COMMENTS ON THE DISCHARGE OF THE CRIŞUL REPEDE RIVER AT THE ORADEA HYDROMETRIC STATION BETWEEN 2011-2016

Köteles Nandor*, Sarca Gheorghe*

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048, Oradea, Romania, e-mail: kotelesnandor@yahoo.com; sarcagheorghe@yahoo.com

Abstract

The paper presents the discharge fluctuation of the Crişul Repede river between 2012 and 2016, based on data recorded at the Oradea hydrometric station. The water discharge data were processed using mathematical and statistical methods, and the results were graphed.

The analysis of the water discharge monthly averages shows that the highest discharge values were recorded in April 2013, 67.2 m^3/s, followed by 47.4 m^3/s in February 2016 and a discharge of 40.2 m^3/s in June 2016. The lowest discharges occurred in 2012, in September (4.0 m^3/s), October, November (4.2 m^3/s) and December (4.7m^3/s).

The maximum discharge of the Crişul Repede river in the period included in the study was recorded on 6 June 2016, 153.9 m^3/s, while the minimum discharge occurred on 15 September 2014, 1 m^3/s.

Key words: averages, discharge, maximums, minimums

INTRODUCTION

The discharge of a river can be influenced by several factors, with the climatic one being the most important. The amount of precipitation is directly responsible for the increase in the water discharge of rivers (Vladimirescu, 1978; Pişota et al., 2010; Köteles, 2010, 2014, 2015). From one month to another, the frequency and intensity of wet and dry air advections change, and the thermal and dynamic convection occurs with different parameters, thus, the amount of precipitation will vary from month to month, following the patterns of the corresponding seasons (Măhăra, 1979; Köteles, Pereş, 2011, 2012, 2015; Pereş, 2012, 2015; Pereş, Köteles, 2014, 2015).

Over the year, in the water catchment area of the Crişul Repede river there are two periods with the highest rainfall amounts (June, December) and two with the lowest ones (January-March, October). The main maximum is typical for the whole country and shows the continental character of the climate, while the secondary maximum shows the influence of the Mediterranean cyclonic circulation in the region studied (Moza, 2008, 2009; Pereş, Costea, 2015).

Air temperature also has an influence on discharge, as snow accumulated in winter time melts when temperature increases. When this

happens, discharge can increase suddenly and the results are floods (Posea, 1968; Morariu et al., 1970; Pişota, Buta, 1983; Pişota, 1995; Gâştescu, 1990, 1998; Savin, 2007; Pişota et al., 2010).

MATERIAL AND METHOD

The paper deals with the Crișul Repede river water discharge observations at the Oradea hydrometric station between 2012 and 2016. The discharge data were provided by the the "Romanian Water" National Administration, Crișuri Water Branch Oradea.

The data were processed using mathematical and statistical methods and the results were graphed to show the fluctuations of discharges in time.

RESULTS AND DISCUSSION

Evolution of monthly averages of water discharges

The processing of water discharge data shows that in 2012 the highest discharges occurred in May, 39.5 m^3/s, June, 36.4 m^3/s and in April, 27.4 m^3/s.

The lowest discharges were recorded in September, 4.0 m^3/s, followed by October and November, 4.2 m^3/s and December, 4.7 m^3/s.

In 2013, the highest discharges occurred in April (67.2 m^3/s), March (39.1 m^3/s) and June (28.3 m^3/s), and the lowest ones in January (6.7 m^3/s), October (7.2 m^3/s) and September (8.1 m^3/s).

Regarding 2014, the highest discharges were recorded in December, August, May – 28.5 m^3/s, 24.7 m^3/s and 21.1 m^3/s. The months with the lowest discharges are November, 11.5 m^3/s, and October, 13.8 m^3/s.

