State Emergency Service of Ukraine
Kherson Regional Hydrometeorology Center

Impact of the Destruction of the Kakhovka Reservoir on the Climate of Southern Ukraine and its Potential Consequences

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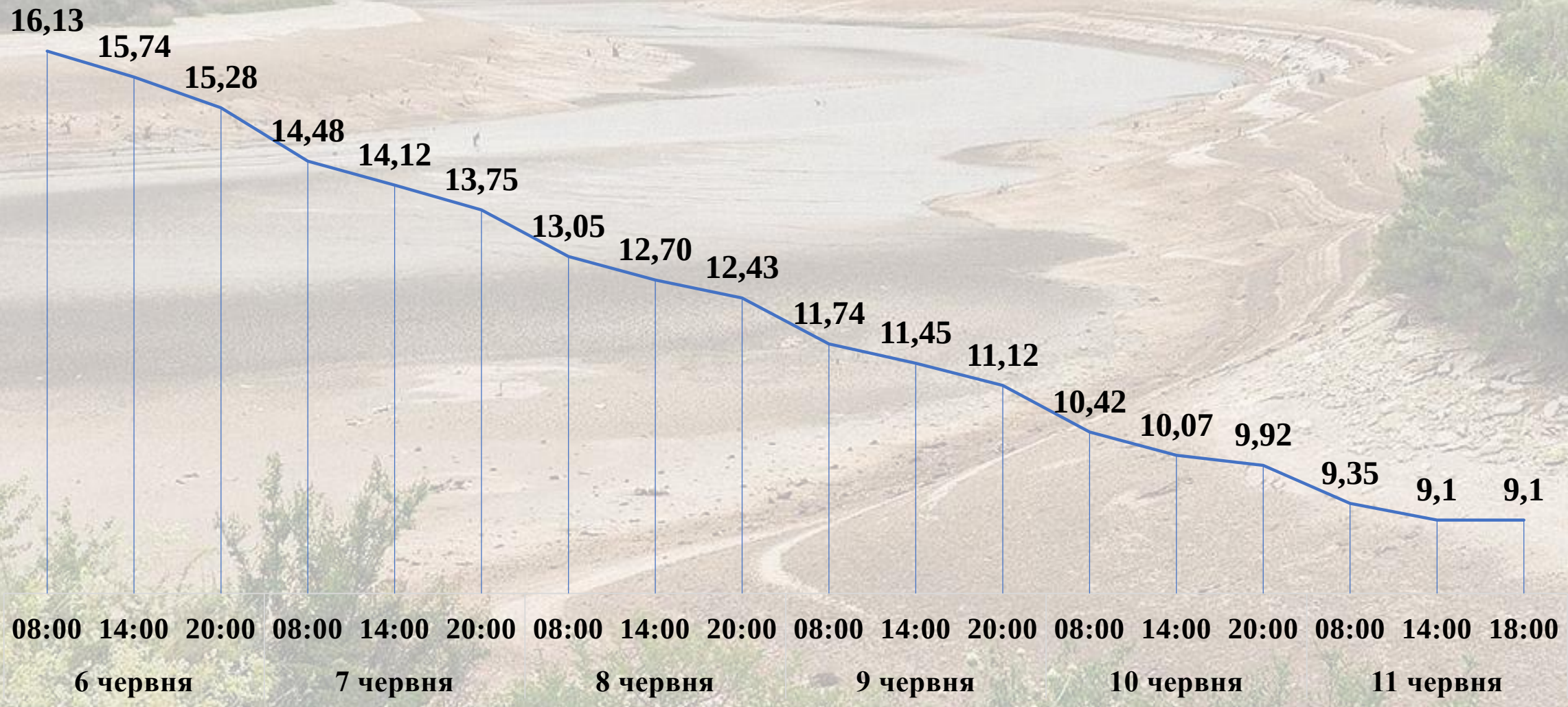
The Kakhovka Hydroelectric Power Station (HES) is the fifth largest in Ukraine in terms of size and has a capacity of 334.8 MW. The dam's length is 3850 meters, and its hydro-aggregate capacity is 6 x 55.8 MW. Prior to the detonation on June 6, 2023, the water level in the Kakhovka Reservoir was 16.77 meters above sea level (BS), which was 0.77 meters higher than the normal retaining level. The reservoir's water volume at that time was 19.9 km^3.

