DOI: 10.31577/ahs-2021-0022.02.0021

ACTA HYDROLOGICA SLOVACA

Volume 22, No. 2, 2021, 177 – 186

Peak maxima on the rivers of the Prut and Siret basins (within Ukraine)

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The study performed in the article revealed how the daily mean maximum discharge of water runoff and peak discharge of water runoff corresponding to this day on the rivers in the Prut and Siret basins are correlated. There are only the upper reaches of these rivers with a total catchment area of 11300 km^2 within Ukraine. Climatic (significant precipitation) and orographic (35% of the territory of these basins is mountain Carpathians) conditions of the Prut and Siret basins contribute to the formation of significant maxima on rivers during rain floods, which often become dangerous with devastating effects and provide the highest peaks in the year. The analysis of maxima is based on the use of historical series of observations at 12 hydrometric gauges. As a result, we found that for small rivers in the mountains, maximum peaks exceed the daily mean maximum discharges on average by 1.8–2.0 times. In the foothills with an increase in the area of the studied catchments and with a decrease in slopes and heights they exceed by 1.4–1.7 times, and with access to the plain – by 1.0–1.3 times. Such research is influential in assessing and forecasting the hazard of the hydrological situation on rivers.

KEY WORDS: Prut and Siret rivers basins, Ukraine, maximum river runoff, daily mean maximum discharge of water runoff, peak discharge of water runoff

Introduction

The maximum river runoff is one of the important extreme regime characteristics of river water runoff. It causes various manifestations of catastrophic situations (flooding of territories, settlements, destruction of bridges, buildings, hydraulic structures, etc.). High rises in water levels and a corresponding increase in water discharges are observed on rivers during periods of spring freshets and floods. They depend on the intensity and duration of water supply to the watershed basin surface, also the flow rates and the state of the catchment. The maximum river runoff is observed at the peak of the main wave of floods or freshets. The maximums on the rivers are characterized by the daily mean maximum discharge of water runoff (defined as an average over the periods daily measurement) or peak discharge of water runoff (the absolute maximum of the day). On small rivers, there could be significant differences in values between these maximum values, but the larger the river, the smaller these differences. Especially, such differences can be traced in mountainous regions, where, flowing from mountains with large slopes, rivers pass into the foothills and then go to the plain or lowland (Lukianets and Moskalenko, 2019b; Lukianets et al., 2019).

The main purpose of the study is to identify how the daily mean maximum and peak maximum of water runoff of the day on the rivers in the Prut and Siret basins are related. This is an influential issue in assessing and forecasting the hazard of the hydrological situation on rivers.

Prut and Siret are the rivers in southeastern Europe (Fig. 1). They belong to the Danube river basin (Black Sea basin) and they are its left tributaries. Only the upper reaches of the Prut and Siret rivers are located within Ukraine. They originate in the Carpathian Mountains. The length of the Prut River in Ukraine is 272 km, the Siret River is 115 km. The total catchment area of these rivers in Ukraine is 11300 km^2 (Lukianets and Moskalenko, 2019a). The heights of the terrain in these basins are distributed as follows: 55% of the study area is within the heights of 200–400 m a.s.l., 16% – 400–800 m a.s.l. and 29% – above 800 m a.s.l.

The Prut and Siret river basins (within Ukraine) belong to areas with a complex nature of atmospheric processes and weather conditions that associated with the location of the watershed basins on the border of circulating systems of temperate and subtropical latitudes and with a pronounced influence of mountain systems. For the south of Eastern Europe, Ukraine, and for the basins of the Prut and Siret rivers, the following circulation features are most characteristic: the predominance of the anticyclonic circulation during the year; increased

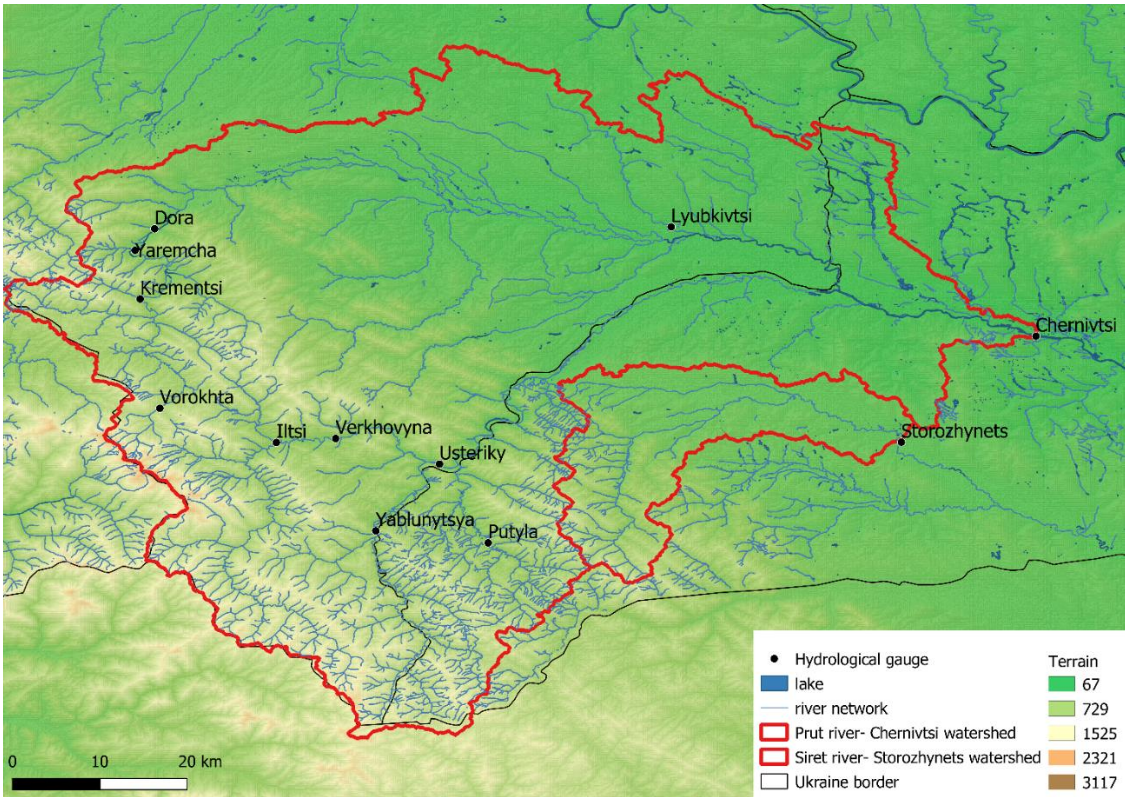


Fig. 1. Area of investigation.

activity of atmospheric processes and sudden changes in weather in the cold season; weakening of the activity of atmospheric processes and the development of intensive convection in the warm season.