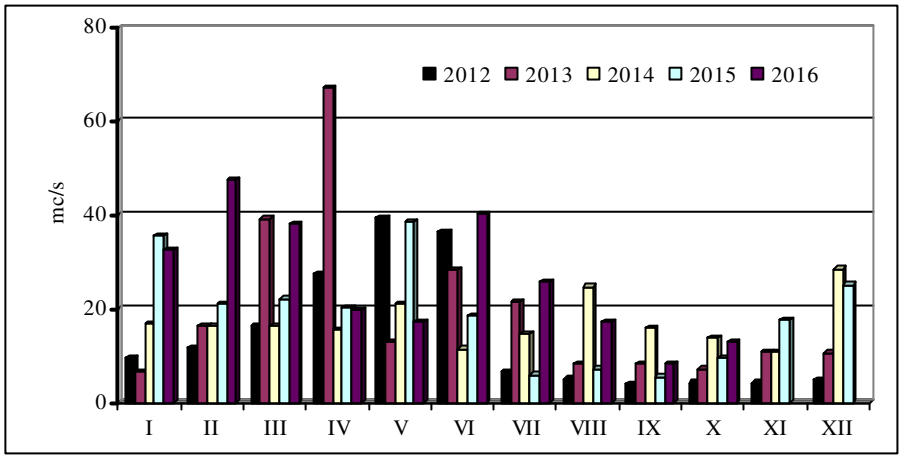

Fig. 1. Evolution of monthly averages of Crișul Repede river water discharges at the Oradea hydrometric station, 2012 - 2016

The highest discharges in 2015 were recorded in May (38.5 m^3/s), January (35.4 m^3/s) and March (22.1 m^3/s), and the lowest ones in September (5.5 m^3/s), July (5.9 m^3/s) and August (5.5 m^3/s).

In the last year included in the study, 2016, the highest discharges occurred in February (47.4 m^3/s), June (40.2 m^3/s) and March (38.2 m^3/s), and the lowest ones in September (8.3 m^3/s), August (17.2 m^3/s) and May (17.3 m^3/s) (Fig. 1).

Monthly discharge totals of the Crișul Repede river

The calculation of the monthly discharge totals for the five years included in the study (2012 – 2016) shows that the highest discharge total was recorded in April 3013, 2015.99 m^3/s, followed by February 2016, 1373.37 m^3/s and May 2012, 1225.07 m^3/s. The lowest discharge totals were recorded in 2012, in September (120.03 m^3/s), November (126.32 m^3/s) and October (128.73 m^3/s) (Fig. 2).

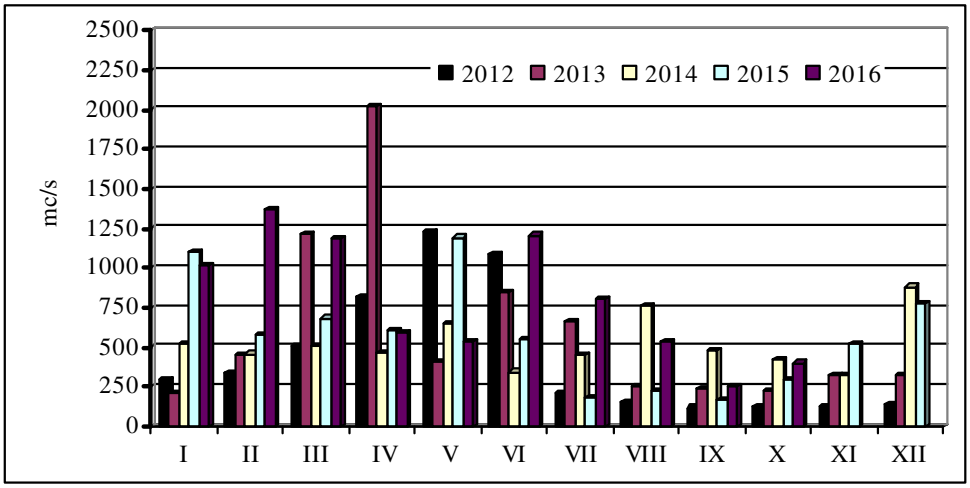

Fig. 2. Monthly discharge totals of the Crișul Repede river at the Oradea hydrometric station, 2012 - 2016

Maximum discharges of the Crișul Repede river

During the period included in the study (2012-2016), the maximum discharges of the Crișul Repede river were 153.9 m^3/s, on 6 April 2013, followed by 97.2 m^3/s on 8 July 2014. High discharges were also recorded on 20 June 2016, 95.9 m^3/s, on 17 May 2012, 95 m^3/s, as well as on 13 January 2015, 90.5 m^3/s (Table 1).

