

THE TEMPORAL DYNAMIC OF THE PRECIPITATIONS REGIME IN THE BÂSCA CHIOJDULUI BASIN AND ITS IMPACT ON THE SURFACE FLOW REGIME

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The temporal dynamic of the precipitations regime in the Bâsca Chiojdului Basin and its impact on the surface flow regime

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Dynamique temporelle des précipitations dans la bassin de Bâsca Chiojdului et des impacts du déversement. Au cours des dernières décennies on remarque une forte variation des quantités pluviométriques dans la région de Courbure (les Carpates et les Sous-Carpates), l'empreinte laissée dans le régime de l'écoulement superficiel étant ressentie y compris dans la zone d'étude. L'analyse spatio-temporelle des précipitations dans la période des années 1962-1998 ainsi que la corrélation avec la variation des débits dans le Bassin Bâsca Chiojdului, mettent en évidence une forte diminution des quantités pluviométriques après 1980, les effets directs se retrouvant dans le régime de l'écoulement superficiel dans le même temps que la diminution simultanée des débits. Bien qu'il y ait aussi des facteurs secondaires qui influent sur le régime de l'écoulement superficiel, cet article envisage d'analyser en particulier la manière où la variation du principal facteur déterminant, les précipitations, conditionne directement le régime de l'écoulement du cours d'eau principal, Bâsca Chiojdului.

Mots clés: précipitations, débits, variation, bassin versant, Basca Chiojdului.

Dinamica temporală a regimului precipitațiilor în bazinul Bâsca Chiojdului și impactul asupra regimului scurgerii de suprafață. În ultimele decenii se remarcă o puternică variație a cantităților de precipitații în zona de curbură (Carpații și Subcarpații de Curbură), amprenta lasată în regimul scurgerii de suprafață resimțindu-se inclusiv în aria arealului de studiu. Analiza spațio-temporală a precipitațiilor în perioada 1962-1998 precum și corelarea cu variația debitelor din bazinul Bâsca Chiojdului, scoate în evidență o puternică scădere a cantităților de precipitații după 1980, efectele directe resimțindu-se în regimul scurgerii de suprafață odată cu scăderea concomitentă a valorilor de debite. Deși există și factori secundari care influenează regimul scurgerii de suprafață, prezentul articol își propune să analizeze în special modul în care variația factorului principal determinant, precipitațiile, condiționează în mod direct variația regimul scurgerii râului principal Bâsca Chiojdului.

Cuvinte cheie: precipitații, debite, variație, bazin hidrografic, Bâsca Chiojdului.

1. GENERAL ASPECTS

The hydrographic basin of the Bâsca Chiojdului River, located at the interference between the Carpathian and Subcarpathian Mountains in the bending area, has presented over the time a major interest for scientific and geographical research. Therefore, in recent years, numerous studies have been strictly conducted in the basin area of the Bâsca Chiojdului River, both in terms of hydrologic and geomorphologic approaches.

From the hydrologic point of view, there is a scientific work named *Calitatea mediului in bazinul hidrografic al raului Basca Chiojdului* [1] which can be remarked among other specialized publications [2], [3]. Furthermore, it is important to remember the geomorphologic specialized studies such as *Bazinul hidrografic Bâsca Chiojdului. Studiu de geomorfologie* [4], *Valea Bâscei Chiojdului – observații geomorfologice* [5] etc.

The analyzed area still remains an important region of geographic research, both in terms of geomorphology (due to the dynamic geomorphic processes specific to the Bend Subcarpathians, but especially in terms of hydrology due to some particular aspects such as the pronounced change over the last decades of the climatic parameters with direct consequences on the surface flow regime, due to the existence of certain anthropic influences on the surface flow regime in the context of the hydrotechnical arrangements with insignificant impact on the riverbed, so that hydrologic researches can be made in quasi-natural conditions.

2. METHODOLOGY

The main methodology used in the current study which follows the multi-annual correlation between the values of the precipitation regime and the values of the discharges consists in applying GIS techniques for spatial representation situations of the natural environment, but also for the interpolation of the values of some climatic parameters such as the temperature. For the representation of the climatic parameters (the precipitations) and of the values of the discharges between 1962 and 1998, there were used tabular evaluation softwares.

