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Summary-PhD Thesis

The study of liquid runoff in the Tur river basin

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Keywords: Tur, river basin, drain liquid, water balance, flood

1. The Tur River Basin – location and geographic subunits

Left-bank tributary of the upper reaches of the Tisza, the Tur, with an area of 1164 km2 of the hidrographic basin on the territory of Romania, lies northward, passing from high mountainous area of Oas and Gutai volcanic mountains to the lower plains of the Somes, running-off from East to West.

The basin can be divided into three great subunits, as follows: a high mountain unit, one that covers the depression surface of Oas as well as the narrow strip of the Western Hills but also the lowest elevation, which extends to the north of the Western Plains.

2. The history of the liquid run-off research in the Tur river

By 1924 hydrometric stations network have grown rather slowly, there were only 124 stations across the country. Subsequently, the pace of development has accelerated so that by 1960, 12 vaporimetric stations appeared.

In order to conduct the extensive activity concerning the construction of the main hydrometric fund data, a decentralized system was adopted. Starting from 1952 until the present day, it has proved its full viability through the hydrological stations that group the hydrometric posts into large basins of several thousand square kilometers.

It is noteworthy to mention that during 1950 and 1967 the number of stations having measurements of water flow increased from 163 to 674.

The series of synthesis studies and hydrological generalization across the entire territory of Romania, based on an enlarged hydrometric fund was described in 1953 in the work "The Average Flow of the Rivers". Ever since that year, the number of the speciality papers have continued to grow. Ultimately, among the researched subjects concerning the flowing waters field, the density of water network, data referring to surface waters and to the Romanian soil, had been added. On the other hand, there are few paper works regarding the Tur River Basin. Tara Oasului benefits a more frequent study within the framework of the geographical studies.

3 Determinative geographical factors of run-off formation

The main role in the course of the run-off reverts to the climate which, through the conditions of precipitations, temperatures, wind speed, vapotranspiration and of other elements, influencing the water reserves of the basin as well as the formation of the flow. The other factors such as relief, soil, geological structure, basin characteristics, vegetation, etc. play a secondary role in the process of the run-off, yet they represent a necessary condition. The anthropic factor should also be taken into account.

3.1. Climatic Factors of the Rivers Run-off

3.1.1 The General Circulation of the Atmosphere and Winds

The main directions are south-east and south-west. The low frequence of east and north-east winds could be attributed to the shelter the Eastern Carpathians. The predominant direction mirrors the local particularities of this circulation which strongly reverberate also towards the other meteorological components.

3.1.2. Precipitations

In time it can be seen that in terms of rainfall distribution, the highest amounts fall in the summer, extending through the autumn months. Thus it can be seen that heavy rains that fall in the summer have detrimental effects because of the sudden level of growth, water course shifts, intensification of the erosion etc.. The variations during the year are significant; in July 1960, 285,7 milimetres of precipitation had fallen, and then later in August of that same year only 8 milimetres were registered.

Tracing the percentage variation of the seasonal precipitations (Fig 1/Table 1) within the basin, one can notice the clear-cut domination of the summer precipitations followed by an almost similar percentage by those that fell during autumn and spring.

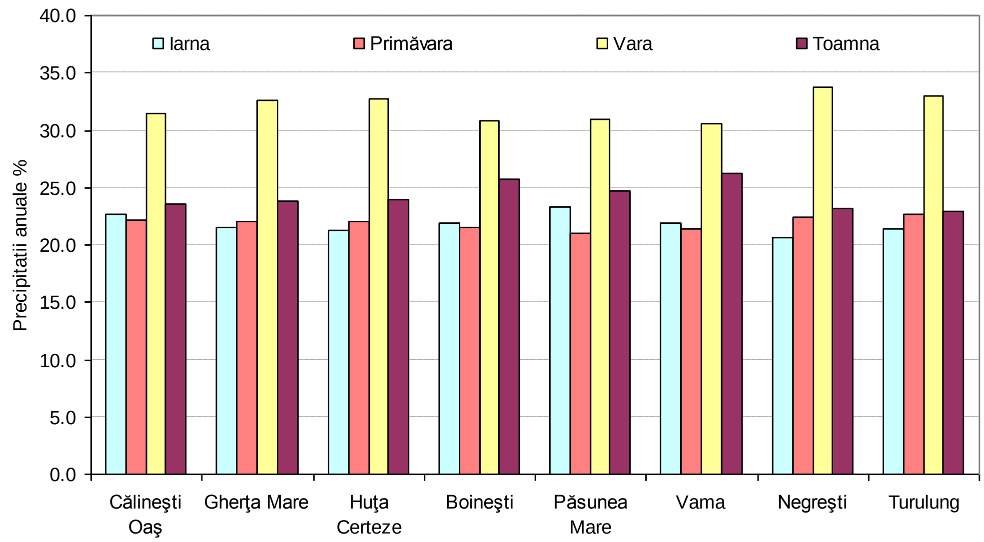


Fig 1. Mean percentage variation in seasonal precipitation stations in the Tur river basin (1970-2006)

Regarding the percentage variation of seasonal precipitations, summer rainfalls strongly dominate, followed by an almost equal percentage by those fallen during autumn and spring. The period of time between 1970 and 2006 had been taken into consideration. (Fig 2)

From the distribution of monthly amounts of precipitation during the studied period, we have results of a maximum rainfall of 290.2 mm recorded at Negreşti station, in August 2005, followed by the value of 280.9 mm, recorded at Călineşti station in the same month of the same year. The pluviometric minimum of 0.2 mm was registered in February (1976), at Turulung station.

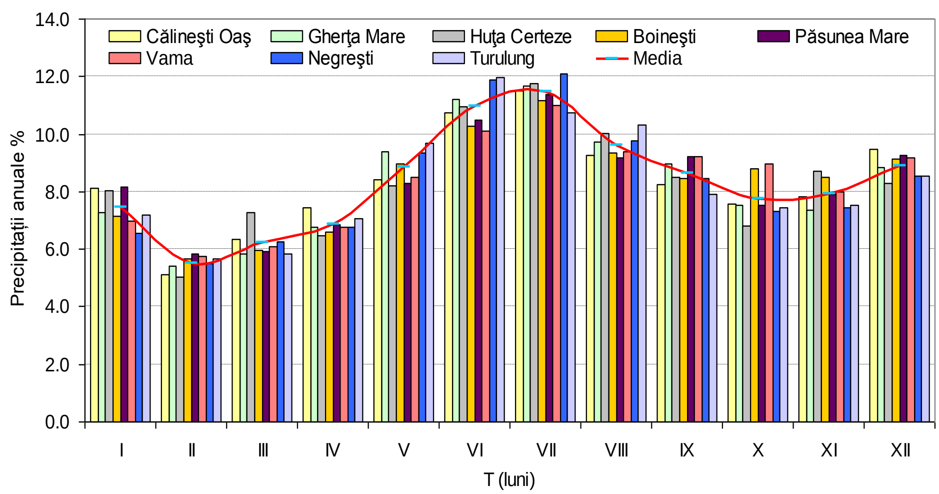


Fig 2. Mean monthly variation of precipitations in Tur ruver basin (1970-2006)

An alternation of foggy and humid periods can be observed during the studied lengh of time.

2.1.3. Temperature

The average annual temperature is 2-4 C in the higher zone and 7-8 C degrees in Oas Depression, some higher temperatures of 9-10 C being registered in south-western part of the lowlands. In winter, the average temperature falls by 6: -12 C in the higher zone, and 2, -4 C in the depression zone.

In spring time, the average temperature rises by 11 C between March and May; the same difference is maintained during the summer, when the monthly average is 12-13 C in high zone and 18-20 in depression. (Fig 3)

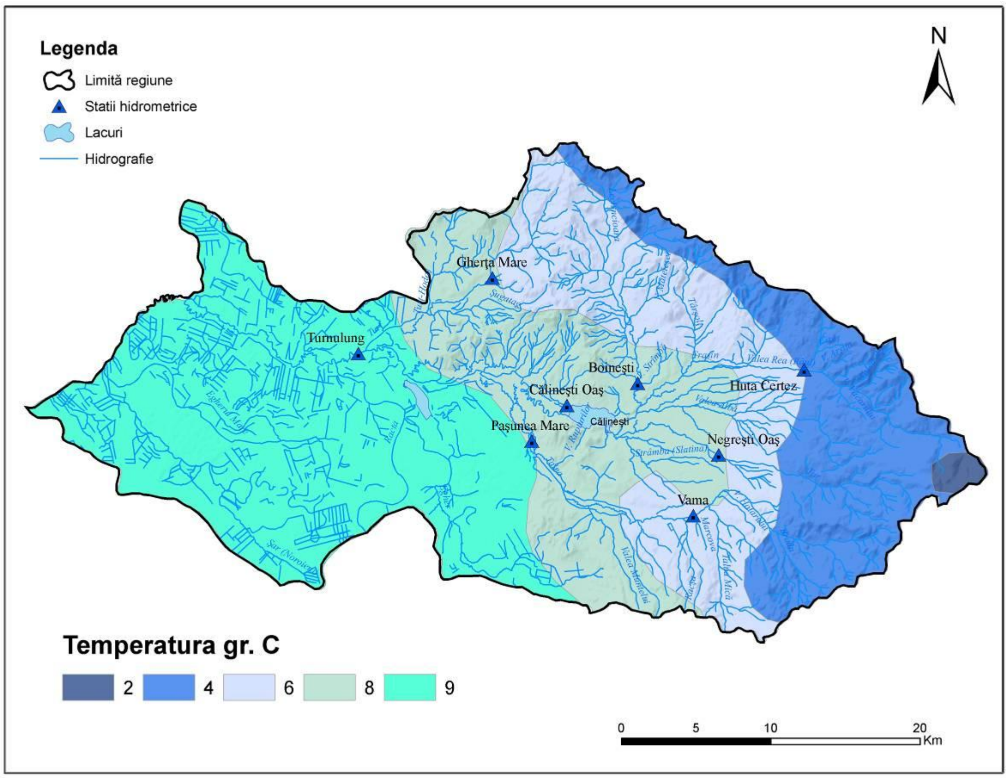


Fig 3. Mean multi-annual temperature of Tur basin

3.1.4. Evapotranspiration

Evapotranspiration which, among others, sums up evaporation, is one of the fundamental components of the water cycle and its estimation accuracy is essential to calculating the water balance, irrigation and water resource management, as well as to activity planning.

