Forum geografic. Studii şi cercetări de geografie şi protecţia mediului
Year 9, No. 9/ 2010, pp. 49-56

ECOCLIMATIC INDEXES WITHIN THE OLTENIA PLAIN

Alina VLĂDUȚ [1]

[1] University of Craiova, Geography Department, str. Al. I. Cuza, no. 13, 200585, vladut_alina2005@yahoo.com.

Abstract

The Oltenia Plain represents an important agricultural region of Romania, which displays vast surfaces that can be properly cultivated if one takes into account the climatic restrictions that generates a series of dysfunctions. In order to underline the problems related to the aridization tendency within the region, as well as to determine the most adequate plants, there were calculated many indexes used in different agroclimatic and biogeographical studies. Thus, according to the processed data, the Oltenia Plain generally belongs to the steppe and forest steppe domain and, with regard to the cultivable plants, there are recommended the thermophilous and xerothermophilous ones, which can get good productions even in the pluvial-thermal conditions characteristic to the region. The thermal regime imposes itself through a slight increasing tendency because of the extremely high values registered in summer, while the pluviometric regime registers obvious fluctuations and a decreasing tendency. Consequently, the issue related to the aridization of the southern part of the Oltenia Plain is confirmed, an issue that is presently stressed by other factors, such as massive deforestation, destruction of the irrigation systems etc., which led to the reactivation of certain areas covered by sands. However, the partial results of the study do not sustain the idea of desertification in the area.

Keywords: *the Oltenia Plain, ecoclimatic indexes, pluvial-thermal regime, aridization, thermophile plants, xerothermophilous plants*

Rezumat

Indicii ecoclimatici din Câmpia Olteniei. reprezintă o importantă regiune agricolă a ţării, care dispune de vaste suprafeţe cultivabile, care pot fi exploatate în cele mai bune condiţii dacă se iau în calcul şi restricţiile climatice care generează o serie de disfuncţionalităţi. Pentru a evidenţia problemele legate de tendinţa de aridizare a regiunii, precum şi pentru a determina cele mai adecvate plante de cultură s-au calculat mai mulţi indici folosiţi în diferite studii agroclimatice şi biogeografice. Astfel, conform datelor prelucrate, Câmpia Olteniei se încadrează în general în domeniul stepei şi silvostepei, în privinţa plantelor de cultură recomandându-se cele termofile şi xerotermofile, care pot da producţii bune chiar şi în condiţiile pluvio-termice caracteristice regiunii analizate. Regimul termic se impune printr-o tendinţă de creştere uşoară datorată valorilor foarte ridicate din sezonul cald, în timp ce regimul pluviometric înregistrează fluctuaţii evidente, tendinţa fiind însă de scădere. Astfel, se confirmă problema legată de aridizarea sudului Câmpiei Olteniei, problemă acutizată în ultimul timp şi de alţi factori, precum defrişările masive, desfiinţarea sistemelor de irigaţii etc., care au dus la reactivarea unor areale acoperite de nisipuri. Cu toate acestea, rezultatele parţiale obţinute prin prelucrarea datelor nu susţin ideea deşertificării.

Cuvinte-cheie: *Câmpia Olteniei, indici ecoclimatici, regim pluvio-termic, aridizare, plante termofile, plante xerotermofile*

INTRODUCTION

The Oltenia plain represents the western extremity of the Romanian Plain, which is bordered by the Danube River in the west and south and by the Olt River in the east. The northern limit is sinuous, as the contact with the Getic Piedmont follows the alignment of certain settlements, such as Drobeta-Turnu Severin, Hinova, Vânju-Mare, Drincea, Plenița, Radovan, Podari, Balş, Slatina (Roşu, 1980, p. 430).

The Oltenia Plain was in many subunits according to different criteria – different morphostructural features, biological-pedological-climatic peculiarities etc. Thus, P. Coteț divided the plain into three large subunits according to the way "these three individualities associate" (the Oltenia Plain is the result of the combination between two interfluves, which are genetically linked to the Getic Piedmont, and the Danube couloir) "as well as according to the constitutive elements of a plain (the plain itself, the terrace and the alluvial meadow)" (Coteț, 1957, p. 54). Al. Roşu also mentioned three subunits the limits of which were similar to the ones previously established by P. Coteț, but it named them differently – Blahnița Plain, Băileştilor Plain, and Romanați Plain (Fig. 1).

