

ASPECTS CONCERNING THE RAINY SPELLS IN THE WESTERN PLAIN OF ROMANIA

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ABSTRACT – The present work analyses the rainy spells on the territory of the Western Plain at the North of the Mureș River. Daily precipitation data were used from a number of 5 weather stations and for a period of 42 years (1961-2002). Only the stations with a common observation period were chosen. Periods with two or more consecutive rainy days were studied and the analyses show a total of about 7,000 rainy spells. The number of the rainy spells grows from the South to the North once with the latitude but also from the West to the East, once with the altitude. Within a year may occur, on the average, about 30-35 rainy spells with an average duration of 4 days. The duration of the rainy spells varies between 2-19 days. On the analysed territory, 119-141 rainy days may occur annually, on the average. Namely, on this territory it rains on the average about 4-4.5 months a year. Most of the rainy days were recorded in the intervals November-January and April-June.

Keywords: rainy spell, rainy day, length, frequency.

INTRODUCTION

The Western Plain of Romania is a narrow strip of land with an approximate North-South orientation, limited by the parallels of 45° and 48° northern latitude. The plain climate is temperate-continental with predominant oceanic influences on most of its territory. The fact gives the moderate character of the atmospheric precipitation regime. Therefore, in the Western Plain at the North of the Mureș River, the annual average precipitation amounts are 525-550 mm towards the national western border and rising up to 630-650 mm towards the East, the hills boundary being marked by the 700 mm isohyet.

The analysis of the number of days with a certain phenomenon is a method largely used in climatology. Such analyses are useful in the process of the meteorological and climatological synthesis. In the present case, the analysis of the number of rainy spells aims at improving the weather forecasts. At the same time, the present study wishes to emphasize the climatic differences between the northern and the southern parts of the studied territory.

The present research theme was chosen because no other such studies had been made for the territory of the Western Plain at the North of the Mureș River.

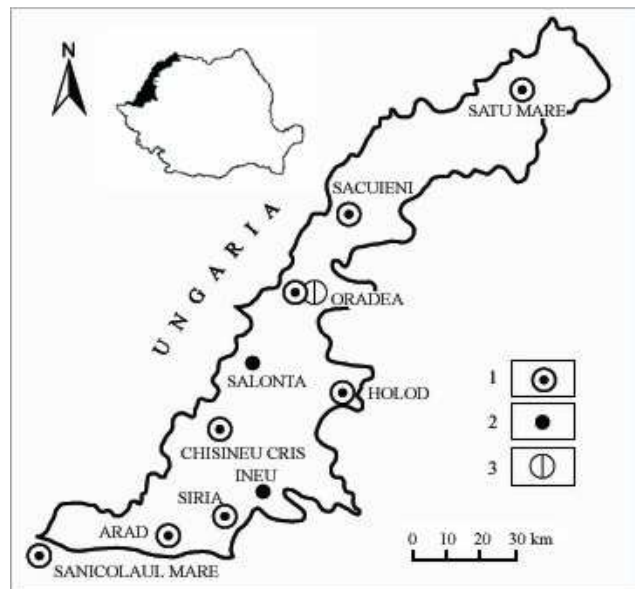


Figure 1. The position of the Western Plain at the North of Mureș, on the Romania territory. The territorial distribution of the weather stations: 1, functioning weather station; 2, inactive weather station; 3, weather radar (after N.M.A.Bucharest).

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DATA AND METHODS

In the present work, the rainy spells have been analysed for the territory of the Western Plain, at the North of the Mureș River. Daily precipitation data coming from the archives of the National Meteorological Administration of Bucharest have been used. A 42 years period has been analysed (1961-2002). Out of the total number of weather stations located on the territory above mentioned, only a few were chosen for the analysis, the ones that had a common observation period (Figure 1). Those stations are as follows: Satu Mare, Săcueni, Oradea, Arad and Sânnicolau Mare. They have a latitudinal displacement, on an approximate northeast to southwest alignment. The station Sânnicolau Mare, located right at the South of the Mureș River has been chosen for the comparison, even if it's not included in the studied area.

Periods of two or more consecutive rainy days were chosen for the analysis of the rainy spells. A *rainy day* is a 24 hours interval with a measured precipitation amount of at least 0.1 mm ($\geq 0,1$ mm) (Marin I., 1986).