Average annual precipitation in the Prut and Siret basins generally increases with the height of the area from 630–660 mm to 1400–1420 mm (Balabukh and Lukianets, 2011). In some years, the annual amount of precipitation can reach from 940 to 1850 mm (also according to the altitude of the territory). However, there were years when they did not exceed 370–560 mm in most parts of basin, and 1000 mm at an altitude above 1000 m.

In the water regime, spring floods are observed, but rain floods prevail in the warm season. They are those who acquire the nature of dangerous phenomena with destructive consequences and provide high maximums per year. Snow – rain floods of the cold period occur on the studied rivers, but they are not typical.

The intensity of the development of rain floods in the basins of the Prut and Siret rivers can be represented by the following data. In the section of the gauging station on mountain rivers, the time interval between the onset of the precipitation core and the flood maximum from a drainage area of 1000–1200 km^2 is 6–10 hours (Grebin et al., 2012). The mountainous part of the basins belongs to the main flow formation zone.

Material and methods

To accomplish the tasks set, statistical methods for processing hydrometeorological information were used (determining the numerical characteristics of random variables, testing statistical hypotheses for the homogeneity of data series, statistical analysis of dependencies between variables, etc.).

A database has been created for a long-term period – the daily mean maximum water discharge and the maximum peak water discharge corresponding them on the rivers of the Prut and Siret river basins. There are 12 gauging stations in the study area, which monitor the flow of water in rivers. Eleven of them are located in the Prut basin and 1 gauging station is in the Siret basin. Table 1 lists the hydrological gauges, periods of water flow monitoring, and hydrographic characteristics of rivers and their catchment areas.

Analyzing the hydrographic characteristics (Table 1), we see that the watersheds in the Prut basin have a fairly large range of their average heights – 450–1200 m. The average height of the Siret – Storozhynets′ river basin is 590 m. The areas of the studied watersheds in the Prut basin vary from 18.1 km^2 (Kam″yanka river – Dora) to 1500 km^2 (Cheremosh river – Usteriky). The point to the outlet of the Prut River basin within Ukraine is the city of Chernivtsi (Prut river- Chernivtsi) with a catchment area of 6890 km^2. The catchment area of the Siret river – Storozhynets′ is 672 km^2.

The source data bank (daily mean maximum water discharge and corresponding them the maximum peak water discharge) was created from the beginning of observations up to 2016 inclusive. At 83% of

Table 1. Hydrographic characteristics of rivers and their catchments of the Prut and Siret river basins

River – Hydrological gauge	Observation period (number of years)	Fall of the river [‰]		River basin				
		Average	Weighted average	Area [km^2]	Mean altitude [m a.s.l.]	Average fall [%]	Waterlogged [%]	Wooded [%]
Siret river – Storozhynets′	1953–2016 (64)	9.3	4.7	672	590	144	<1	51
Prut river – Vorokhta	1978–2016 (39)	–	–	48.3	–	–	–	–
Prut river – Krementsi	1959–2016 (57)	27.5	11.9	366	1000	285	0	85
Prut river – Yaremcha	1950–2016 (67)	21.8	9.6	597	990	281	0	87
Prut river – Chernivtsi	1895–1911, 1920–1924, 1926–1935, 1945–2016 (109)	7.8	3.6	6890	450	–	<1	42
Kam″yanka river – Dora	1946–2016 (71)	111	66.4	18.1	870	446	0	76
Chornyava river – Lyubkivtsi	1984–2016 (32)	–	–	333	–	–	–	–
Cheremosh river – Usteriky	1957–2016 (59)	9.8	9.0	1500	1100	–	0	51
Bilyy Cheremosh river – Yablunytsya	1958–2016 (59)	19.0	10.2	552	1200	334	0	56
Chornyy Cheremosh river – Verkhovyna	1958–2016 (59)	16.7	11.4	657	1200	321	0	57
Il′tsya river – Il′tsi	1959–2016 (58)	40.2	30.5	86.1	1100	303	0	52
Putyla river – Putyla	1963–2016 (54)	24.2	15.8	181	960	325	0	50

hydrological stations on the rivers of the Prut and Siret basins have observation periods for water runoff of 54÷72 years, only 2 stations have an observation period less than 40 years.

Results and discussion

Statistical parameters were determined for the series of maximum peak water discharge, as the most important in practical application in hydrological calculations and forecasts. Variation coefficient of maximum annual peak water runoff on the rivers of the Prut and Siret basins in the vast majority vary in the range of 0.8–1.0. The skewness coefficients have positive values and they are generally in the range of 1.8–2.5 (Table 2).

Relative values of root mean square errors σ_n [%] for each gauge is determined by the Eq. (1):

$$\sigma_n = \pm(100 \cdot C_v)/\sqrt{n} \quad (1)$$

where

C_v – variation coefficient,

n – number of years of continuous observations.

The relative values of the root mean square errors do not exceed 15–20%. The highest value σ_n=19.8% was obtained for Chornyava river – Lyubkivtsi, which is explained by a short series of observations. But in general, the series of observations of the maximum water runoff on the studied rivers are representative.