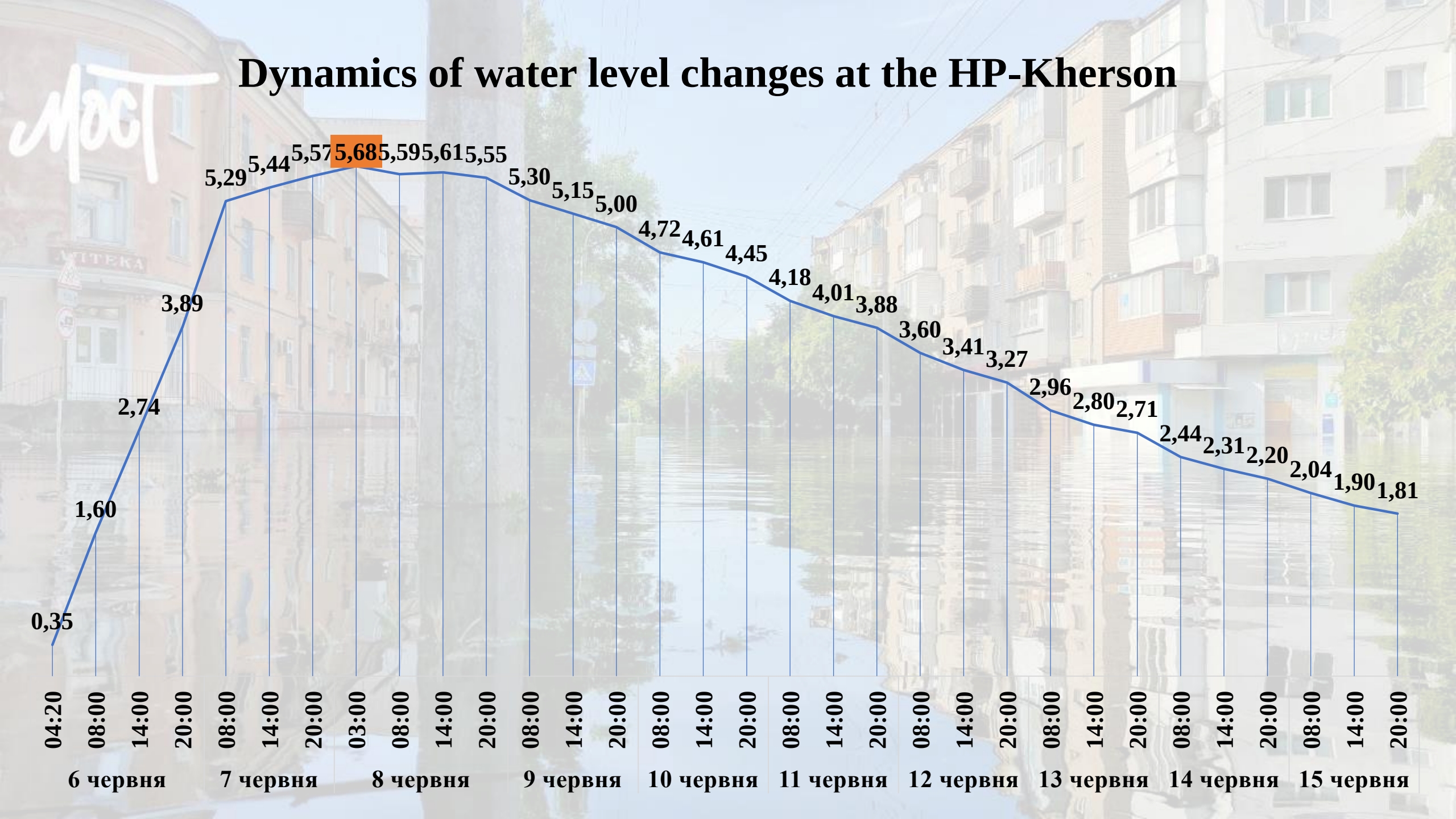
On June 6, 2023, at approximately 03:00 AM, the Russian forces detonated the Kakhovka HES dam. As a consequence, a significant amount of water surged downstream, causing a sudden increase in water levels and inundating vast territories, leading to catastrophic consequences.

