

Project

Water Management and Climate Change: Local and Global Challenges



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The Main Aims of the Research

- ▶ **The object** of this study is the Vorskla River and its tributaries.
- ▶ **Subject of the study:** the impact of climate change and military actions on changes in the water regime of the Vorskla River.
- ▶ **Purpose of the project:** to identify changes in the characteristics of the water regime phases of the Vorskla River in Sumy region at the present stage.
- ▶ To study the water quality in Trostyanets community.



Global Climate Change

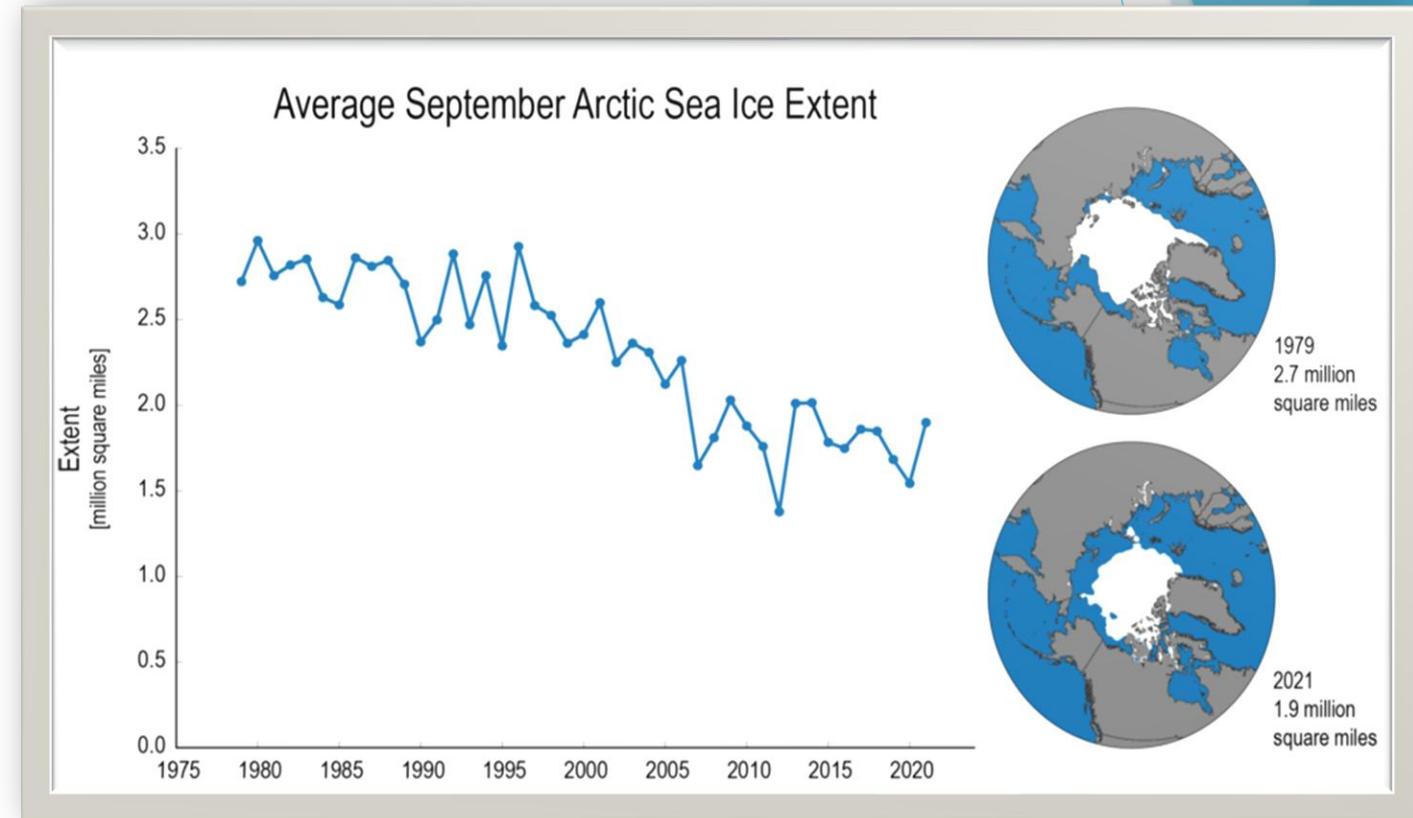
Global climate change is one of the most pressing issues of our time, affecting all areas of life on our planet. Ukraine also feels the consequences of these changes.