This sector is well individualized as compared to the other sectors of the Romanian Plain because of a series of morphostructural elements. It is a

typically piedmont-like plain, where all the valleys, including the Danube's, display well-developed systems of terraces. Its main feature is the presence of sand dunes, which covers almost half of the surface of the plain. The presence of the dunes is extremely important from the climatic point of view as sandy soils impose a series of restrictions. Within these areas, the precipitation amount is relatively low and the temperatures quite high, especially in summer; thus, due to the physical-chemical features of the soil the water deficit must be covered through irrigation.

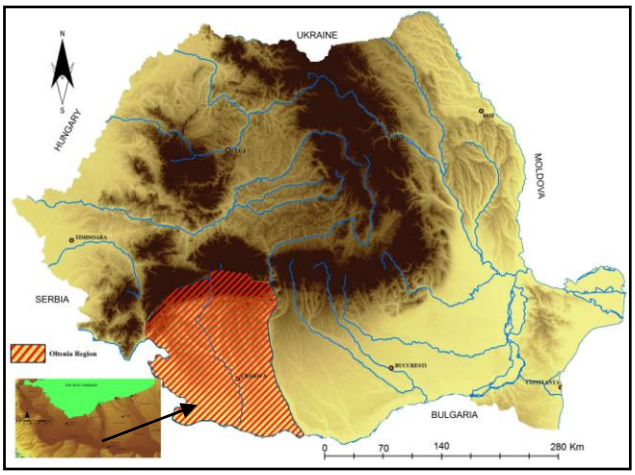

Fig. 1 Location of the Oltenia Plain within Romania and Oltenia region

In the south of the plain, there is located the Danube's Valley and Floodplain, which develops between Gura Văii and the Olt River, covering a distance of 335 kilometers. The landforms of the alluvial meadow underwent numerous modifications induced by the action of natural factors, such as the fluvial and aeolian processes, which are still quite active, and especially of the man-induced factors, as this area was highly schemed (Tomescu, 1998, p.19). Besides the terrace system, we mention the presence of the eyots (Ostrovu Mare, Dragavelu etc.) and of the lakes (Gârla Mare, Maglavit, Ciuperceni, Rast, Bistreț etc.) within the alluvial meadow the width of which oscillates between 4 and 13 kilometers (Geografia României, vol. I, 1980, p. 347).

All features of the subjacent active surface influence the features of the main climatic parameters. The Oltenia Plain is an important agricultural region and the land use and the cultivated plants should take into account the evolution tendency of precipitation, temperature, humidity, evaporation etc.

DATA AND METHODS

The data correspond to the period 1984-2009, a problematic period from both the thermal and pluviometric points of view and they were supplied by Craiova Regional Meteorological Center. There were analysed five meteorological stations: Drobeta Turnu-Severin, Calafat, Bechet, Băileşti, Craiova, Caracal, and Slatina (Table 1).

The climatic ecometric indexes can offer important information for the adequate capitalization of the agricultural fields by taking into account the local climatic features.

Mayr tetratherm represents the arithmetic mean of the temperatures registered in May, June, July, and August.

$$T_{Mayr} = \frac{\sum (t_V + t_{VI} + t_{VII} + t_{VIII})}{4}$$

It emphasizes the thermal optimum of the vegetation during the period characterized by a maximum biological activity. Its values increase as the altitude decreases.

Table 1 The geographical position of the meteorological station

Station	Altitude (m)	Latitude	Longitude
Dr. Turnu-Severin	77	44°38`	22°38`
Bechet	36	43°47`	23°57`
Calafat	61	43°59`	22°57`
Băileşti	57	44°01`	23°20`
Craiova	192	44°19`	23°52`
Caracal	106	44°06`	24°22`
Slatina	172	44°26`	24°21`

"De Martonne" aridity index is calculated both for annual and monthly values. For annual values, it is used the following formula:

$$I_a = \frac{P}{T + 10} \text{ where,}$$

P – the annual amount of precipitation

T – the mean annual temperature

10 – a coefficient that is added in order to obtain positive values

This index was firstly used by De Martonne, E. (1926). It is used for emphasizing the restrictive character of the climate with regard to certain vegetal formations: values ≤5 correspond to desert areas, those close to 10 to the steppe areas, those above 30 indicate the forest steppe area, while the values ≥40 the forest areas (Gaceu, 2002, p. 69; Dumitrașcu, 2006, p. 156). At the same time, there can be deduced a series of thermal and pluviometric

features of a region, as well as certain peculiarities of the river system (Gaceu, 2002, p. 70).

