International Research-to-Practice Conference
CLIMATE SERVICES: «SCIENCE AND EDUCATION»,
22-24 September 2021, Odessa, Ukraine

DETECTION OF THE CLIMATE CHANGE IMPACT ON THE RIVER RUNOFF OF SPRING FLOOD IN PIVDENNY BUG RIVER BASINTHE UKRAINIAN PART

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In this work **the climate change impact on the river runoff of spring flood is detected** and **the regional methodology of long-term forecasts of characteristics of spring flood of the rivers in the Pivdenny Buh river basin** (Fig.1) **is developed.**

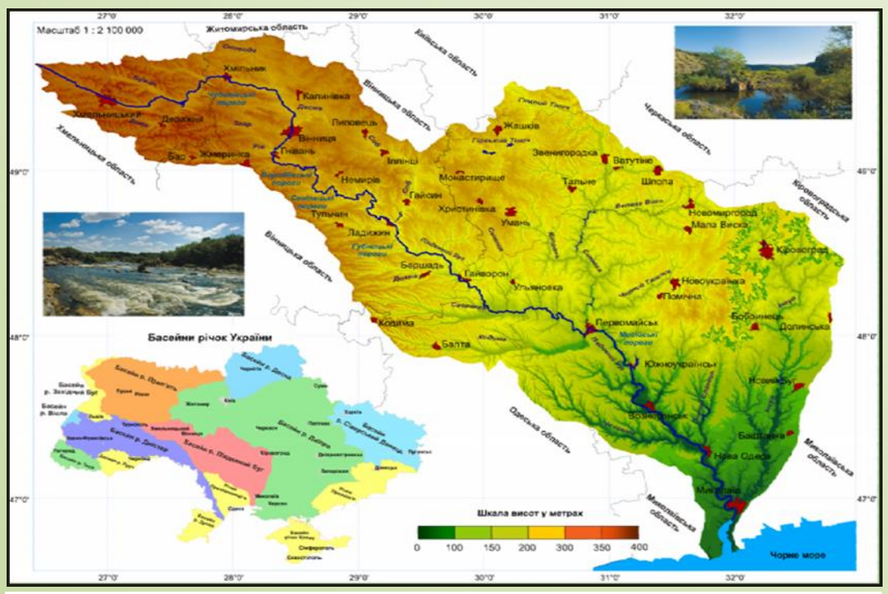

Figure 1 - Physical-geographical map and geographical position of the Pivdenny Buh river basin

The methodology forecasts based on the ***preliminary typification of floods by water content*** **(Fig.2)** in choosing the main factors of spring runoff formation, establishing regional parameters (within the basin zoning by a set of hydrometeorological factors) for long-term forecasting of runoff layers and maximum discharge, determining their probabilistic values over many years in climate change conditions.

Researches ***of temporal trends*** **(Fig.3,4)** and ***cyclicity in long-term series of maximum runoff characteristics of spring floods*** (Fig.5,6) in the Pivdenny Buh basin showed that the decrease of spring runoff of rivers in recent decades is caused by climate change due to rising air temperature in cold period, deficiency of stable snow covers and significant reducing the depth of soil freezing (since 1989). There is a rescheduling tendency of maximum snow reserves and spring floods to earlier dates *(Dokus, Shakirzanova, 2017).*

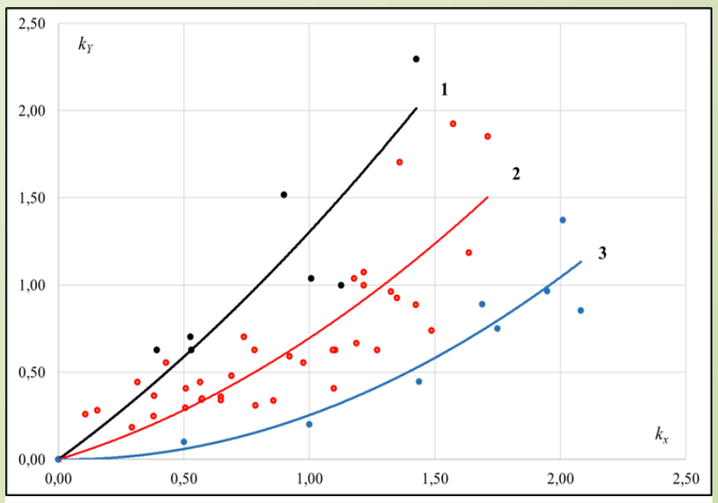

Figure 2 – Dependence of modular coefficients of spring flood runoff layers k_Y on modular coefficients of moisture reserves in the basin k_X for district II, subdistrict IIb (Pivdenny Buh river basin - Pidhirya village)
Symbols in the figure:
1 – DF1> DF2, DF3; 2 – DF2> DF1, DF3;
3 – DF3>DF1, DF2