The main factors of climate change:

- ▶ global warming
- ▶ greenhouse effect
- ▶ CO₂ emissions

Consequences of climate change

- Global warming
- Devastating fires in Australia
- Tsunami in the Indian Ocean
- Fires in Siberia
- Floods and landslides in Brazil
- Earthquakes around the world
- Melting glaciers in Antarctica



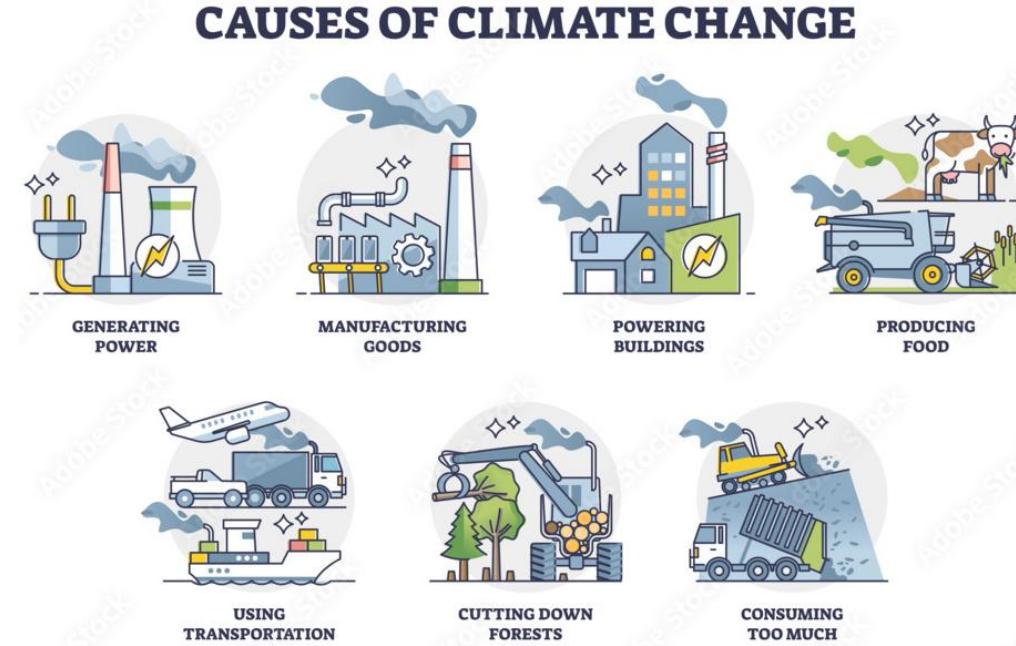
The impacts of climate change in Ukraine

- Changes in precipitation
- Rising temperatures
- Soil degradation due to droughts in the south and east of the country
- Shifts in climate zones. Changes in the geographical range of biological species
- Water shortages for the needs of the population, agriculture, and industry
- Risks to water resources: the Dnieper level, drying up of small rivers. In recent years, the water level in Ukraine's rivers during the summer period has been below normal.
- Increase in the number of natural disasters: forest fires, floods, etc.