The Dynamics of Water Level Decrease in the Kakhovka Reservoir:

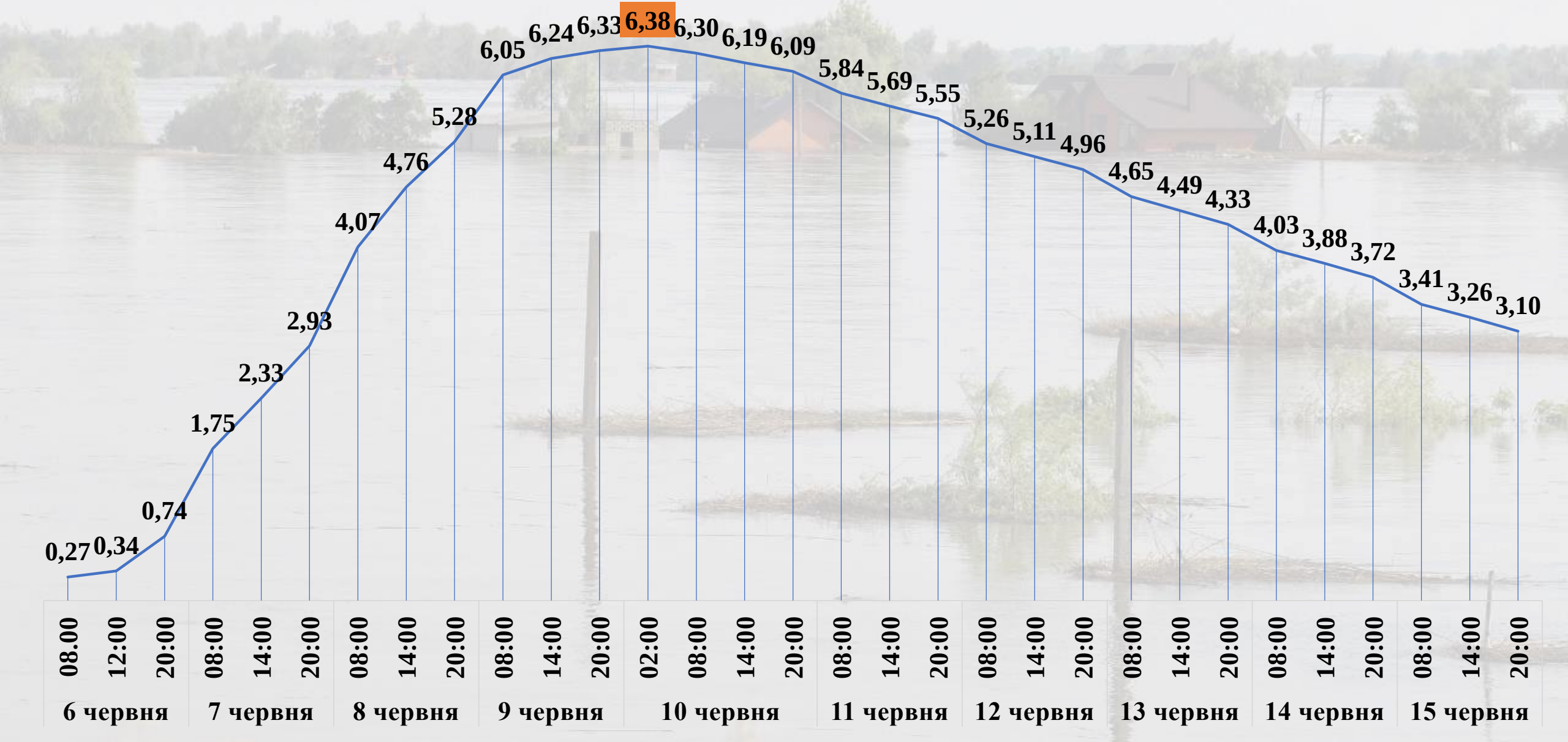
Nikopol



Dynamics of water level changes at the HP-Kherson



Dynamics of water level changes at the HP-I, Kalynivske village, Ingulets River



Characteristics of the water balance of the Kakhovka Hydroelectric Power Plant (HPP) in the example of 2021

The total annual inflow through the Dnipro HPP to the Kakhovka reservoir in 2021 was 34,688 million cubic meters.

