INTERNATIONAL RESEARCH-TO-PRACTICE CONFERENCE

CLIMATE SERVICES: SCIENCE AND EDUCATION

September 22-24, 2021

Odesa, Ukraine

SCIENTIFICALLY SUBSTANTIATED RECOMMENDATIONS OF WATER MANAGEMENT OF KATLABUKH LAKE UNDER CURRENT AND FUTURE CLIMATE CHANGE

Shakirzanova Zh. R*., *Prof., Romanova Ye. O.*, PhD, Medvedieva Iu.S. **, PhD*

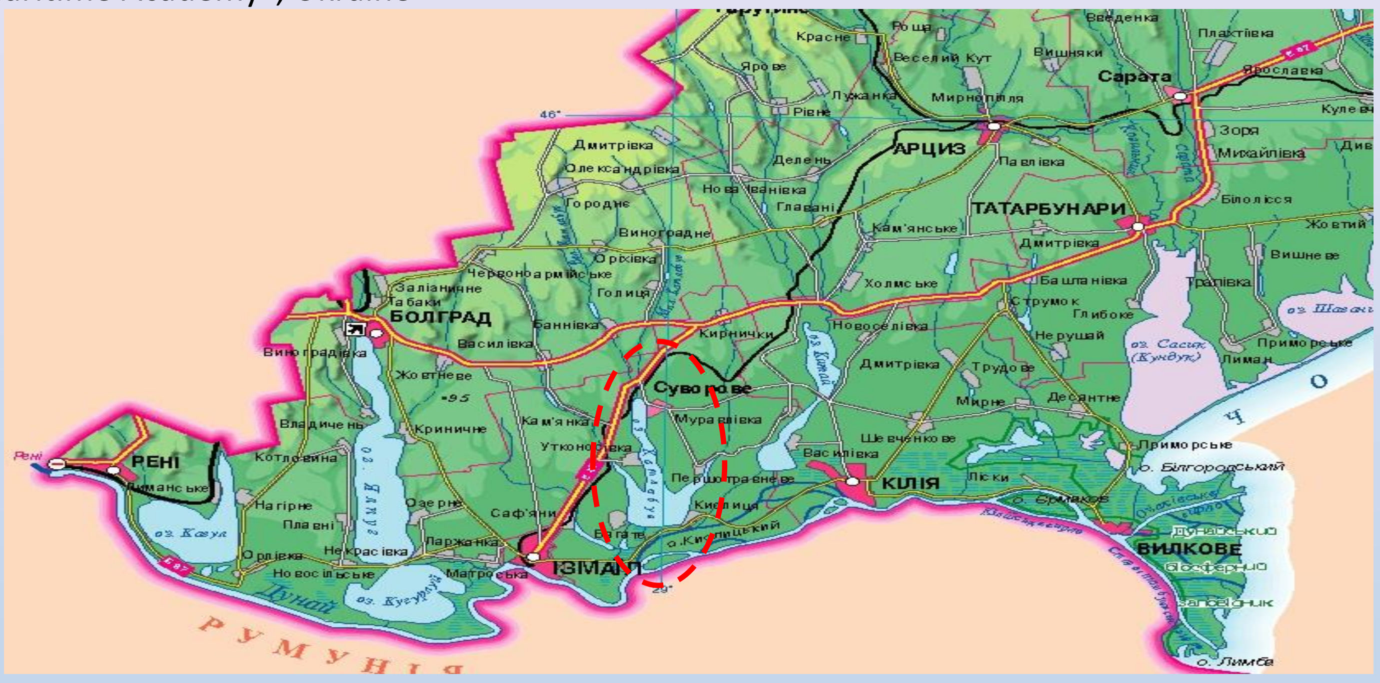
*Odessa State Environmental University, Ukraine

gidro@odeku.edu.ua

**National University "Odessa Maritime Academy", Ukraine

The relevance of the work is related to the study of water and salt regimes of the Danube Katlabukh Lake, which is one of the sources of water supply in the southern region of Ukraine (**Fig.1**). In this case, the hydrological regime of the lake is poorly understood, and some components of the water and salt balance do not have systematic observations, which requires the development of methods for their assessment and determination. In recent decades, water exchange in the lake, as an artificially regulated reservoir, has deteriorated, leading to a critical decrease in water levels and an increase in the mineralization of water in it. This has led to restrictions on the use of lake water for water management and drinking water supply [1].