Lang rain index, also called the pluviothermal index, indicates the atmospheric moisture degree, as well as its variation; it can be calculated at an annual, summer or vernal level (Gaceu, 2002, p. 70; Dumitraşcu, 2006, p. 155). It increases with the altitude up to the condensation level, as the precipitation amounts get bigger and the temperature lower.

$$I = \frac{p}{t}$$ where,

p – the annual precipitation amount
t – the mean annual temperature

The sum of precipitation in the months when the mean temperature is higher than 10ºC refers to the total amount of precipitation registered during the vegetation period. Within the Oltenia Plain, this sum corresponds to the sum of precipitation registered during the warm season, as the mean monthly thermal values are higher than 10ºC during seven months per year (April-October).

The sum of precipitation during the cold season of the year represents the total water quantity resulted from both liquid and solid precipitation. It is an important index as it underlines the water accumulation in the soil, water that can be used by the vegetal formations at least during the first phonological phases (Gaceu, 2002, p. 74).

The sum of the precipitation amounts during the maximum consumption period represents the precipitation amount corresponding to the interval July-August, when there are also registered the highest thermal values.

DISCUSSIONS

1. Mayr tetratherm is used in different agroclimatic studies being an important index for determining the most important crop plants according to the thermal optimum. As it can be noticed, the thermal means registered obvious fluctuations in the last 30 years, the values oscillating between 18 and almost 24°C. At the same time, there is a clear tendency of increase of the values after 1990. The 22°C threshold was frequently exceeded at the level of the entire analysed region, the years with the highest values being 2000, 2003, and 2007 (22.6°C and 23.9°C) (Fig. 2).

According to these values, within the Oltenia Plain, there are recommended heat-loving plants (thermophilous and xerothermophilous), which can adapt to high temperatures and drought conditions characteristic especially in the last years.

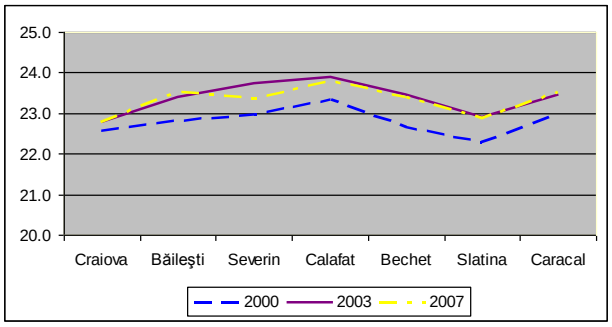

Fig. 2 Mayr tetratherm values within the Oltenia Plain in 2000, 2003, and 2007

With regard to the spatial distribution of the Mayr tetratherm values, the differenced are quite reduced, both from north to south and from east to west, which is not extremely surprising if we take into account that the altitudinal differences are not relevant and the surface is quite homogenous, as well as the exposure to distinct climatic influences. However, there is a slight difference from north to south, meaning that the most homogenous and the lowest values registered at Craiova, in the north, where the 22°C threshold was exceeded only in 2000, 2003, and 2007. As we go southwards, the values increase, the same tendency being noticed from east to west because of the intensification of the southwestern influences. The multiannual mean values are very homogenous, oscillating between 20.9 at Craiova and 21.9 at Caracal.

2. "De Martonne" aridity index eloquently emphasizes the features of the vegetal cover. Its mean annual value is relatively homogenous (Table 2). Thus, the highest mean values are registered in the western and northern parts of the plain, namely at Drobeta Turnu-Severin and Craiova (above 28), while the lowest values correspond to the southern part of the plain (Bechet, Calafat, Caracal – about 23) (Fig. 3). These mean values indicate that the analysed region belongs to the dry steppe, which is real problem for agriculture.