Through the hydro turbines of the Kakhovka HPP, 31,500 million cubic meters of water were released. This not only facilitated electricity generation but also accounted for ecological costs downstream of the Dnipro River.

The water withdrawal from the Kakhovka reservoir for water management purposes amounted to 2,059 million cubic meters, which represents 6% of the total annual inflow through the Dnipro HPP structures.

The overall water usage was 1,916 million cubic meters, distributed as follows:

- Industrial needs: 751 million cubic meters (39%)
- Drinking and sanitation needs: 9 million cubic meters (less than 1%)
- Irrigation needs: 53 million cubic meters (3%)
- Other purposes: 2.3 million cubic meters (less than 1%)
- Transfer to other water users for irrigation purposes - the Main Kakhovka Canal and the North Crimean Canal: 1,100 million cubic meters of water (57%)

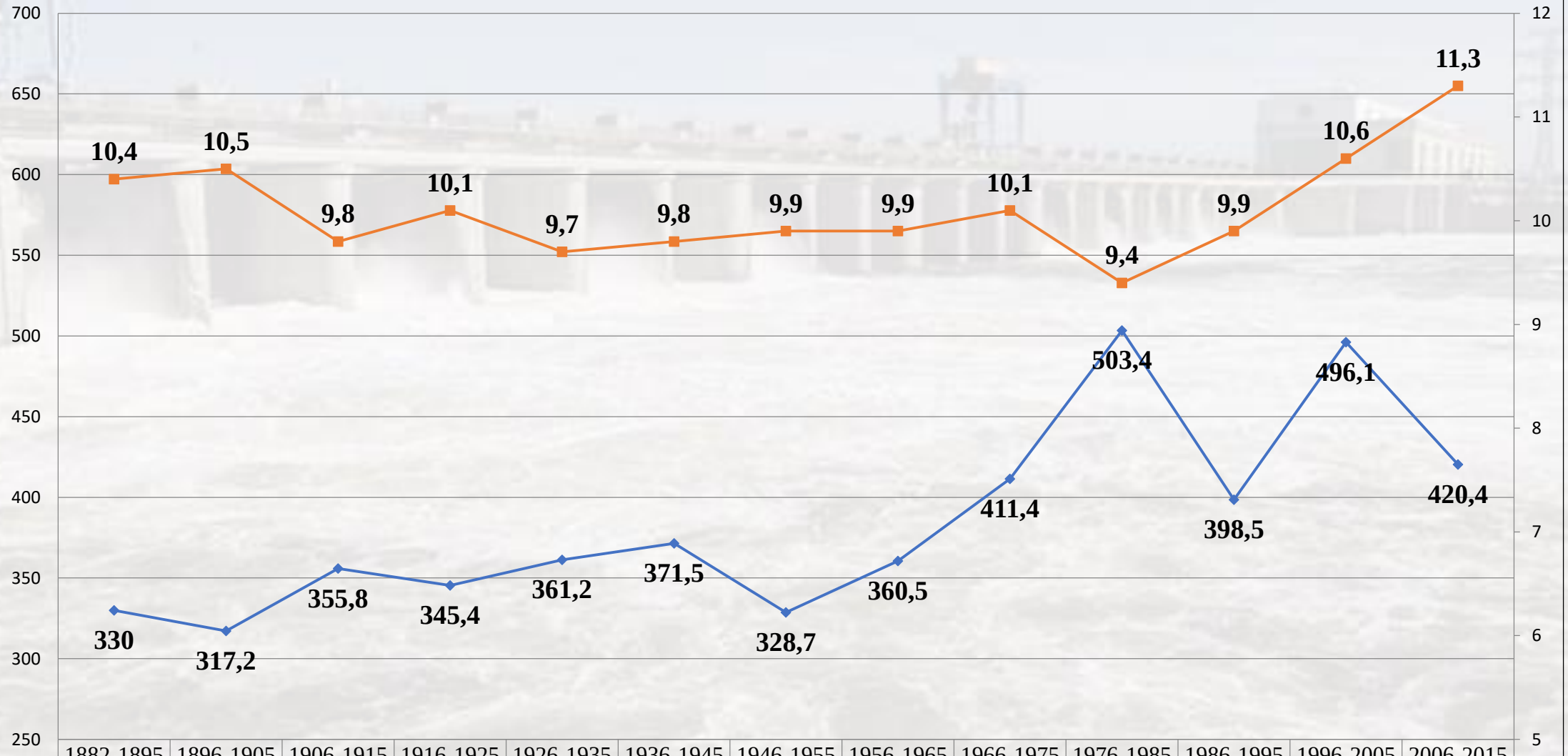
The Kakhovka reservoir impact on the weather and climatic conditions of the southern region of Ukraine