In order to check the statistic viability of the temporal variation of the analyzed parameters, there was used the Makesens statistic test. The use of the geo-spatial database also led to the graphical and implicitly scientific unification of the current study.

3. THE ELEMENTS OF THE NATURAL ENVIRONMENT AND THEIR INFLUENCE ON THE SURFACE FLOW REGIME

The hydrographic basin of the Bâsca Chiojdului River is located in the Central South-Eastern part of Romania at the border between Buzău and Prahova. Both counties share almost equally its catchment area (Figure 1). The hydrographic basin of the Bâsca Chiojdului River is part of the hydrographic basin of Buzău and occupies an area of approximately 340 km², which represents about 6% of the hydrographic basin of Buzău.

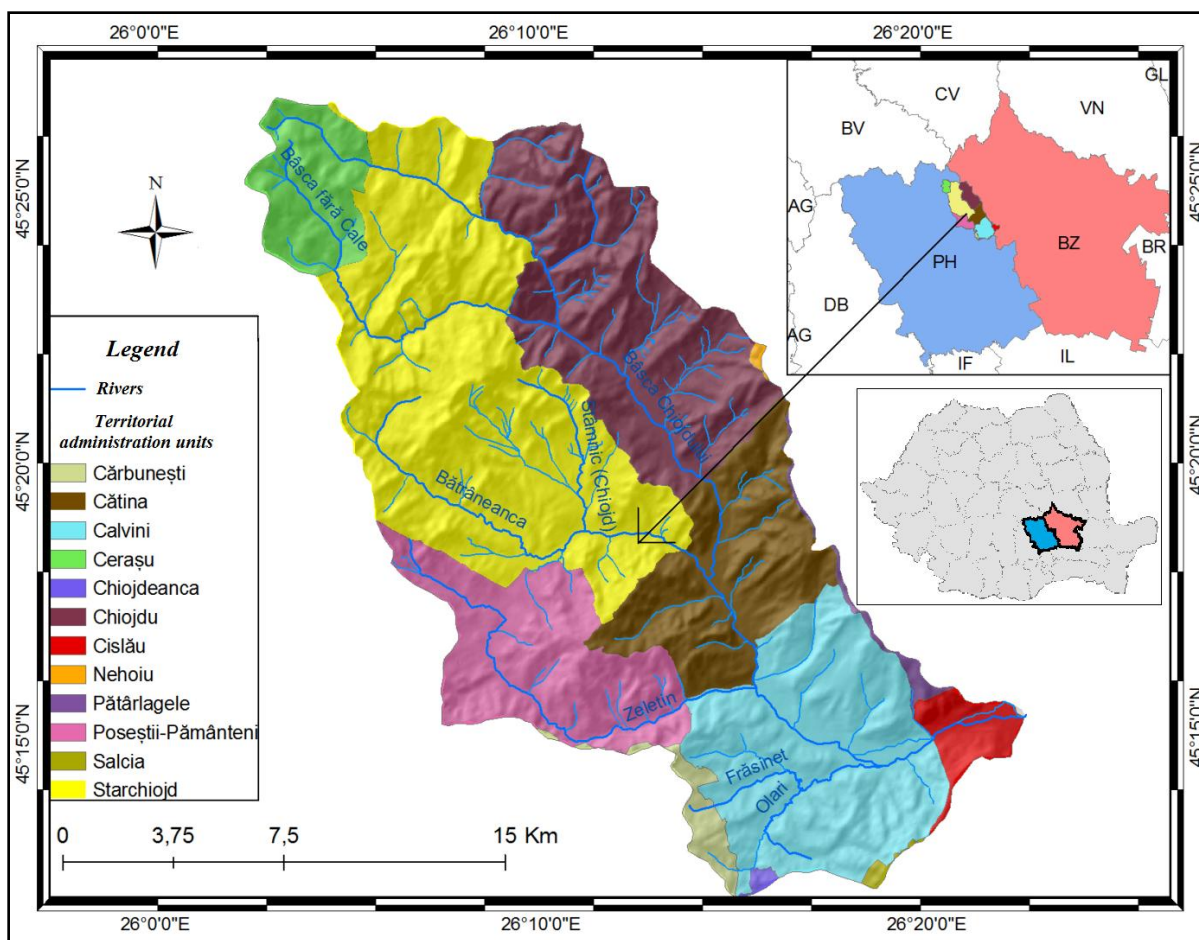


Figure 1. Localizing Bâsca Chiojdului basin area in Romania

Taking into account the surface, the most important territorial administration units superposed to the Bâsca Chiojdului basin are Starchiojd, Chiojdu, Calvini etc.

The physical and geographical particularities put their mark on the surface flow regime and therefore it is required a brief assessment of the landscape.

In terms of the characteristics of the landscape, the hydrographic basin of the Bâsca Chiojdului River expands over some units of relief which belong to the Carpathian Bend area and the Subcarpathian Bend area. The average altitude of the basin is of 668 m, with a

minimum value of 239 m at the point of the confluence between Pătârlagele Depression and Buzău, and a maximum of 1453 m in the Tartar Peak from the Carpathian Bend area. The natural setting of the altitude plays an important role, among other important features of the landscape, in the distribution of the annual amount of precipitations and implicitly in the surface flow regime. The morphometric elements, in particular the slope, also crucially influences the surface flow regime.

The climatic conditions represent one of the most important aspects of the surface flow regime. The annual average temperature is about 7.4° C. Although there were no available data on annual average temperatures, this value was determined according to the GIS techniques after the use of the interpolation operations of various values of temperature considered in different parts of the basin in the physical and geographical conditions similar to some weather stations. The vertical thermal gradient of 0.65° C/100 m was also taken into consideration.