Table 1

Maximum discharges of the Crișul Repede river, 2012-2016

Year	Max./Date	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2012	Max.	42.3	46.4	74.2	83.8	95	86	16	8.2	17.9	12.7	6.7	54.6
	Date	21	22	21	19	17	13	03	01	28	08	24	21
2013	Max.	16.8	31.8	77	153.9	44.7	72.1	42.2	14.1	15.8	14	22.6	19
	Date	25	08	15	06	31	12	02	28	03	29	09	24
2014	Max.	57.3	53.2	49.1	47.8	47.8	50.5	97.2	92.8	47.8	82.5	78.6	92.8
	Date	23	11	28	01	07	04	08	12	01	24	07	09
2015	Max.	90.5	49.1	78.6	50.5	120	82.5	28.7	35.5	31.4	42.3	80	82.5
	Date	13	06	06	20	27	09	08	28	07	28	26	01
2016	Max.	49.6	58.6	77.1	60.1	33.9	95.9	56.4	57.7	25.6	25.8		
	Date	30	25	03	28	10	20	05	03	01	27		

Minimum discharges of the Crișul Repede river

The lowest minimum discharge of the Crișul Repede river at the Oradea hydrometric station was recorded on 15 September 2014, 1 m^3/s, followed by 1.75 m^3/s on 28 September and 24 October 2012. Low discharges were also recorded on 6 August 2015, 2.5 m^3/s, on 3 January 2013, 28 September 2013 and 15 October 2013, 3.12 m^3/s, as well as on 21 September 2016, a discharge of 4 m^3/s (Table 2).

Table 2

Minimum discharges of Crișul Repede river, 2012-2016

Year	Min./Date	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2012	Min.	4.06	22	4.06	2.65	6	7.5	4.06	3.1	1.75	1.75	2.65	2.65
	Date	11	03	20	10	28	04	24	29	28	24	04	19
2013	Min.	3.12	5.5	6	4.06	7.5	5.5	5.5	5.02	3.12	3.12	4.54	5.5
	Date	03	12	09	18	20	16	04	12	28	15	10	02
2014	Min.	5.02	11	5.63	6.37	6.37	5.63	6	6	1	5.26	5.63	4.9
	Date	07	08	15	06	05	21	01	08	15	03	27	12
2015	Min.	2.83	7.17	7.17	7.17	7.17	3.21	2.72	2.5	2.62	2.83	3.59	2.72
	Date	04	11	31	01	14	17	29	06	09	02	16	26
2016	Min.	6.1	34	9.5	6.8	5.9	9	13.4	6.6	4	4.6		
	Date	03	03	24	19	21	1	14	11	21	01		

CONCLUSIONS

The evolution of water discharge monthly averages over the period included in the study shows that the highest discharges occurred between December and June, and the lowest from July to November.

The high discharges recorded between December and June are due to the significant amount of rainfalls in this period, the main maximum of rainfalls is recorded in June, and the secondary maximum in December, but also to the melting of snow in spring.

The sudden melting of snow leads to floods, which increase the water supplies of streams and rivers, hence the water discharges will also increase significantly.

Acknowledgments

This work was supported by a grant of the Romanian Ministry of Research and Innovation, CCCDI–UEFISCDI, project number 41CI/2017 "Seceta factor de risc pentru culturile din Câmpia Crişurilor" PN–III–P2–2.1–CI –2017–0226 within PNCDI III