A quantitative assessment of the temporally homogeneity of the maximum annual water discharges at a 5% significance level on the rivers of the Prut and Siret basins was carried out according to the standard parametric criteria of Student and Fisher (Table 3). One of the most stringent, the Wilcoxon test, was used from nonparametric criteria (Table 4).

Checking the equality of mean values by Student's test (statistics t) and equality of variance by Fisher's test (statistics F) showed that the hypothesis of homogeneity of samples of the maximum annual water runoff for all rivers of the Prut and Siret basins is accepted. The result is the same for Wilcoxon's test (statistics of the number of inversions U).

Due to the fact that water discharge is directly dependent on the catchment area of the river, the water discharge of two or more different rivers is incomparable, because their catchment areas are not the same. To enable a spatial comparison of the maximum values on the rivers of the Prut and Siret basins, was used such characteristic as the specific discharge of water runoff. This indicator shows the amount of water (dm^3 or liter) flowing down in one second (1 s) from a unit area (1 km^2) of the river basin. Or, we can say that the specific discharge of water runoff is the discharge rate from 1 km^2 of the basin as shown in Eq. (2):

$$q = 1000 \cdot Q \cdot F^{-1} \quad (2)$$

where

q – specific discharge of water runoff [l s^{-1} km^{-2}],

1000 – conversion factor from cubic meters to cubic decimeters or liters,

Q – discharge of water runoff [m^3 s^{-1}],

F – catchment area [km^2].

To clarify the differences in the values of the specific discharge of water runoff (daily mean maximum vie with the corresponding peak maximum) on the rivers of the Prut and Siret basins, we constructed dependences between the indicated characteristics.

Fig. 2 shows that the relationships between the maximum mean daily specific discharge and the corresponding maximum peak specific discharge on the rivers of the investigated catchments are quite significant. The approximation coefficients R^2 vary from 0.59 to 0.97, which corresponds to the correlation coefficients r – from 0.77 to 0.98. But the ratios themselves between the daily mean maximums and the corresponding peak maxima on the rivers of the Prut and Siret basins are different.

To identify patterns in detected differences graphs of relations between the maxima and the mean altitude of the catchments and their areas were constructed. (Fig. 3). As follows from Fig. 3 the greatest ratio between the peak maximum and daily mean maximum of water discharge is observed in small mountain watersheds with mean altitude of 1000–1200 m a.s.l. where, the peak maxima

Table 2. Statistical parameters of the maximum peak water runoff on the rivers of the Prut and Siret basins

River – Hydrological gauge	Catchment area	Maximum annual water runoff (peak values)				
		Normals		Variation coefficient Cv	Skewness coefficient Cs	Relative root mean square error $\boldsymbol{\sigma_n}$
	[km^2]	Discharge of water runoff [m^3 s^{-1}]	Specific discharge of water runoff [l s^{-1} km^{-2}]			[%]
Siret river – Storozhynets′	672	177	265	0.96	2.62	12.0
Prut river – Vorokhta	48,3	31.6	666	0.56	1.42	8.92
Prut river – Krementsi	366	121	331	0.72	2.17	9.55
Prut river – Yaremcha	597	309	518	0.84	2.26	10.3
Prut river – Chernivtsi	6890	1131	164	0.83	1.99	9.84
Kam″yanka river – Dora	18.1	15.2	855	0.83	1.55	9.88
Chornyava river – Lyubkivtsi	333	22.7	68.2	1.12	2.22	19.8
Cheremosh river – Usteriky	1500	393	261	0.60	2.05	7.80
Bilyy Cheremosh river – Yablunytsya	552	158	285	0.84	1.80	11.0
Chornyy Cheremosh river – Verkhovyna	657	164	250	0.85	2.91	11.0
Il′tsya river – Il′tsi	86.1	42.1	489	0.99	2.06	13.0
Putyla river – Putyla	181	62.0	343	0.94	1.86	12.8

Table 3. Results of the test for the temporal homogeneity of the maximum water runoff of the rivers of the Prut and Siret basins according to parametric criteria (Student's and Fisher's) at a significance level of 2α = 5%

River – Hydrological gauge	Homogeneity criteria					
	Student's, statistics t			Fisher's, statistics F		
	Statistics value		Results of hypothesis test	Statistics value		Results of hypothesis test
	empirical t_e	analytical t_a	$t_e < t_a$	empirical F_e	analytical F_a	$F_e<F_a$
Siret river – Storozhynets′	0.15	2.00	homogenous	1.26	2.14	homogenous
Prut river – Vorokhta	0.13	2.04	homogenous	3.49	2.86	heterogeneous
Prut river – Krementsi	0.67	2.01	homogenous	1.94	2.19	homogenous
Prut river – Yaremcha	1.56	2.00	homogenous	3.37	2.10	heterogeneous
Prut river – Chernivtsi	0.94	2.00	homogenous	2.02	2.06	homogenous
Kam″yanka river – Dora	0.81	2.00	homogenous	1.46	2.06	homogenous
Chornyava river – Lyubkivtsi	0.48	2.07	homogenous	3.18	3.33	homogenous
Cheremosh river – Usteriky	0.82	2.01	homogenous	1.38	2.17	homogenous
Bilyy Cheremosh river – Yablunytsya	0.16	2.01	homogenous	2.01	2.17	homogenous
Chornyy Cheremosh river – Verkhovyna	0.88	2.01	homogenous	1.96	2.18	homogenous
Il′tsya river – Il′tsi	1.51	2.01	homogenous	1.46	2.19	homogenous
Putyla river – Putyla	1.25	2.01	homogenous	1.46	2.25	homogenous

Table 4. Results of the test for the temporal homogeneity of the maximum water runoff of the rivers of the Prut and Siret basins according to nonparametric criteria (Wilcoxon's) at a significance level of 2α = 5%)

River – Hydrological gauge	Empirical quantity of inversions, U_e	analytical critical values of statistics, U_a		Results of hypothesis test
		lower $U_{a, L}$	upper $U_{a, U}$	
Siret river – Storozhynets′	528	366	658	homogenous
Prut river – Vorokhta	150	120	260	homogenous
Prut river – Krementsi	438	283	529	homogenous
Prut river – Yaremcha	648	405	718	homogenous
Prut river – Chernivtsi	680	474	822	homogenous
Kam″yanka river – Dora	565	460	800	homogenous
Chornyava river – Lyubkivtsi	127	76.0	180	homogenous
Cheremosh river – Usteriky	490	306	564	homogenous
Bilyy Cheremosh river – Yablunytsya	366	306	564	homogenous
Chornyy Cheremosh river – Verkhovyna	474	306	564	homogenous
Il′tsya river – Il′tsi	331	294	547	homogenous
Putyla river – Putyla	309	251	478	homogenous

typically exceed in 1.8–2.0 times the daily ones. From catchments with mean altitude of 400 m a.s.l. such ratios decrease to 1.1–1.3 with increasing catchment area.