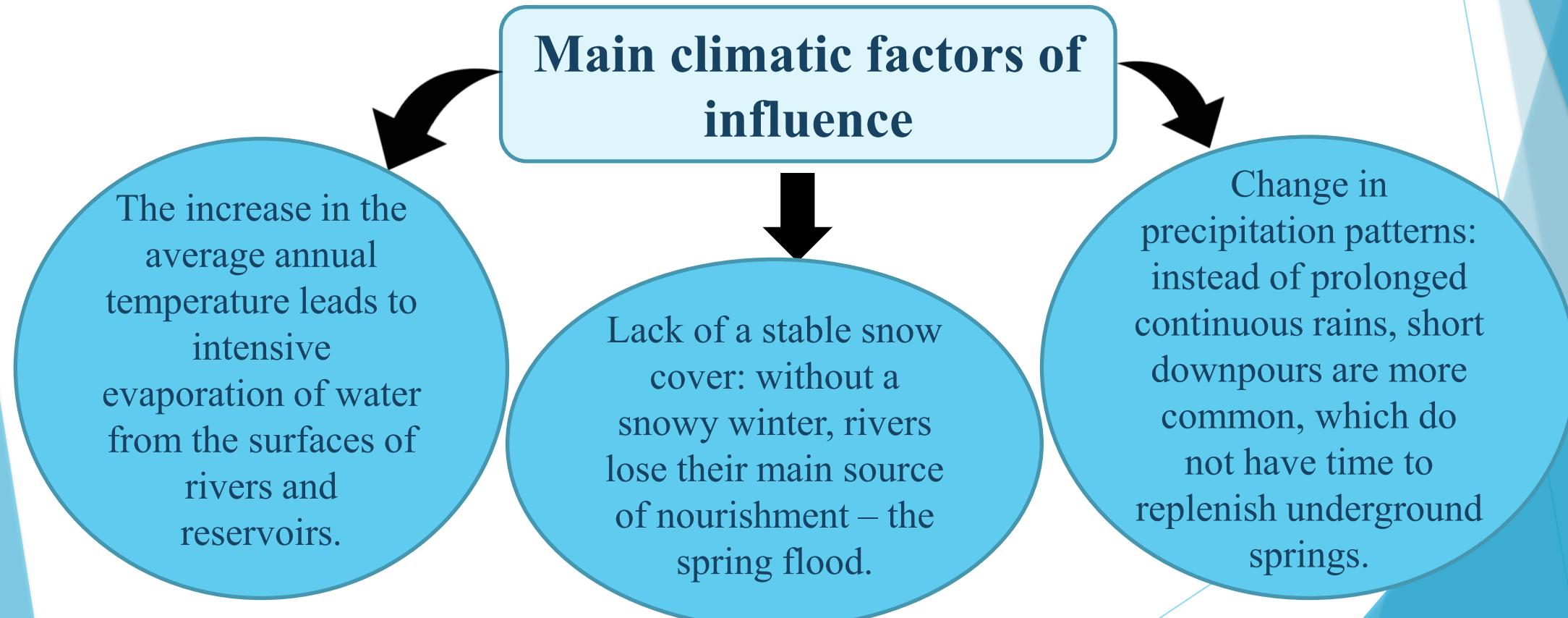
Causes of climate change in Ukraine

- Deforestation
- Depletion of the Earth's resources
- Pollution of surface and groundwater
- Gigantic accumulation of harmful industrial waste
- Air pollution
- Russian military aggression



The impact of climate change on rivers in Ukraine

Ukraine is considered one of the water-scarce countries in Europe. Most of our rivers are snow-fed, but due to warming, the amount of precipitation is changing. This poses a threat to environmental safety, agriculture, and drinking water supply.



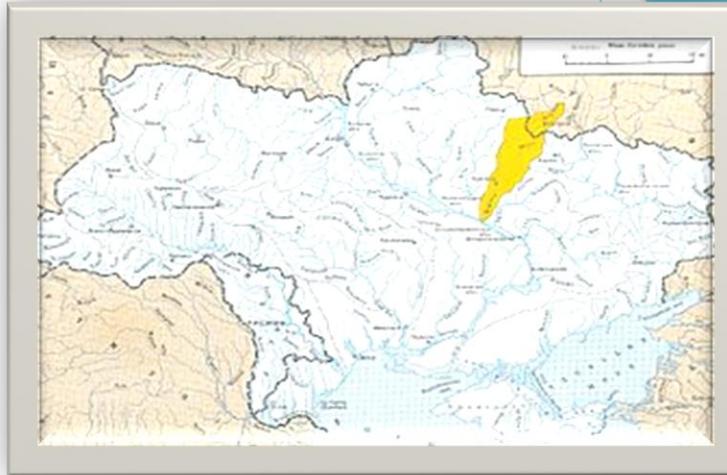
Key Problems of Rivers in Ukraine and Sumy Region

- ▶ Low water levels and shallowing.
Small rivers in the south and center of Ukraine are simply drying up, turning into streams or chains of swamps.
- ▶ Due to rising water temperatures and slowed river flow, blue-green algae are actively multiplying. This leads to:
 - Decreased oxygen levels in the water
 - Mass fish die-offs
 - Deterioration of drinking water quality for cities
 - Changes in the hydrological cycle
 - Loss of biodiversity



