Use the data of the EURO-CORDEX ensemble of regional climate model simulations for probabilistic modeling of the maximum runoff of the spring flood on the rivers of the South of Ukraine

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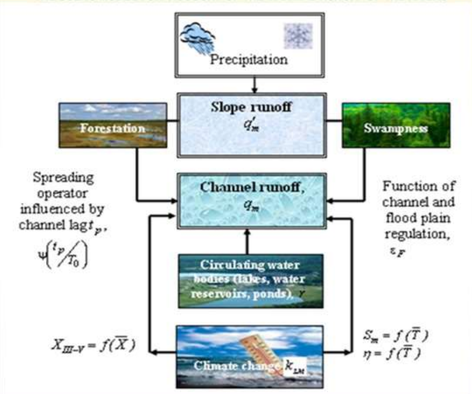
For the South of Ukraine, which is characterized by the practical absence of systematic hydrological observations on small rivers, and often on medium ones, the most effective is regional probabilistic stochastic modeling, for example, based on the operator scheme for the river's maximum runoff formation[1]. If, at the stages of primary statistical processing, the presence of significant trends in the values of maximum water discharges is revealed, and the analysis shows that these trends are caused by modern climate changes, then the calculation method has the possibility of taking in account climate changes through the coefficient Kch. The calculation of the coefficient is carried out in the following order: 1) based on the data of global climate modeling, a model and scenario are selected, which will take into account the impact of climate change on the maximum runoff; 2) after that, the period for which forecast values will be used is determined; 3) for the calculation period and according to the coordinates of the geometric center of the water catchment, forecast values of the *average* annual mean temperature and precipitation are determined; 4) based on regional dependencies, forecast values of average multi-year maximum snow supplies and precipitation during spring flood are determined, which are compared with modern data

THE OSENU MODEL FOR ACCOUNT OF THE MAXIMAL RUNOFF OF THE RIVERS

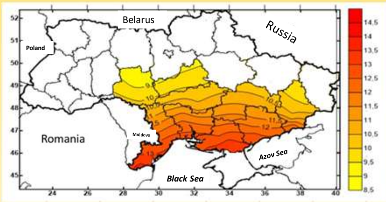


Study area and research object

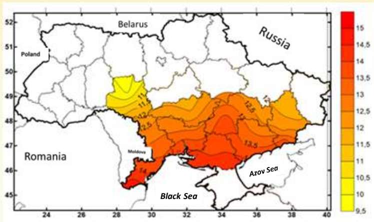
The *maximal runoff of medium and small rivers in the South of Ukraine (basins of the lower reaches of the Danube, Dniester, Dnieper, Southern Bug, and Azov rivers)*

FORECASTED VALUE OF ANNUAL TEMPERATURE (ºC) OF THE EURO-CORDEX ENSEMBLE OF REGIONAL CLIMATE MODEL FOR THE TERRITORY SOUTH OF UKRAINE

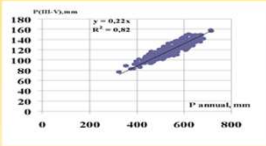
RCP 4.5

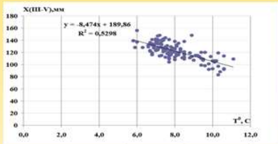


RCP 8.5

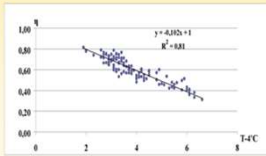


Precipitations during spring flood

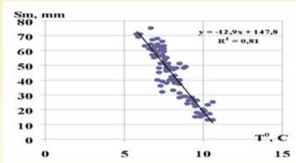




Runoff coefficient

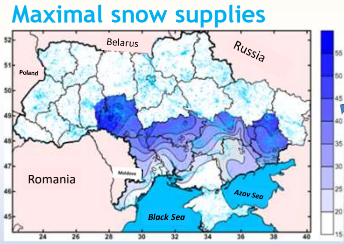


Snow supply's



THE TOTAL WATER INFLOW ON THE CATCHMENTS

Maximal snow supplies



$$P_s = S_m + P$$

Precipitation during spring flood

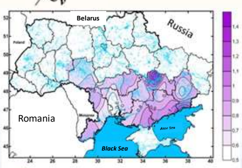
$$P=5.4+8,1Lg(A+1)$$

THE PROBABILITY VALUES OF TOTAL WATER INFLOW ON THE CATCHMENTS

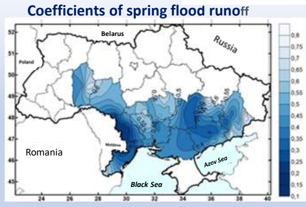
$$(P_s)_p = \{S_0 + [5,4 + 8,1 lg(A+1)]\}\, k_p$$

$$k_p = f(P, C_v, C_s/C_v) \qquad C_s/C_v = 3.5$$

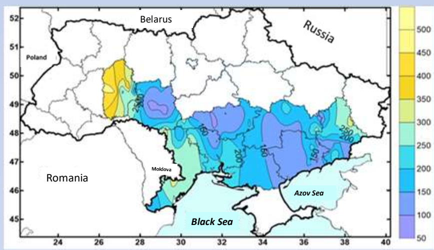
$P = 1\%$



Coefficients of spring flood runoff



Duration of slope influx (spring flood)