During the year, the temperature plays an indirect role in the surface flow regime. In the winter, due to the low temperatures which determine a high frequency of frost, it occurs the poorest discharge of all year, while in the spring due to snow melt combined with liquid precipitations, it occurs the richest discharge. In the summer, the high temperatures generate a decrease in the surface flow regime due to the intense evaporation and to the increased water infiltration.

To characterize the precipitation regime, there were taken into consideration the values from the Pătârlagele station for the inferior basin and the values from the Lăcăuți station for the superior one. The medium multi-annual amount of atmospheric precipitations (1962-1998) in the Bâsca Chiojdului basin ranges from 631.5 mm / year at Pătârlagele and 832.2 mm / year at Lăcăuți. In both cases, over 40% of the total precipitation fall during the summer season, which is followed as weight by the spring season, the autumn and the winter. Although it is the factor with the biggest influence in the discharge of rivers, in the case of the Bâsca Chiodjului basin the richest discharge occurs in the spring, season which, although it ranks the second in the hierarchy of precipitations, it is characterized by mixed flowing (precipitations and snow melt). The summer flowing is the second as weight, although the amount of precipitations is the richest.

From the point of view of the hydrographic characteristics, the main stream of the analysed basin is the Bâsca Chiojdului River. This water course has as main tributary streams the Bâsca fără Cale, the Stamnic River with its Bătraneanca tributary stream, the Zeletin river and the Frasinet River with its Olari tributary stream on the right side and the Preseasca stream on the left side. The river has a total length of 42 km, a basin area of

340.29 km² and the multi-annual average flow of 1.20 m / s at the exit of the mountain area, respectively 2.65 m / s at the inflow in the Buzău river. This is one of the important tributary streams which Buzău receive from the right side [1].

The vegetation stands out especially through the broad-leaved forests such as the beech (*Fagus sylvatica*), the birch (*Betula verucosa*), the oak (*Quercus petraea*), etc. and mixed forests with the species of main broad-leaved forests mentioned before and coniferous species such as the fir (*Abies alba*), the pine (*Pinus silvstris*) and the spruce (*Picea abies*) at higher altitudes in the superposed sector of the Subcarpathian Bend area [6].