The full measurement of evapotranspiration in a hydrographic basin is impossible, thus one resorts to different methods of mathematical assessing by introducing in the calculus formula measurable meteorological variables.

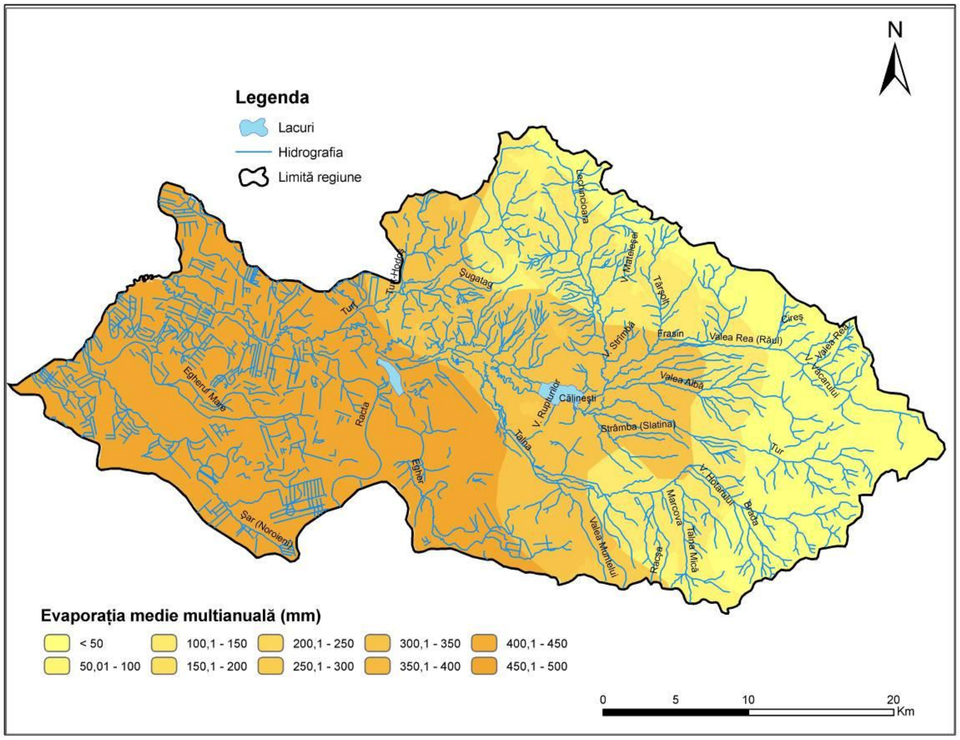


Fig 4. Evapotransportation value in Tur basin (calculated by the Turc formula

3.2. Unclimatic factors

The influence of unclimatic factors (relief, soils, vegetation, geological structure, anthropic activity etc.) on the run-off regime manifests differently in comparison to the climatic ones. Here we notice two types of influences: direct and indirect.

3.2.1. Topograpghy

The influence of topography on the characteristic phases of rivers run-off, manifests itself mainly indirectly, with the help of altitude which leads to the setting of climatic elements, vegetation and lands. The mean values of the rainfalls, the temperature as well as the maximum thickness of the snow layer, are in direct connection to altitude growth. Thus, the relief nuances the conditions of reception, accumulation and shifting of waters derived from precipitations and snow melt.

An important feature of this area is made by the irregularities of slopes as a result of land degradation as fiund in the Talna basin.

As for the proportion of surfaces of different intervals of depth fragmentation (Fig 5) it can be seen that, as with density, the lowest values of under 50 m/km2 covers a vast area of more than 50% of the total surface of the basin. As we are going to see, this also reverberates over the run-off formation inside the basin. We note also that values higher than 250 m cover a little over 6% of the total area, and this can be explained by the large share of plain flat surfaces within the basin.

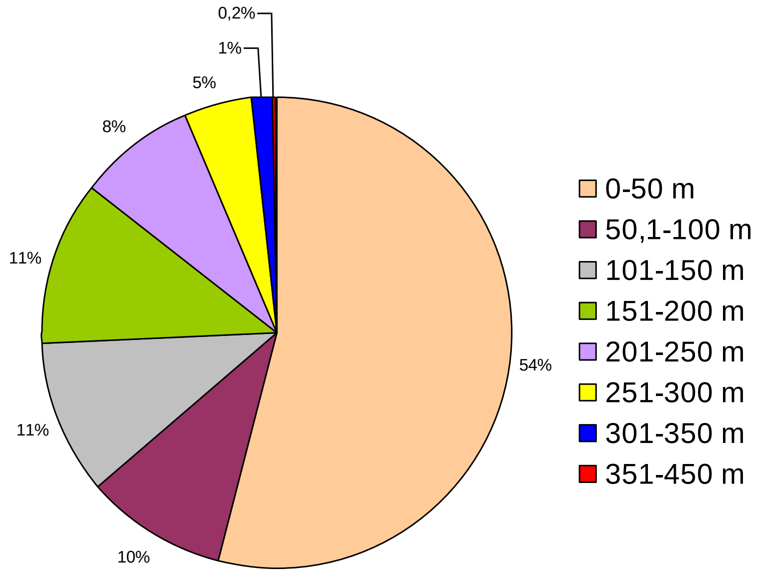


Fig 5. Percentage values of fragmentation depth in the Tur basin (m/km2)

3.2.2 Geological structure

The basis of the depression is made of Paleogene deposits flysch deposits that form the western flank of the crystalline Eastern Carpathians.

In the sedimentary deposits frequent insertions of volcanic manisfestations can be found, which are made of lava and pyroclastic material. Deposits originating back in the Sarmatian stage are to be found on the southern border of Oas Depression, in the contact zone with Gutai Mountains, respectively.

Talna Valley is characterized by landslides, ever-widening transversal profile, and in the lonitudinal one small slope cracks appear as a result of harder rocks intercalations (andesite tuffs).

3.2.3. Soils

The less fertile surfaces are found in the Orasu-Nou sector where the swamping processes occur and where pseudogleic podzolic soils are currently formed in swampy grassland.

By the solidification stage there are three alluvium types: unsolidified - in the internal meadow of Talna and Tur; alluvial soils that are stratified - in the internal meadow, on the hills of Lechincioarei, Talna and Tur, and alluvial soils of fallowed in all river valleys of the network.

Pseudorendzinas are found in the Tur river basin in very low quantities.

3.2.4. Vegetation

The relief, climate and soil conditions allows the vegetation to normally set in altitude, starting with the soft essences accompanying the Tur valleys and its affluents, continuing with oak and fagus forests, and ending with conifers and pastures on the highest peaks of Oas and Gutai Mountains.

Forests cover the slopes of Oas and Gutai Mountains, extending over the upper and the high piedmonts. The largest expansion is in the upper Lechinioarei basin where forests drop below 300 m in altitude, overlapping piedmont areas.

The largest extension is the plain vegetation at Talna's, Tur's and Lechinioara's gates, but also along Rau rivulet. Ligneous vegetation of the meadows is formed by various species of willow and poplar trees that can be found on the hills that accompany the rivers.

3.5 Antropic Factors

The antropic may have a direct or indirect effect on the formation and development of leakage. The direct impact is mostly linked to the functions of hydrotechnical works (dams, barrage) through velocity change and thus through the water discharge change, and the indirect one is mostly linked to the way lands are used.

Over time villages became specialized on cultivating different fruits: Cămârzana, Târşoţ, Călineşti-Oaş, Negreşti-Oaş, Turţ, Gherţa Mare, Tarna Mare specialized on plumbs, Tâşolţ and Lechincioara on apples, Certeze, Huţa-Certeze, Oraşul-Nou and Tarşolţ on sweet cherries and morello cherries, Gherţa Mare and Gherţa Mică on walnuts.

4. Characteristics of the hydrographic network

Now, the Tisa opening is characterized by a slow subsidence, and the Tur, the main collector river, overflows directly into the Tisa, on the terrtory of Hungary. In some past phase, the convergence was made through the Somes, Orasul Nou Gate being activated; now it is suspended.

4.1. River Network Structure

The Tur is part of the northern group of rivers, draining the western sides of the Oas-Gutai vocanic range, passing over the Low Field of the Somes and the boundary line.

The Tur springs at 950 m in altitude, from Mount Ignis, the water flow has a 20 m/km slope in the mountainous sector , diminishing to 2-8 m/km in the back of the depression and under 1m/km in the field sector. (Fig. 6)

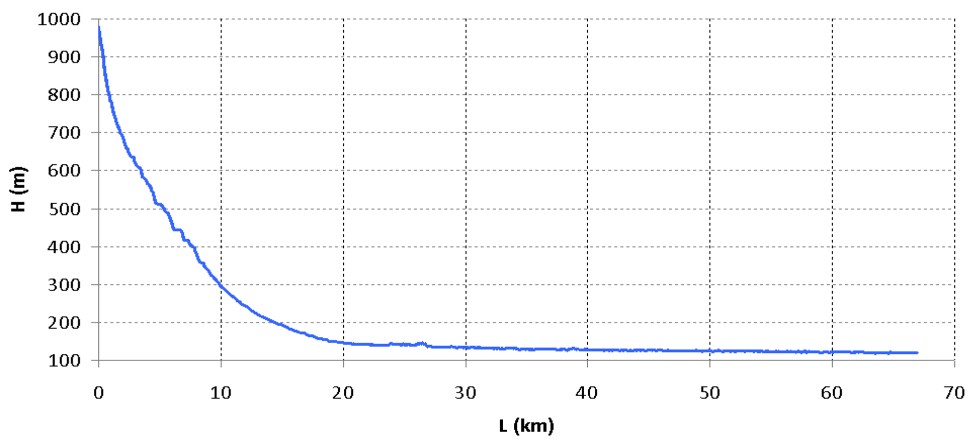


Fig 6 The longitudinal profile of Tur River

Calculi of density of fragmentation show that 49.0% of the basin surface has values under 1.0 km/km2. The greatest value reaches 4.5km/km2 but covers an area of only 0.3%. Areas having values of 1-2km/km2 represent 34.8% of the surface. The average value of fragmentation is of 1.05km/km2. (Fig 7).