RESULTS

1. The number of rainy spells

The researches performed at the 5 weather stations over the Western Plain at the North of the Mureș River found a total number of almost 7,000 rainy spells (Table 1). The number of those intervals varies between 1270 in the South, at the station Sânnicolau Mare and 1464 in the North, at the station Satu Mare. It was also noticed that the number of intervals recorded in 42 years for Oradea station is higher than for Săcueni station, located at higher latitude.

In this case we can say that on the territory of the Western Plain at the North of the Mureș River, *the number of rainy spells rises from the South to the North* once with the latitude but also *from the West to the East*, once with the altitude. This is due to the different influences of this territory's climate: the southwestern part has a temperate-continental climate with Mediterranean influences, while the most part of the plain area has a temperate-continental climate with predominant oceanic influences. Those influences bring to a higher frequency of cloudy formations towards North, where the amount of precipitation increases, and a precipitation decrease towards South, where the lowest values are recorded.

The increased number of rainy spells from the West to the East is the result of altitude. In this respect, Oradea station gets an average multi-annual precipitation amount higher than the stations at its South or North, because it lies at the boundary between the Western Plain and the Western Hills. The air masses are forced here to climb up the hills and this movement upwards generates precipitation (Măhăra Gh., 1977).

On the analysed territory throughout a year may occur, on the average, ***30-35 rainy spells with an average duration of 4 days***. So, in the Crișano-Someșană Plain, about 33-35 rainy spells can be recorded each year, while at the South of the Mureș, there are only 30 rainy spells a year (Table 1). Most of the spells are recorded at the northern station of Satu Mare. Consequently, by using this analysis method, we can say that ***on the Western Plain territory, the area at the North of the Mureș may occur on the average, about 4-4.5 months with rainfall a year***.

The length of the rainy spells varies between 2-19 days (Table 2). The longest spells are recorded at the station Satu Mare – 18, respectively 19 days – and at the stations Săcueni and Arad, 16 days. The shortest spells occur at the station Sânnicolau Mare, 2-12 days long. We can observe once more that on the analysed territory *the length of the rainy spells increases from the South to the North*, once with latitude growth.

The most frequent rainy spells are 2 days long (43-50%) and 3 days long (24-26%). As the spells length increases, their frequency decreases. Broadly, 2-4 days long spells are most frequent (12-50%), then 5-9 days long ones (0.6-8%) and finally over 10 days long spells, much less frequent (0.1-0.4%) and only happening accidentally. As a conclusion, *the most frequent the rainy spells, the lesser their duration*.

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Table 3 shows the longest rainy spells recorded in the Western Plain, between 1961 and 2002. It can be noticed that the longest spells were recorded during the cold season (especially in December and January). The cause could be the higher frequency of the Mediterranean cyclones over our country during those months, respectively the predominance of stratiformis clouds, which give long lasting precipitation during the cold season. Besides, December is the month with maximum nebulosity values.

Table 1. *The number of rainy spells in the Western Plain (1961-2002).*

Number of rainy spells					
Station	Sănnic.Mare	Arad	Oradea	Săcueni	Satu Mare
Total (1961-2002)	1270	1389	1413	1400	1464
Annual average	30	33	34	33	35
General total: 6936 spells					

Table 2. *The frequency of the rainy spells according to their different lengths in the Western Plain (1961-2002).*

Spell length (no.days)	Sănnicolau Mare		Arad		Oradea		Săcueni		Satu Mare	
	No.case	%	No.case	%	No.case	%	No.case	%	No.case	%
2	623	49.1	645	46.4	645	45.6	642	45.9	629	43.0
3	317	25.0	331	23.8	367	26.0	346	24.7	354	24.2
4	159	12.5	184	13.2	181	12.8	192	13.7	221	15.1
5	85	6.7	117	8.4	103	7.3	95	6.8	116	7.9
6	36	2.8	47	3.4	47	3.3	55	3.9	64	4.4
7	27	2.1	27	1.9	31	2.2	32	2.3	28	1.9
8	13	1.0	13	0.9	16	1.1	22	1.6	26	1.8
9	7	0.6	16	1.2	13	0.9	8	0.6	9	0.6
10	-	-	-	-	6	0.4	2	0.1	6	0.4
11	2	0.2	2	0.1	2	0.1	3	0.2	3	0.2
12	1	0.1	4	0.3	-	-	1	0.1	3	0.2
13	-	-	1	0.1	1	0.1	1	0.1	1	0.1
14	-	-	-	-	1	0.1	-	-	-	-
15	-	-	-	-	-	-	-	-	1	0.1
16	-	-	2	0.1	-	-	1	0.1	1	0.1
17	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	1	0.1
19	-	-	-	-	-	-	-	-	1	0.1
Total	1,270		1,389		1,413		1,400		1,464	