IRREGULARITY COEFFICIENT FOR SLOPE INFLUX

$$\frac{n+1}{n} = 6,0$$

Transformation function of spring flood

a) At tp<To

$$\psi(t_p/T_0) = 1 - 0,76\left(\frac{t_p}{T_0}\right)^{0,2}$$

b) At tp>o

$$\psi\left(t_p/T_0\right) = 0,16\frac{T_0}{t_p}\left[2 - 0,54\left(\frac{T_0}{t_p}\right)\right]$$

Where

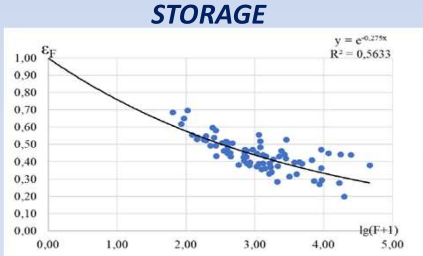
$$t_p = \frac{L}{1.30 I^{0.33} A^{0.13}}$$

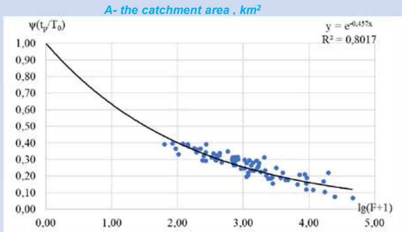
L - the length of the watercourse, km

I - the weighted average slope of the watercourse,‰

A- the catchment area , km²

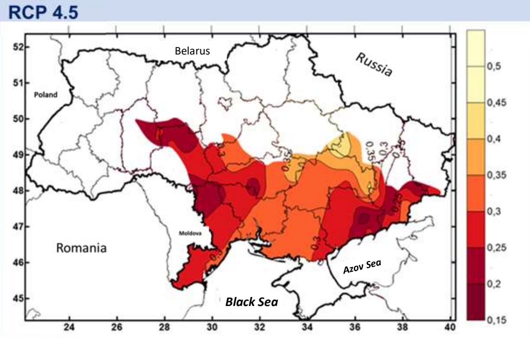
CHANNEL AND FLOOD PLAIN STORAGE



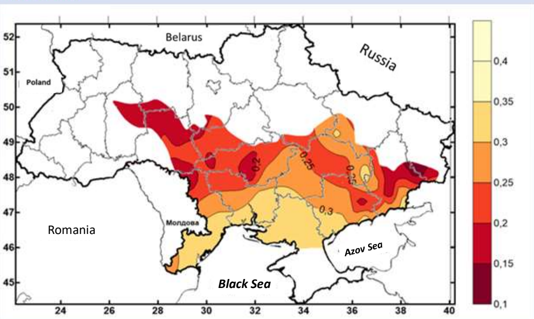


COEFFICIENT OF CHANGE THE SPRING FLOOD (the period 2021-2050 EURO-CORDEX)

RCP 4.5



RCP 8.5



The research used the climate change projections for Europe based on an ensemble of regional climate model simulations provided by the EURO-CORDEX; ensemble average annual mean temperature and precipitation for the RCP4.5 and RCP8.5 scenarios.

According to the RCP4.5 scenario, in the South of Ukraine in the period 2021-2050, a significant decrease in the maximum runoff of spring floods is predicted. For example, a 75-80% decrease is predicted for the rivers of the Black Sea, the Southern Bug basin, and the Azov River; in the central part of the studied territory and the northeast - a decrease of spring flood by 65-70%. The simulation results under the RCP8.5 scenario are somewhat different. The greatest decrease in maximum runoff is expected in the upper part of the Southern Bug and Azov river basins - up to 80%, in the rest of the territory by 2050, a decrease in spring flood by 65-70% is predicted.

1.Ovcharuk, V.A., Hopchenko, Y.D. The modern method of maximum spring flood runoff characteristics valuation for the plain rivers of Ukraine. Ukrainian Geographical Journal, 2018(2), pp. 26–33