REFERENCES

1. Gâştescu P., 1990, Fluviile Terrei. Ed. Sport - Turism, Bucureşti
2. Gâştescu P., 1998, Hidrologie. Ed. Roza vânturilor, Târgovişte
3. Köteles N., 2010, Hidrologie şi hidrogeologie aplicată. Ed. Universităţii din Oradea
4. Köteles N., 2014, Hidrologie. Ed. Universităţii din Oradea
5. Köteles N., 2015, The Multiannual Discharge Fluctuation of Topa River at the Hidişel Hydrological Station. Analele Universităţii din Oradea, Fascicula Protecţia Mediului Vol. XXIV, Anul 20, Ed. Universităţii din Oradea 2015, ISSN 1224-6255, pp.163-166
6. Köteles N., Pereş A.C., 2011, The Conditions of Atmospheric Precipitations in Huedin Depression. Analele Universităţii din Oradea, Fascicula Protecţia Mediului Vol. XVI A, Anul 16, Ed. Universităţii din Oradea, 2011, ISSN 1224-6255, pp.404-410
7. Köteles N., Pereş A.C., 2012, The Crisul Repede Water Quality Features from the Crisuri Hydrographic Basin. Analele Universităţii din Oradea, Fascicula Protecţia Mediului Vol. XIX, Anul 17, Ed. Universităţii din Oradea 2012, ISSN 1224-6255, pp.699-704
8. Köteles N., Pereş A.C., 2012, The Crisul Negru Quality Features from the Crisuri Hydrographic. Analele Universităţii din Oradea, Fascicula Protecţia Mediului Vol. XIX, Anul 17, Ed. Universităţii din Oradea 2012, ISSN 1224-6255, pp.705-710
9. Köteles N., Pereş A.C., 2015, The Multiannual Discharge Fluctuation of the Crişul Negru River at the Tinca Hydrological Station. Analele Universităţii din Oradea, Fascicula Protecţia Mediului Vol. XXIV, Anul 20, Ed. Universităţii din Oradea 2015, ISSN 1224-6255, pp.167-170
10. Măhăra Gh., 1979, Circulaţia aerului pe glob. Ed. Ştiinţifică şi Enciclopedică, Bucureşti
11. Morariu T., Pişota I., Buta I., 1970, Hidrologie generală. Ed. Didactică şi Pedagogică, Bucureşti
12. Moza A.C., 2008, Aspects Regarding the Mean Annual Quantities of Rainfall in the Crişul Repede Hydrographic Basin. Analele Univeristăţii din Oradea, Seria Geografie, Tom XVIII, Ed. Universităţii din Oradea, ISSN 1221 – 1273, pp.74-80
13. Moza A.C., 2009, Clima şi poluarea aerului în bazinul hidrografic Crişul Repede. Ed. Universităţii din Oradea
14. Pereş A.C., 2012, Meteorologie şi climatologie. Ed. Universităţii din Oradea
15. Pereş A.C., 2015, Meteorologie şi climatologie: lucrări practice. Ed. Universităţii din Oradea
16. Pereş A.C., Köteles N., 2014, Spatial Distribution of Air Humidity in Bihor County. Analele Universităţii din Oradea, Fascicula Protecţia Mediului Vol. XXII, Anul 19, Ed. Universităţii din Oradea, ISSN 1224-6255, pp.169-176

17. Pereş A.C., Köteles N., 2015, The Annual Rainfall Regime in the Area of Oradea City. Analele Universităţii din Oradea, Fascicula Protecţia Mediului Vol. XXIV, Anul 20, Ed. Universităţii din Oradea, ISSN 1224-6255, pp.215-220
18. Pereş A.C., Costea M., 2015, The Monthly Rainfall Regime in the Area of Oradea City. Analele Universităţii din Oradea, Fascicula Protecţia Mediului Vol. XXIV, Anul 20, Ed. Universităţii din Oradea, ISSN 1224-6255, pp.221-226
19. Pişota I., 1995, Hidrologie. Ed. Universităţii Bucureşti
20. Pişota I., Buta I., 1983, Hidrologie. Ed. Didactică şi Pedagogică, Bucureşti
21. Pişota I., Zaharia L., Diaconu D., 2010, Hidrologie. Ed. Universitară, Bucureşti
22. Posea A., 1968, Hidrologie generală. Bucureşti
23. Savin C., 2007, Hidrologie şi protecţia calităţii apelor. Ed. Sitech, Craiova
24. Vladimirescu I., 1978, Hidrologie. Ed. Didactică şi Pedagogică, Bucureşti