STUDIA UBB GEOGRAPHIA, LIX, 1, 2014, pp. 137-154
(RECOMMENDED CITATION)

THE THERMAL REGIME IN CRIŞUL NEGRU DRAINAGE BASIN

V. GALIŞ[1]

ABSTRACT. – **The Thermal Regime in Crişul Negru Drainage Basin.** The paper presents the main features of the thermal regime in Crişul Negru drainage basin on the basis of meteorological data recorded at 10 stations distributed across the basin. After the statistical processing of the data, according to the methodology specific for climatology, it was found that the thermal regime is influenced by the movement of air masses and by landforms, as evidenced by the processed values for each parameter that characterizes it.

Keywords: *thermal regime, Crişul Negru drainage basin.*

1. INTRODUCTION

Several features are present, according to altitude, slope, aspect and so on, generating a mountain climate characterized by a decrease in air temperature together with an increasing altitude (due to the heat loss through terrestrial radiation that is greater than insolation), through the different heating of the slopes (northern slopes are cooler than the southern ones) etc. (Gaceu, 2005). The air temperature is one of the most important elements of climate that presents space and time changes as a result of the interaction between the climatic factors. It varies greatly both close to the ground and in the atmosphere, influencing the distribution of other climate elements. Besides, the thermal criterion is used in all weather and climate assessments as it defines the climatic zones, the types of air masses, the atmospheric fronts, the air temperature being a limiting factor in the distribution of the living world on Earth (Cristea, 2004).

2. HISTORY OF RESEARCH

Up to present no complex and complete climatic study has been conducted on Crişul Negru drainage basin (Măhăra *et al*, 1999; Moza, 2009), so there is only information about the study of wider areas. Among these we mention the doctoral theses published by: Cristea (2004) who marks the climate risks in Criş basin and mentions certain climatic elements, including temperature, all analyzed using data from several weather stations in Crişul Negru drainage basin; Gaceu (2005) who analyzes a period of 40 years and refers to climate and climate risks in Vlădeasa and Bihor Mountains, including the thermal regime, a more detailed and highly parameterized analysis but which focuses less on our study area

[1] *University of Oradea, Department of Geography, Tourism and Territorial Planning, Romania, e-mail: yeoman8@yahoo.com*.

(with the weather stations at Stâna de Vale and Ştei); Şerban (2010) who, in a detailed analysis, refers to climate hazards in the Western Plain North of Mureş and reveals aspects concerning air temperature at Salonta, Holod, Chişineu Criş and Ineu stations.

Climatic aspects concerning the thermal regime in Crişul Negru drainage basin were presented in other articles (Măhăra & Linc, 1993; Gaceu, 1997; Dragotă & Gaceu, 2002, 2004; Gaceu, 2004; Gaceu, 2009). Some references to Crişul Negru drainage basin climate appear in the works of Gaceu *et al* (2002, 2003), Măhăra *et al* (1999), Bogdan & Niculescu (1999).

3. DATA AND METHODOLOGY

Crişul Negru drainage basin covers all landforms (plains, hills, mountains), an aspect considered when selecting the weather stations for a better measurement of air temperature characteristics. Thus, we chose 10 meteorological stations (fig. 1) distributed as follows: Vlădeasa (1836 m), Stâna de Vale (1108 m), Zece Hotare (642 m) and Moneasa (703 m) for the mountain area, Dumbrăviţa de Codru (586 m) and Ştei (278 m) for the hilly area, Holod (163 m), Salonta (95 m), Chişineu Criş (96 m) and Ineu (110 m). Unfortunately, the climate analysis was more difficult due to the lack of homogeneity of the data, the stations being set up in different stages, before 1970 (1959 – Ştei, 1961 – Vlădeasa 1800, 1962 – Chişineu Criş, 1967 - Holod), during the 1970s (1975 – Moneasa, 1979 – Stâna de Vale and Ineu), the 1980s (1983 – Dumbrăviţa de Codru and Salonta), after 2000 (Zece Hotare, Moneasa, Salonta, Ineu), which is why we used data from the 1978-2007 period, for 30 years , thus respecting the climate research methodology.

A process started in Romania in the 2000s to dispense with the weather stations due to the question of the automation and computerization of the National Meteorological system. Therefore, the data of 4 out of the 10 stations in Crişul Negru basin (Zece Hotare, Moneasa, Salonta, Ineu) is 7 years short, but the remaining 6 stations (Vlădeasa 1800, Stâna de Vale, Ştei, Dumbrăviţa de Codru, Holod, Chişineu Criş) have continuous data for 30 years so they are representative according to the WMO norms and are uniformly distributed across the studied basin (Kostin & Pokrovskaia, 1964; Belozerov & Fărcaş, 1971; Arlery *et. al*, 1973; Marin, 1986; Fărcaş, 1988; Bogdan & Niculescu, 1999; Gaceu, 2002).

Thus, we tried to conduct a comparative analysis as objective as possible, which is why we used pure data, without interfering with statistical processing which can sometimes drift away from the factual reality, a goal accomplished due to the existence of six meteorological stations with complete data for 30 years.

4. RESULTS AND DEBATES

4.1. The annual average temperature

The meteorological observation data analyzed for the 1961-2010 period or for certain stations (table 1), indicates a territorial distribution of the annual average air temperature, with distinct features due to the inhomogeneity of Crişul Negru drainage basin. Overall, the average annual values of the air temperature present a setting given by the vertical thermal gradient of 0.5-0.7^{0}C/100 m and highlight the climatic profile based on the thermal environments of the 10 weather stations located in the drainage basin.

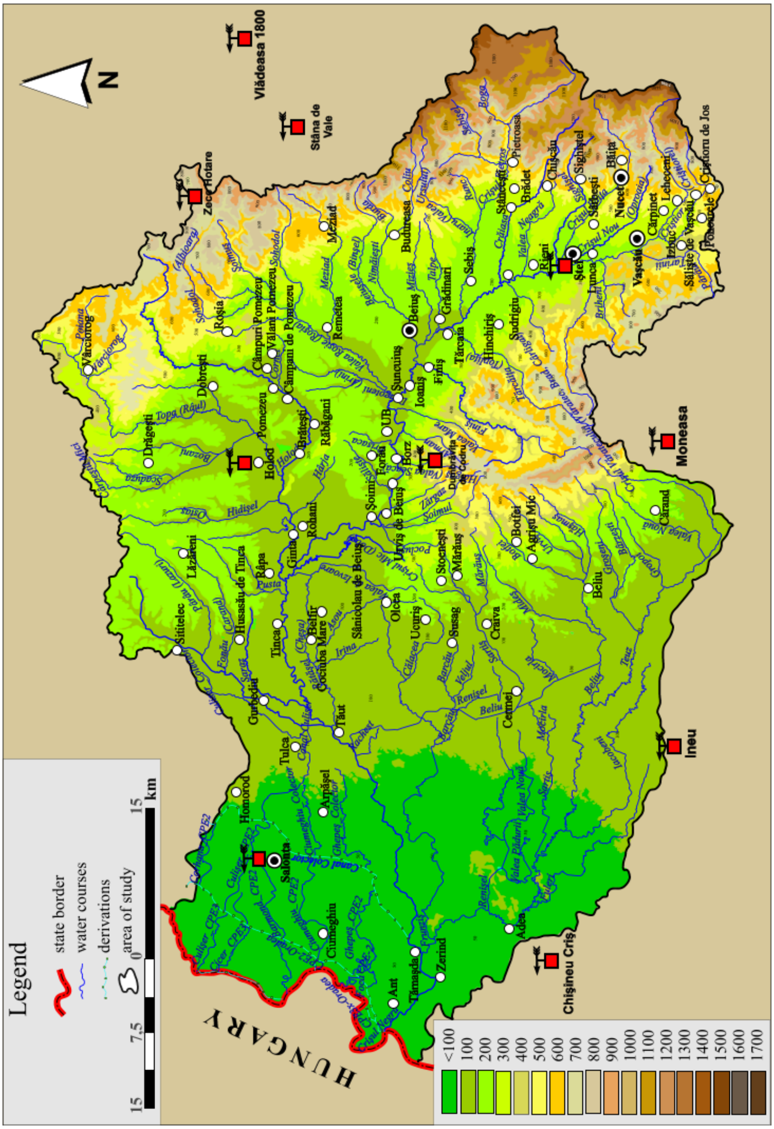

Fig. 1. The location of the meteorological stations in Crişul Negru drainage basin.