In terms of hydrological function, the forest plays an essential role because it retains and accumulates in the soil important quantities of precipitations through the radicular system, it reduces the impact of the surface erosion and protects the soil against the degradation processes through the canopy of the trees and through the litter layer [7].

4. RESULTS

In order to analyze the correlation precipitations – flows between 1962 and 1998, there were used tabular calculus means to point out a pronounced decrease both regarding the precipitations at the two weather stations previously analyzed (Pătârlagele and Lăcăuți) and also in the case of the flows at the Bâsca Chiojdului hydrometric station in the analyzed period. However, those changes of the climate and of the hydrology are not consisted, but they present both variations from year to year and from season to season. This is the reason why a rigorous comparative analysis (1962-1980, 1981 - 1998) is required at the same time on the multi-annual environments and on seasonal multi-annual environments.

Thus, the average annual values of the precipitation amount at the Pătârlagele station (Figure 2) which represent the inferior basin of the Bâsca Chiojdului river between 1962 and 1998 has fluctuated around the average multi-annual value of 631,5 mm, between the minimum value of 431,7 mm in 1985 and the maximum value of 857, 2 mm in 1969. There is a slight tendency of decrease of that amount of precipitations at the beginning of the observations and until to the end of it.

At the Lăcăuți meteorological station, the annual average value of precipitations is of 823.3 mm (Figure 3). The values of the annual average amount ranged between 443 mm in 1990 and 1319.9 mm in 1972. The upper basin of the Bâsca Chiojdului river was characterized by a general tendency of decreasing which was extremely obvious in the case of the annual amount of precipitations. This phenomenon can be attributed to the increased frequency of the foehn wind phenomenon of the Western air masses passing over the Carpathian Bend area.

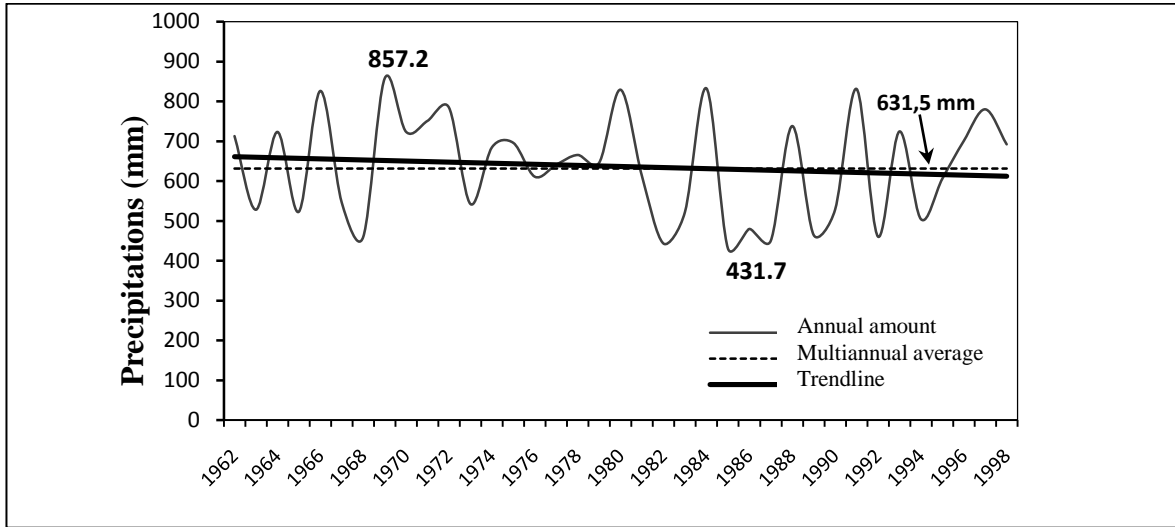


Figure 2. The variation of annual average rainfall (1962-1998) at Pătârlagele weather station