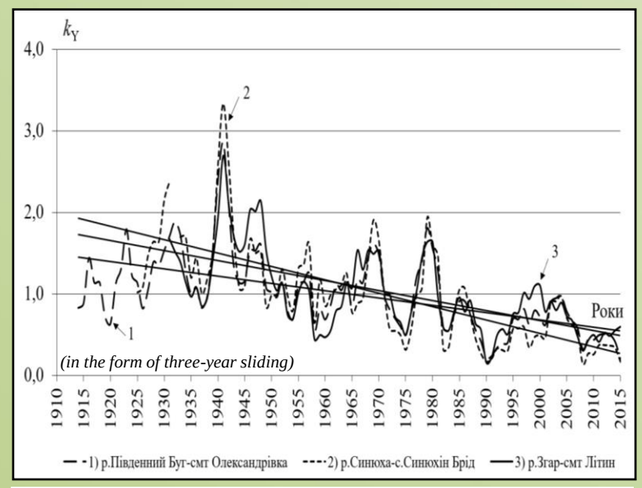

Figure 3 – Time series of modular coefficient layers of spring flood runoff in relative values (relative to the average long-term value) in the basin of the Pivdenny Buh

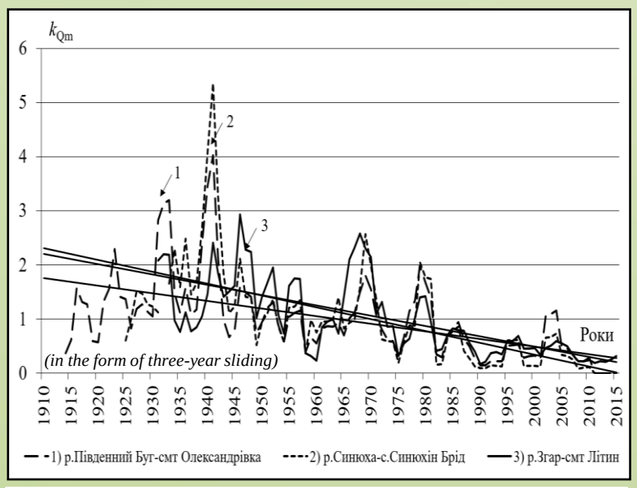

Figure 4 – Time series of modular coefficient of the maximum discharge of spring water in relative terms (relative to the average long-term value) in the basin of the Pivdenny Buh

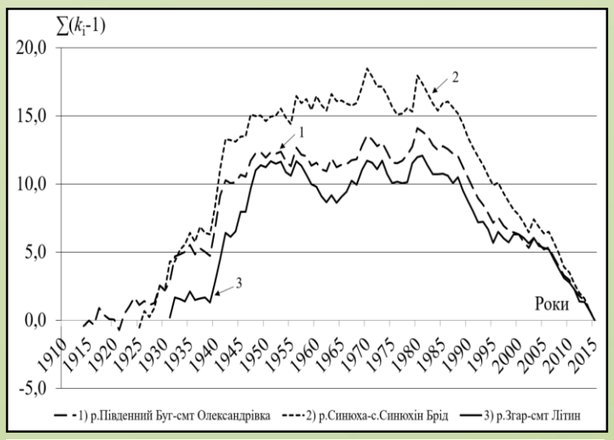

Figure 5 – Residual mass curves of modular coefficient of spring water runoff layers in the basin of the Pivdenny Buh

