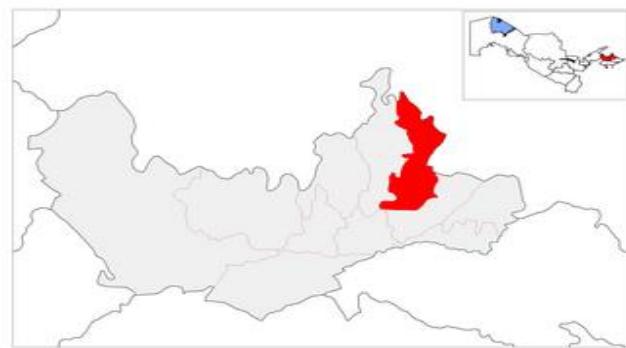


Figure 4. Research area (Chartoq district)

Briefly about the nature of this area: Chartok district is located on the southern slopes of the Chatkal ridge. The surface consists of plains and hills. The altitude from south to north is from 300 m to 1500 m. There are oil and minerals, and gravel, limestone, and clay soils as building materials of local importance. The climate is continental; summers are hot and dry, winters are cold. The average temperature in January is from 0 C to -4°, in July 25-26°. The lowest temperature is -29° in winter, and the highest temperature in summer is 40°. 300-400 mm of precipitation falls per year (more in winter and spring). The growing season is 175 days. Large and small streams flow from the mountains and hills. Some of them flow only during the rainy season and dry up in summer. The largest streams: Chortoqsoy, Namangansoy (Pochchaotasoy in the upper reaches) and other streams cause severe floods during spring rains and cause great damage to the economy. Flood control structures have been built in some streams. The waters of the river are widely used for irrigation. The Great Namangan (Chortoq) canals pass through the southern part of the district, and the North Fergana canals pass through its southern border. The soils are mainly typical gray soils. Land suitable for agriculture has been developed. Natural vegetation has been preserved mainly in

the hills: ephemeral herbs and shrubs grow. The Botanical Institute of the Academy of Sciences of Uzbekistan

has an experimental plot for the study and enrichment of hill plants. Wild animals include foxes, skunks, turtles, various snakes, lizards; birds include partridges, pheasants, and others; there are various fish in the waters.[2.] The structure of the Chartok Hills is occupied by anticlinal folded Neogene - early Quaternary rocks. The axis extends from the southwest to the northeast for 33 km, its width is 2-3 km, the slope of the northern wing is 2-6 °, the southern one is 2-7 °. [3. 279-282 b] The nature of the Chartok district is a very beautiful area, but today we are witnessing significant changes in the amount of precipitation and climate change, which are among the global environmental problems in the district:

Table 1. Average 10-year precipitation in Namangan region (Chortoq district) (1950-2022), mm

Between 1950 and 1960	316.8
Between 1960 and 1970	334.12
Between 1970 and 1980	266.67
Between 1980 and 1990	313.462
Between 1990 and 2000	354.253
Between 2000 and 2010	322.54
Between 2010 and 2022	260.1

As can be seen in the table, after normal precipitation was observed between 1950 and 1970, we can observe a decrease in precipitation between 1970 and 1980. While normal precipitation was also observed between 1980 and 2010, we can see that it changed significantly in the last 12 years. Finally, everyone feels that the amount of precipitation decreased between 2023-2024-2025.

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Table 2. Soil moisture of the Chortok hills (according to G. Toshmirzayeva)
Natural soil moisture of the Chortok hills at a depth of 1 meter
(According to the vegetation period of 2022-2023-2024, in %)

Months (growing season)	2022	2023	2024
March	--	13.2	11.2
April	12.1	12.1	12.1
May	11.1	10.1	11.1
June	10.1	10.5	9.5
July	10.5	9.2	9.2
August	10.5	9.0	8.0
Average	10.86	10.68	8.5

We can also see in this table that the last 3-year calculation has dropped significantly in 2024, which is a major negative turn in plant life. Above we can observe the amount of moisture in the soil and the average amount of precipitation over the years. I can say that the reason for these changes is the development of industry and the depletion of the ozone layer:



(Figure 5) Industrial indicators of Namangan region

[5. main page]

The development indicators of this industry certainly show that our economic growth makes people's lives easier. But we must also take into account that the production process of each product is different:



Figure 6. Industrial zones

It is reported that in the first half of 2019, 175 complaints were received from citizens regarding environmental pollution by large industrial enterprises. According to the statement of the First Deputy Chairman of the Committee, Ibratjon Karimov, at the end of 2018, 2 million 449 thousand tons of harmful substances were released into the environment. Of this, 1 million 600 thousand tons are vehicles, and 880 thousand tons are industrial enterprises. There are more than 300 thousand economic enterprises in the republic, 5 thousand of which are enterprises of the first and second categories in terms of environmental pollution. [4.8.124-127 b] It is a sad situation that we see these harmful substances in some parts of the region, city, district and rural areas. As an example, here are the cases I saw in my district:



Figure 7. Illegal garbage dumping zones in Chartak district

In particular, I can point out that another cause of climate change is the depletion of the ozone layer, which is also due to the development of industry and human interest in space. Science has long proven that the depletion of the ozone layer is mainly due to Freon gases released during the production of industrial products and that rockets launched into space cause the depletion.