Table 2 Mean values of "De Martonne" aridity index

Station	"De Martonne" aridity index
Dr. Turnu-Severin	28.47
Bechet	23.10
Calafat	23.96
Băileşti	24.86
Craiova	28.09
Caracal	23.38
Slatina	25.51

By analyzing the annual values of this index, it resulted great variations, especially after 1998, the differences between 2000 (values below 15), for example, and 2005 (values above 38) being of about 30. In the central and eastern sides of the plain, the

highest values correspond to 2005, while in the west to 1999. Thus, in 2000, the highest value was registered at Craiova, but it did not exceed 16, while the lowest correspond to Băileşti, 11.96. In 2005, even if there were registered the highest values, there should be noticed a great difference from north to south, namely from 52.77 at Craiova to 38.65 at Bechet.

The territorial differences are clear, meaning that in the western and northern sides, the aridity index displays high values underlining the passage towards forest steppe as compared to the southern and eastern sides, where the values are lower. Here, together with a slight decrease of the precipitation amounts and with a visible deterioration of the precipitation pattern, there occurred an increase of the mean monthly temperatures, which makes the aridization and even the desertification issue be one of great importance.

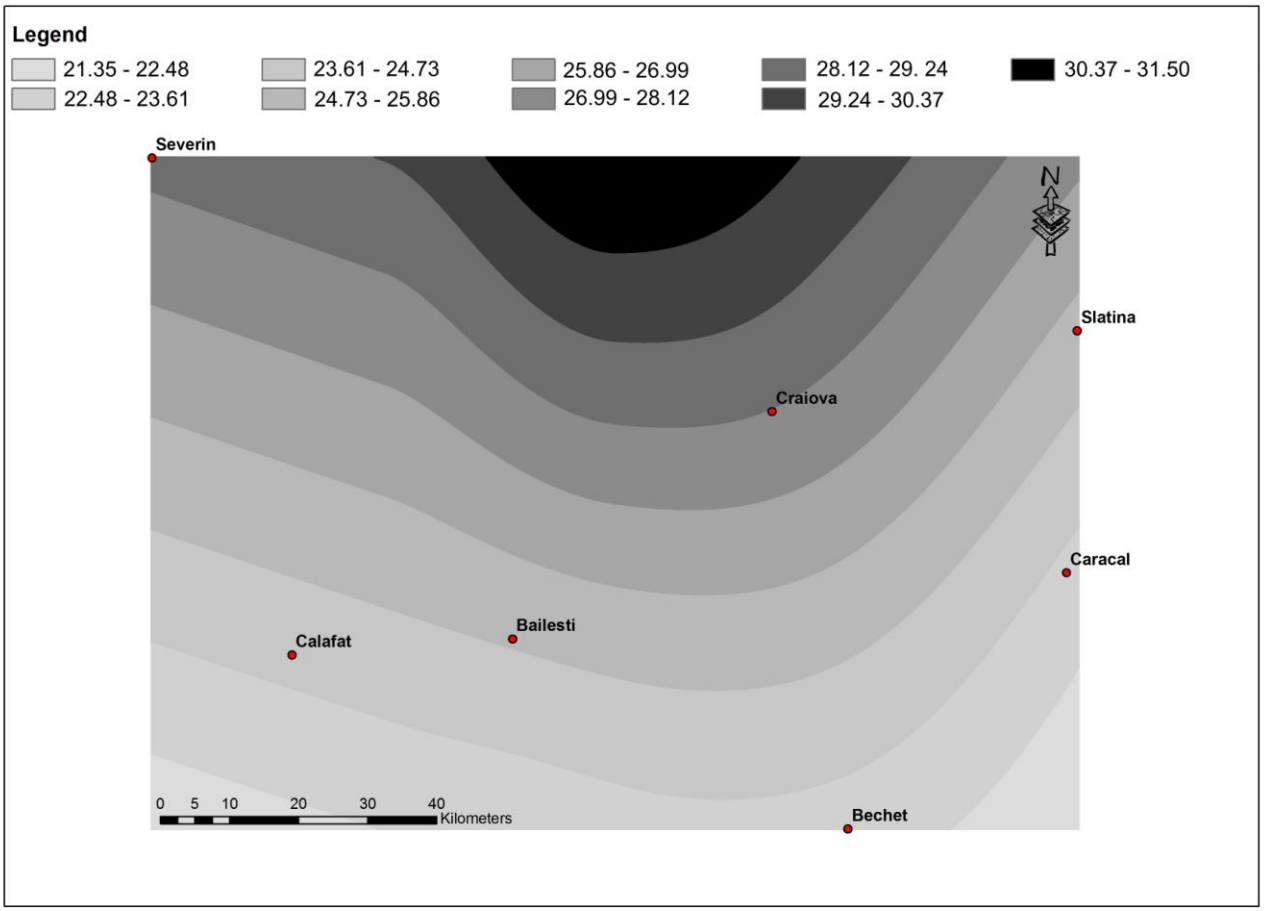

Fig. 3 Territorial distribution of the mean values of "De Martonne" aridity index (1984-2009)