Therefore, one of **the important tasks** is the restoration and rational use of the natural resources of Katlabukh Lake, improving its hydrological and hydrochemical regimes in the interaction of ***natural and anthropogenic factors*** and in the conditions of present and ***future climate fluctuations***, ***developing recommendations for improving the conditions of the reservoir's functioning.***



-- --- Study area

Fig. 1. The system of the Danube Lakes

In terms of climate, the study area is characterized by a temperate continental climate with insufficient humidity. The annual rainfall (for the period 1961-2020) for the meteorological stations Bolgrad and Izmail are 487 mm and 454 mm (respectively), and their greater mass (from 64-66% of the annual sum) falls in the warm period (IV-X). The average annual air temperatures at these stations are 10.9°C and 11.1°C and are higher by 0.6-0.5°C than the climate standard.

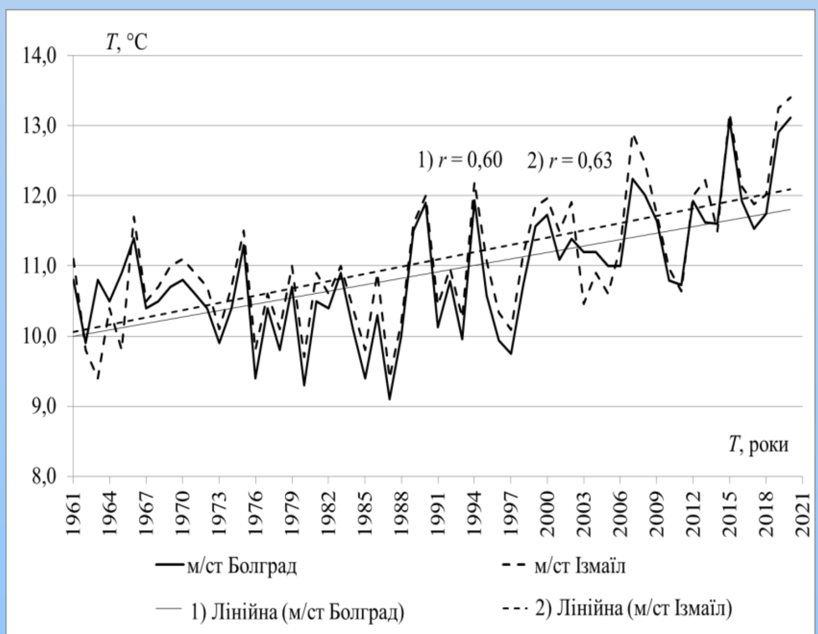


Fig. 2. Chronological schedule of annual air temperatures in Bolgrad and Izmail (1961 to 2020)

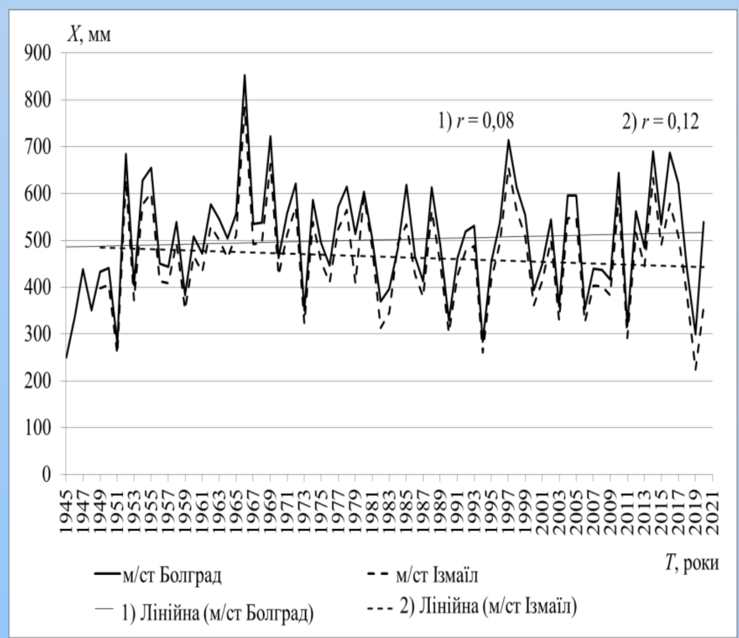


Fig. 3. Chronological schedule of annual precipitation by Bolgrad (1945-2020) and Izmail (1949-2020)