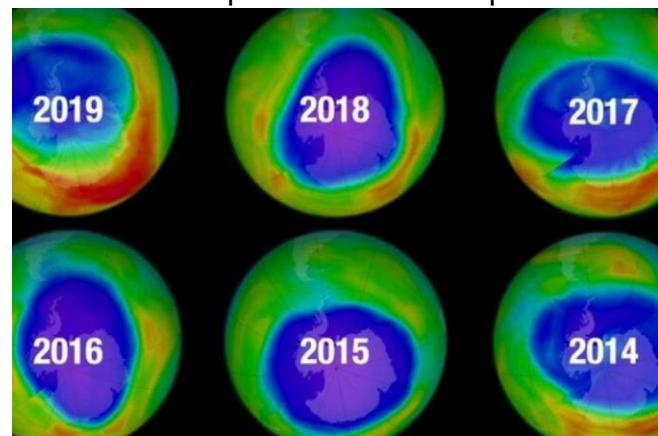


Figure 8. Ozone layer depletion

The climate predictions from the digital world above show that climate change is very serious. In my opinion, such changes once again confirm that we need to increase security and pay serious attention to environmental problems.

Ecosystems and biodiversity advantage - One of the most dangerous impacts of climate change on ecosystems and biodiversity is the disruption and failure of

ecosystems. Ecosystems, as natural systems that include several interdependent organisms, play an important role in combating change. However, as a result of global warming, some ecosystems may lose their functions. For example, the depletion of water resources and the loss of forests are major threats to ecosystems. Many plant and animal species are being displaced from their habitats due to climate change. Several species are facing difficulties in developing and adapting to changing climate conditions. Some plants in forests will disappear as a result of climate change or will fail during the wintering and breeding seasons. Such changes are especially noticeable in polar and tropical regions. One of the most effective ways to preserve and restore biodiversity is to stabilize ecological systems.

This is done by restoring ecosystems, effectively managing their resources, and introducing green technologies. To maintain ecological sustainability, modern approaches to protecting nature and reducing environmental impacts are necessary. A number of measures are being implemented globally to reduce the impact of climate change on biodiversity. These include measures such as reducing carbon dioxide emissions, supporting renewable energy sources, and developing environmental education. At the international level, the UN agreements and strategies to combat climate change are important parts of the global effort to protect the climate. The impact of climate change on biodiversity is an increasingly serious global problem, posing a significant threat to ecological systems and biodiversity. Effective and rapid measures are needed to ensure the stability of ecological systems and preserve biodiversity. [6. 47-50 p.] The impact of climate change on biodiversity is currently one of the most significant,

especially when we look at the impact on plant diversity:

Found in the hills of Chortok district, it is an endemic species included in the "Red Book":



A



B

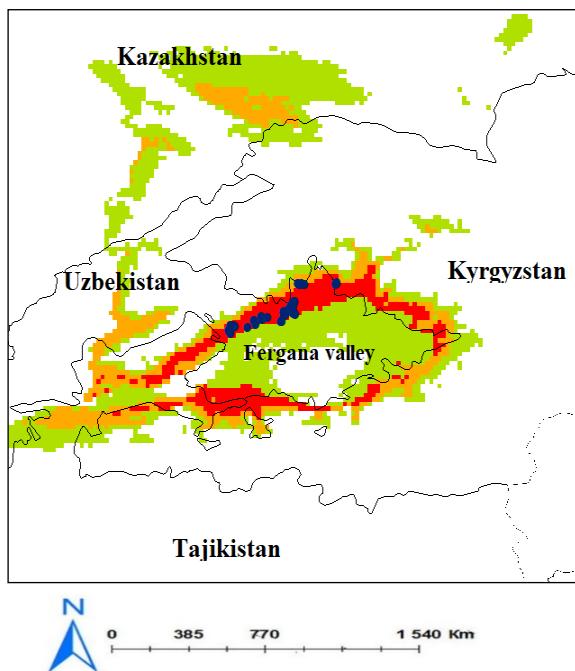


C

Figure 9. *Acantophyllum albidum* a) at the bottom of the hill b) in the middle of the hill c) at the top of the hill

Acantophyllum albidum Schischk. (Cinniguldoshlar) occupies a special place as a valuable saponin-containing plant. Saponins obtained from this plant are widely used in the textile, perfumery, confectionery, pharmaceutical industries, non-ferrous metallurgy and other sectors of the national economy. Despite the fact that during the period of industrial development (1970–2000) the sharp anthropogenic climate change had a limiting effect on the species' range, the ecological niche of the species showed that it could spread throughout the entire foothills and foothills

surrounding the Fergana Valley. In general, the areas of high and medium suitability amounted to 50<40 thousand km².[7.15-22 b]



Acanthophyllum albidum area suitability index

- █ Yuqori potensial yaroqli hududlar
- █ O'rtacha yuqori potensial hududlar
- █ Yaroqlilik potensiali past hududlar
- █ Yaroqsiz hududlar

Figure 10. Modeling results of Acanthophyllum albidum under RCP2.6_2070s climate scenarios.

Conclusion. I would not be wrong if I said that climate change is the biggest global problem on Earth because the climate is changing day by day, humanity is building a big industry but measuring its products with money. Everyone sees that there is money in industry but no one feels how harmful the waste is. O humanity, open your eyes, if this climate change continues like this, the apocalypse in those 4 great divine books is

near. O humanity, think, isn't it time to form an army to save our polluted world. Climate change, especially its impact on biodiversity, is increasing greatly, if changes continue like this, the "Red Book" will become even thicker. We need to reduce the means that cause climate change. We have seen the impact of climate change on biodiversity in the *Acanthophyllum albidum* plant, which is one of the most vulnerable species to climate change and is rapidly disappearing. In my opinion, such changes once again confirm the need to increase security and pay serious attention to environmental problems.

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