Mentions of catastrophic floods in the area of investigative appear in chronicles and in literary sources from the 12th century (1229, 1230, 1464, 1668, 1674, 1700, 1730, 1750). The longest series of observations of the maximum water runoff has a hydrological gauge on the Prut River near the city of Chernivtsi (since 1895). See Table 1. But such observations are intermittent. According to the available data (Fig. 4) it can be stated that for the last 120 years in the Prut and Siret basins high maxima during floods were observed in 1897, 1908, 1911, 1930, 1941, 1948, 1955, 1969, 1974, 1996, 2008, 2010 (Tymulyak, 2012).

There is not enough information about the characteristics of some floods, for example, about the flood in September 1941, but it is known from the literature that then flood waters flooded settlements in the river valleys of the Prut basin, and led to significant destruction and casualties.

At other hydrological stations, systematic observations of maximum water runoff began mainly in the 1950s (Table 1).

To be able to compare the intensity of formation of maximum peak values on the rivers of the Prut and Siret basins we performed a standard conversion of maximum peak specific discharge to modular coefficient through the process of normalization k_q (3):

$$k_{(q,i)} = q_i / \bar{q} \tag{3}$$

where

q_i – maximum peak specific discharge for long-term period [l s^{-1} km^{-2}],

$\bar{q}$ – normal value of maximum peak specific discharge [l s^{-1} km^{-2}].

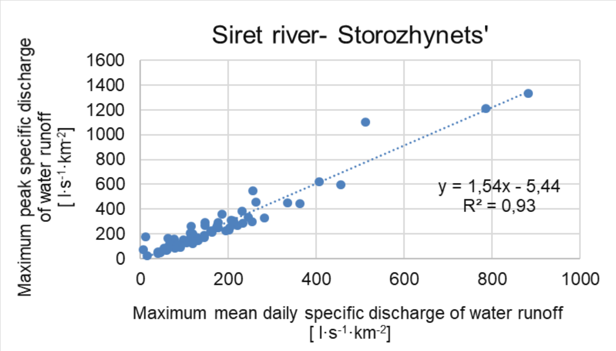
Fig. 5 shows temporal change of modular coefficients in different regions of the investigated area for the period of observations 1945–016.

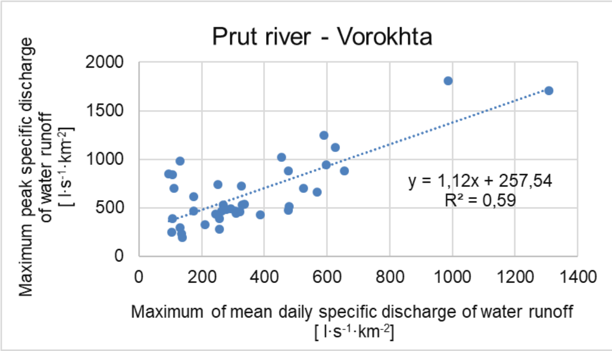
As we can see, in the spatial relation (Fig. 5A-B) high floods (at $k_q \geq 2$) occur synchronously in both regions of the study area, although different intensity of peak peaks is noticeable. Over the past 60–70 years in the Prut river basin extremely high peak runoff ($k_q \approx 5$) was noted in 1969 and currently it remains the absolute maximum (Fig. 5A). In the basin of the Cheremosh and Siret rivers, an extremely high maximum, which was reached during the observation period (Fig. 5B), was recorded in 2008 ($k_q \approx 5$ as well).

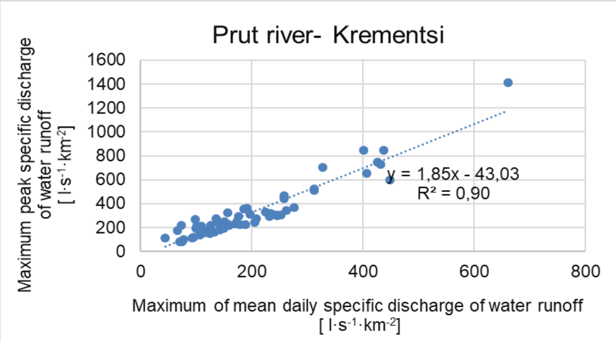
Fig. 5C presents temporal change of modular coefficients for small mountain rivers. Their catchment areas do not exceed 180 km^2, and the mean altitude of the basins is 900–1100 m a.s.l. On such rivers it is possible to allocate many equivalent high peak maxima in different years. It is caused by sensitivity of small mountain catchments and their fast reaction to heavy local rains in mountains.

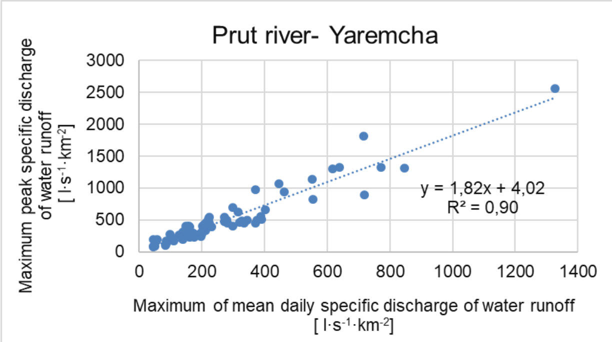
Table 5 contains values of extremely high maximum peak specific discharge which were formed during the observation period (1969–2008) on the rivers of the Prut and Siret basins. Their comparison is shown in Fig. 6. The largest maximum peak specific discharges associated with small mountain catchments and reach values 3000–3500 l s^{-1} km^{-2}.