Analysis of the data on observations of air temperature **(Fig. 2)** and precipitation **(Fig. 3)** at the meteorological stations Bolgrad and Izmail as a whole confirms the available data on the current warming of the climate - the increase in annual air temperatures over the period 1961-2020 averages 1.0 °C than the climate standard. Synchronization is observed annual rainfall and temporal trends are insignificant.

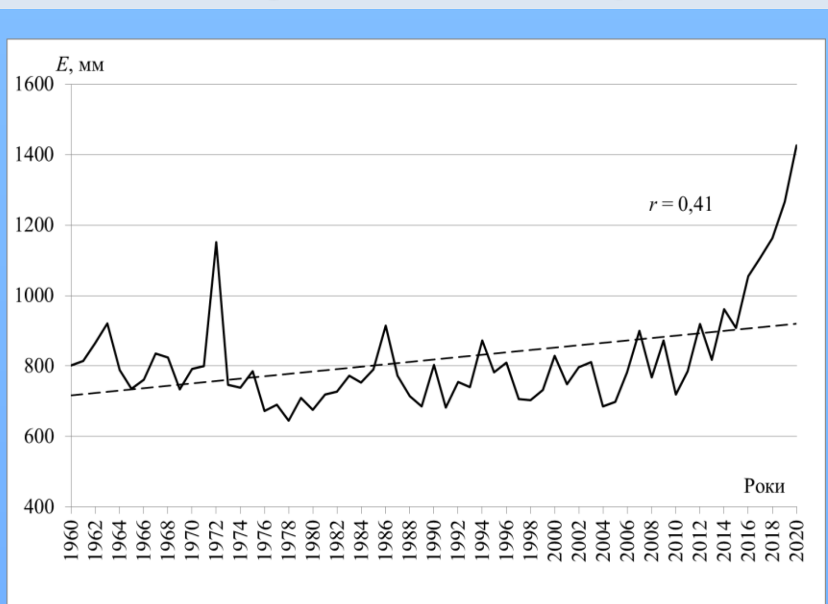


Fig. 4. Chronological schedule of annual amounts of evaporation from the surface of the reservoir in the city of Bolgrad (1960-2020)

Regarding the evaporation values from the water surface (station Bolgrad) **(Fig. 4)**, which are an expense component of water balances of reservoirs, with the average annual (for the period 1960-2020) the evaporation value for the year 819 mm, they tend to increase, especially since 2012.

The research of the water regime of Katlabukh Lake [1], its rivers and the Danube [2] have shown that they have long-term trends and seasonal variations **(Fig. 5)**, and for Katlabukh Lake they have a regulatory influence on hydraulic structures. Against the backdrop of not significantly decreasing water levels in the Katlabukh Lake (1980-2020), in recent years (since 2012), there have been long-term seasonal reductions, with minimal levels sometimes below the dead storage (LDS = 0,7mBS).