The air temperature is relatively evenly distributed in the plain, ranging between 10.2^{0}C at Chişineu Criş, 10.3^{0}C at Salonta, 10.4^{0}C at Holod and 10.6^{0}C at Ineu. Less significant differences occur in the hills and depressions, respectively 9.2^{0}C at Ştei and 9.6^{0}C at Dumbrăviţa de Codru. In the mountains differences are clearer: 8.2^{0}C at Zece Hotare, 7.9^{0}C at Moneasa, 4.1^{0}C at Stâna de Vale and 1.1^{0}C at Vlădeasa which represent the highest point in Crişul Negru drainage basin (fig. 2, table 1).

Table 1.

The annual average temperature in Crişul Negru drainage basin

Station	Alt. (m)	Period	The multiannual average temperature (^{0}C)
Vlădeasa 1800	1836	1961-2010	1.1
Stâna de Vale	1108	1979-2010	4.1
Moneasa	703	1978-1997	7.9
Zece Hotare	642	1988-1997	8.2
Dumbrăviţa de Codru	586	1983-2010	9.6
Ştei	278	1961-2010	9.2
Holod	163	1978-2010	10.4
Ineu	110	1979-1997	10.6
Chişineu Criş	96	1962-2010	10.2
Salonta	95	1983-1997	10.3

Source: Data from the A.N.M. Archives

Indeed, these values are representative for the areas where the platforms of the mentioned weather stations are located, but the local slopes with different aspects recorded significant thermal differences as some are more shaded and cooler while others are sunnier and warmer.

4.1.1. The deviations of the annual average temperature from the multiannual average

The average temperature is the "norm" or the average calculated over several years, but this value can vary from year to year and thus we calculated the value and the direction of these deviations for each year using the Hellman criterion (table 2).

Therefore, we calculated the average annual temperature deviations from the annual average for the 10 stations in Crişul Negru drainage basin. According to this criterion, most of the years are normal from the point of view of temperature and have a frequency between 60 % and 75 % (table 3). As the altitude increases, the frequency of these normal years decreases from 69.4% recorded at the Chişineu Criş station located in the plain area, to 60 % at Vlădeasa, which indicates the situation on the highest point of Crişul Negru drainage basin (table 3).

Table 2.

The thermal character of the months and years according to the Hellman criterion

Average monthly deviation (%)	Average annual deviation (%)	Remarks
>10.0	> 5.0	excessively rainy
5.1 ÷ 10.0	2.1 ÷ 5.0	very rainy
2.1 ÷ 5.0	1.1 ÷ 2.0	rainy
1.1 ÷ 2.0	0.6 ÷ 1.0	moderately rainy
-1.0 ÷ 1.0	-0.5 ÷ 0.5	normal
-2.0 ÷ -1.1	-1.0 ÷ -0.6	moderately dry
-5.0 ÷ -2.1	-2.0 ÷ -1.1	dry
-10.0 ÷ -5.1	-5.0 ÷ -2.1	very dry
<-10.0	< -5.0	excessively dry

Source: Bogdan & Niculescu (1999); Gaceu (2002; 2005).

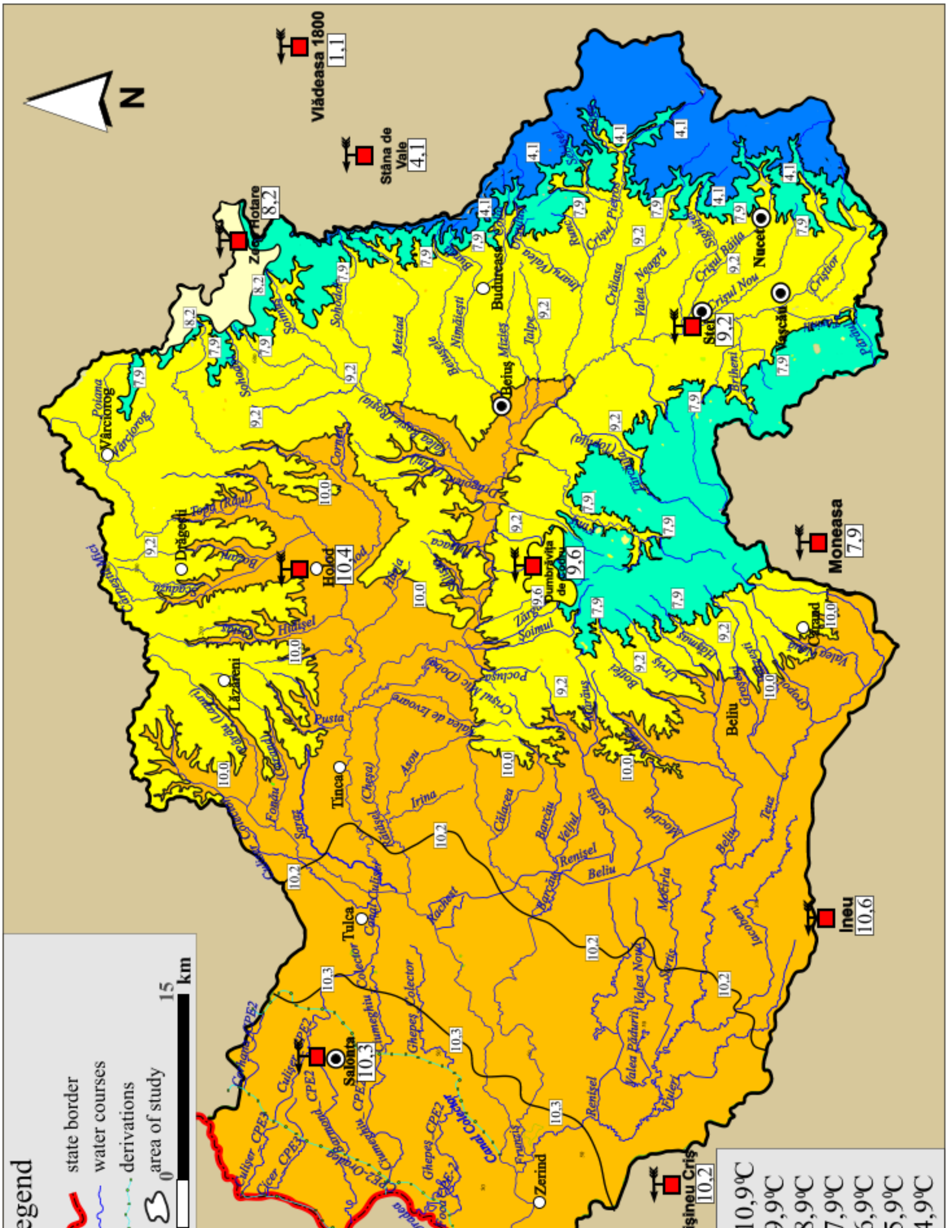

Fig. 2. The distribution of the annual average temperature in Crişul Negru drainage basin.