With a surface area of 2,252 square kilometers, it serves as a water and thermal energy accumulator during temperature fluctuations. Moreover, according to official data, about 4.5% of the total water inflow is lost through evaporation from the reservoir's surface. This means that the reservoir releases a considerable amount of moisture into the atmosphere, which undoubtedly influences the local weather and climate.

However, it is essential to understand that irrigation has an even more significant impact on the region's weather and climate. Irrigation creates a similar effect to a water reservoir, but over a much larger area. The irrigation process also releases moisture into the air, affecting weather patterns on a broader scale.

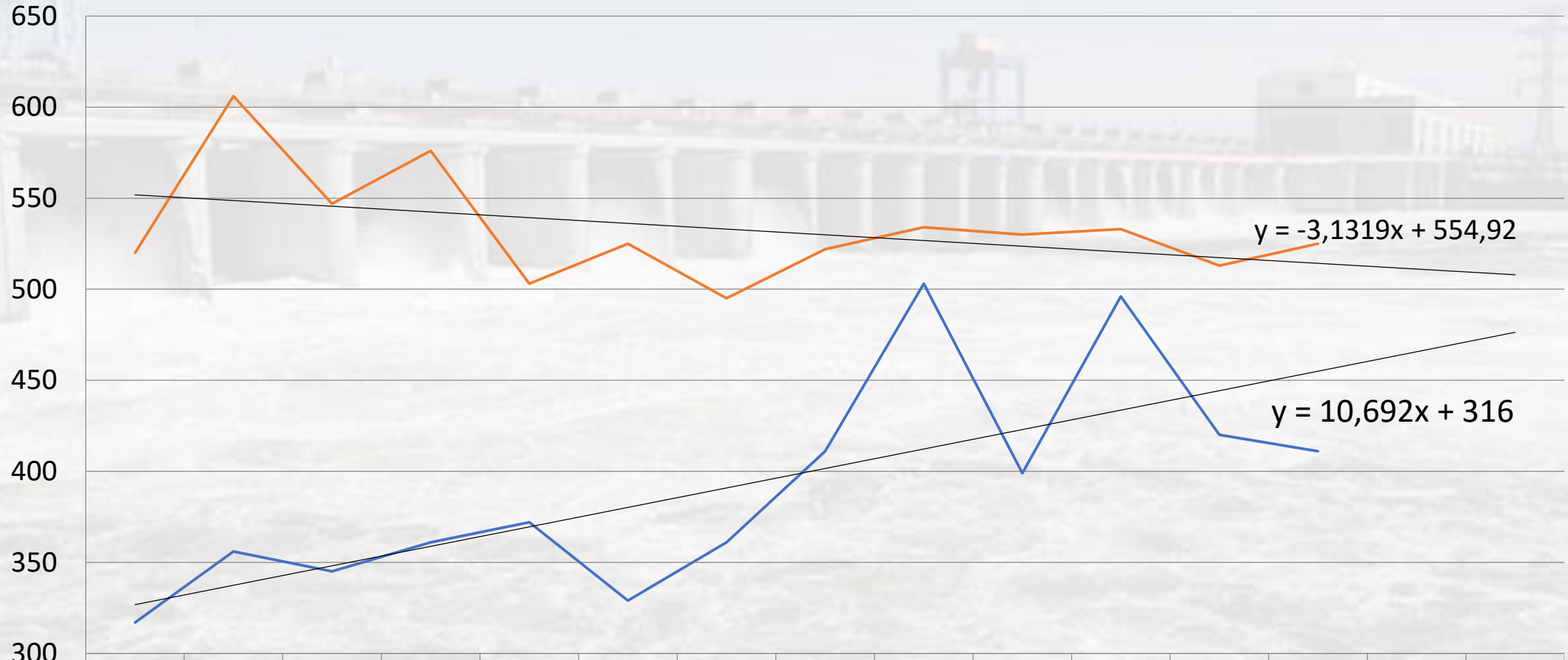
Another relevant factor is the substantial amount of one-sided filtration from the Kakhovka reservoir into the artesian basin and the Black Sea, accounting for approximately 2% of the reservoir's water volume. Although this is a notable percentage, during irrigation, these processes have even more significant effects due to higher water volumes being involved.