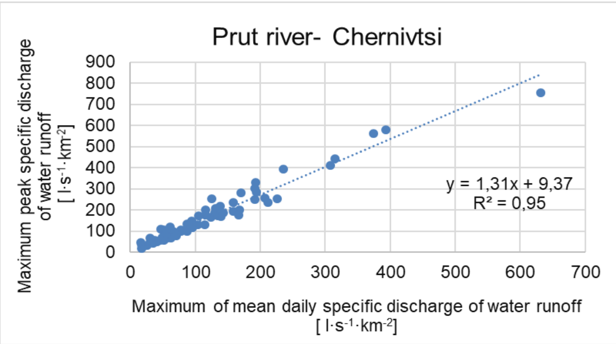
On the rivers of the Prut and Siret basins maximum values are ten times higher than the average annual runoff. To identify the influence of the maximum peak runoff at an average annual runoff of the rivers of Siret and Prut basins we constructed correlations between them. The generalization of such influence is carried out by the coefficient of determination denoted R^2 and presented on Fig. 7. It is an indicator of the degree of connection between variables and shows the share of the scatter relative to the mean value, which is "explained" by the constructed regression.

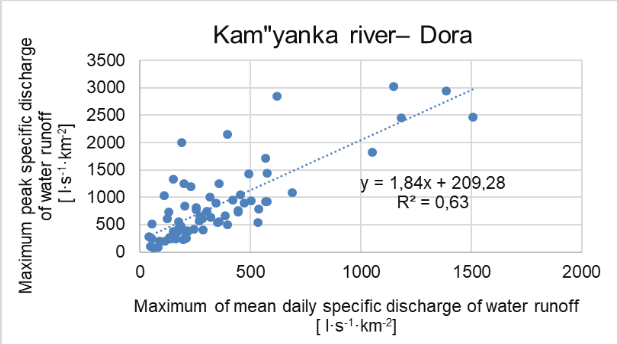

Siret river- Storozhynets'
Maximum peak specific discharge of water runoff [l·s-1·km-2]
0 200 400 600 800 1000 1200 1400 1600
0 200 400 600 800 1000
y = 1,54x - 5,44
R² = 0,93
Maximum mean daily specific discharge of water runoff [l·s-1·km-2]

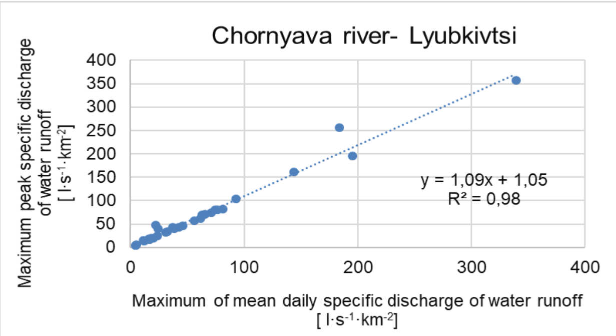

Prut river - Vorokhta
Maximum peak specific discharge of water runoff [l·s-1·km-2]
0 500 1000 1500 2000
0 200 400 600 800 1000 1200 1400
y = 1,12x + 257,54
R² = 0,59
Maximum of mean daily specific discharge of water runoff [l·s-1·km-2]

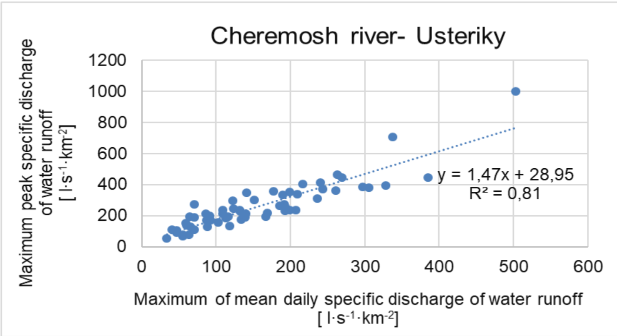

Prut river- Krementsi
Maximum peak specific discharge of water runoff [l·s-1·km-2]
0 200 400 600 800 1000 1200 1400 1600
0 200 400 600 800
y = 1,85x - 43,03
R² = 0,90
Maximum of mean daily specific discharge of water runoff [l·s-1·km-2]

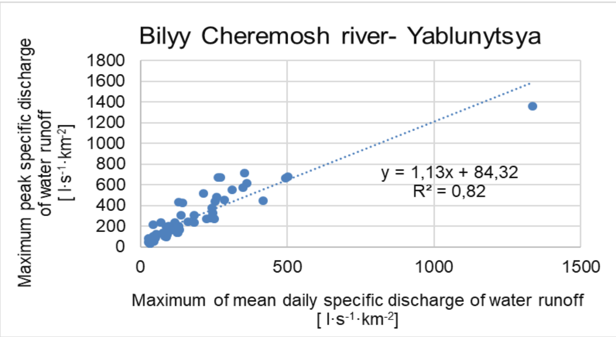

Prut river- Yaremcha
Maximum peak specific discharge of water runoff [l·s-1·km-2]
0 500 1000 1500 2000 2500 3000
0 200 400 600 800 1000 1200 1400
y = 1,82x + 4,02
R² = 0,90
Maximum of mean daily specific discharge of water runoff [l·s-1·km-2]