Table 3.

The thermal character of the years in Crișul Negru drainage basin, according to the Hellman criterion

Station (Period)		Vlădeasa 1800 (1961-2010) 50 years	Stâna de Vale (1979-2010) 32 years	Moneasa (1978-1997) 20 years	Zece Hotare (1988-1997) 10 years	Dumbrăvița de Codru (1983-2010) 28 years	Ştei (1961-2010) 50 years	Holod (1978-2010) 43 years	Ineu (1979-1997) 19 years	Chișineu Criş (1962-2010) 49 years	Salonta (1983-1997) 20 years	Total years	The average frequency in the basin (%)
Alt. (m)		1836	1108	703	642	586	278	163	110	96	95		
Excessively Rainy	Y	-	-	-	-	-	-	-	-	4	-	4	1.2
	F	-	-	-	-	-	-	-	-	8.2	-		
Very Rainy	Y	5	3	1	1	5	2	5	1	2	2	27	8.4
	F	10.0	12.5	5.0	10.0	18.5	4.0	11.6	5.3	4.1	10.0		
Rainy	Y	5	-	2	-	1	2	2	1	2	-	15	4.7
	F	10.0	-	10.0	-	3.7	4.0	4,7	5,3	4.1	-		
Moderately Rainy	Y	30	23	15	7	16	37	28	13	34	16	219	68.2
	F	60.0	71.9	75.0	70.0	59.3	74.0	65.1	68.4	69.4	80.0		
Normal	Y	9	5	1	1	5	6	5	3	3	2	40	12.5
	F	18.0	15.6	5.0	10.0	18.5	12.0	11.6	15.8	6.1	10.0		
Moderately Dry	Y	1	1	1	1	1	3	3	1	1	-	13	4.1
	F	2.0	3.1	5.0	10.0	3.7	6.0	7.0	5.3	2.0	-		
Dry	Y	-	-	-	-	-	-	-	-	3	-	3	0.9
	F	-	-	-	-	-	-	-	-	6.1	-		

Y=Years
F=Frecv.%

Source: Data from the A.N.M. Archives.

The *cool years* have frequencies between 5 and 10% at Moneasa and Zece Hotare (in medium mountains) and 18% at Vlădeasa (on the highest peaks of the basin) and the moderately dry years are less frequent, with frequency values between 0% at Salonta, Zece Hotare, Stâna de Vale and 10% at Moneasa and Vlădeasa (table 3).

The *dry* years have an even lower frequency, between 4-5% at Ştei and Moneasa and 12.5% at Stâna de Vale, being closer to that of the cold years which occur in 2-3% at Vlădeasa and Stâna de Vale and in 10% of the cases at Dumbrăviţa de Codru (table 3).

In conclusion, table 2 shows that both at the meteorological stations and the level of Crişul Negru drainage basin *the normal years predominate (69.1 %), followed by cool ones, while the cold and warm years are rare and the very cold, the very warm, the excessively cold and the excessively warm years rarely occur. Moreover, the analysis shows that excessively warm years (1994, 2000, 2002, 2010) and the very cold ones (1978 , 1980, 1985) are specific to the area of the plains, while in the hills and mountains there were no dangerous years in terms of heat (very warm, excessively warm , very cold or excessively cold years), due to the geographic location of Crişul Negru drainage basin against the oceanic air masses and the altitude that acts as a thermal moderator*, a situation emphasized by Gaceu

(1997, 2004, 2005) for the lowland, hilly and mountainous area and by Şerban (2010) for the plain areas, even though those studies analyzed a shorter period by 10 years, respectively 8 years.

4.2. The monthly average of the temperature

4.2.1. Changes in air temperature throughout the year

The air temperature registered throughout the year can be analyzed based on monthly averages which indicate a summer maximum in July and a winter minimum in January, while the largest variations occur in the transition seasons, namely during March-April and September-October (table 4).

Table 4.

Monthly and annual average temperature and the annual thermal average amplitude

Station		Vlădeasa 1800 (1961-2010) 50 yrs.	Stâna de Vale (1979-2010) 32 yrs.	Moneasa (1978-1997) 20 yrs.	Zece Hotare (1988-1997) 10 yrs.	Dumbrăviţa de Codru (1983-2010) 28 yrs.	Ştei (1961-2010) 50 yrs.	Holod (1978-2010) 43 yrs.	Ineu (1979-1997) 19 yrs.	Chişineu Criş (1962-2010) 49 yrs.	Salonta (1983-1997) 20 yrs.
Alt. (m)		1836	1108	703	642	586	278	163	110	96	95
Month	**I**	**-7.2**	**-5.0**	**-2.1**	**-1.2**	**-0.7**	**-1.1**	**-0.9**	**-1.0**	**-1.4**	**-0.9**
	II	-7.0	-4.8	-1.0	-0.3	-0.1	0.4	1.0	0.7	-0.1	0.1
	III	-4.6	-1.3	3.4	3.0	4.0	5.0	5.4	5.7	5.2	5.0
	IV	-0.4	3.0	7.6	7.6	9.6	9.6	10.6	10.7	10.3	10.8
	V	4.8	8.8	12.8	12.7	13.7	14.8	16.1	16.4	16.1	16.4
	VI	7.8	12.0	15.1	15.9	17.3	17.7	18.9	19.2	19.1	19.0
	VII	9.6	**13.7**	**16.9**	**18.5**	**20.1**	**19.3**	**20.6**	**21.0**	**20.9**	**21.5**
	VIII	**9.7**	13.0	16.4	18.3	20.0	19.1	20.1	20.7	20.4	20.9
	IX	6.2	9.0	12.3	13.0	15.2	15.1	15.6	16.3	15.9	16.0
	X	2.7	4.8	9.0	8.6	10.5	10.2	10.6	10.7	10.3	10.4
	XI	-2.1	-0.2	2.9	3.0	4.5	4.7	5.5	5.0	4.3	4.5
	XII	-5.7	-3.3	0.3	-0.7	0.6	1.1	0.7	1.4	0.8	0.4
Annual average		**1.1**	4.1	7.9	8.2	9.6	9.7	10.4	**10.6**	10.2	10.3
Annual amplitude		**16.9**	18.7	19.0	19.7	20.8	20.4	21.8	22.0	22.3	**22.4**

Source: Data from the A.N.M. Archives.

Following the evolution of the monthly average temperatures over the year, we can observe that they have values between -7.2^{0}C at Vlădeasa in January, on the highest point of Crişul Negru drainage basin and 21.5^{0}C at Salonta in July, hence the thermal vertical amplitude of 28.7^{0}C (table 4).