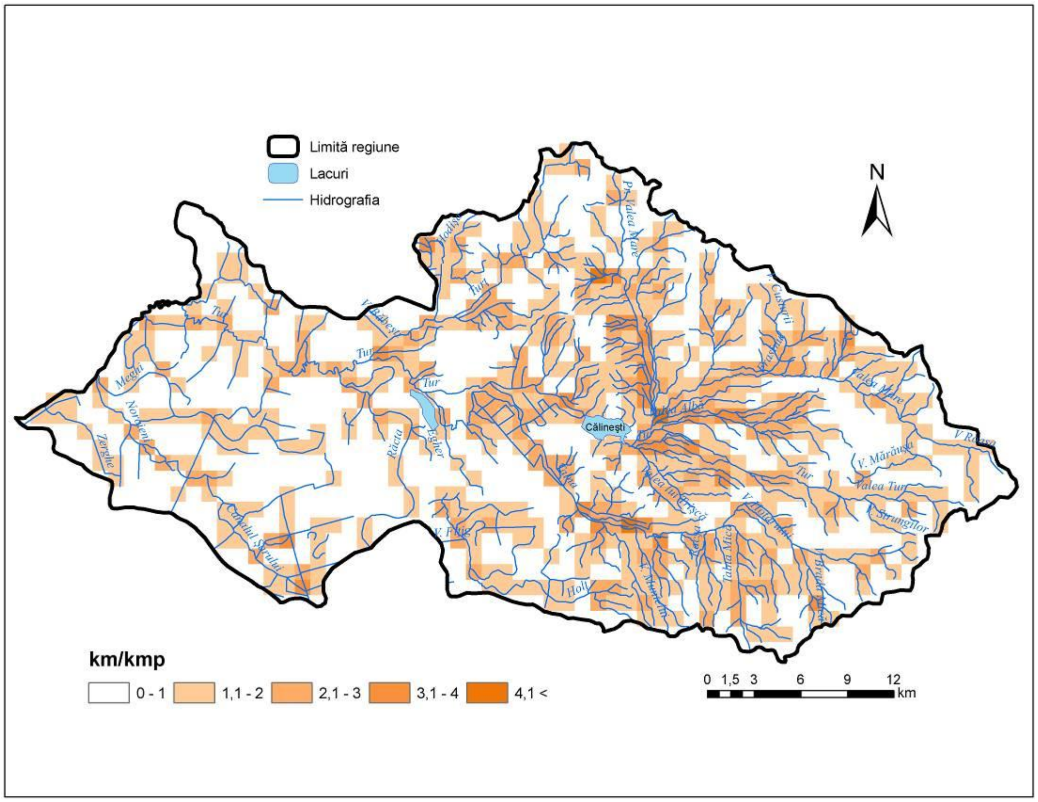


Fig 7. Density of relief fragmentation in the Tur water basin (km/km2)

Concerning the degree of relief fragmentation one can distinguish areas with large fragmentation, beteewn 0.8 to 1km/km2, where water appears at the bottom of the piedmont deposits or in case of confluents such as Rau rivulet, Talna, etc.

4.2. Morphometric Characteristics of River Networks and Water Basins

Following the hypsometric curve it can be seen that surfaces that are adjacent to altitudes under 300 m cover more than 50% of the total area of the basin studied, which explains the significant variation of hydric components in the longitudinal profile of the river. Although the surfaces having altitudes of more than 1000 m are under 1%, these have an important role because it is here that we meet the largest quantities of water that encompass the run-off and rainfalls. (Fig 8)

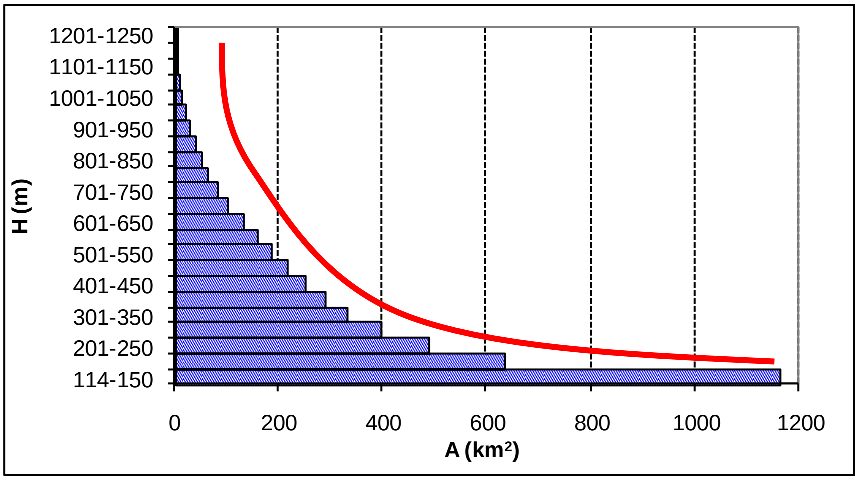


Fig. The hypsometric curve of the Tur basin and the distribution of areas on intervals of altitude

4.3. Lacustrine Units

Of all hydrotechnical arrangements from within the hydrographic Tur basin, the Calinesti-Oas reservoir has the most significant impact on the run-off.

The artificial lake Calinesti-Oas had been created by damming the river Tur at 6 km downstream of its confluence with the Valea Rea river.

The clogging rhythm of the accumulation was tracked for the next characteristic volumes. (Fig 9): total volume, used volum, dead volume and attenuation of flash floods volume. The topobatimetric elevations taken into consideration are those carried into effect in 1983, 1987 , 1996, 2001 and 2007 which relate to the initial values given by the designer in 1974.

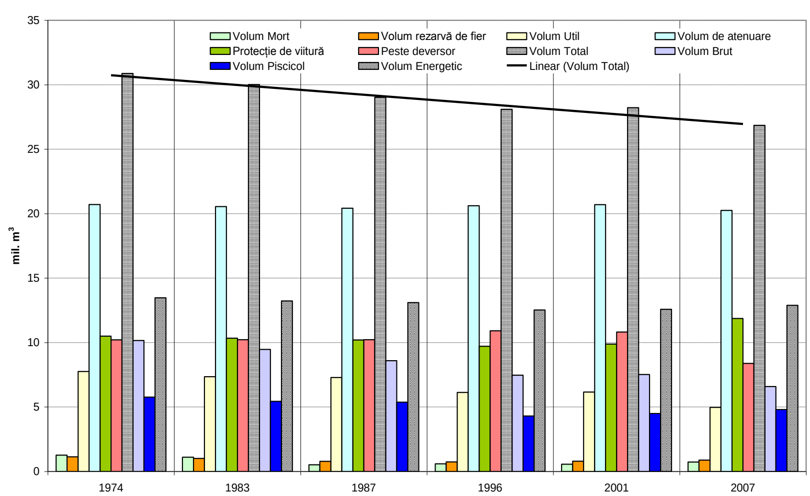


Fig.9 Volume variation typical of Calinesti-Oas reservoir

4.4. The Degree of Hydroligical Knowledge

As with the entire territory of Romania, a series of hydrometric stations are being made on the river Tur, the most important of them being observation stations even today.

The first hydrometric station made within the studied basin was Turulung station in 1909, the following being made only after the 1950s (Table 1).

The hydrometric network of the Tur water basin

Table 1.

River	Station	The distance from confluence	The reception basin		The altitude of 0 point graphic	Foundation date
			Area km^2	Altitude m		
Tur	Negrești Oaș	80/55,5	45,0	640,0	229,5	1951
Tur	Turulung	49,5/25,0	708,0	370,0	123,9	1909
Valea Rea	Huta Certez	14,5	60,0	719,0	279,4	1966
Lechincioara	Boinești	2,0	86,5	306,0	149,9	1979
Talna	Vama	21,0	52,0	605,0	192,0	1961
Talna	Pășunea Mare	4,7	179,0	395,0	135,6	1979
Turț	Gherța Mare	8,5	40,0	331,0	144,8	1974

5. Liquid drain

As a result of the anthropic factors influence on the natural flow (Negreşti Oas reservoir, the damming system in the plains) restoration of the natural drainage basin is needed, thus making data comparable with the string data from the period when this influence did not exist (Fig. 10)

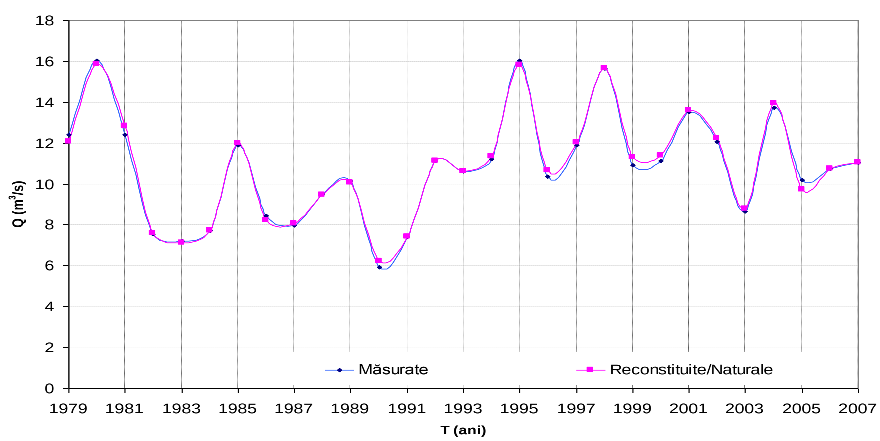


Fig. 10. Annual average flow rates measured and reconstructed to the hydrometric station of Turulung (1979-2007)

Thus one can distinguish between two major types of leakage: the leakage of the natural and the managed regime.