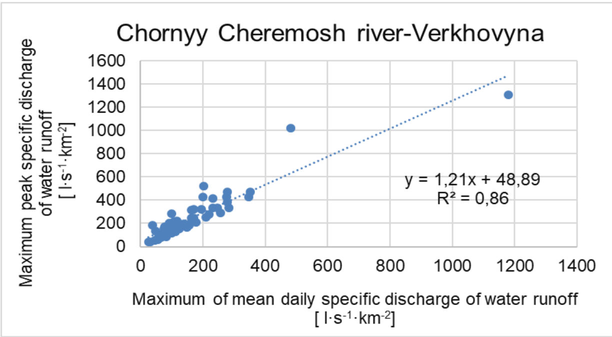

Prut river- Chernivtsi
Maximum peak specific discharge of water runoff [l·s-1·km-2]
0 100 200 300 400 500 600 700 800 900
0 100 200 300 400 500 600 700
y = 1,31x + 9,37
R² = 0,95
Maximum of mean daily specific discharge of water runoff [l·s-1·km-2]


Kam"yanka river– Dora
Maximum peak specific discharge of water runoff [l·s-1·km-2]
0 500 1000 1500 2000 2500 3000 3500
0 500 1000 1500 2000
y = 1,84x + 209,28
R² = 0,63
Maximum of mean daily specific discharge of water runoff [l·s-1·km-2]


Chornyava river- Lyubkivtsi
Maximum peak specific discharge of water runoff [l·s-1·km-2]
0 50 100 150 200 250 300 350 400
0 100 200 300 400
y = 1,09x + 1,05
R² = 0,98
Maximum of mean daily specific discharge of water runoff [l·s-1·km-2]


Cheremosh river- Usteriky
Maximum peak specific discharge of water runoff [l·s-1·km-2]
0 200 400 600 800 1000 1200
0 100 200 300 400 500 600
y = 1,47x + 28,95
R² = 0,81
Maximum of mean daily specific discharge of water runoff [l·s-1·km-2]


Bilyy Cheremosh river- Yablunytsya
Maximum peak specific discharge of water runoff [l·s-1·km-2]
0 200 400 600 800 1000 1200 1400 1600 1800
0 500 1000 1500
y = 1,13x + 84,32
R² = 0,82
Maximum of mean daily specific discharge of water runoff [l·s-1·km-2]


Chornyy Cheremosh river-Verkhovyna
Maximum peak specific discharge of water runoff [l·s-1·km-2]
0 200 400 600 800 1000 1200 1400 1600
0 200 400 600 800 1000 1200 1400
y = 1,21x + 48,89
R² = 0,86
Maximum of mean daily specific discharge of water runoff [l·s-1·km-2]

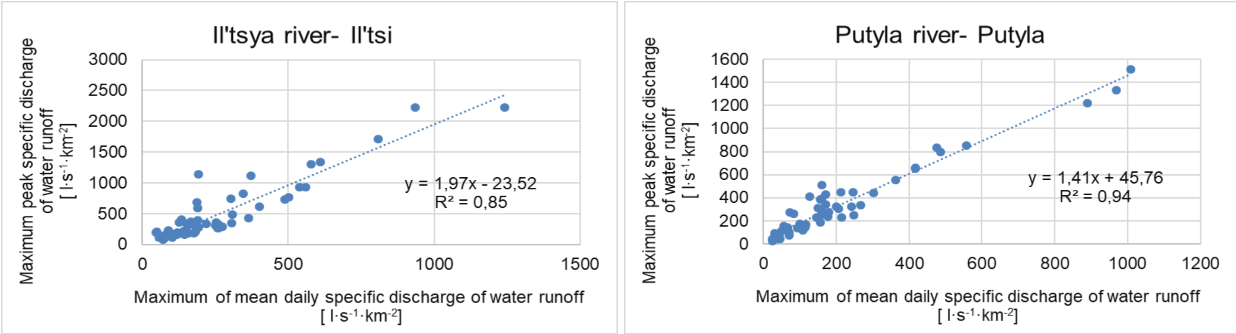


Fig. 2. Ratios between the maximum mean daily specific discharge and the corresponding maximum peak specific discharge on the rivers of Prut and Siret basins.

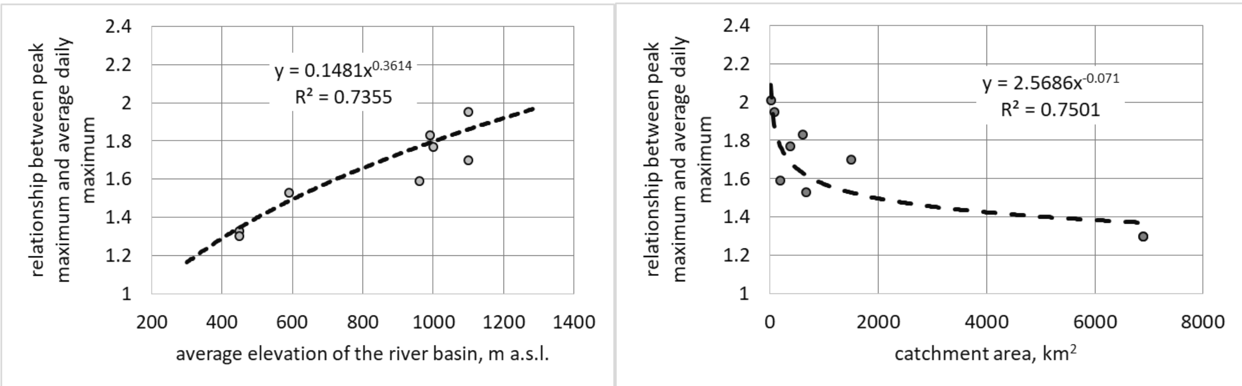


Fig. 3. Dependencies of ratios between peak maximum and average daily maximum to: a) average elevations, b) catchment area in the rivers of the Prut and Siret basins.