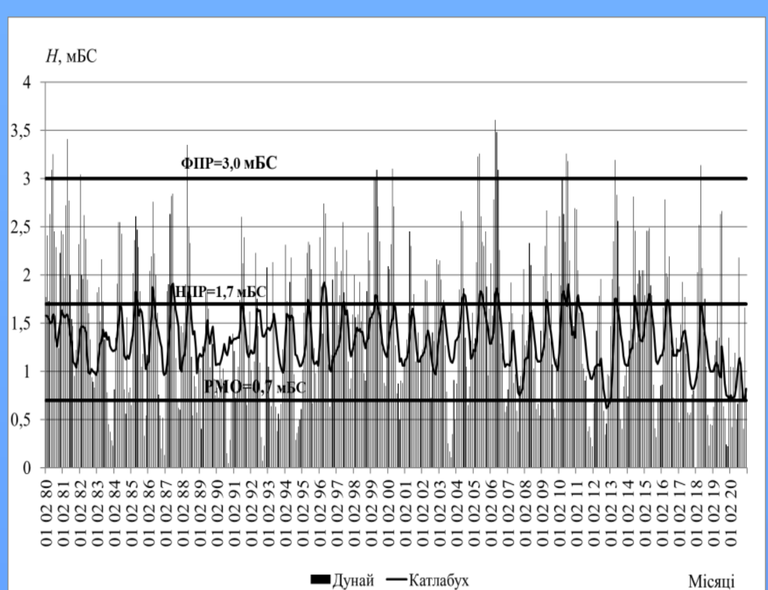


Fig. 5. Schedule of water levels of Katlabukh Lake and the Danube River - Izmail for the period 1980-2020

It is established that ***the main reasons for increasing the water mineralization of the lake*** are the seasonal decrease of the water levels in the lake (almost to the mark of LDS = 0,7mBS) due to the increase of evaporation volumes from the water surface and reduction of water exchange from the Danube. The deterioration of water exchange conditions in the reservoir is also associated with a decrease in irrigation water intakes in the northern part of the reservoir, which led to critical values of water mineralization in this water area of the lake (up to 3.1-4.1 g/dm³ and more) **(Fig. 6)**.

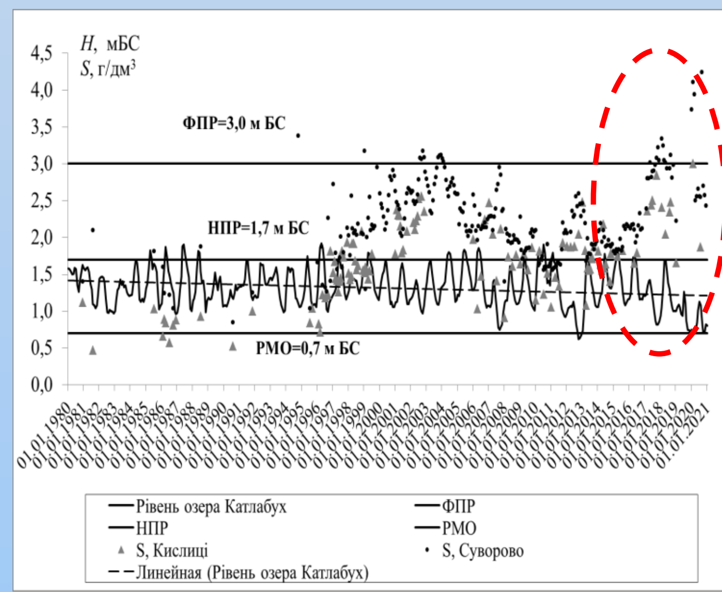


Fig. 6. Combined chronological schedule of average monthly levels and water mineralization in Katlabukh Lake