5.1 Liquid flow under natural conditions

5.1.1 . Water supply

Regading the Tur basin, the superficial water supply is of a mixed type, solid precipitations being a characteristic of winter, while liquid precipitations characterize the warm seasons,

5.1.2. Average flow and water balance

The correlation between specific average flow values and the average altitude (Table 2) of the river gauging stations, allowed the identification of a curve of life for the studied area (Fig. 11.).

Basic data on annual average flow (1979-2007) in Tur basin.

Table 2.

Nr Crt	River	Station Hidrometric	Hm (m)	F (km^2)	Q (m^3/s)	q ($l/s*km^2$
1	Tur	Turulung	366	733	10,855	14,8
2	Talna	Păşunea Mare	402	170	2,311	13,59
3	Turţ	Gherţa Mare	315	36,6	0,523	14,28
4	Tur	Negreşti Oaş	716	38	0,891	23,44
5	Valea Rea	Huta Certeze	726	61	1,782	29,21
6	Talna	Vama	604	51	1,212	23,76
7	Lechincioara	Boineşti	318	84,6	1,009	11,9
8	Tarna	Tarna Mare	394	26,8	0,337	12,6

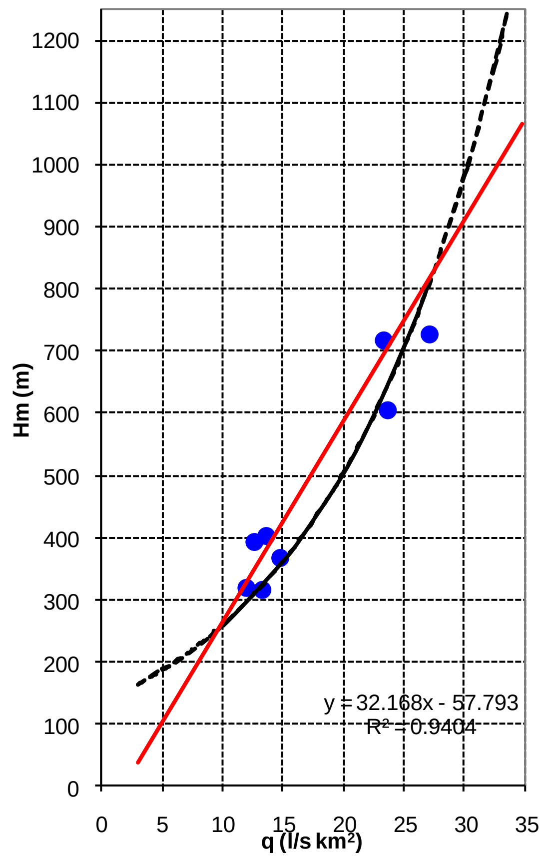


Fig. 11. Relationship between specific average flow and average altitude of the basin

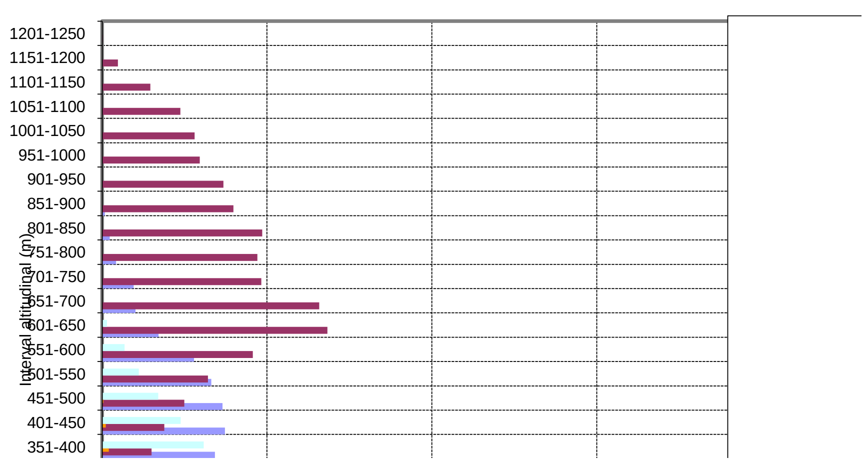


Fig. 12. The average volume of water in the Tur basin based on altitude intervals in major physical and geographical subunits

In terms of average flow volume according to the main physico-geographical subunits (Fig. 12), Gutai highlights more than 120 million m3 of water followed by 80 million m3 in the Oas depression.

5.1.2.1 Spatial distribution of water balance components

Distribution of mean amounts of precipitation (Xo)

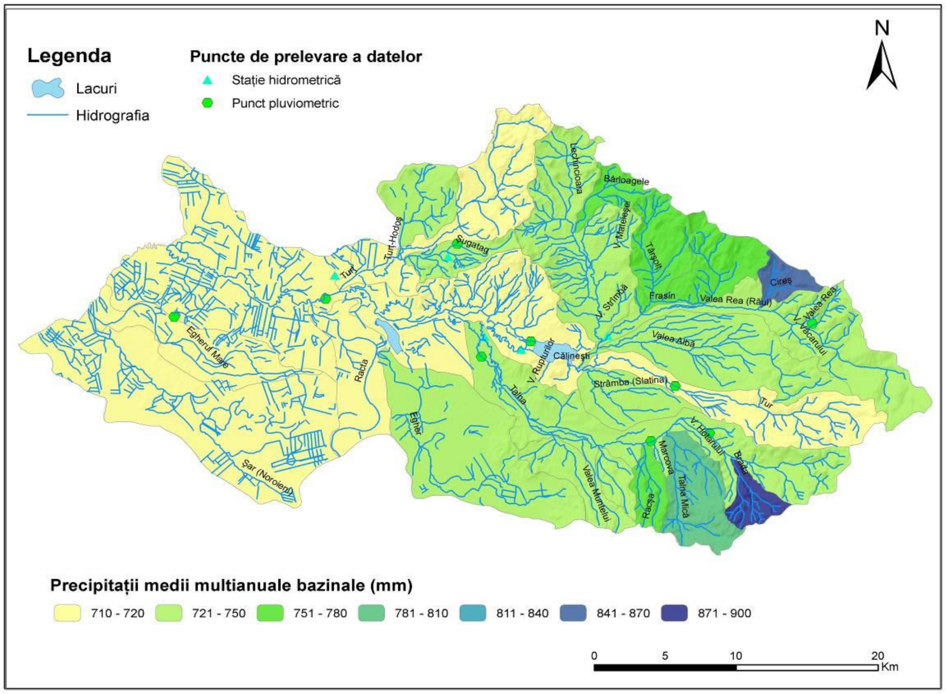


Fig. 13. Multi-annual rainfall distribution in the studied main catchment area

Distribution of average flow (Yo)

Following the distribution of medium layer ran off the main basins, the same regularity as for rainfall is observed, small mountain basins holding the highest values of the average flow.

Evapotranspiration (Zo)

Evapotranspiration values calculated in this way range between 58-350 mm. Lowest values were found in the highest parts of the basin, and highes values also correspond to the altitude i characteristic of lowland areas.

5.1.2.2 Water balance

For the entire basin of the River Tur in our country the balance can be expressed based on average annual values of the main components of the balance sheet. Thus the contribution includes 819.6 mm / year average rainfall of 353 mm which is consumed in the process of global average flow formation and 466 mm by evapotranspiration. Table 3.)

Structure of the water balance in subunits of the Tur basin

Table 3

	Precipitaţiile X_o			**Scurgerea globală Y_o**			**Evapotranspiraţia Z_o**		
	mm	**(mil. m^3)**	**%**	**mm**	**(mil. m^3)**	**%**	**mm**	**(mil. m^3)**	**%**
Mţi. Oaş	919,3	106,0	11,2	480,1	55,4	13,5	439,2	50,6	9,4
Mţi. Gutâi	1027,3	181,7	19,2	686,1	121,3	29,5	341,2	60,4	11,2
Dealurile Oaşului	788,1	90,2	9,5	292,5	33,5	8,1	495,6	56,7	10,6
Depresiunea Oaşului	817,2	197,4	20,8	332,9	80,4	19,5	484,3	117,0	21,8
Câmpia Micula	719,0	212,3	22,4	234,0	69,1	16,8	485,0	143,2	26,7
Câmpia Livada	730,4	161,2	17,0	234,6	51,8	12,6	495,8	109,4	20,4
Total	**819,6**	**948,800**	100,0	**353,0**	**411,474**	100,0	**466,6**	**537,326**	100,0