3. Lang rain index (pluviothermal index) or the pluvial factor displays higher values with the increase of the altitude. Thus, within the Oltenia Plain, according to the altitude, the highest values correspond to the northern and western sides, while the lowest ones to the Danube Valley and to the central part of the plain. At Craiova, the annual mean reaches 53.55, while at Drobeta Turnu-Severin, it is 52.15. These values are 10 units higher than in the south (Calafat – 44.26, Bechet 43.32), where they do not exceed 45 units (Fig. 4), which certifies the favorability of the region to thermophilous and xerothermophilous species. As for the evolution during the analysed period, we also mention the years 1992 and 2000 with extremely reduced values (in 2000, the highest value was only 27.12 at Craiova, the rest of the values being lower), while the year displaying the highest values is by far 2005 (103.2 at Craiova, this value being about 30 units higher than at the other meteorological stations).

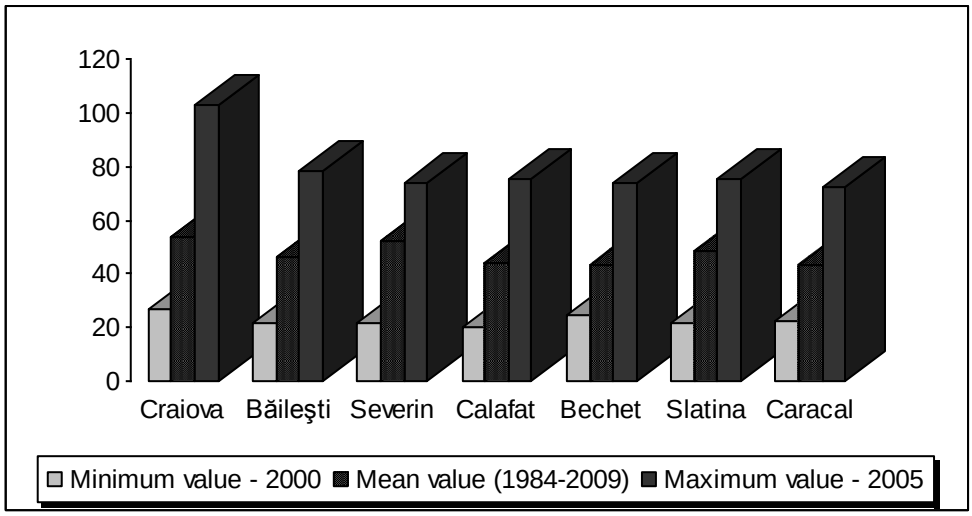

Fig. 4 Lang rain index (1984-2009)

4. The sum of precipitation in the months when the mean temperature is higher than 10ºC refers to the precipitation amount registered during the vegetation period. As within the analysed region the interval with monthly temperatures above 10ºC is of seven months, the precipitation amount corresponding to this interval represents more than 60 percent of the mean annual amount. These amounts are higher than 300 mm within the entire plain, but they are not enough for supporting the optimal development of the culture plants and this is why irrigation is a necessity, especially in July and August, when temperatures exceed 22ºC (Table 3, Fig. 5). For example, sun flower needs an optimum water quantity of 650 mm during the vegetation period, even if we can get good productions at 400-450 mm, maize about 400 mm, sugar beat 400-600 mm. The main issue is the great temporal variability of precipitation: Craiova – 220.1 mm in 1992 and 802.2 mm in 2005; Băileşti – 172.2 mm in 1993 and 614.6 mm in 2005; Drobeta Turnu-Severin – 186.3 mm in 2000 and 704 mm in 1999; Calafat – 183.2 mm in 1984 and 568.2 mm in 2005; Bechet – 162 mm in 1993 and 613.8 mm in 2005. There can be also mentioned the fluctuations from one month to another, which are extremely important for agriculture.