In *January* (fig. 3, table 4) the monthly average temperatures are negative throughout the basin. The lowest value of -7.2^{0}C is recorded on the highest peak at Vlădeasa station (1836 m) and the highest value of -0.7^{0}C at Dumbrăviţa de Codru (586 m) that is at medium altitudes, not at lower ones, as it would be expected. There are three explanations for this situation:

a) Thermal inversions occur frequently during this month and the inversion layer of cooler air is located below the altitude of Dumbrăviţa de Codru station (586 m) (Gaceu, 2005);
b) During winter, in January, the condensation of the stratiform clouds, current in this time of the year, is located at the level of Dumbrăviţa de Codru station. The condensation of the water vapors is done releasing heat, which increases the temperature;

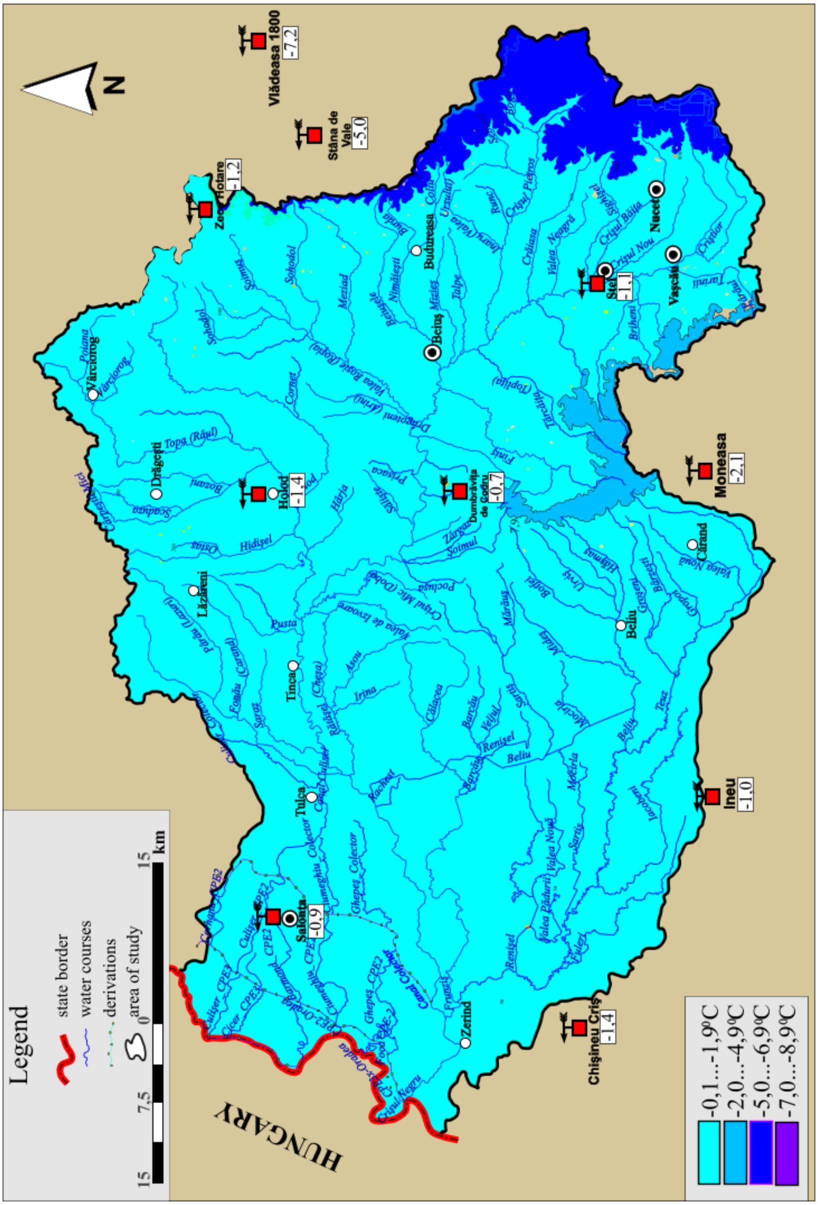

Fig. 3. The distribution of the average temperature during January in Crişul Negru drainage basin.

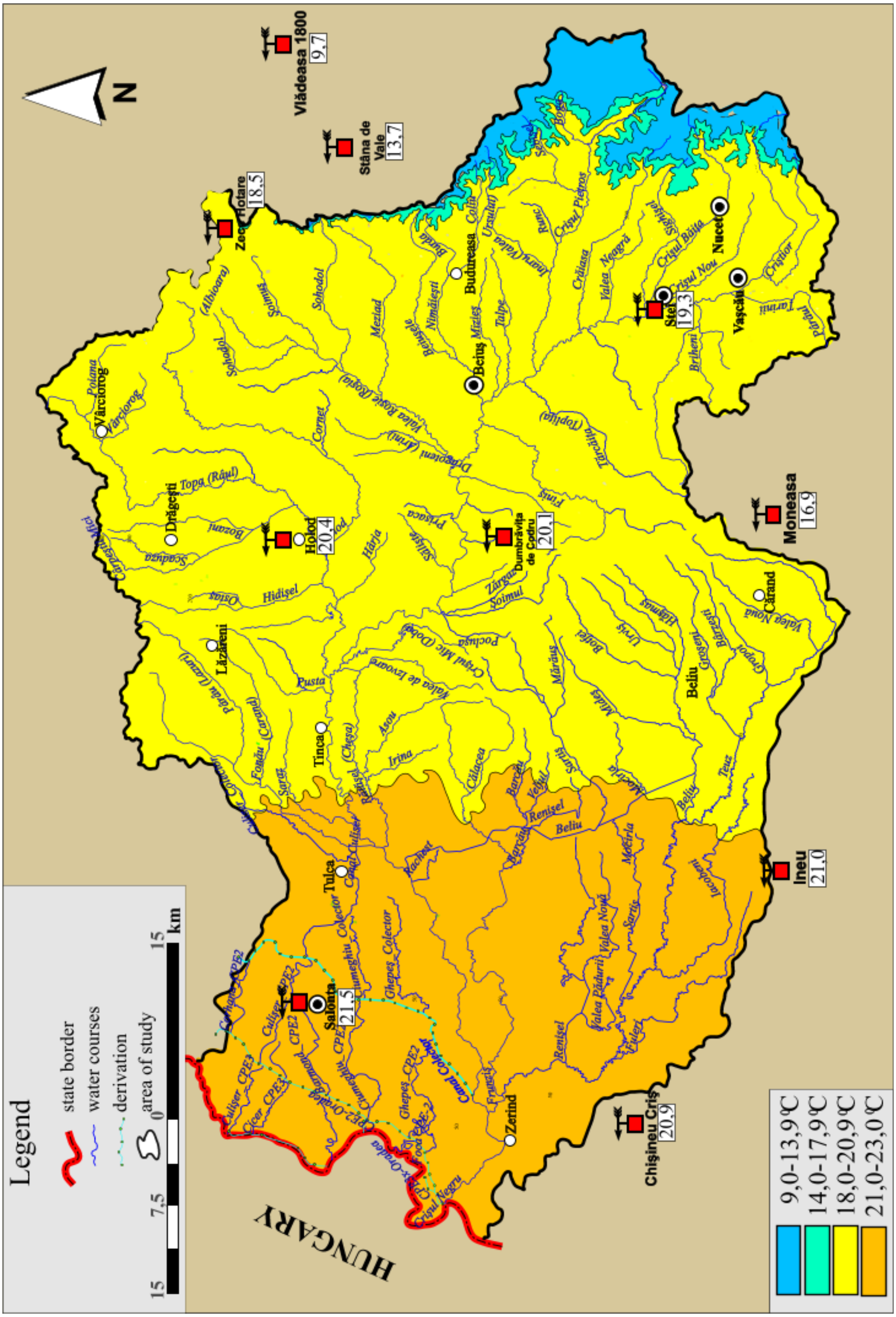

Fig. 4. The distribution of the average temperature during July in Crişul Negru drainage basin.

c) The meteorological station Dumbrăviţa de Codru is located "under the wind", in the way of the air masses that forward mainly from the southwest, so there is a process of drying caused by the downward movement of air in the station area (Măhăra & Linc, 1993; Măhăra *et al*, 1999).

In *February*, the average monthly temperature begins to rise and becomes positive at all stations below 250 m, and in March the temperature becomes positive up to 1000 m. In April only the highest peaks of the basin still have negative temperatures, while the rest of the territory has a positive average temperature (table 4).

The increase of temperature generally continues until July (fig. 7) when highest values are reached due to the high global radiation of this month. The average values range from 9.6^{0}C at Vlădeasa to 21.5^{0}C at Salonta in the low plains.