% - Percentage of total volume

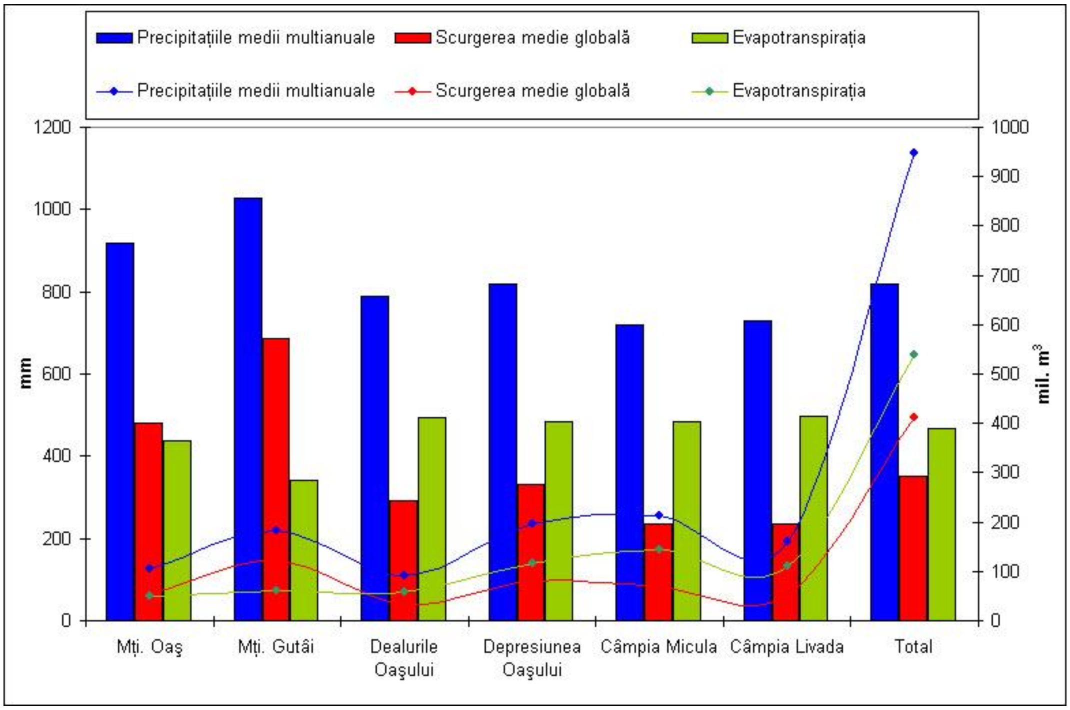


Fig. 14. Basin Tur: Global water balance structure of physical geographical units and the total

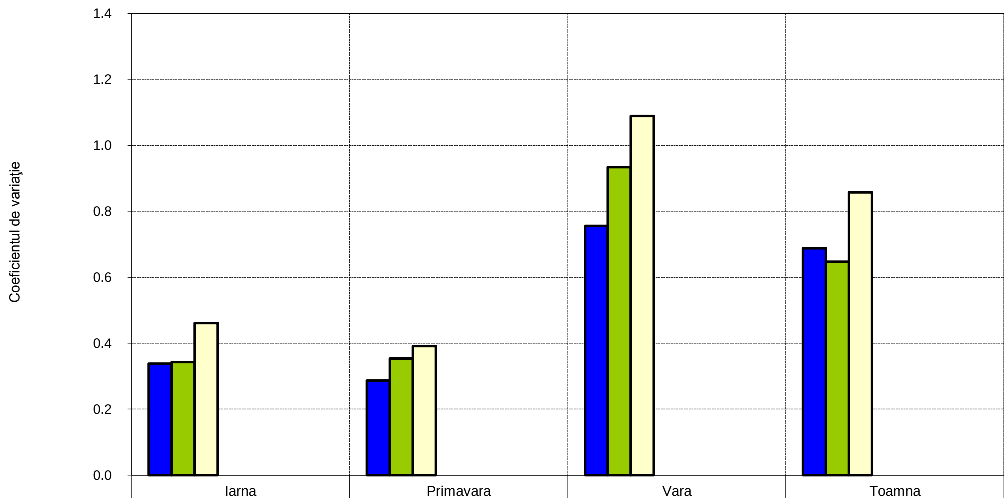
Following the chart of the structure of global balance (Fig. 14.) the lawfulness carrying of the components inside the basin can be observed. Thus, in the mountainous areas the amount of leakage is higher than the evapotranspiration while in the lowlands, from Oas Hills evapotranspiration becomes dominant.

5.1.3 Natural flow regime

5.1.3.1 Seasonal flow regime

Following the percentage values of the median runoff per season, calculated among the gauging stations in the Tur Basin, relatively small differences can be observed between the various stations; this is explained by the relatively uniform conditions for input. Small differences that appear, however, are related to the spatial arrangement of the various stations, especially of the climatic tiering characteristics of the basin adjacent stations.

Analyzing seasonal variation coefficients (Fig. 15.) it can be noticed that the lowest values link to spring and the highest to summer and autumn. During spring the melting snow accumulated and the precipitation overlap appears every year while the big waters in summer and autumn are strictly related to the presence or absence of significant rainfall in these seasons.

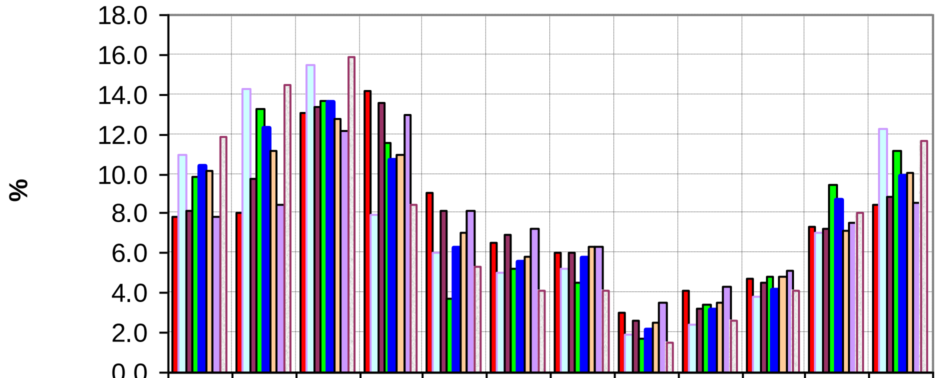


	Iarna	Primavara	Vara	Toamna
Negreşti - Oaş	0.338	0.287	0.756	0.688
Călineţti Oaş	0.343	0.353	0.934	0.647
Gherţa mare	0.461	0.391	1.089	0.858
Turulung	0.401	0.342	0.796	0.712
Vama	0.338	0.294	0.750	0.701
Păşunea Mare	0.372	0.334	0.891	0.759
Huta Certez	0.361	0.357	0.630	0.613
Boineşti	0.411	0.395	1.183	0.796

Fig 15. The values of seasonal variation coefficients

5.1.3.2 Monthly Flow Regime

Distribution of monthly average flow during the year, highlights the peak in the whole Tur basin, March-April and a minimum in August (Fig 16).



	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Negresti Oas	7.81%	8.00%	13.10	14.14	9.09%	6.56%	6.04%	3.00%	4.10%	4.74%	7.32%	8.40%
Gherta Mare	10.94	14.28	15.50	7.91%	5.98%	5.08%	5.20%	1.91%	2.42%	3.85%	6.99%	12.25
Vama	8.14%	9.71%	13.36	13.58	8.14%	6.90%	6.02%	2.66%	3.25%	4.51%	7.22%	8.81%
Calinesti Oas	9.83%	13.24	13.68	11.57	3.68%	5.21%	4.48%	1.73%	3.44%	4.85%	9.47%	11.11
Turulung	10.34	12.24	13.61	10.63	6.28%	5.50%	5.78%	2.11%	3.13%	4.13%	8.69%	9.87%
Pasunea Mare	10.16	11.13	12.72	10.99	7.01%	5.84%	6.33%	2.52%	3.54%	4.81%	7.19%	10.06
Huta Certez	7.87%	8.47%	12.13	12.98	8.16%	7.23%	6.39%	3.57%	4.28%	5.17%	7.51%	8.55%

Fig. 16. The repartition of mean monthly runoff during the year

5.1.3.3 Daily flow regime

As an example we show the hydrograph of the average daily flow for two gauging stations within the basin (Fig 17, 18)

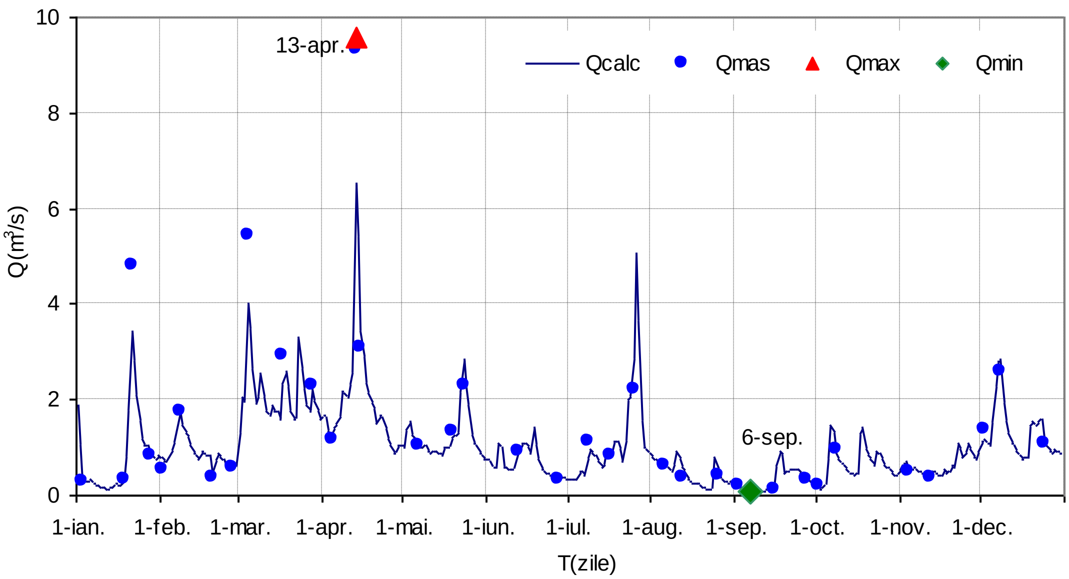


Fig. 17 The hydrograph of flow capacities. Negresti-Oas gauging station.