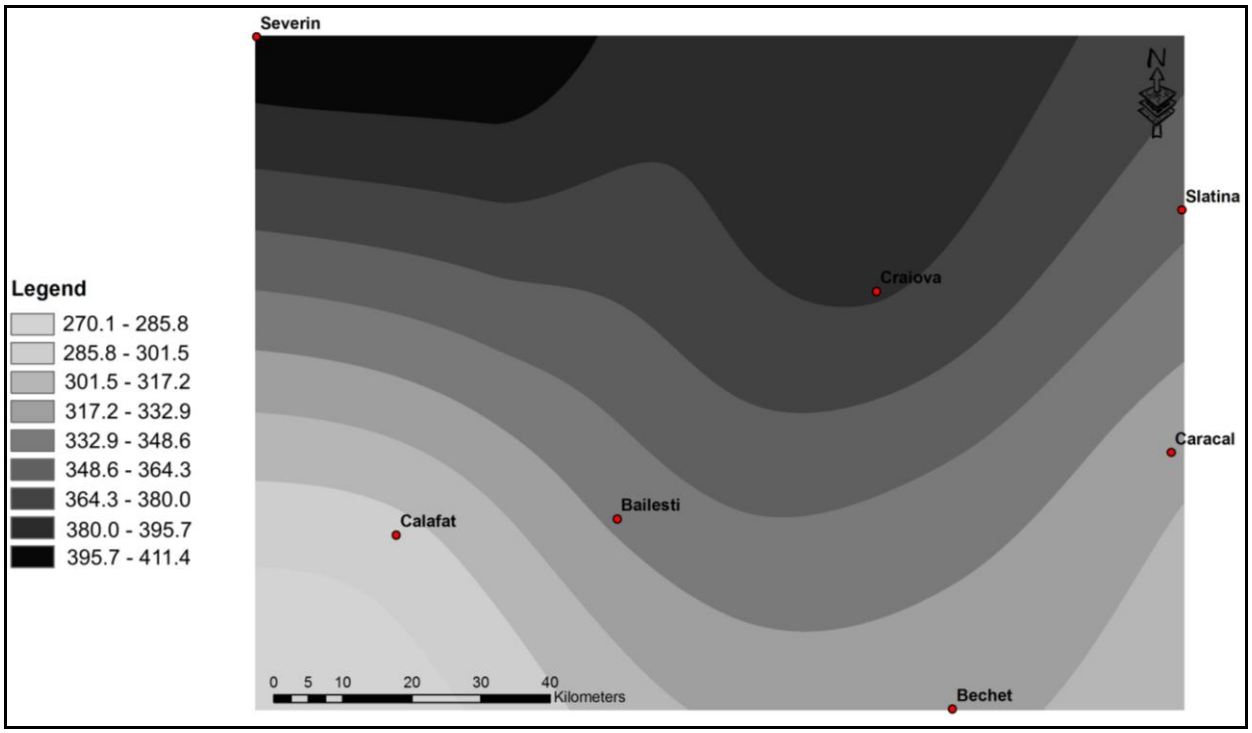

Fig. 5 The sum of precipitation in the months when the mean temperature is higher than 10ºC

5. The sum of precipitation during the cold season of the year represents the total water amount resulted from both solid and liquid precipitation. The cold season is as important as the warm one from the pluviometric point of view, as it ensures the water reserve in the soil that is then used during the first phonological phases. The amounts registered during this interval represents about 35-40 percent of the annual mean, which is about 200 mm. The only station displaying higher values is Drobeta Turnu-Severin, where there are reached 249.3 mm (Table 3, Fig. 6). Generally, the amounts are higher in the central and western part of the plain, due to the increased amounts from November and December and, thus, the soil water reserve is high enough. There are also particular cases generated by special synoptic situations, such as the one registered in 2001-2002, when the amounts did not generally exceed 60 mm within the entire plain or in 1991-1992 with values below 100 mm in the central and western parts.

6. The sum of the precipitation amounts during the maximum consumption period represents the precipitation amount corresponding to the interval July-August, when there are also registered the highest thermal values. These amounts represent about 19 percent of the annual mean. Generally, this interval is characterized by long and intensive drought periods. The values decrease southwards, from 112.4 mm at Craiova to 95 mm at Bechet, while westwards the variations are so reduced that they can be ignored (Fig. 6).