The exceptions are the greatest heights, where the air gets warm more slowly and the monthly maximum temperature is recorded in August, 9.7^{0}C at Vlădeasa.

In *August*, when the average thermal values are close to those of the previous month, the average monthly temperature begins to decrease at all stations in Crişul Negru drainage basin until December, reaching the minimum value in January (table 4, fig. 3).

4.2.2. The deviation of the monthly average temperature during January and July as compared to their multiannual average, according to the Hellman criterion

Given the fact that the data gathered is not heterogeneous enough for highlighting the thermal character of the distinguishing months of the year, January and July, we decided to analyze only three stations with longer data series, representative for the three landforms: high mountains (Vlădeasa), low hills - mountains (Stâna de Vale), plains (Ştei).

Analyzing the thermal character of January, we found that the thermally normal months are predominant, having a frequency of 30% at Vlădeasa, 37.5% at Ştei and 45.5% at Stâna de Vale.

Table 5.

The thermal character of Crişul Negru drainage basin during January, according to the Hellman criterion

Station Period	Hot		Warm		Normal		Cool		Cold		Very cold	
	M	F	M	F	M	F	M	F	M	F	M	F
Ştei 1961-2010	135	22.5	60	10.0	225	37.5	30	5.0	120	20.0	30	5.0
Stâna de Vale 1979-2010	52	13.6	52	13.6	175	45.5	17	4.5	88	22.8	-	-
Vlădeasa 1800 1961-2010	105	17.5	120	20.0	180	30.0	75	12.5	105	17.5	15	2.5

M=Month
F=Freq %

Source: Data from the A.N.M. Archives.

Cold months also have a high frequency in Crişul Negru drainage basin. They have values between 17.5% at Vlădeasa and 22.8% at Stâna de Vale, followed by the hot months whose frequency ranges between 13.6% at Stâna de Vale and 22.5% at Ştei. The warm months occur in a proportion of 20% at Vlădeasa to 10% at Ştei. The cool months are rare, their frequency reaching at most 12.5% at Vlădeasa. The very cold months are the least frequent, occurring in 5% of the cases at Ştei station (table 4).

The analysis shows that there were no excessively cold or excessively hot January months in Crişul Negru drainage basin.

In Crişul Negru drainage basin, *July* has similar characteristics to January, with the predominance of the *normal character*, having frequencies between 55% at Vlădeasa and 63.8% at Stâna de Vale. The *cool* months are in second place, in terms of frequency, with a percentage ranging from 4.5% at Stâna de Vale up to 17.5% at Vlădeasa (table 6). A close frequency is also met for the *warm* months with values between 7.5% at Vlădeasa and 22.7% at Stâna de Vale. *Hot* and *cold* July months are the least frequent in Crişul Negru drainage basin, rarely exceeding 10% (table 6). Therefore, the studied period showed no *very cold, excessively cold, very hot or excessively hot* month of July, due to the influence of the western air masses and the thermal role of the mountain.

Table 6.

The thermal character of Crişul Negru drainage basin during July, according to the Hellman criterion

Station Period	Hot		Warm		Normal		Cool		Cold	
	Months	Freq %	Months	Freq %	Months	Freq %	Months	Freq %	Months	Freq %
Ştei 1961-2010	30	5.0	105	17.5	360	60.0	75	12.5	30	5.0
Stâna de Vale 1979-2010	17	4.5	87	22.7	246	63.8	17	4.5	17	4.5
Vlădeasa 1961-2010	75	12.5	45	7.5	330	55.0	105	17.5	45	7.5

Source: Data from the A.N.M. Archives.

4.3. The average annual amplitude of air temperature

Calculating the thermal amplitudes, as differences recorded during the year, is important in order to highlight the temperature contrasts between summer and winter and to find the degree of continental climate.

The thermal amplitude values are determined by the movement of air masses, altitude, fragmentation of the landforms, slope aspect and local geographical conditions. The lowest thermal amplitudes are recorded at the highest altitudes: 16.9^{0}C at Vlădeasa, as the air is less heated on the mountain peaks. Up to about 650 m high the average thermal amplitude is below 20^{0}C: 18.7^{0}C at la Stâna de Vale, 19^{0}C at Moneasa, 19.7^{0}C at Zece Hotare (table 4, fig. 5).

At lower altitudes, the annual amplitude values increase in the depression corridor and reach 20.8^{0}C at Dumbrăviţa de Codru, 20.4^{0}C at Ştei and 22.4^{0}C at Salonta (table 4, fig. 5). As opposed to this general trend, there are also exceptions determined by local geographical conditions, slope aspect etc. Thus, at the same altitudes the annual average thermal amplitudes are higher on the northern, shaded slopes, with lower temperatures in the summer months and on the western slopes, exposed to the western wet and cloudy air masses, the average annual temperature amplitudes being lower than on the sunny, eastern slopes.

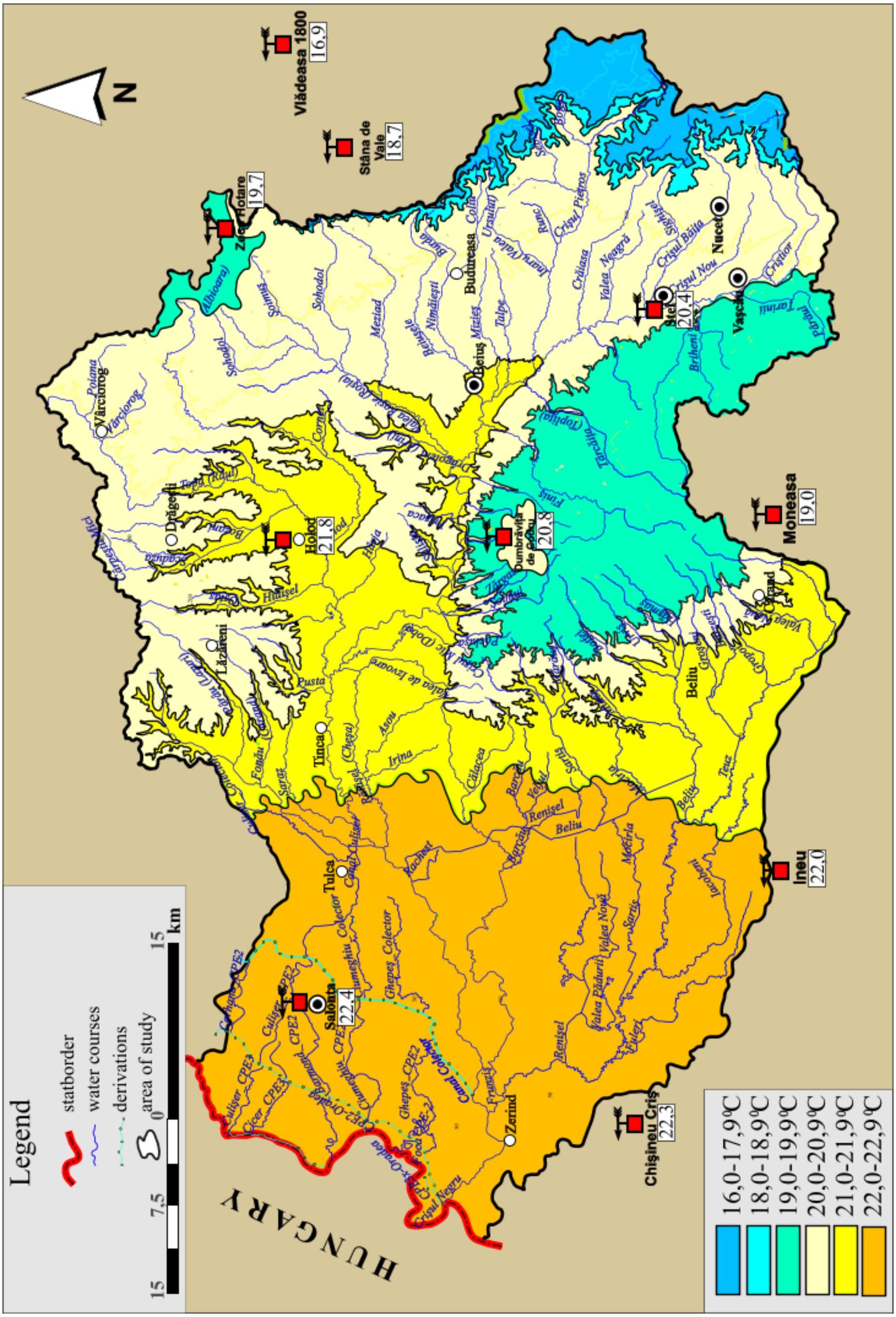

Fig. 5. The average annual amplitude for air temperature in Crişul Negru drainage basin.