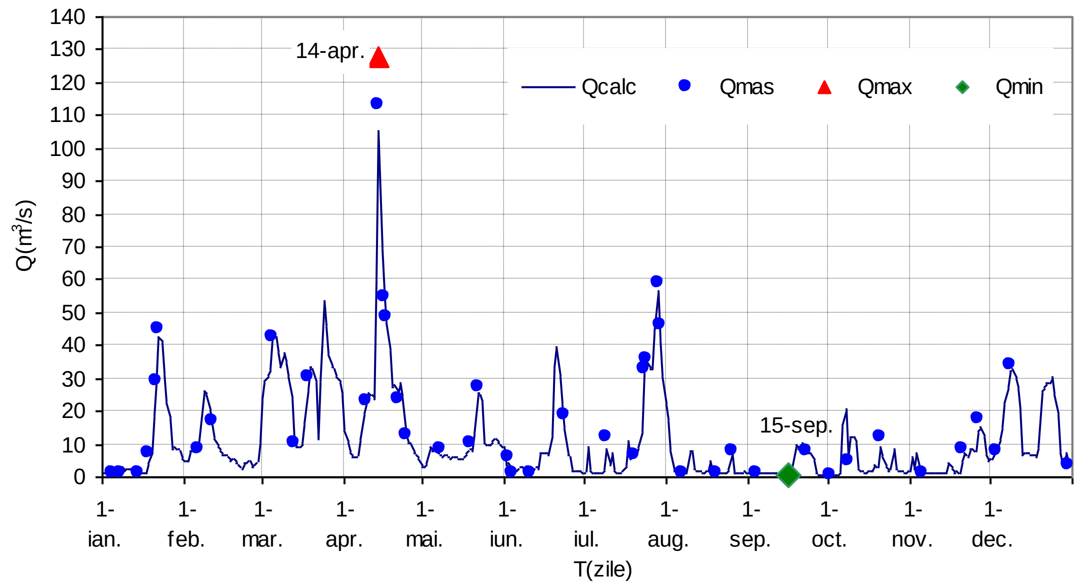


Fig. 18. The hydrograph of flow capacities. Turulung (2008)

The observed changes in daily flow for both average gauging stations may reflect the various phases of the drainage system.

The correlation of KZ coefficient with average altitude of the reception basins allow generalising its values. (Fig. 19).

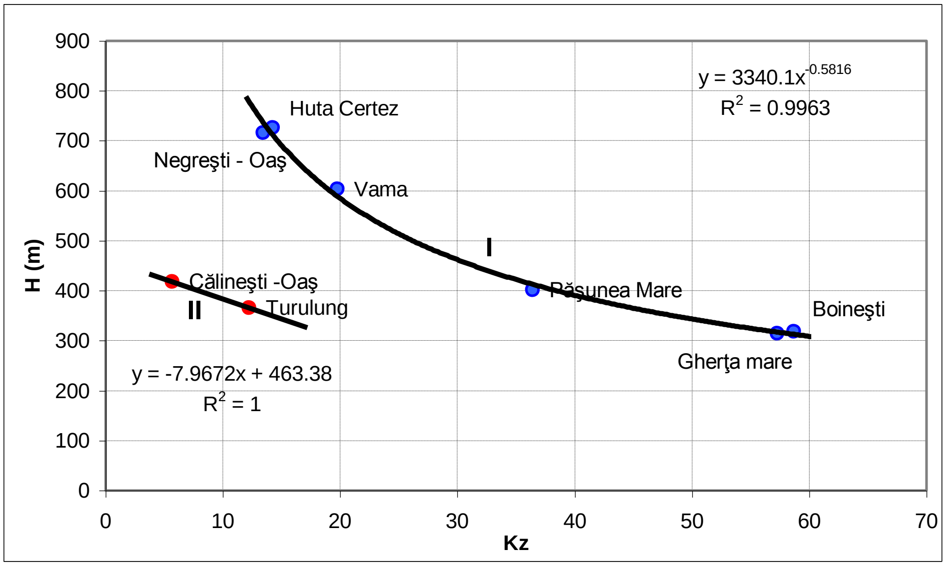


Fig. 19. The link between the Kz coefficient and the mean altitude of reception basins

5.1.4 Distinctive phases of the river natural flow

5.1.4.1 High flow periods

High waters have a high frequency in spring when the condition of their climate are most favorable, by printing their appearance regularly.

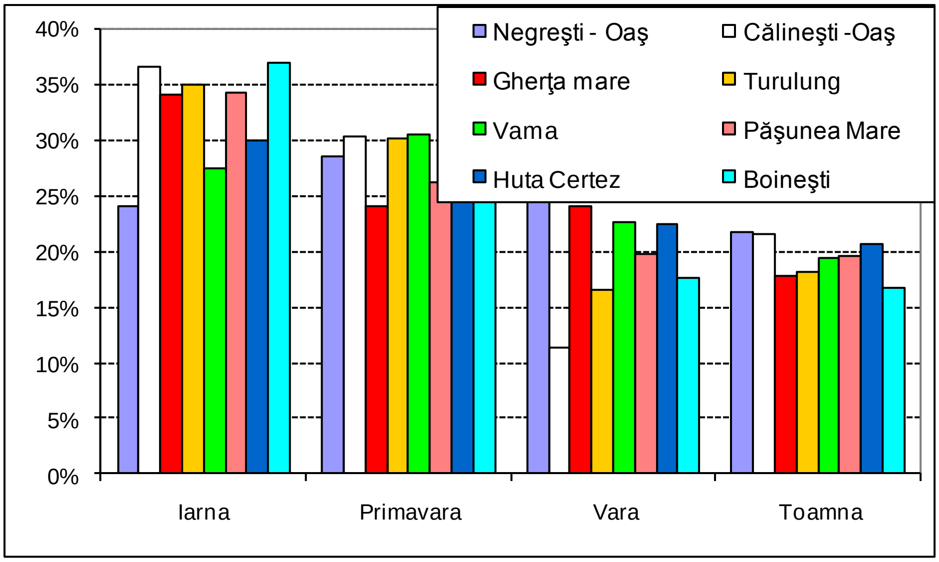


Fig. 20 The seasonal percentage values of of maximum discharge (1979-2007)

Floods

Characteristics of floods at Turulung-Tur river station (2002-2008)

Tabel 4

Year	Wt	Tt	Tcr	Tsc	hs	Qb	qmax	Qmax	□
	mil. m^3	ore	ore	ore	mm	m^3/s	$l/s*km^2$	m^3/s	
2002	47,582	206	50	156	221,5	31,900	877,78	94,8	0,677
2002	21,082	59	19	40	55,3	71,150	1231,48	133	0,746
2002	41,392	206	107	99	207,1	25,650	810,19	87,5	0,638
2003	8,573	90	42	48	54,0	8,465	386,11	41,7	0,635
2004	47,524	268	132	136	281,0	17,800	877,78	94,8	0,520
2004	51,677	179	20	159	279,2	33,400	1342,59	145	0,553
2005	42,577	156	51	105	228,9	31,800	1222,22	132	0,574

2005	7,198	33	21	12	5,2	55,900	591,67	63,9	0,948
2006	30,903	144	40	104	155,1	27,300	790,74	85,4	0,698
2007	34,574	192	68	124	175,8	22,550	739,81	79,9	0,626
2007	76,180	312	84	228	509,3	18,850	990,74	107	0,634
2008	34,919	168	46	122	197,0	22,550	1185,1 9	128	0,451
2008	29,523	265	41	224	197,6	8,575	561,11	60,6	0,511

Flood-frequency generation

Return times and probabilities of exceeding at Boinesti station (HYFRAN)

Table 5

The probability exceeded	Return Time	Q*	Confidence Interval 95 %
%	years	(m^3/s)	(m^3/s)
0.1	1000	83.9	69.7 - 98.1
1	100	62	52.1 - 71.9
10	10	39.7	34.1 - 45.3
50	2	21.8	19.0 - 24.7
95	1,05	7,93	5.17 - 10.7
99	1,01	3.85	0.612 - 7.09
0.33	**305**	**72.6**	**60.6 - 84.6**

Flows are presented in Table 5, empirical likelihood and the range flow for a few return times, but during the return calculated for maximum flow station Boinesti considered, empirical likelihood of not exceeding it and its range.

In terms of frequency of floods monthly occurrence rate is the lowest recorded in August and September and the highest link either February or March.

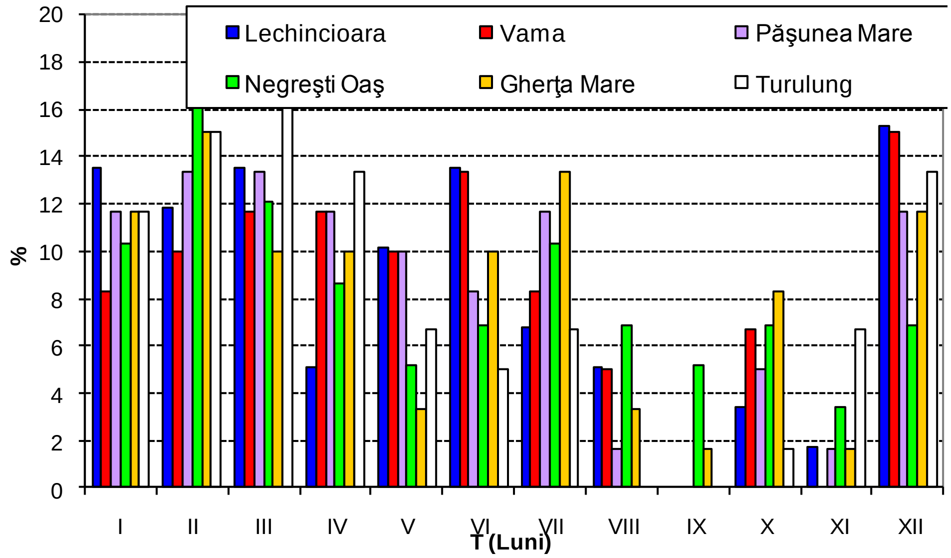


Fig. 21. Monthly frequency of floods in the basin Tur (1979 - 2008)

Following the flood frequency peak winter seasons is remarkable.