Average annual precipitation and temperatures (1882-2015)



	1882-1895	1896-1905	1906-1915	1916-1925	1926-1935	1936-1945	1946-1955	1956-1965	1966-1975	1976-1985	1986-1995	1996-2005	2006-2015
опади, мм	330	317,2	355,8	345,4	361,2	371,5	328,7	360,5	411,4	503,4	398,5	496,1	420,4
температура	10,4	10,5	9,8	10,1	9,7	9,8	9,9	9,9	10,1	9,4	9,9	10,6	11,3

Annual precipitation (Kyiv, Kharkiv, Kherson) for the years 1896-2020



	1896-1905	1906-1915	1916-1925	1926-1935	1936-1945	1946-1955	1956-1965	1966-1975	1976-1985	1986-1995	1996-2005	2006-2015	2016-2020		
Опади Харків	520	606	547	576	503	525	495	522	534	530	533	513	525		
опади Херсон"	317	356	345	361	372	329	361	411	503	399	496	420	411		

The need to restore the Kakhovka Hydroelectric Power Station (HES) is crucial to ensure irrigation in the southern part of Ukraine

Certainly, the restoration of the Kakhovka HES is vital for all sectors of the economy! However, if the decision to restore it is not implemented, there is an alternative for the agricultural sector, which involves reconfiguring the irrigation system without flooding significant territories.

To understand the situation, let's consider the volumes of inflow and water intake to the Kakhovka reservoir for the year 2015, which had low water levels.

The total annual inflow through the Dnipro Hydroelectric Power Stations (DHES) amounted to 19,455 million cubic meters (m^3). The overall annual water use for irrigation and water supply was 2,602 million m^3 (13% of the total inflow).

The maximum water intakes for water management purposes from the Kakhovka reservoir occurred in July and August, reaching 440 million m^3 and 521 million m^3, respectively, in 2015.

The monthly water discharges during the same period in 2015 were 1,821 million m^3 and 1,523 million m^3. The water intake from the reservoir for water management needs was 24% and 34%, respectively.

Conclusions

The calculations provided indicate that the restoration of the Kahovska Hydroelectric Power Station (GES) is necessary and essential from an energy, navigation, and irrigation perspective. However, if we assume that the reservoir will not be restored, there are certain benefits we can still obtain:

We will gain an additional 2,000 km2 (200,000 hectares) of land that can be used for agricultural production.

By implementing specific engineering measures such as constructing reservoirs and pumping stations to supply water to existing irrigation canals, the issue of irrigating agricultural lands can be resolved without building the reservoir.

Recently, concerns have arisen about the deteriorating water quality in the Kahovska reservoir. Stagnant processes have transformed it into a swamp. Without the reservoir and by returning the Dnipro River to its natural course, the water quality in it will significantly improve.

Proposals

Preparing for the presentation, I have extensively researched the impact of the construction of the Kakhovka Reservoir on the weather and climate conditions in our region. Unfortunately, I couldn't find any substantial information on the topic. However, I have come to realize that we have a unique opportunity to investigate this influence ourselves.

The disappearance and reappearance of such a significant water body in natural conditions over such a short period are virtually impossible. Therefore, we have a rare chance to organize quality observations of the changes in the natural environment, as well as the weather and climate conditions in our region following the restoration of this water reservoir.

I call upon all present to seize this opportunity and collectively, with the support of governmental organizations and the scientific community, conduct these observations. This endeavor will provide us with valuable insights into the effects of the appearance of such a substantial water body on the climate and the surrounding environment.

Let's not miss this chance and work together to uncover the answer to the question of HOW THE EMERGENCE OF SUCH A LARGE WATER OBJECT AFFECTS THE CLIMATE AND NATURAL ENVIRONMENT AROUND IT.

Thank you for attention