4.4. The seasonal average temperature

The distribution of the seasonal average temperature within Crişul Negru drainage basin is as follows: between 0.4⁰C at Ineu and -6.6⁰C at Vlădeasa during winter, so it is not very cold due to the Atlantic and the Mediterranean influences; during spring and autumn the seasonal average temperature values are close to the multiannual average air temperature; during summer, however, the air temperature in the plain area is above 20⁰C (20.1⁰C at Chişineu Criş; 20.3⁰C at Ineu, 20.5⁰C at Salonta) and it gradually decreases with increasing altitude reaching 19.1⁰C at Dumbrăviţa de Codru, 16.1⁰C at Moneasa, the stations representative for the altitudes specific for small mountains, 12.9⁰C at Stâna de Vale at medium altitudes and 9.0⁰C at Vlădeasa, the station representing the highest peak in Crişul Negru drainage basin (table 7).

Table 7.

The seasonal average temperature in Crişul Negru drainage basin

Station	Alt. (m)	Winter	Spring	Summer	Autumn	Seasonal average temperature
Vlădeasa 1800	1836	-6.6	-0.1	9.0	2.3	1.1
Stâna de Vale	1108	-4.4	1.6	12.9	4.5	4.1
Moneasa	703	-0.9	7.9	16.1	8.1	7.9
Zece Hotare	642	-0.7	7.7	17.6	8.2	8.2
Dumbrăviţa de Codru	586	-0.1	9.3	19.1	10.1	9.6
Ştei	278	0.1	9.8	18.7	10.0	9.7
Holod	163	0.3	10.7	19.8	10.6	10.4
Ineu	110	0.4	10.9	20.3	10.7	10.6
Chişineu Criş	96	-0.2	10.5	20.1	10.2	10.2
Salonta	95	-0.1	10.7	20.5	10.3	10.3

Source: Data from the A.N.M. Archives.

4.5. Absolute extreme temperatures

The climate of an area is not sufficiently characterized only by the average values of the parameters that define it, which is why we use absolute values. They indicate the actual boundaries between which the air temperature values in the studied area oscillate, so they are of great theoretical and practical importance.

4.5.1. The absolute maximum temperature

The occurrence of the lowest and highest values of the temperature in a geographical area depends on the characteristics and the origin of the air mass, and the balance of radiation.

In Crişul Negru drainage basin, almost all the meteorological stations recorded the maximum temperature in the month of August, 38.7⁰C at Ineu on 28.08.1992, 37.8⁰C at Holod on 30.08.1992, 37.7⁰C at Chişineu Criş on 28.08.1992, 37.2⁰C on 28.08.1992 at Salonta, 33.2⁰C at Zece Hotare on 30.08.1992, 30.6⁰C at Stâna de Vale on 22.08.2000.

At the stations Vlădeasa 1800, Moneasa and Dumbrăviţa de Codru, it was registered in June and July: 25.2^{0}C on 15.06.1987 at Vlădeasa, 31.6^{0}C on 02.07.1987 at Moneasa and 35.7^{0}C on 20.07.1987 at Dumbrăviţa de Codru (table 8, fig. 6). So, the highest absolute temperature value was recorded in the plain area (38.7^{0}C at Ineu) and the lowest at the highest altitudes of Crişul Negru drainage basin (25.2^{0}C at Vlădeasa).

Table 8.

The monthly and annual maximum absolute temperature in Crişul Negru drainage basin

Station	Vlădeasa 1800	Stâna de Vale	Moneasa	Zece Hotare	Dumbrăviţa de Codru	Ştei	Holod	Ineu	Chişineu Criş	Salonta
t^{0}C	25,2	30,6	31,6	33,2	35,7	37,2	37,8	38,7	37,7	37,2
Date	15.06. 1987	22.08. 2000	02.07. 1987	30.08. 1992	20.07. 1987	28.08. 1992	30.08. 1992	28.08. 1992	28.08. 1992	28.08. 1992

Source: Data from the A.N.M. Archives.

The causes producing these temperature values are dynamic in nature: the advection of the warm and dry tropical continental air masses coming from the North African or Arabic Depression anticyclones. We have to note that, due to the geographical location in western Romania and to the high altitudes (in the mountain areas), the absolute maximum temperatures recorded in Crişul Negru drainage basin are much lower than in other regions of the country (***, 2008).

4.5.2. The absolute minimum temperature

The lowest recorded temperature values in Crişul Negru drainage basin occurred in January due to cold continental polar or arctic air invasions from the Eastern European Anticyclone or the Scandinavian Anticyclone. The lowest value was recorded at Vlădeasa: -30.0^{0}C on 16.01.1963, on the highest peak of the basin, and the highest value: -19.8^{0}C at Dumbrăviţa de Codru on 13.01.1987 due to thermal inversions present at the level of this station (Măhăra & Linc, 1993; Măhăra *et al*, 1999; Gaceu, 2005) (table 9, fig. 7).

Table 9.

The monthly and annual absolute minimum temperature in Crişul Negru drainage basin

Station	Vlădeasa 1800	Stâna de Vale	Moneasa	Zece Hotare	Dumbrăviţa de Codru	Ştei	Holod	Ineu	Chişineu Criş	Salonta
t^{0}C	-30.0	-28.9	-22.4	-21.0	-19.8	-24.1	-24.6	-25.1	-27.5	-25.6
Date	16.01. 1963	31.01. 1987	20.02. 1985	01.02. 1991	13.01. 1987	18.01. 1963	31.01. 1987	31.01. 1987	31.01. 1987	14.01. 1985