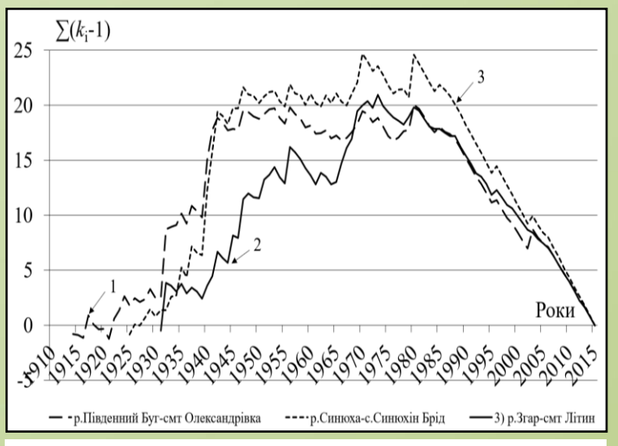

Figure 6 – Residual mass curves of modular coefficient of the maximum discharge of spring water in the basin of the Pivdenny Buh

The time series of the maximum discharge and runoff layers of spring floods are synchronous in terms of cyclical fluctuations, and from the end of the 1980s to 2015 the low-water phase was observed on the rivers.

Analysis of the total curves of runoff layers and maximum discharge of spring flood and their difference integral curves in the Pivdenny Buh river basin (at posts with the largest operating hydro-electric power stations on them) showed that in the modern period of spring flood formation in the basin, the impact of river control on the maximum runoff is not significant, the deviations on the total curves are mainly explained by natural cycles and the impact of climate change on river water content. In the research using the methods of factor and cluster analyzes; hydrological zoning was performed under the conditions of spring flood of rivers in the basin of the Pivdenny Buh, which allowed to distinguish two hydrological regions (region I and region II with subregions IIa, IIb, IIc). The analyzed natural conditions have shown that within limits of the carried out hydrological zoning these regions have specific features of spring floods formation. Data from long-term meteorological, agrometeorological and hydrological observations in the Pivdenny Buh river basin (as of 2020) were used as input information for the development of the methodology forecasts, using data from observations in the Velykyi Kuyalnyk and Tiligul rivers.

To assess the impact of future climate change on the water regime of rivers in the spring flood period, climate change coefficients were calculated (according to IPCC climate models (CORDEX project) of RCP 4.5 scenario for the period 2021-2050) **(Fig.7,8)**, which were taken into account in determining the basic characteristics of forecasting methods – average long-term runoff layers and maximum spring discharge rates; and modeling of spring runoff layers in the Pivdenny Buh basin in affected period was made.

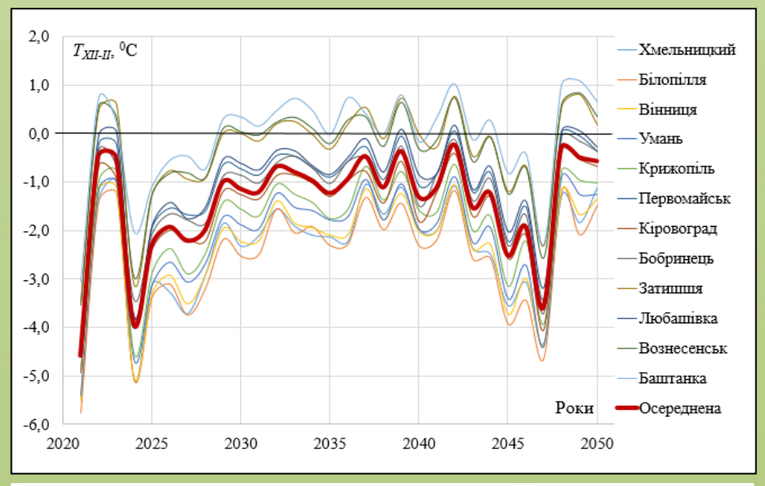

Figure 7 – Combined time series of average monthly air temperatures (December-February) according to the average model of meteorological stations in the Pivdenny Buh river basin (in the period 2021-2050)

