ANALYSIS OF WATER DISCHARGE IN THE MOUTHS OF LARGE UKRAINIAN RIVERS FLOWING INTO THE BLACK SEA UNDER CLIMATE CHANGE

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The northwestern part of the Black Sea (NWBS) within Ukraine includes the mouths of its largest rivers—the Dnipro, Southern Buh, Dniester, and Danube. The inflow of fresh surface water from these rivers significantly affects the hydrological and chemical regimes of transitional and marine waters in the study area. In recent years, climate change and increasing anthropogenic pressure have led to substantial changes in river runoff in southern Ukraine. The objective of this study is to analyze the water discharge trends of recent decades to identify current changes in the volume of water flow from major rivers entering the Black Sea within the NWBS, which significantly influence the spatial-temporal variability of temperature, salinity, and the thermohaline structure of the waters.

To achieve this objective, archival data stored in the Research and Educational Laboratory of Hydrological Information and Calculations at the Department of Land Hydrology, Faculty of Hydrometeorology and Ecology, Odesa National University, were used. The study was conducted within the framework of the project funded by the Ministry of Education and Science of Ukraine—"Advanced Automated Modeling Complex for Diagnosis and Forecast of Oceanographic Characteristics in the Ukrainian Part of the Azov-Black Sea Basin Water Area and Results of Its Application in Test Mode", under the supervision of Prof. Y.S. Tuchkovenko.

The study analyzes the water discharge dynamics of the largest Ukrainian rivers discharging into the Black Sea over the past four decades (1981–2021), along with the latest available data up to December 2024.

The analysis of Southern Buh's water discharge indicates a sharp decline since 2010, reaching a historical minimum in 2020. According to real-time data from the ARM-Hydro resource, this decreasing trend continues to the present (Fig. 1a).

Between 1981 and 2021, the Dnipro River's discharge exhibited relatively stable periods of high and low water levels compared to the norm. However, the last decade has shown a prolonged low-water phase, with two record-low discharge values observed in 2015 and 2020 (Fig. 1b).

The fluctuations in the Dniester River's discharge over the past 40 years exhibit a cyclic pattern, alternating between high-water and low-water periods. However, over the past decade, the river has predominantly experienced low-

flow conditions, similar to those observed in the Dnipro and Southern Buh Rivers (Fig. 1c).

An analysis of the discharge dynamics in the Danube Delta within Ukrainian territory shows a low-water phase between 1983 and 1994, followed by a high-water period from 1995 to 2002. From 2003 to 2015, high- and low-water years alternated with a 2–3-year periodicity. However, since 2016, a persistent low-water phase has been observed (Fig. 1d).

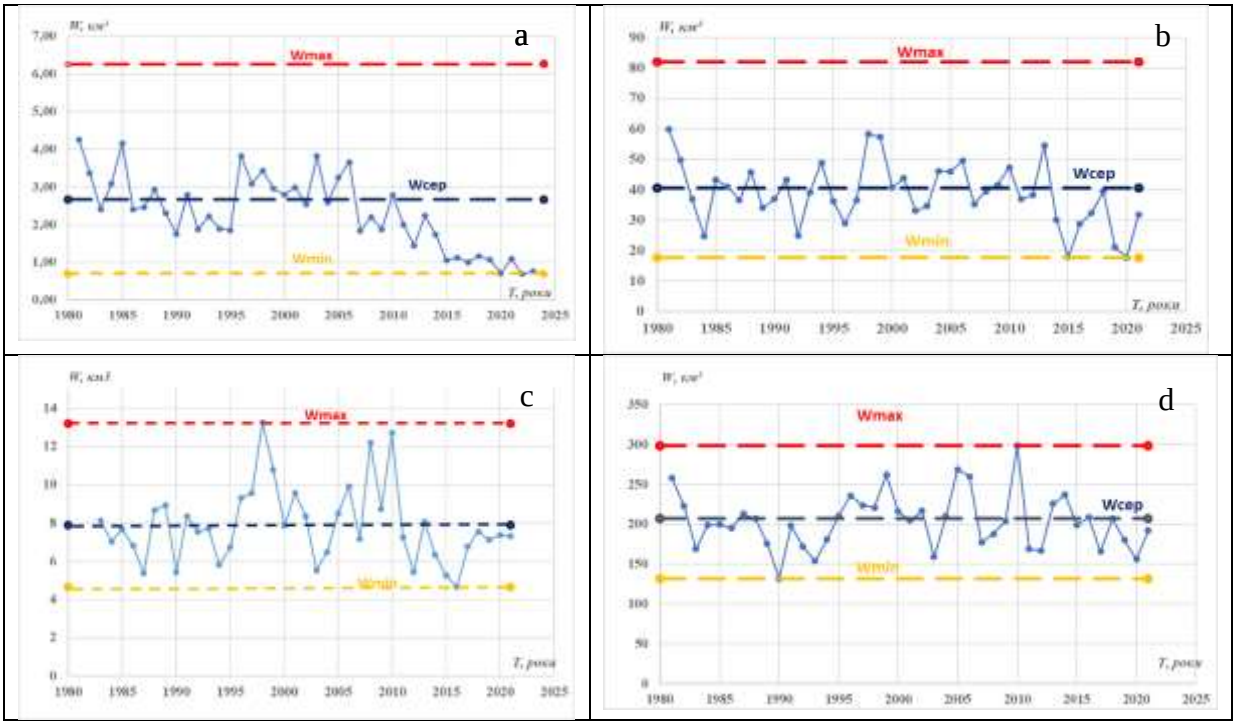

Fig. 1. Chronological graph of annual water discharge volumes (1981–2021)**:**
a – Southern Buh River (Oleksandrivka settlement);
b – Dnipro River (Kakhovka HPP);
c – Dniester River (Mohyliv-Podilskyi city);
d – Danube River (Reni city, hydrological station, 54th mile).

The study indicates that all major Ukrainian rivers are currently experiencing a prolonged low-water phase, with varying onset times and durations. However, the past decade has been characterized by consistently low water levels across all analyzed rivers. The situation is particularly critical for the Southern Buh, where discharge has reached historical minimum values in the entire period of instrumental observations.

Given these results and the projected climate change scenarios outlined by the Intergovernmental Panel on Climate Change (IPCC), it is recommended to use a typical low-water year distribution when modeling the current hydrological conditions of the Dnipro, Southern Buh, Dniester, and Danube Rivers.