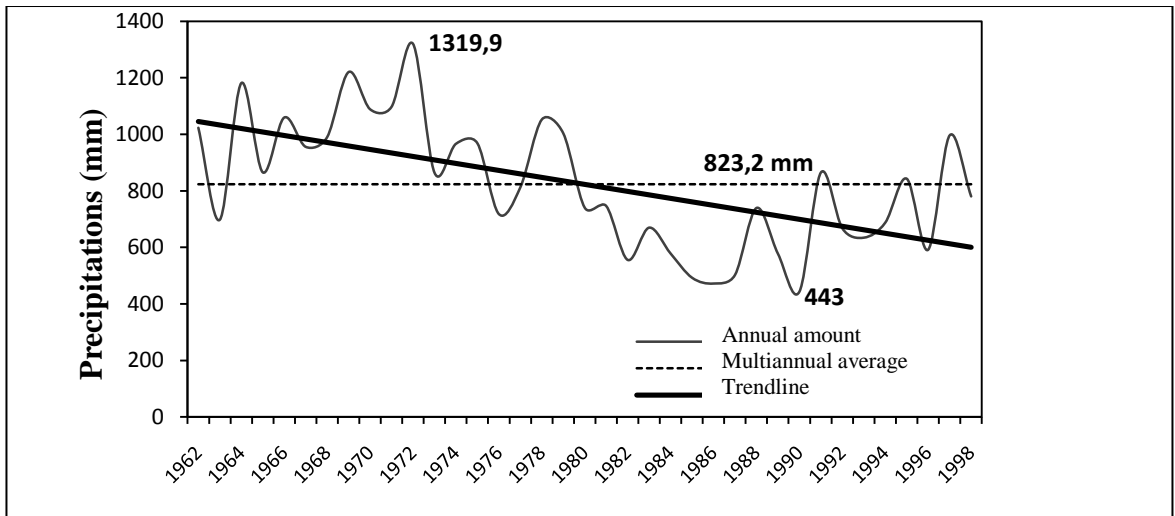


Figure 3. The variation of annual average rainfall (1962-1998) at Lăcăuți weather station

In terms of the flow, the multi-annual average value measured at Chiojdu hydrometric station is of $1.22 \text{ m}^3/\text{s}$ (Figure 4). In time, the flows ranged between $0.3 \text{ m}^3/\text{s}$ in 1989 and $2.01 \text{ m}^3/\text{s}$, the maximum value recorded in 1969. During the study, the general tendency of the flow values was on the down grade. The slope line that defines this tendency is situated between the values of the slope tendencies of precipitations characteristic for the inferior and superior basin of the Bâsca Chiojdului river between 1962 and 1998.