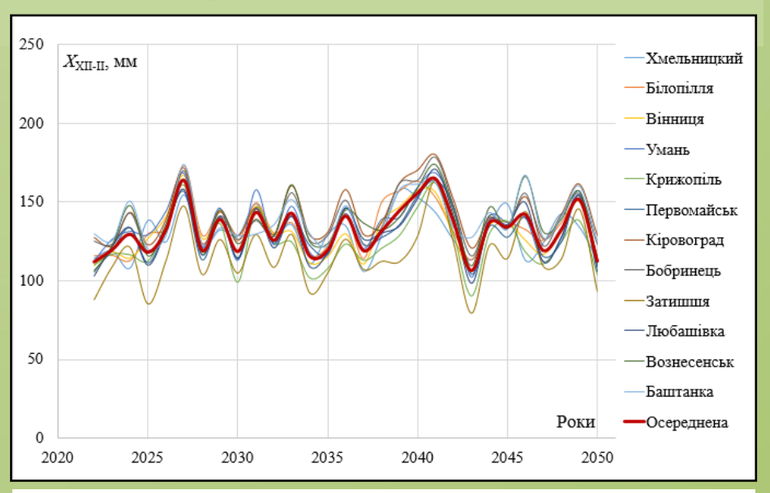

Figure 8 – Combined time series of winter precipitation amounts (December-February) according to the average statistical model for meteorological stations in the Pivdenny Buh river basin (in the period 2021-2050)

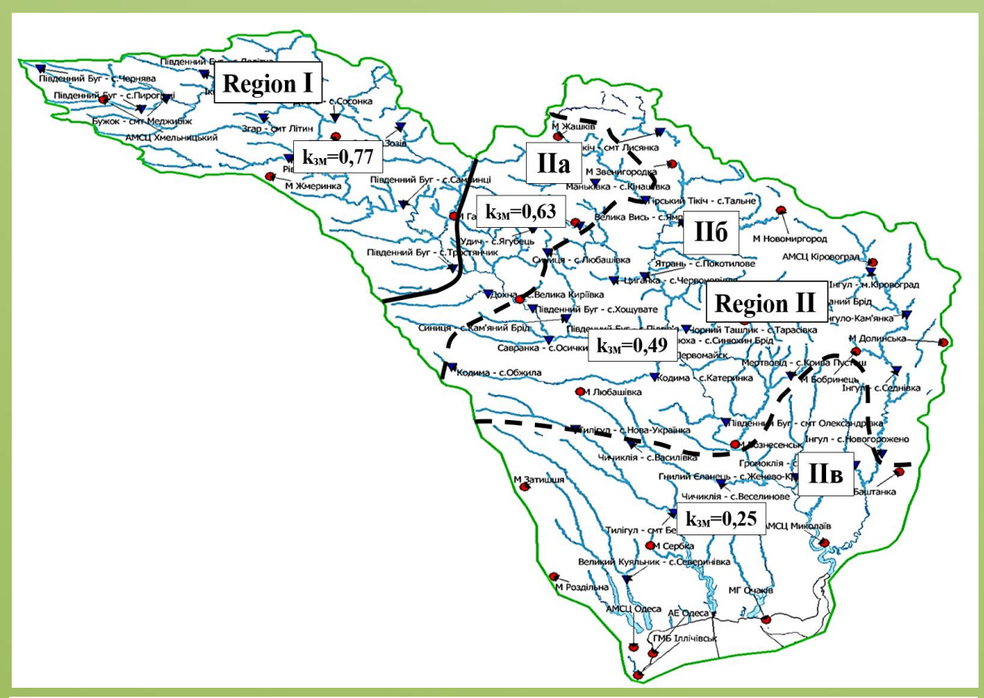

Figure 9 – Average values of climate change coefficients to the average long-term characteristics of the maximum runoff of spring flood (in the period 2021-2050) within the zoning of the Pivdenny Buh river basin under the conditions of spring flood formation

The results showed that in the Pivdenny Buh basin in the region I in the period 2021-2050 was expected to reduce the long-term average characteristics of runoff (runoff layers and maximum water flow) of spring floods on average by **23 %** (k_{ch}=0.77), and in region II: sub-district IIa – by **37 %** (k_{ch}=0.63), sub-region IIб – by **51 %** (k_{ch}=0.49), sub-region IIв – by **75 %** (k_{ch}=0.25) **(Fig.9)**.

Conclusion. The layers of spring water runoff modeled according to climatic models in the period of 2021-2050 were expected to be lower than their long-term average value (established taking into account), which was 23 mm. The formation of catastrophically high floods in the period 2021-2050 according to the regional methodology of long-term forecasts of characteristics of spring flood of the rivers in the Pivdenny Buh river basin is not predicted.

References: *Dokus A., Shakirzanova Zh. (2017). Forecasting the hydrological risks of floods using the method of forecasting the maximum runoff of spring high water Collected Papers «Geography in Global Context: Achievements and Challenges», Akaki Tsereteli State University Kutaisi, Georgia, 3-4 June 2017. P. 40-55.*