5.1.4.2 Low flow periods

Extracting monthly minimum flows recorded between 1979-2007 (Fig. 22) shows that if all stations the lowest values of flow are found in summer and autumn.

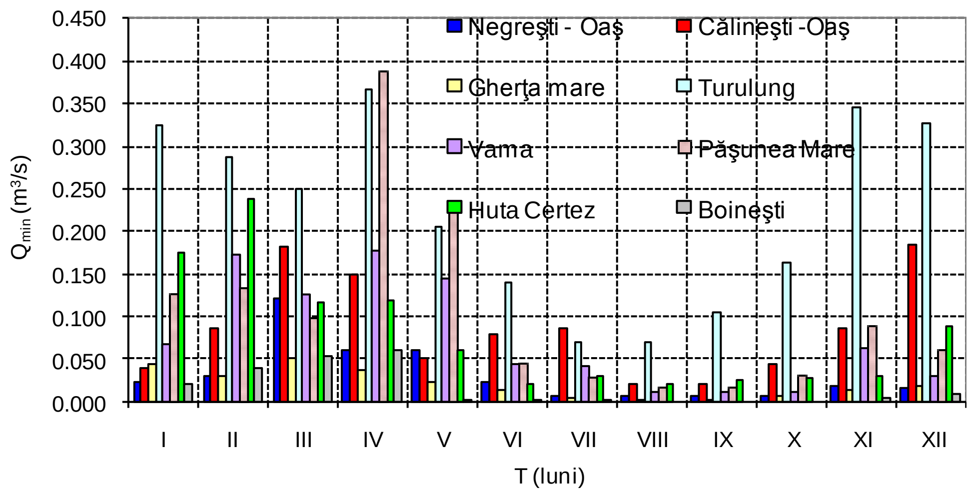
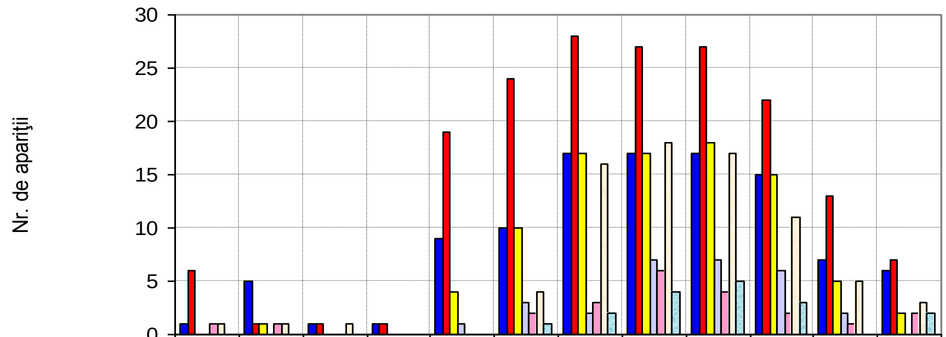


Fig. 22. Minimum monthly multiannual flow in the river Tur

The drainage fenomenon occurs at only one gauging station among those analyzed that are inside the Tur basin; it is called Boinesti and is situated on the Lechinioara river.

The frequency of draining phenomenon

Following Figure 23 note that the phenomenon is specific particularly to summer and autumn, and that in only a few cases values below 1 l / s km2 in appear during the other seasons.



	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Turulung	1	5	1	1	9	10	17	17	17	15	7	6
Boinesti	6	1	1	1	19	24	28	27	27	22	13	7
Gherta Mare	0	1	0	0	4	10	17	17	18	15	5	2
Huta Certez	0	0	0	0	1	3	2	7	7	6	2	0
Negresti Oas	1	1	0	0	0	2	3	6	4	2	1	2
Pasunea Mare	1	1	1	0	0	4	16	18	17	11	5	3
Vama	0	0	0	0	0	1	2	4	5	3	0	2

T (luni)

Fig. 23 Frequency of the occurance of specific flow of under 1 l/s km2 at the main gauging stations inside the Tur basin. (1979-2007)

5.1.5 Types of regime

From the study of the characteristics of the water flow regime in the Tur Basin, its membership to the type of Carpathian regime in the depressionary and mountainous area and but also its membership to the pericarpathian plains is emphasized. (Fig. 24)

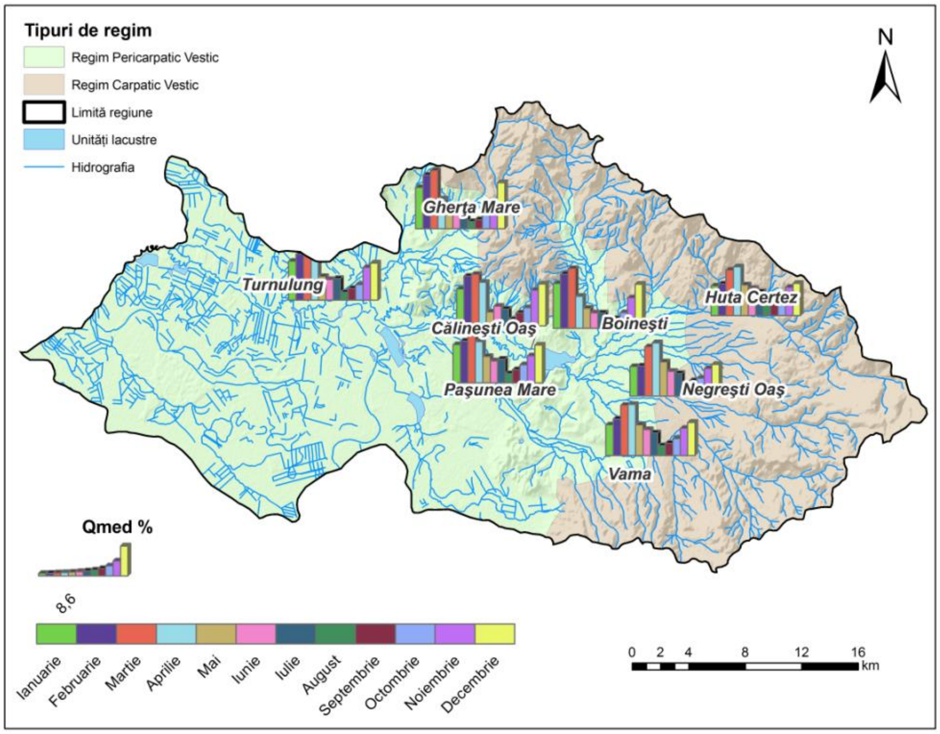


Fig. 24. Types of flow regime within the Tur gauging basin

5.2 Liquid flow in arranged regime

Regarding the impact of the lake in daily flow, it can be illustrated best with overlapping the tributary flows and defluente lake volume changes. It notes as well as for flood control their volume is retained within the reservoir, it was only later given back to the flow.

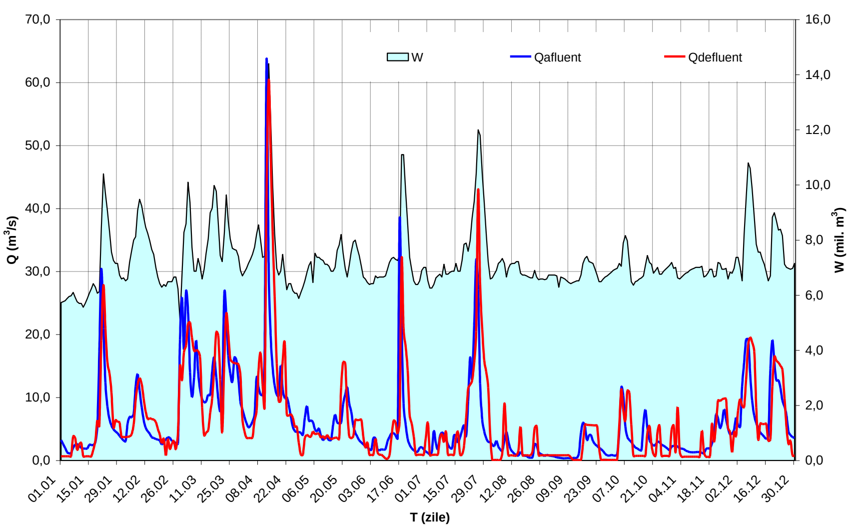


Fig. 25 The effect of Călinești Oaș reservoir on the daily run-off. (2008)

5.2.1 Case study: flood of March, 2001

In March 2001 a great flood level was formed in the upper basin of the Tisza to which has been contributed much the formation of significant floods in the Tur Basin, although they have not reached the maximum level recorded in May 1970.