Source: Data from the A.N.M. Archives

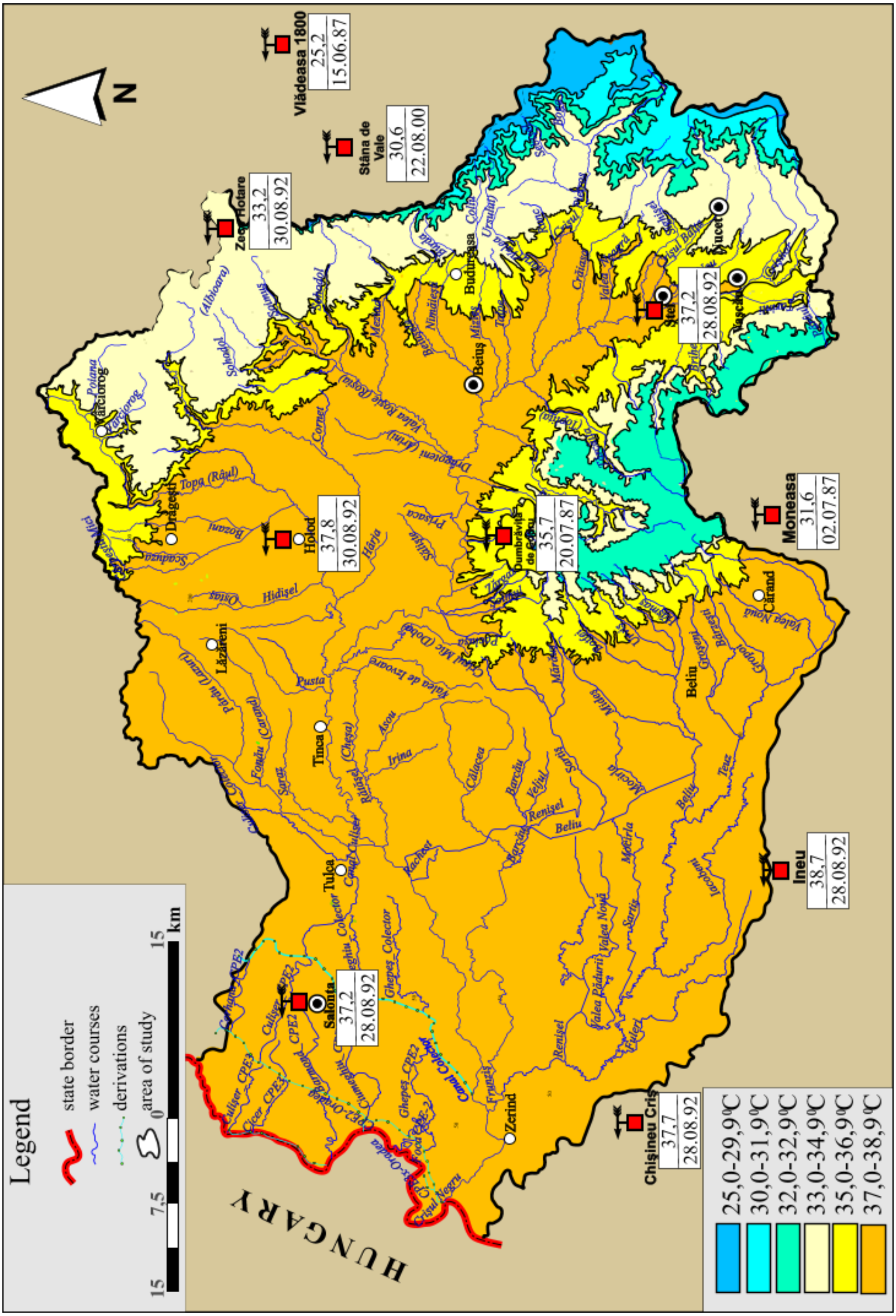

Fig. 6. The absolute maximum temperatures registerd in Crişul Negru drainage basin.

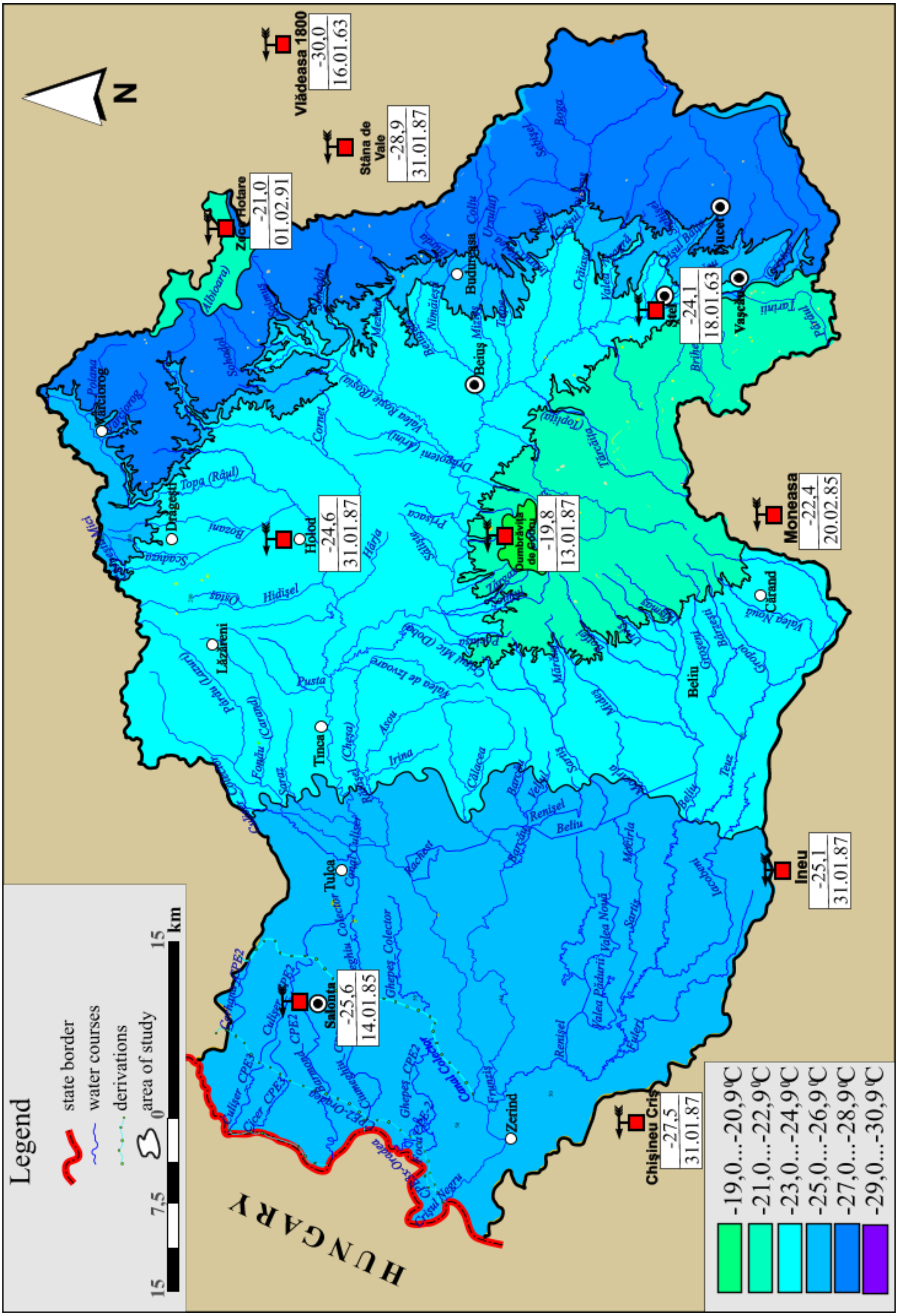

Fig. 7. The absolute minimum temperatures registerd in Crişul Negru drainage basin.

The meteorological stations located at lower altitudes registered lower thermal values: -25.6^{0}C at Salonta in 14.01.1985; -27.5^{0}C at Chişineu Criş in 31.01.1987; -25.1^{0}C in 31.01.1987 at Ineu; -24.6^{0}C in 31.01.1987 at Holod (Table 8, Fig. 3).

4.5.3. Absolute amplitudes of air temperature

In order to better highlight the degree of thermal continentalism, we determined the extreme limits of the oscillating air temperature values and we calculated the absolute thermal amplitudes. As shown in table 10, the lowest absolute thermal amplitudes are recorded at the highest altitudes of Crişul Negru drainage basin, 55.2^{0}C at Vlădeasa and 59.5^{0}C at Stâna de Vale, while the highest ones are recorded in the plain areas: 65.2^{0}C at Chişineu Criş, 63.8^{0}C at Ineu, 62.8^{0}C at Salonta and 62.4^{0}C at Holod.