Research of the River Vorskla

- ▶ The Vorskla River is a left tributary of the Dnieper and one of the largest, classified as a medium-sized river.
- ▶ The total length of the river is 464 km, of which 122 km are within the Sumy region.
- ▶ In the Sumy region, the river flows through the Okhtyrka district.
- ▶ The Vorskla has tributaries – 180 small rivers, with a total length of 851 km, among which are the rivers of Trostyanecchyna: the Boromlia River and the Trostianka River.
- ▶ It flows through a valley that has a wide floodplain and an upper flood terrace. The riverbed is meandering and winding, and there is also branching of the river into channels and arms.

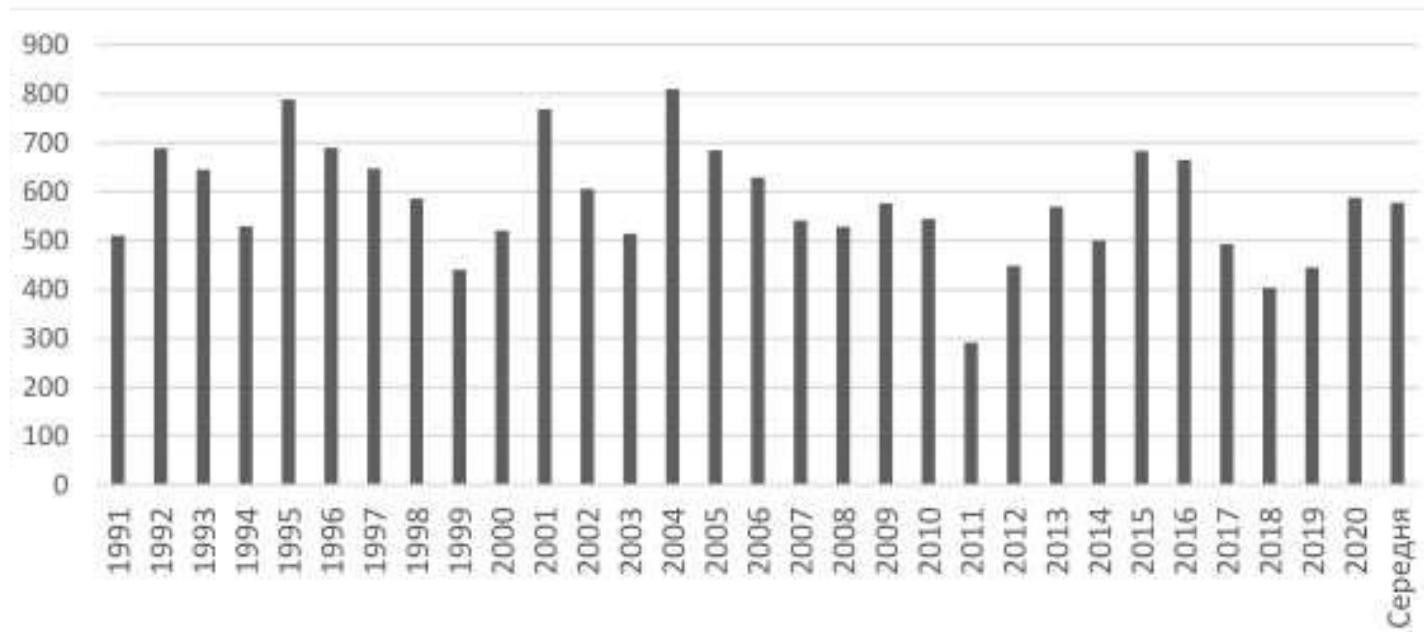


The Vorskla River Basin



The Climate change in the Vorskla Basin

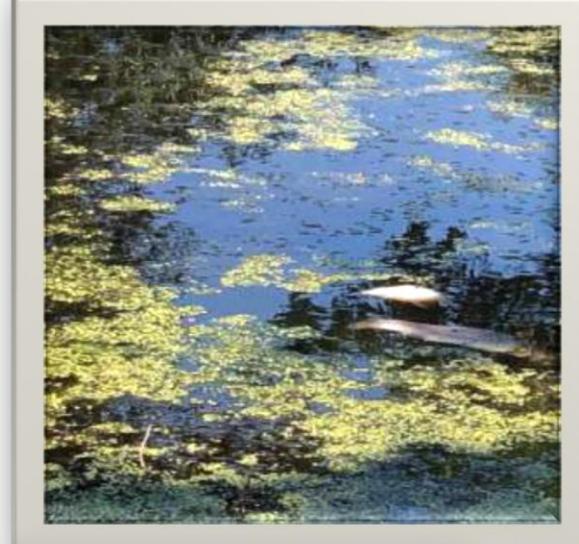
The climate of the Vorskla River basin is moderately continental, with mild winters and warm summers. According to long-term meteorological observations by the Krasnotrostyanets department of UkrNDILGA, the average annual air temperature is $+6.9^{\circ}\text{C}$, the average January temperature is -7.1°C , and July is $+19.1^{\circ}\text{C}$. Analysis of the dynamics of the average annual air temperature indicates that in 2020 it was 1.1°C higher than the average over the past 10 years. The average annual precipitation is 588 mm. It is worth noting a significant decrease in annual precipitation over the last 10-year period – only 508.7 mm.



Dynamics of annual precipitation over the past 30 years (according to data from the Krasnotrostyanets branch of UkrNDILGA)

The water Pollution in our Region

- ▶ While studying the ecological condition of the Vorskla river, it was found that the river does not have direct discharges, but its tributaries suffer from direct pollution. One of these tributaries is the Okhtyrka river, which condition becomes worse every year.
- ▶ During the study, the discharge of domestic sewage into the watercourse was discovered. The water has very unpleasant smell, blue-black color, and a massive fish die-off has occurred.
- ▶ But, nevertheless, the Vorskla river is considered to be one of the cleanest rivers in Europe.



Main environmental problems of the Vorskla:

Water Pollution:

Sewage: Insufficiently treated municipal and industrial wastewater (especially in the Poltava region) enters the river, reducing water quality.

Industrial Emissions: The oil and gas transportation network creates risks of corrosion and leaks, polluting the river, which is particularly relevant for Poltava.

Agrochemicals: Runoff of fertilizers and pesticides from agricultural lands during heavy rains exacerbates pollution.

Hydrological drought: A prolonged absence of rainfall and irrational water use lead to critically low water levels and drying up of tributaries.



Shallowing and narrowing of the riverbed:

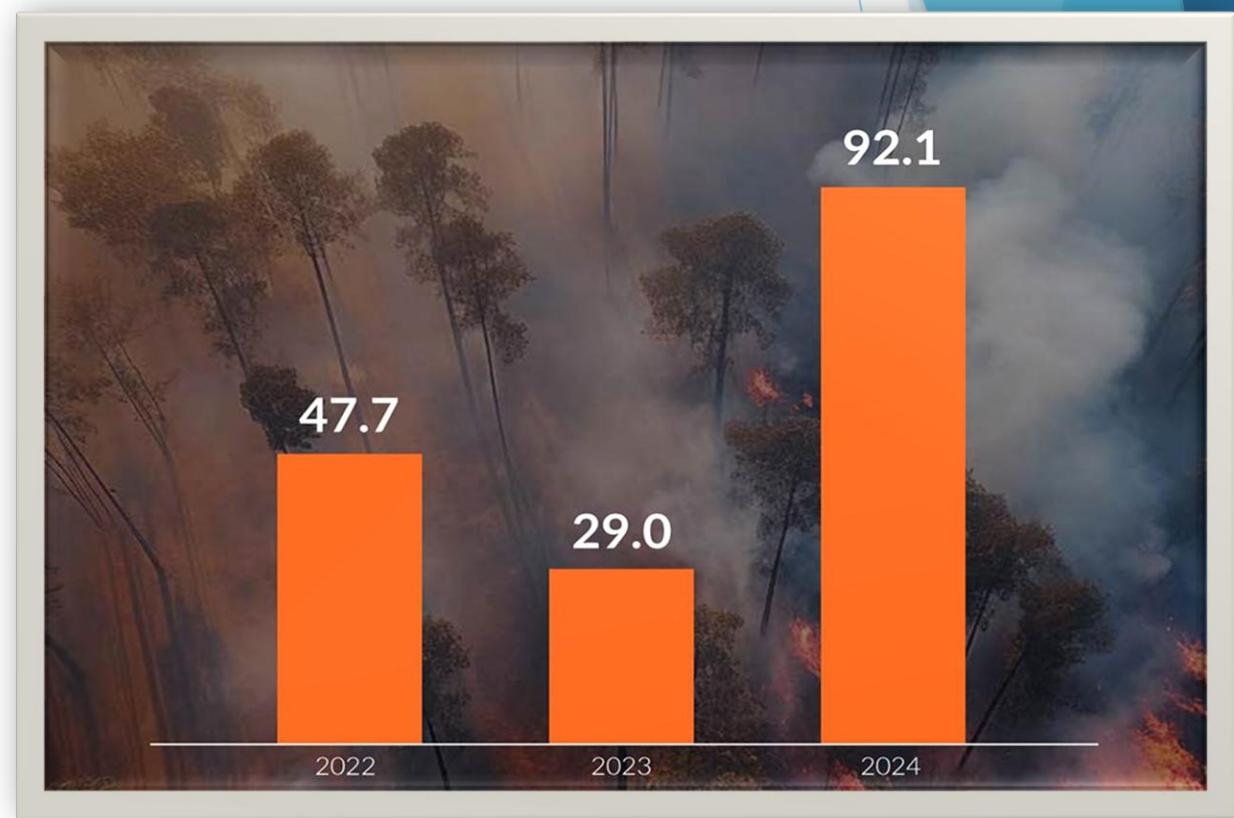
The river becomes shallow, which worsens the dilution of effluents and complicates the operation of water intakes and hydroelectric power plants.

Loss of biodiversity: Changes in the river regime, pollution, and the disappearance of natural floodplain areas negatively affect aquatic organisms.

Anthropogenic transformation: Construction of reservoirs (Kremenchuk Reservoir on the Dnipro, which affects the Vorskla), dredging, irrational land use in the river basin.

Impact of the War

- ▶ Russian aggression in Ukraine significantly worsens the climate situation due to massive greenhouse gas emissions from machinery and fires, the destruction of ecosystems (forests, fields) that absorb CO₂, and the disruption of energy infrastructure, which forces the use of dirtier energy sources; these factors exacerbate existing climate changes, creating a destructive cycle where war is intensified by climate risks, and the consequences of war amplify climate change.



The amount of the forest fires for the last 3 years

The main mechanisms of the military actions impact

- Greenhouse gas emissions (GHGs): Tanks, aircraft, artillery, and other military equipment consume a lot of fuel, releasing large amounts of CO₂. The destruction of energy facilities forces the use of less environmentally friendly energy sources.
- Large-scale fires: Military actions often lead to forest and steppe fires that are impossible to extinguish. Fire releases stored carbon, pollutes the air with combustion products, and burned vegetation can no longer absorb CO₂.
- Ecosystem destruction: The destruction of forests and vegetation alters the Earth's ability to reflect sunlight (albedo), affecting local and global climate conditions, and reduces biodiversity.
- Environmental pollution: Damage to chemical plants and oil refining facilities leads to the release of hazardous substances into the air, soil, and water. Dry conditions (caused by climate change) contribute to the spread of fires from military actions, which in turn further exacerbate climate change.
- Combat substances: The risk of exposure to toxic chemical warfare agents into the water



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The Ways of Solving the Water Problems

- ▶ Restoration of the river's natural floodplain
- ▶ Cleaning of springs and prohibition of plowing protective riparian zones
- ▶ Modernization of treatment facilities: reducing the discharge of phosphates that stimulate algae growth
- ▶ Efficient water use



Conclusions

The rivers of Ukraine are indicators of climate change. Due to the insufficient efficiency of treatment facilities, industrial pollution, agriculture, increased frequency of droughts, and changes in the water regime, the Vorskla River is increasingly turning into a degrading river, which requires comprehensive measures to improve its ecological condition. Without a systematic state approach and a change in the population's attitude toward water resources, we risk facing a shortage of drinking water in the coming decades.