Table 5. Maximum peak water runoff on the rivers of the Prut and Siret basins

River – Hydrological gauge	Area of the river basin [km²]	Mean altitude [m a.s.l.]	Maximum peak specific discharge [l s⁻¹ km⁻²] 1969 p.	2008 p.
Siret river – Storozhynets′	672	590	1214	1336
Prut river – Vorokhta	48.3	–	–	1805
Prut river – Krementsi	366	1000	1413	746
Prut river – Yaremcha	597	990	2563	1327
Prut river – Chernivtsi	6890	450	755	579
Kam″yanka river – Dora	18.1	870	2939	3028
Chornyava river – Lyubkivtsi	333	–	–	161
Cheremosh river – Usteriky	1500	1100	707	1000
Bilyy Cheremosh river – Yablunytsya	552	1200	672	1359
Chornyy Cheremosh river – Verkhovyna	657	1200	1304	1018
Il′tsya river – Il′tsi	86.1	1100	2230	1707
Putyla river – Putyla	181	960	652	1331

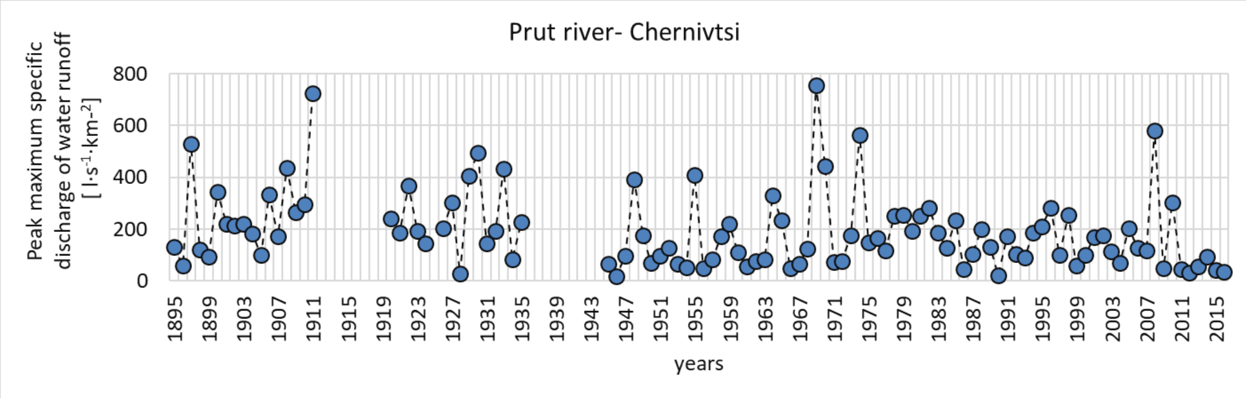


Fig. 4. Peak maxima according to observations (1895–2016). Prut River – Chernivtsi.

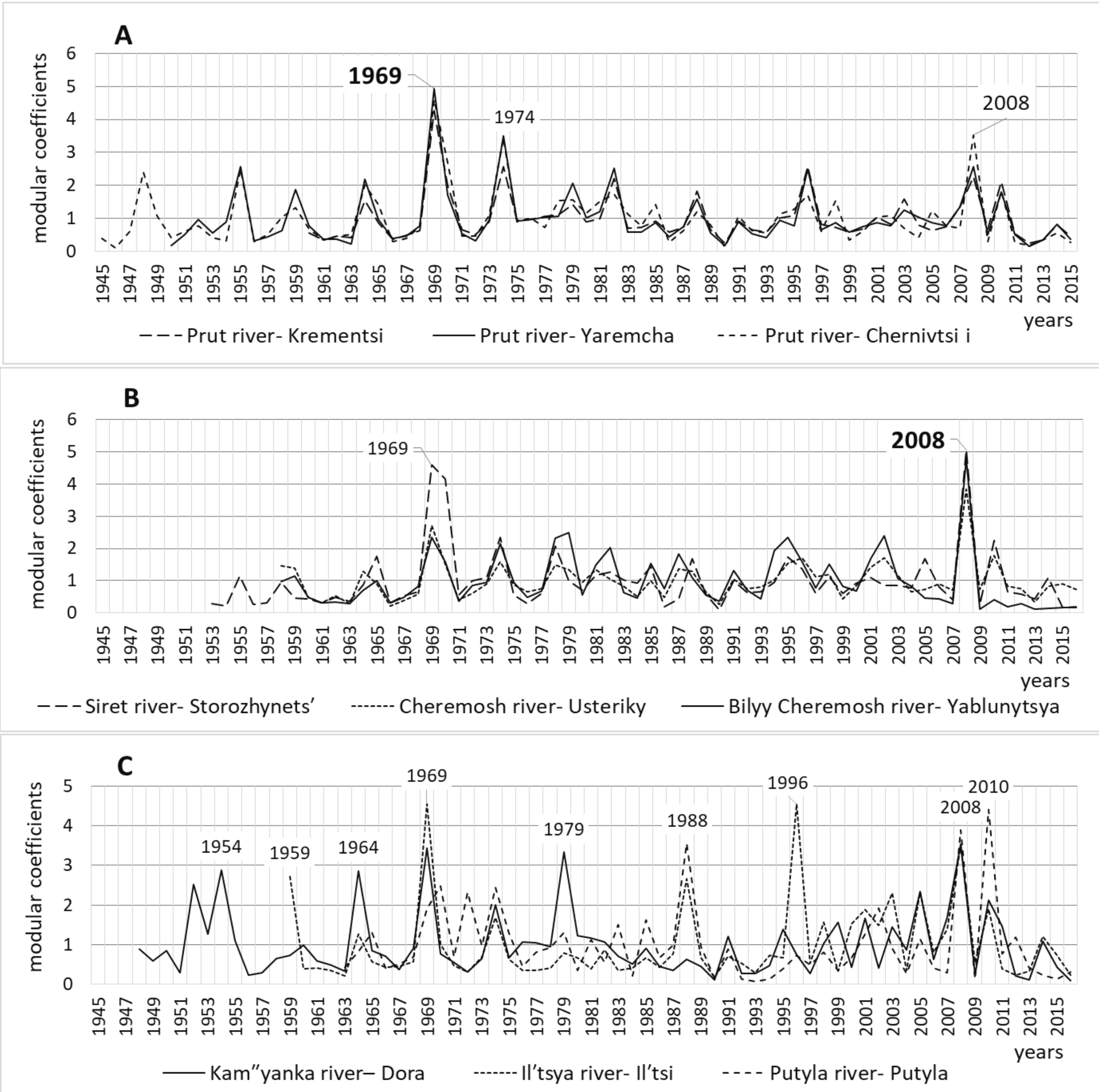


Fig. 5. Temporal change of modular coefficients in different regions of the investigated area. 1945–2016. A) – in the Prut river basin (to Chernivtsi city), B) – in the basin of the river Cheremosh (tributaries of the river Prut), C) – in the basin of the Siret river.