Table 10.

The annual absolute thermal amplitudes in Crişul Negru drainage basin

Station	Vlădeasa 1800	Stâna de Vale	Moneasa	Zece Hotare	Dumbră-viţa de Codru	Ştei	Holod	Ineu	Chişineu Criş	Salonta
Abs.Ampl.	55.2	59.5	54.0	54.2	55.5	61.3	62.4	63.8	65.2	62.8

Source: Data from the A.N.M. Archives

This is explained by the landforms and the mainly western movement of air masses, so that the plain area is strongly heated in summer and cooled in winter, unlike the peaks of the mountains where the intense wind stops the air from getting warm and makes it cool. Overall though, the maximum and minimum air temperature and the absolute amplitudes derived from them are not as high as in other areas of Romania and highlight the importance of the western atmospheric circulation in reducing continentalism.

5. CONCLUSIONS

The analysis that we conducted revealed that the air temperature regime in Crişul Negru drainage basin is strongly influenced by the circulation of air masses and landforms, as evidenced by:

a) *The average annual temperature* that decreases with increasing altitude from 10.6^{0}C at Ineu in the plain area to 1.1^{0}C at Vlădeasa, at the highest altitude.

b) The *extreme temperatures* are higher during summer in the plain area (38.7^{0}C at Ineu and 37.7^0 C at Chişineu Criş) and lower during winter in the mountain area (-30^{0}C at Vlădeasa and -28.9^{0}C at Stâna de Vale).

c) The *average and absolute thermal amplitudes* are higher in the plain area (22.4^{0}C at Salonta and 65.2^{0}C at Chişineu Criş respectively) and lower in the mountain areas (16.9^{0}C at Vlădeasa and 54.0^{0}C at Moneasa and 55.2^{0}C at Vlădeasa respectively).

d) The *high frequency of thermal inversions* which at average altitudes (about 600 m) determine average temperatures close to those recorded in the plain area (9.6^{0}C at Dumbrăviţa de Codru, as compared to 10.2^{0}C at Chişineu Criş), lower extreme temperatures at 100 m altitude (an absolute minimum of -19.8^{0}C at Dumbrăviţa de Codru, as compared to -27.5^{0}C at Chişineu Criş; an absolute maximum of 35.7^{0}C at Dumbrăviţa de Codru, as compared to 38.7^{0}C at Ineu), thermal amplitudes lower than in the plain area (an average annual thermal amplitude of 20.8^{0}C at Dumbrăviţa de Codru , as compared to 22.4^{0}C at Salonta, 22.3^{0}C at Chişineu Criş, 22.0^{0}C at Ineu; 55.5^{0}C the thermal absolute amplitude at Dumbrăviţa de Codru, as compared to 65.2^{0}C at Chişineu Criş).

e) The *predominance of the normal years* followed by the cool years, the cold ones and the warm years that are rare, and the very cold, the excessively cold, very warm and excessively warm years that occur even more rarely. The excessively warm years and the very cold years occur only in the plain area while in the depressions, hills and mountains there was no record of thermally dangerous years (very warm, excessively warm, very cold or excessively cold years).

REFERENCES

1. Arléry, R., Grisollet, H., Guilmet, B. (1973), *Climatologie. Méthodes et practiques,* Edit. Gauthier-Villars, Paris.
2. Belozerov, V., Fărcaş, I. (1971), *Îndrumător metodologic pentru lucrările practice de meteorologie – climatologie,* Univ. Babeş – Bolyai, Cluj – Napoca.
3. Bogdan, Octavia, Niculescu, Elena (1999), *Riscurile climatice din România,* Edit. Sega International, Bucureşti.
4. Cristea, Maria (2004), *Riscurile climatice din bazinul hidrografic al Crişurilor,* Edit. Abaddaba, Oradea.
5. Dragotă, Carmen, Gaceu, O. (2002), *Consideraţii asupra temperaturilor extreme în Munţii Bihor şi Vlădeasa,* Universitatea "Ovidius" Constanţa.
6. Dragotă, Carmen, Gaceu, O. (2004), *Des considerations sur les temperatures extremes dans les Montagnes de Bihor et Vlădeasa,* Analele Universităţii "Ovidius" Constanţa, pag. 84-88.
7. Fărcaş, I. (1988), *Meteorologie-Climatologie (Prevederea vremii),* Fac. de Biol.-Geogr., Cluj-Napoca.
8. Gaceu, O. (1997), *Regimul termic al staţiunii balneoclimaterice Stâna de Vale,* A.U.O, **VII**, Oradea, pag. 114-121.
9. Gaceu, O. (2002), *Elemente de climatologie practică,* Edit. Univ. din Oradea, Oradea.
10. Gaceu, O. (2004), *Caracteristici ale temperaturii aerului în Munţii Bihor şi Vlădeasa,* Comunicări de Geografie, IX, Universitatea din Bucureşti, Bucureşti.
11. Gaceu, O. (2005), *Clima şi riscurile climatice din Munţii Bihor şi Vlădeasa,* Edit. Univ. din Oradea, Oradea.
12. Gaceu, O. (2009), *Thermic inversions in the area of Oradea,* Studia UBB Geographia, LIV, 2, Cluj-Napoca, pag. 63-70.
13. Gaceu, O., Vlaicu, M., Pâle, Luminiţa, Filimon, C. (2003), *Scurt istoric al cercetărilor microclimatice şi topoclimatice în România cu privire specială asupra Munţilor Apuseni*, Analele Universităţii din Oradea, Geografie, XIII, Oradea, pag. 69-76.
14. Gaceu, O., Vlaicu, M., Pâle, Luminiţa, Filimon, Claudiu (2002), *Scurt istoric al cercetărilor meteorologice în România cu privire specială asupra Munţilor Apuseni*, Analele Universităţii din Oradea, Geografie, XII, Oradea, pag. 7-18.
15. Kostin, S.I., Pokrovskaia (1964), *Climatologie. Metode de prelucrare a datelor*, Edit. Ştiinţifică, Bucureşti.
16. Marin, I. (1986), *Măsurători şi calcule în meteorologie şi climatologie,* Univ. Bucureşti.
17. Măhăra, Gh. (1977), *Câmpia Crişurilor – studiu fizico-geografic cu accent asupra climei,* în *Câmpia Crişurilor, Ţara Beiuşului, Ţara Zarandului,* Edit. Ştiinţifică şi Enciclopedică, Bucureşti.
18. Măhăra, Gh., Josan, N., Benţe, Fl., Petrea, D., Ilieş, Al., Petrea, Rodica, Linc, Ribana, Nistor, S., Pâle, Luminiţa, Vlaicu, M., Staşac, M., Gaceu, O. (1999), *Potenţialul turistic al bazinului hidrografic al Crişului Repede,* Edit. Univ. Oradea, Oradea.
19. Măhăra, Gh., Linc, Ribana (1993), *Anomalii termice în Munţii Codru Moma,* A.U.O., III, Oradea, pag. 57-63.
20. Moza, Cornelia Ana (2009), *Clima şi poluarea aerului în bazinul hidrografic Crişul Repede,* Edit. Univ. din Oradea, Oradea.
21. Şerban, Eugenia (2010), *Hazarde climatice generate de precipitaţii în Câmpia de Vest situată la nord de Mureş,* Editura Universităţii din Oradea, Oradea.
22. *** (1983), *Geografia României, I, Geografia fizică,* Edit. Academiei R.S.R., Bucureşti.
23. *** (2008), *Clima României,* Edit. Academiei Române, Bucureşti.