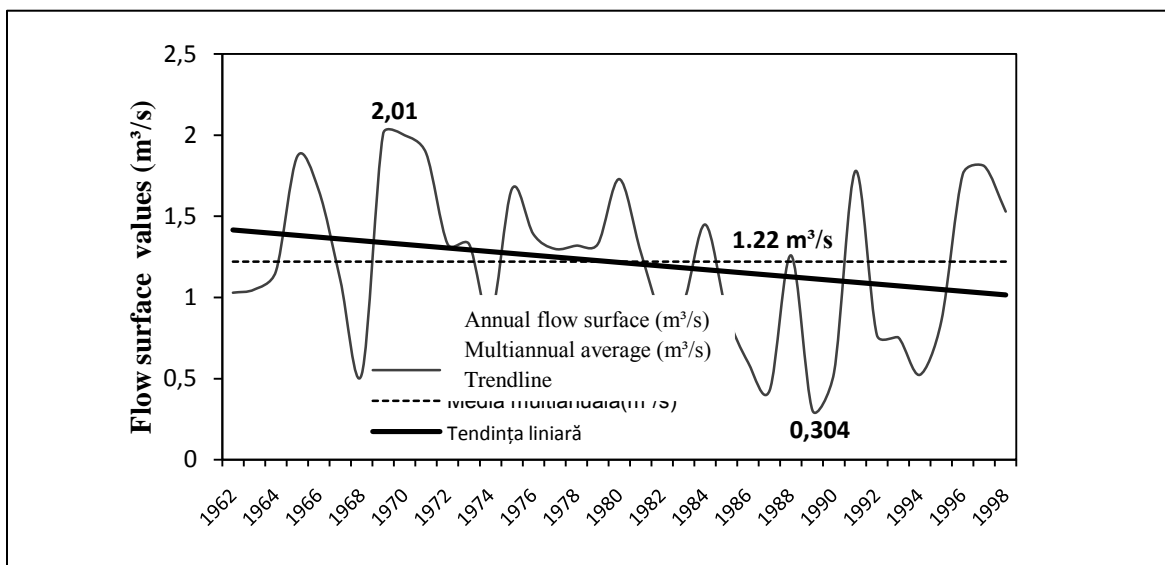


Figure 4. The evolution of the flow surface at Bâsca Chiojdului hydrometric station

Concerning the comparative analysis of the average monthly precipitation amount for the Pătârlagele station between 1960-1980 and 1981-1998, it can be observed a decrease for 8 of the 12 months of the year of the monthly average amount (Figure 5). The largest decrease occurred in July when the precipitations reduced with an average value of 25 mm. Increases in the monthly average quantities were reported in August, in October and in December. Those increases limited just to 5 mm, an appropriate value for October. After 1980, the total annual amount of precipitation at the Pătârlagele station reduced with 70.9 mm.

During the seasonal regime, the average amount for the inferior basin of the Bâsca Chiojdului river is characterized by an overall decline having the highest value of 32.1 mm for the summer season.

At the Lăcăuți station, the decrease of precipitations after 1980 occurred in 11 of the 12 months of the year (Figure 5). The only month characterized by a growth was March. To the average amount of precipitations between 1962 and 1980, there were added 2.7 mm between 1981 and 1998. The most striking decrease of the monthly average amount was recorded in July. This was of is 74 mm. In all the 12 months of the year, the decrease of the precipitation amount totalized 322.4 mm.

After 1980, the upper basin of the Bâsca Chiojdului river is characterized during the season by a decrease of the amount of precipitation with the highest value of 142.5 mm for the summer season.