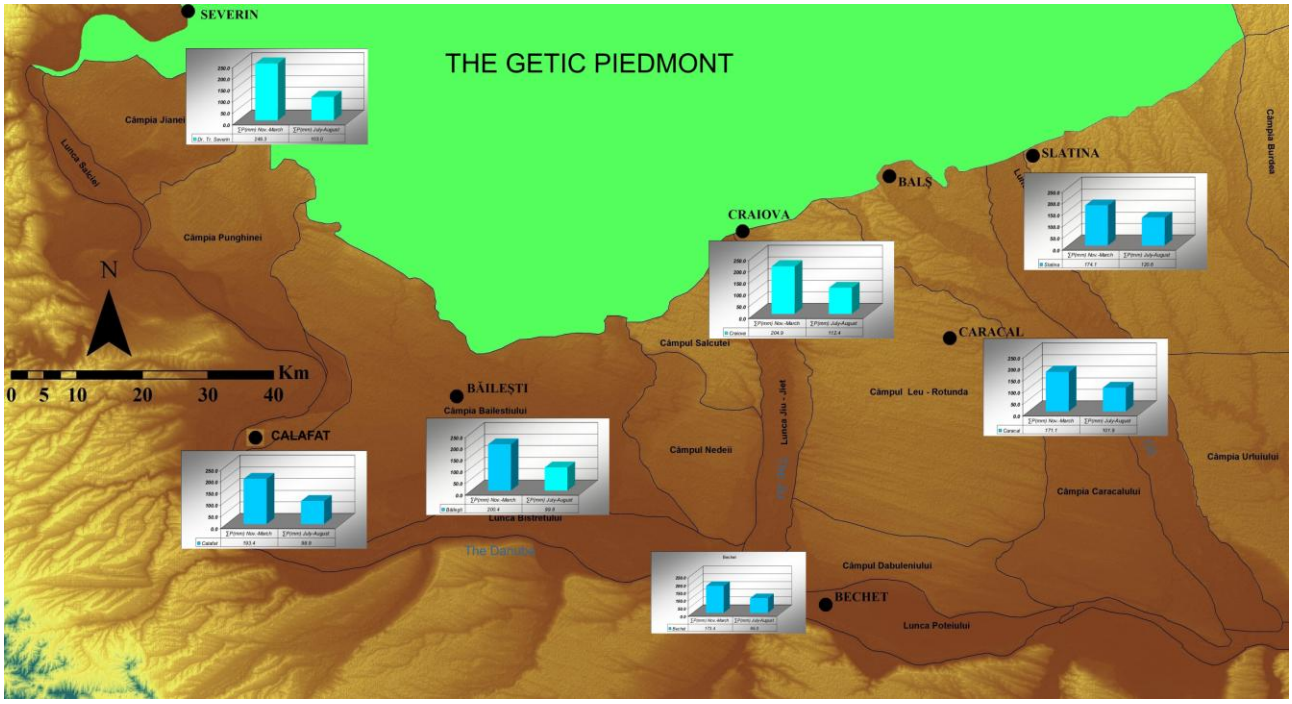

Fig. 6 Rate of different precipitation amounts (∑P(mm) November-March, ∑P(mm) July-August) mean annual values

In the western extremity, at Drobeta Turnu-Severin, the lowest amount corresponds to 1988 – 25.6 mm, while the highest to 1999 – 342.8 mm. In the north-eastern part of the plain, at Slatina, the minimum value was registered in 1987 – 24.9 mm, while the highest in 1991 – 240 mm. So, according to the analysed data, in spite of a relative uniformity at the level of mean values, the Oltenia Plain is characterized by a great temporal variability, imposed by different synoptic situations affecting only certain parts of the plain.

Table 3 Rate of different precipitation amounts, mean annual values

Station	∑P(mm) when t≥10°C	∑P(mm) Nov.-March	∑P(mm) July-August
Craiova	381.4	204.9	112.4
Băileşti	335.7	200.4	99.8
D.T. Severin	409.7	249.3	103.0
Calafat	331.0	193.4	98.9
Bechet	322.5	173.4	95.0
Slatina	352.7	174.1	120.6
Caracal	322.6	171.1	101.9

CONCLUSION

In spite of the homogeneity of the active surface, at the level of the Oltenia Plain there can be noticed a series of regional particularities imposed by the exposure at different climatic influences. By calculating certain ecoclimatic indexes, we aimed at identifying certain climatic dysfunctions, which jeopardize the agricultural activities.