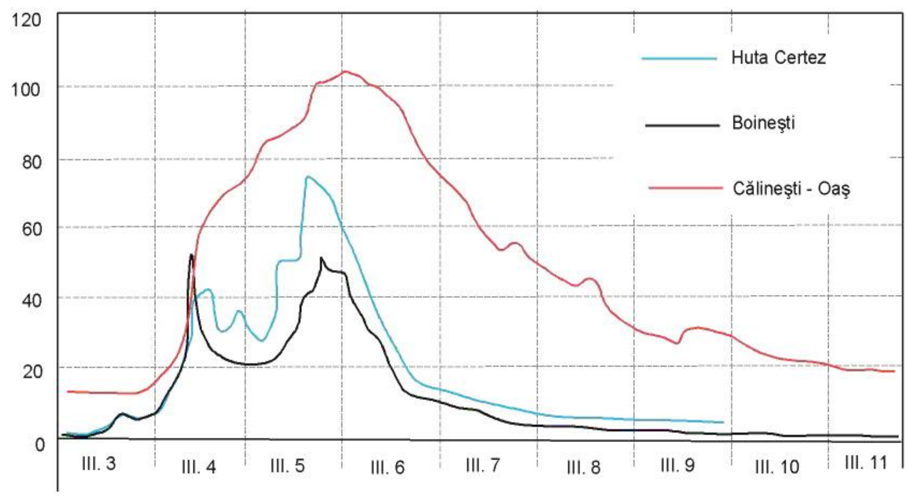


Fig 26 The flow evolution in Tur River Basin 3-11 March 2001

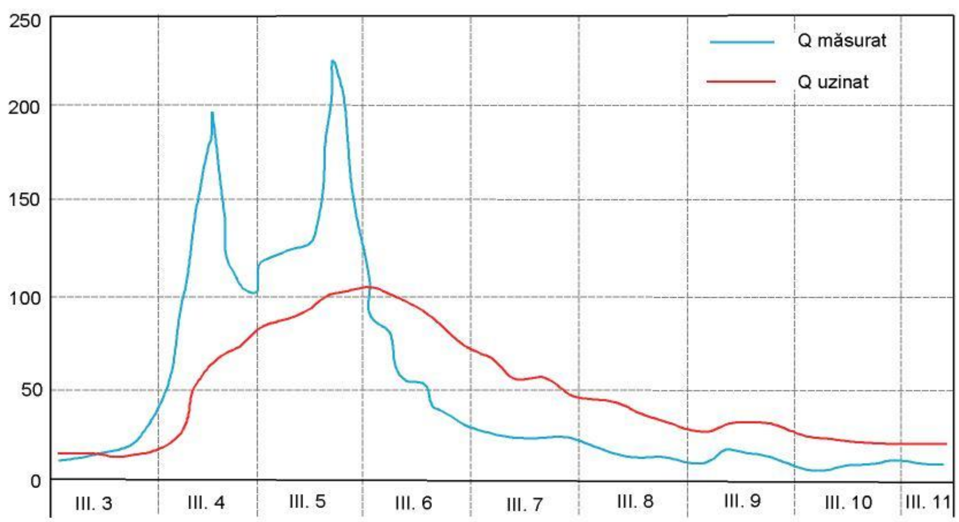


Fig. 27 The lessening of the flood wave (March 2001) in Calinesti-Oas reservoir

As the degree of attenuation, you can track the max flow reached by the lake of 229 m3 / s at 16 March 5, while the maximum flow discharged from the lake was only 106 m3 / s. So the degree of flood wave attenuation is very good reaching 54%, with direct consequences downstream, the maximum attenuation at the border as a result of being less than 60-80 cm.

6. Thermal regime and ice water

During the year, water temperature variation is almost identical to that of air temperature, but with a more attenuated disposition.

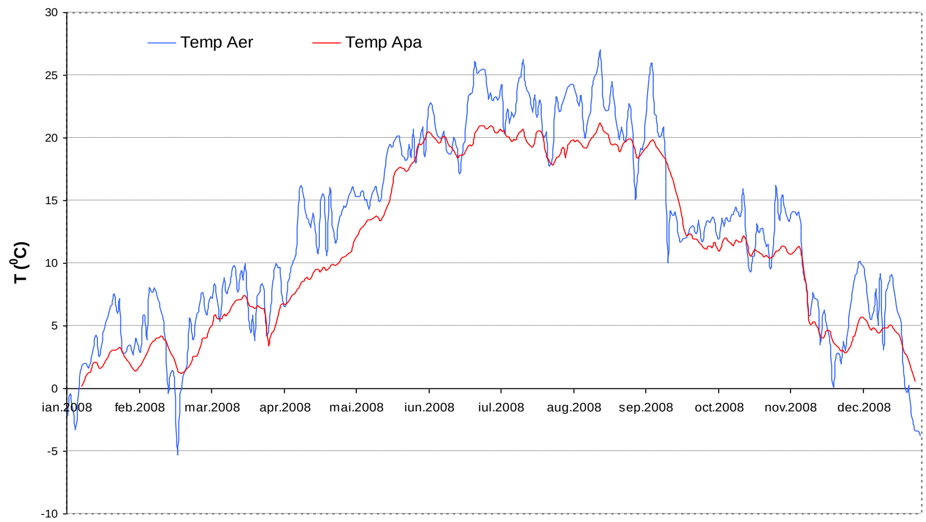


Fig. 28. The variation of the daily temperature of water and air at Turulung gauging station (2008)

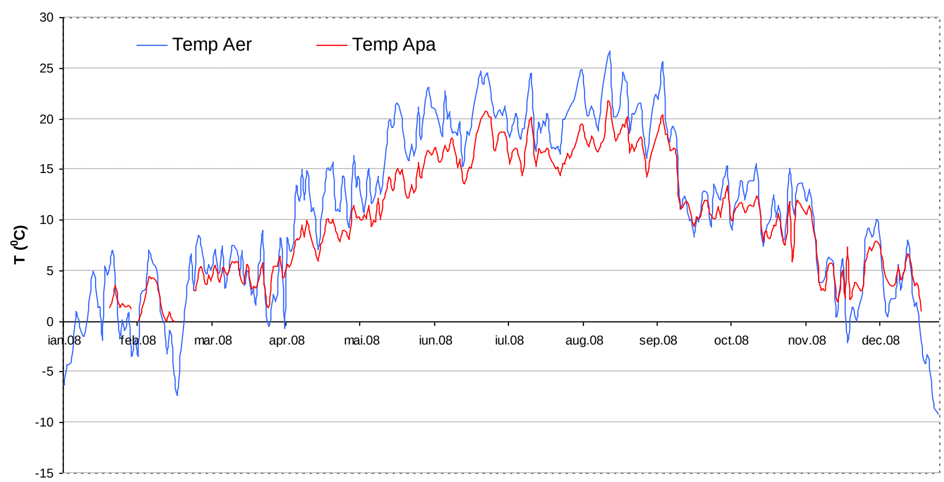


Fig 29. The variation of the daily temperature of water and air at Hutza Certez gauging station (2008)

Following Table 6 we see that the frequency of ice to shore and floes is 100%, explained by the country's northern position of the basin.

Frost evolution in basin Tur

Table 6

	Frecventa producerii gheții la mal și a sloiurilor %	Frecvența producerii podului de gheață %	Data apariției gheții la mal și a sloiurilor			Data apariției podului de gheață		
			Media	Timpurie	Târzie	Media	Timpurie	Târzie
Negresti	100	69	03.dec	01.nov	04.ian	02.ian	03.dec	13.feb
Turulung	100	55.2	20.dec	01.nov	05.feb	04.ian	26.nov	05.mar

Frost evolution in basin Tur

Tabel7

	Durata în zile a podului de gheață (raportat la nr. de ierni cu pod de gheață)			Durata în zile a podului de gheață (raportat la nr. de ierni cu observații)			Durata în zile a formelor de gheață (raportat la nr. de ierni)		
	Media	Timpurie	Târzie	Media	Timpurie	Târzie	Media	Timpurie	Târzie
Negresti	24	56	7	16	58	0	60	114	17
Turulung	28	75	1	16	75	0	44	99	4

7. Chemistry and water quality in the Tur Basin

Environmental objective of heavily modified water bodies and man made ones is the attainment of good ecological potential and not the good status like that of the surface water bodies. However, a modified or artificial water body may fall into a typology of natural water, in which case it would be the same environmental objective as if they were natural.

7.1. Water chemistry in the Tur Basin

To follow the progress of hydrochemical characteristics of water in the Tur Basin there were datas compiled from three control sections on the main course and seven tributaries. The period tagged was 2005 - 2008, except that the sections of the tributaries were missing some data rows.

7.1.1. The chemical composition of water

Annual average content of calcium in sections analyzed ranged from 81.3 mg / l (Turţ River - Upstream of the confluence with the River Tur) and 3.1 mg / l (Valea Rea - Călineşti-Oas). In general, the Tur Basin river water has a low calcium (22.8 mg / l). The spread of variation in the concentration of calcium is quite high (3.1 to 81.3 mg for monthly averages). Depending on the amount of water drained, calcium concentration in river water varies both in multi profile and during the year.

7.1.2. Conditions of biogenic and organic substances

The existence of ammonium ion may indicate recent contamination with cellular breakdown products or discharges of wastewater. Average monthly amounts of ammonium ion (NH4 +) are higher in the section Turţ reaching 0.8 mg / l, indicating second-class quality.

In the basin studied both iron and manganese passed admissible concentration indicating water quality class III and IV of the profile control on the Turţ River upstream from its confluence with the River Tur. And these breaches are due to mine water infiltrated from the mines upstream.

7.1.3. Conditions of dissolved gas and hydrogen ions

Hydrogen ion concentration expressed in units of pH, has average annual values between 6 and 8. Extreme values of annual averages ranged between 5.5 and 8.7 pH units. The most acidic waters are met, in this case also for the profile of the Turţ River upstream from its confluence with the River Tur, largely due to mine water.

7.1.4. Analysis of water quality indicators

Monthly average values of biochemical oxygen were maintained between 0.5 mg / l at Turulung (January) and even 8 mg / l in the Turt river profile. Monthly determinations of biochemical oxygen indicate relatively high oscillations, their concentration making the water to fall on two profiles (Turt and Remetea) grade III quality.

7.2. Water quality in the Tur Basin

Regarding the environmental status of the basin in 2008, River Tur saw a good ecological state of the sources to the border over a length of 68 km. Valea Rea River, the main tributary of the Tur, had a very good ecological status on a stretch of 15 km from Negreşti-Oas, and on a stretch of 14 km had a good ecological status until confluence.

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