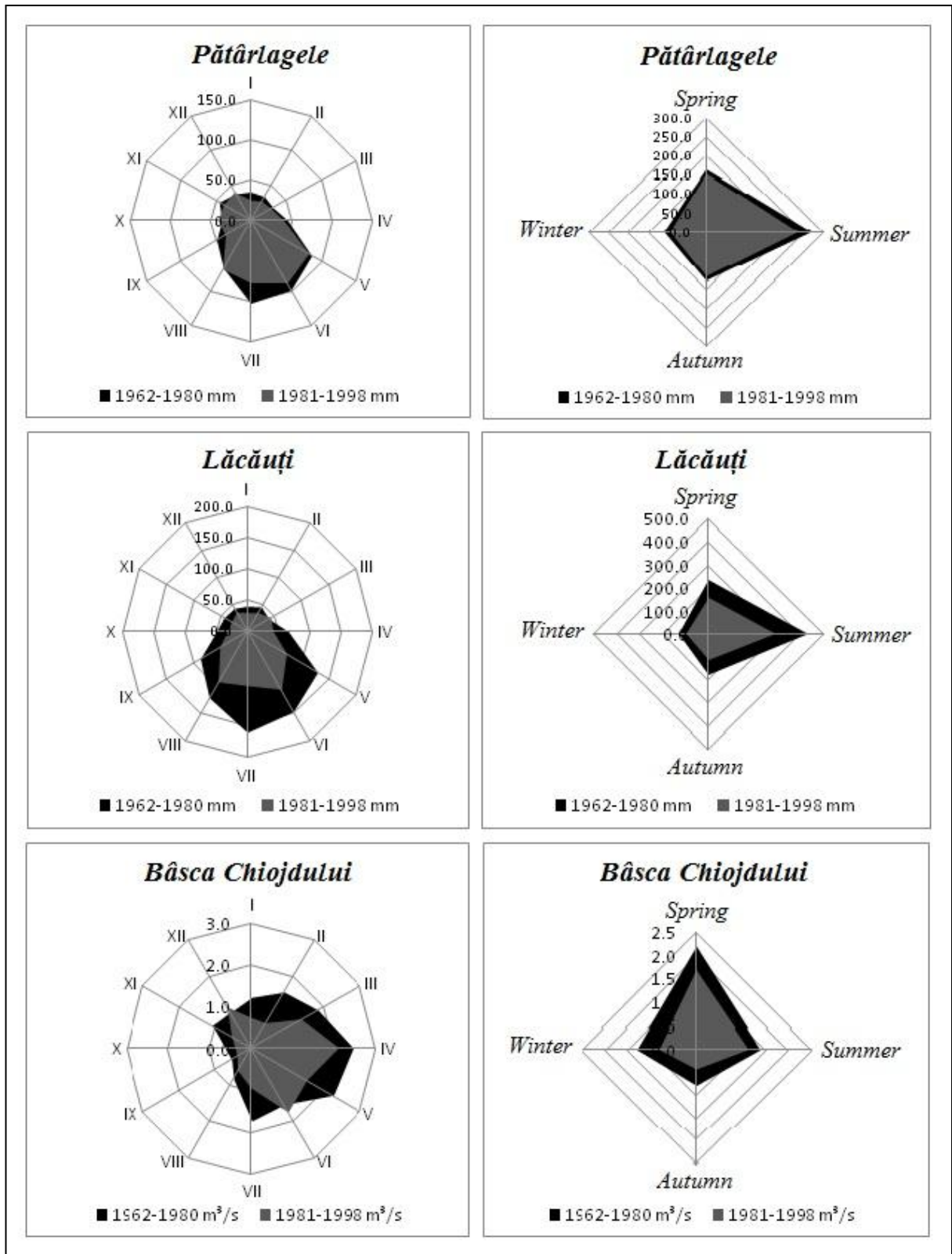


Figure 5. The variation of multiannual monthly/seasonal average rainfall at Pătârlagele and Lăcăuți weather stations and of flow surface at Bâsca Chiojdului hydrometric station

The comparison between the amount of precipitations during 1962-1980 and 1981-1990 was performed using the radar chart and it shows its decline for the second mentioned period in a total number of 10 months of the 12 months of the year. The largest decrease, of about $1 \text{ m}^3/\text{s}$, was recorded in February, closely followed by a similar one in July. The months characterized by an increase of the precipitations were June and December, but the increases reached a maximum value of $0.2 \text{ m}^3/\text{s}$. As for the whole year, it was observed a general average decrease of $0.4 \text{ m}^3/\text{s}$ of the river flow.

Regarding the seasonal values of the average flows of the Bâsca Chiojdului river, there is a decrease for all the 4 seasons, with a maximum value in the winter and with a minimum one in the summer.