Thus, according to the thermal and pluviometric values registered between 1984 and 2009, the Oltenia Plain faces a deterioration of the regime of the above-mentioned parameters. Precipitations registered a decrease tendency after 1990, tendency slightly marked by the exceptionally high amounts from 1999 and 2005; the annual thermal values frequently exceeded 12-13°C, which means that in summer the temperatures were close or even much higher than 25°C.

According to the results obtained from the processing of the climatologic data, the Oltenia Plain faces an aridization tendency ("de Martonne" aridity index), especially in the southern and southeastern extremities, as well as in the central part, where the frequency of the drought periods is high (Vlăduţ, 2004, p. 90).

From the biogeographical point of view, the area belongs to the steppe with graminaceous plants (southeast, east, and center), to the steppe with high plants (southwest), and to the forest steppe (north and west). The obtained values (Mayr tetratherm) indicate that agriculture should direct towards thermophilous and xerothermophilous plants able to get good crops even in these pluvial and thermal conditions. At the same time, for optimum crops there are strongly recommended irrigations, in order to supply the necessary water amount during the warm season as the precipitation is clearly insufficient. There should not be ignored the problem of the strong evapotranspiration, as well as the sandy soils, which impose numerous restrictions. Thus, the Oltenia Plain disposes of a great agricultural potential, but it cannot be well-capitalized if the climatic problems of the region are ignored.

ACKNOWLEDGEMENTS

This work was supported by the strategic grant POSDRU/89/1.5/S/61968, Project ID61968 (2009), co-financed by the European Social Fund within the Sectorial Operational Program Human Resources Development 2007 – 2013.

REFERENCES

Ali, M.H., Talukder M.S.U., (2008), *Increasing water productivity in crop production—A synthesis*, Agricultural Water Management, Volume 95, Issue 11, November 2008, pp. 1201-1213.

Beck, C., J. Grieser and B. Rudolf, (2005), *A New Monthly Precipitation Climatology for the Global Land Areas for the Period 1951 to 2000*. Klimastatusbericht 2004, 181-190.

Coteţ, P., (1957), *Câmpia Olteniei*, Editura Ştiinţifică, Bucureşti.

De Martonne, E., (1926), *Une nouvelle fonction climatologique: L'indice d 'aridité*, „La Meteorologie", p. 449-458.

Dumitrescu, Elena, Glăja, Maria, (1972), *Metodica prelucrării datelor climatologice*, Centrul de multiplicare al Universităţii din Bucureşti, Bucureşti.

Dumitraşcu, Monica, Dumitraşcu, C., Douguédroit, Annick, (2001), *Seceta şi impactul ei asupra mediului în Câmpia Olteniei*, Revista Geografică, T. VII, Serie nouă, Academia Română, Institutul de Geografie, Bucureşti, p.166-172.

Dumitraşcu, Monica, (2006), *Modificări ale peisajului în Câmpia Olteniei*, Editura Academiei Române, Bucureşti.

Gaceu, O., (2002), *Elemente de climatologie practică*, Editura Universităţii din Oradea, Oradea.

Roşu, Al., (1980), *Geografia fizică a României*, Editura Didactică şi Pedagogică, Bucureşti.

Tomescu, Viorica, (1998), *Lunca Dunării – sectorul oltean*, Editura Sitech, Craiova.

Vlăduţ, Alina, (2004), *Deficitul de precipitaţii în Câmpia Olteniei în perioada 1961-200*0, Forum Geografic – Studii şi cercetări de geografie şi protecţia mediului, Anul III, nr. 3, Editura Universitaria, Craiova, p. 99-104.

*** (1969), *Geografia Văii Dunării Româneşti*, Editura Academiei R.S.R., Bucureşti.

*** (1983), *Geografia României, I, Geografia fizică*, Editura Academiei R.S.R., Bucureşti.

*** (2003), *Indici şi metode cantitative utilizate în climatologie*, Editura Universităţii din Oradea, Oradea.

*** (2005), *Geografia României, V, Câmpia Română, Dunărea, Podişul Dobrogei, Litoralul Românesc al Mării Negre şi Platforma continentală*, Editura Academiei Române, Bucureşti.

*** (2008), *Clima României*, Editura Academiei Române, Bucureşti.