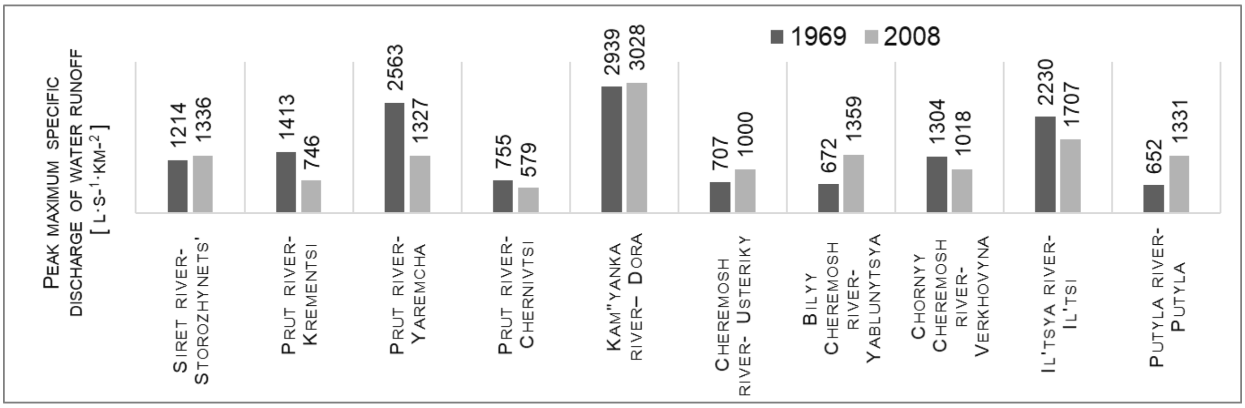


Fig. 6. Comparison of maximum peak specific discharge on the rivers of the Prut and Siret basins. 1969–2008.

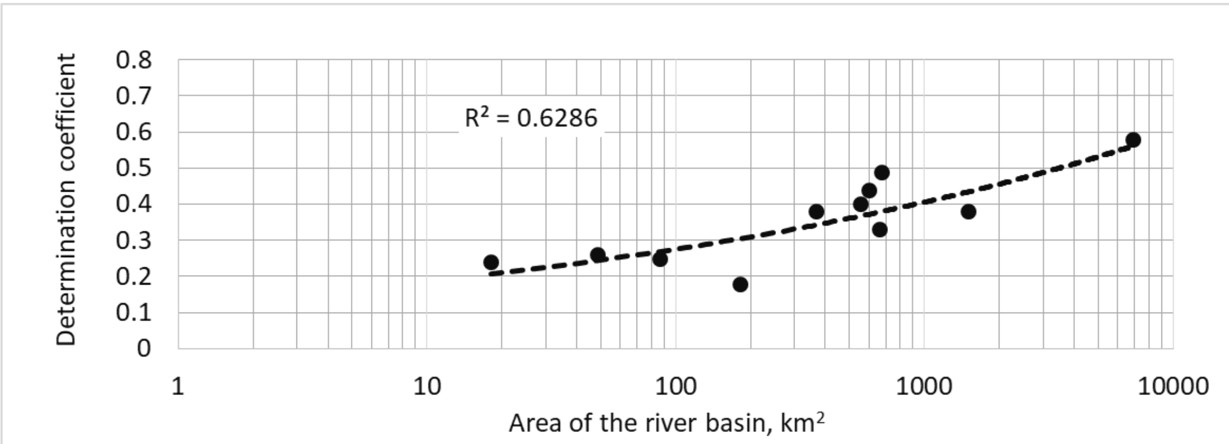


Fig. 7. Changes in the degree of influence (based on the values of the determination coefficients R^2) of the peak runoff on the average annual runoff of the rivers of the Prut and Siret basins, depending on the areas of their basins.

Maximum peak annual water runoff in small river (from catchment areas of 100–200 km^2) has little effect on the value of the average annual, only 15–20% (Fig. 7). For rivers with catchment areas of 500–2000 km^2, the formation of the average annual runoff by 30–50% determines the values of maximum peak. For hydrological gauge on the Prut river that is located near the city of Chernivtsi (Prut river – Chernivtsi) with the largest catchment area of 6890 km^2 the degree of such impact increases to 60%.

Conclusion

The physical and geographical conditions of the Prut and Siret river basins (first of all, climatic and orographic) contribute to the formation of significant maxima on the rivers. The study area has elements of mountain and foothill orography. The water regime of rivers is characterized by spring freshets, but rain floods in the warm period of the year predominate, and snow-rain floods of the cold period are not inherent in these catchments. It is in the warm period we observe the greatest maximum peaks over the year, which have a rather intensive development during their formation. The time interval between the onset of the precipitation core and the maximum flood for the catchment area of 1000–1200 km^2 does not exceed 6–10 hours. Therefore, between the peak maximum and daily mean maximum on the rivers of Prut and Siret basins are observed significant differences in values. In mountain watersheds with mean altitude of 1000–1200 m a.s.l, the peak maxima typically exceed in 1.8-2.0 times the daily ones. From catchments with mean altitude of 400 m a.s.l. such ratios decrease to 1.1–1.3.

The highest maximum peaks of water runoff on the rivers in the Prut and Siret basins during the observation period were recorded in 1969 and 2008. The highest maximum peak specific discharge can reach 3000–3500 l s^{-1} km^{-2} on small mountain rivers with small-scale catchment areas.

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