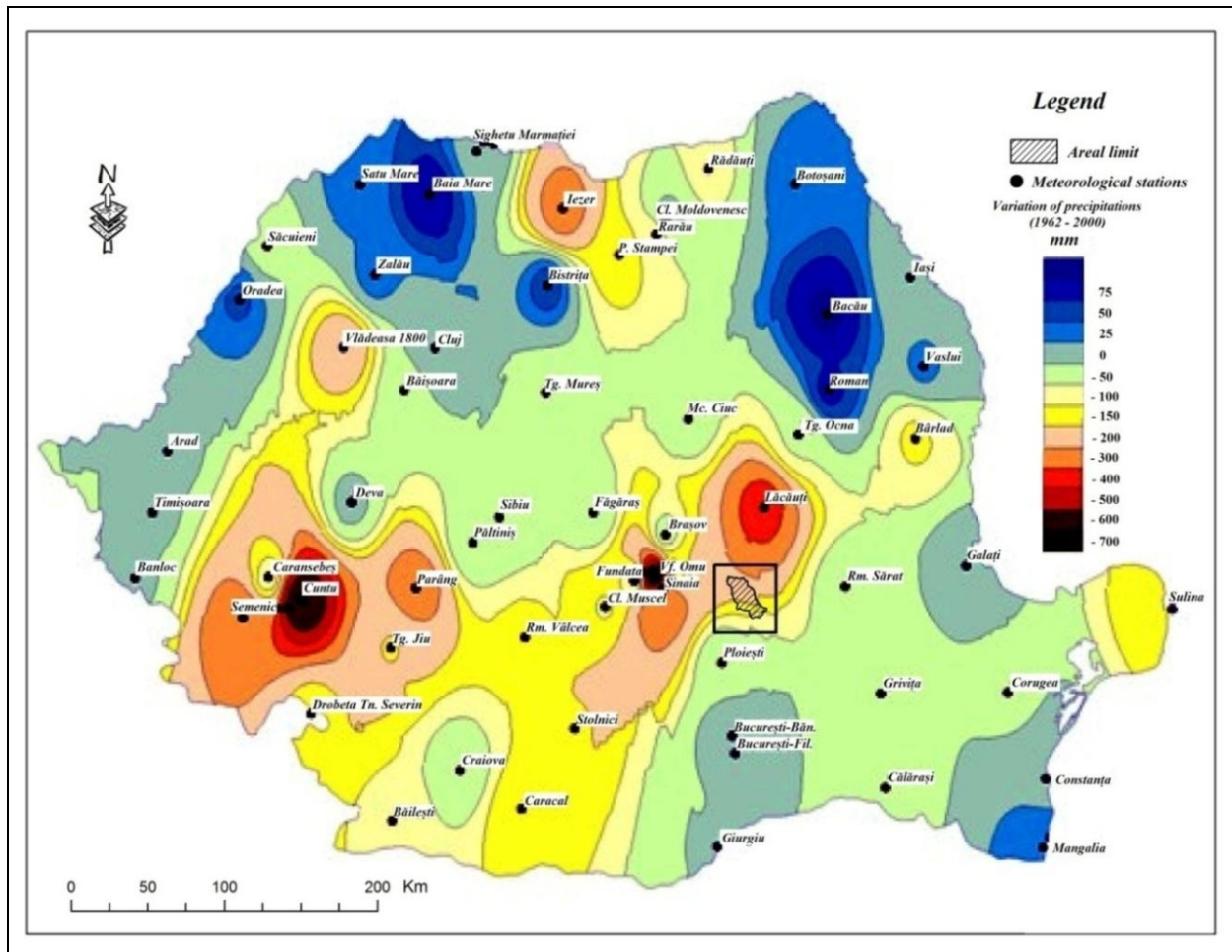


Figure 6. The variation of annual average rainfall (1962-2000) in Romania

There should be also mentioned another important national studies which point out considerable decreases of the precipitation amount between 1962 and 2000. Therefore, there are two major areas in Romania where over the past decades the annual average amount of precipitations decreased significantly, especially in the first bending of the Carpathian Mountains (in the analyzed area) and in the Banat region (Figure 6). These studies confirm the strong decline of average annual rainfall in last decades in the Carpathian and Subcarpathian Mountains in the bending area, the region which overlaps the study area.

5. CONCLUSIONS

In terms of the water flow regime of the rivers, the basin of the Bâsca Chiojdului, located at the interface between the Carpathian and Subcarpathian Mountains, presents the characteristics of both major units of relief of our country. However, throughout time, the flow changed due to the variation of the generator factors with the highest influence, namely the precipitations. For that purpose, there was observed a significant decrease of the average monthly amount of precipitations for the two analyzed stations, Pătârlagele and Lăcăuți with direct consequences in the obvious decrease of the average monthly flow, especially after 1980 and particularly in February and July, but in the seasonal regime a general reduction of the discharge having a maximum value during the summer season.

The capturing of these changes occurred in the surface flow regime at the level of the analyzed basin, but also in the case of any other hydrographic basin, constitutes a great importance because the modification of the water balance can have negative repercussions, both on the components of the natural environment, but also on the anthropic elements. In this case, the modification of the water resources which are necessary in the development of the human society is taken into consideration.

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