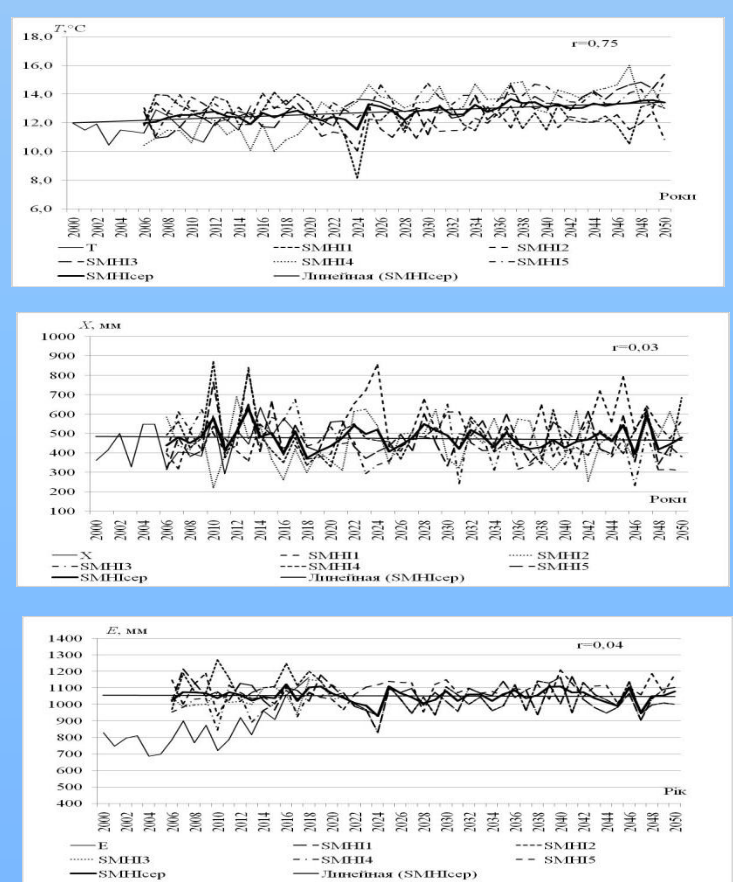


Fig. 7. Perennial variability of the average annual air temperature, annual precipitation and annual values of potential evaporation for the period 2000-2050

Using data from the **SMHI-RCA4 Climate Model Ensemble** (RCP4.5 scenario) **(Fig. 7)**, the variability of water levels and lake salt regime was simulated under current (2006-2018) and future climatic change (up to 2050) **(Fig. 8)**.

It is established that the modeled and, according to the climate models, the level and, accordingly, the salt regime of the Katlabukh Lake are largely determined by the water content of the Danube, which will change in the coming decades due to climate change.

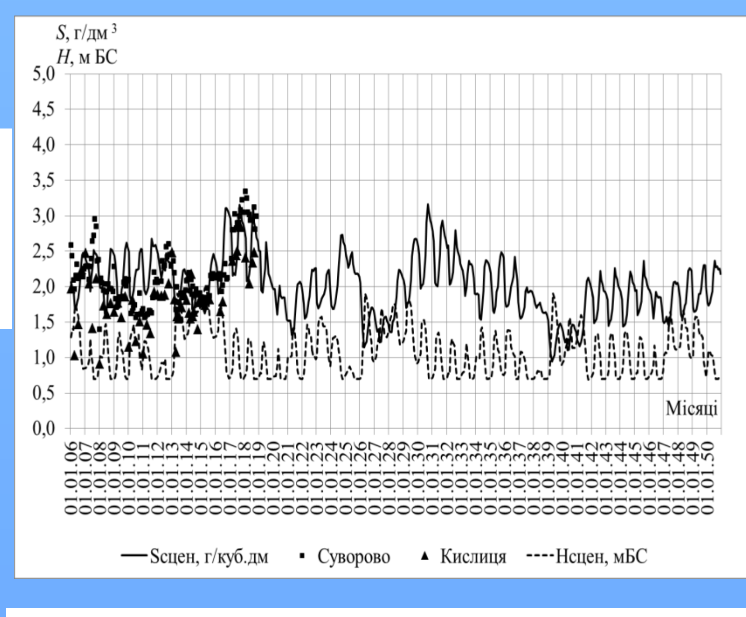


Fig. 8. Perennial variability of water levels and mineralization in Katlabukh Lake for the period 2006-2050

Therefore, ***the results of the evolution of the simulated levels and the mineralization*** of the water in the lake serve to illustrate their sensitivity to climate change scenarios (greenhouse gas emission trends) rather than to the actual prediction of the lake water level and mineralization.

Conclusion. Scientifically substantiated recommendations of possible management decisions of further water management use of the reservoir aimed at maintenance and restoration of natural resources of the lake.

References

1.Romanova Y.A., Shakirzanova ZH.R., Gopchenko E.D, Medvedieva I.S., 2019: Water and salt balances of Katlabukh Lake under different conditions of water reservoir operation. *Hydrology, hydrochemistry and hydroecology*. V. 4 (55). pp. 23-40.

2. Yelyzaveta Romanova, **Zhannetta Shakirzanova**, Valeriya Ovcharuk, Olena Todorova, Iuliia Medvedieva, Andrii Ivanchenko. Temporal variation of water discharges in the lower course of the Danube River across the area from Reni to Izmail under the influence of natural and anthropogenic factors // Energetika, 2019. T.65. Nr. 2 - 3. P. 144 – 160. doi.org/10.6001/energetika.v65i2-3.4108