Table 3. *The longest rainy spells in the Western Plain (1961-2002).*

Station	Spell	Length (no.days)	Prec. amount (mm)
Sănnic.Mare	5 – 16.12.1990	12	58.4
	30.12.1962 – 9.01.1963	11	51.7
	5 – 15.02.1978	11	30.0
Arad	30.12.1962 – 14.01.1963	16	68.3
	2 – 17.12.1981	16	86.6
	8 – 20.01.1966	13	47.8
Oradea	24.04 – 7.05.1981	14	46.9
	2 – 14.01.1963	13	61.4
	26.12.1985 – 5.01.1986	11	32.7
	29.08 – 8.09.1996	11	116.7
Săcueni	30.12.1962 – 14.01.1963	16	103.4

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	8 – 20.01.1966	13	57.6
	25.07 – 5.08.1991	12	93.9
Satu Mare	29.11 – 17.12.1981	19	73.8
	31.12.1962 – 17.01.1963	18	63.9
	10 – 25.06.1998	16	135.2
	24.04 – 8.05.1981	15	36.2

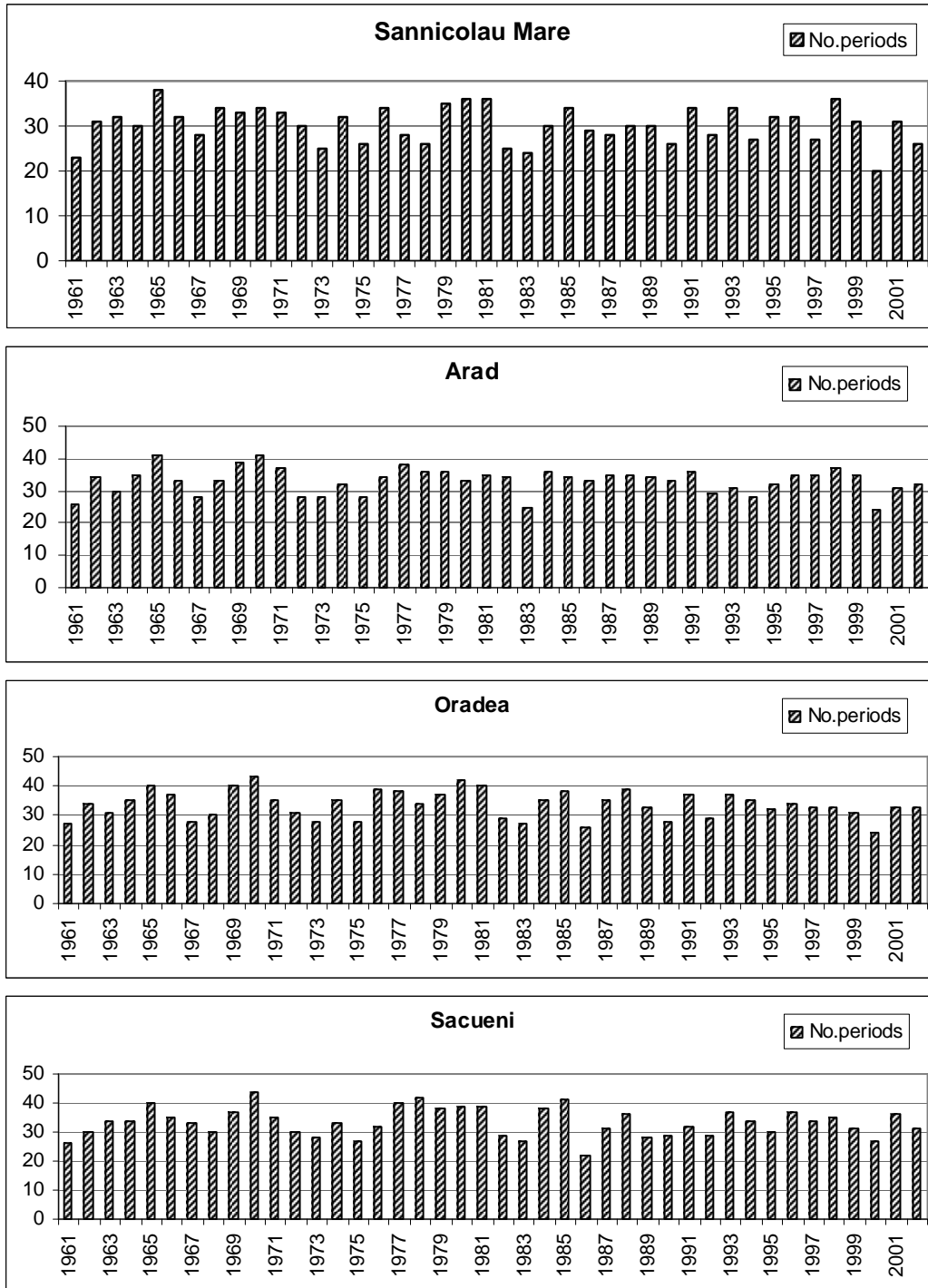


Figure 2. The distribution of the annual number of rainy spells in the Western Plain (1961-2002).

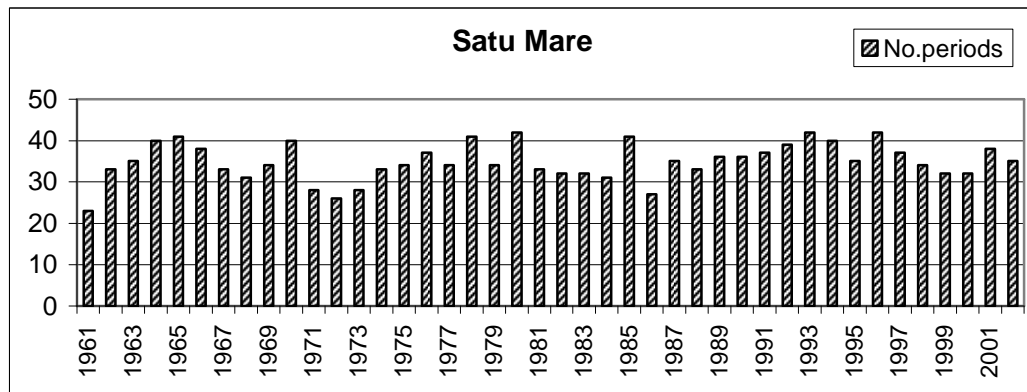


Figure 3. The distribution of the annual number of rainy spells in the Western Plain (1961-2002).

The longest rainy spell lasted 19 days and occurred at the station Satu Mare in the interval 29 November – 17 December 1981. It was recorded in the secondary maximum pluviometric month and the precipitation totaled up 73.8 mm. At the other stations precipitation occurred during this interval, but they were interrupted here and there for 1-3 days. So, at the stations Sânnicolau Mare, Oradea, and Săcueni 4 rainy spells were recorded, 2-4, 7 or 9 days long. At Arad station, a 2 days long and a 16 days long spell was recorded (2-17 December 1981), the last of them with a total of 86.6 mm precipitation amount. Generally speaking, on the entire plain, the common rainy spell, uninterrupted, was 7-13 December 1981 (7 days).

Rich precipitation amounts fell over the entire plain in the interval 29 November-17 December 1981 (70-100 mm) but the richest rainfall did not occur in the North, at Satu Mare, but in the South, at the stations Sânnicolau Mare (106.5 mm) and Arad (92 mm). Towards North, the precipitation grew longer in time but weaker (about 70 mm).

Other long common rainy spells (table 3), which we can make mention of are: December 1962-January 1963, the spell January 1966 or the interval April-May 1981. So, longer precipitation spells were recorded in winter and in spring.

Figures 2-3 show that the annual number of rainy spells keeps up to 30 at the southern station Sânnicolau Mare and slightly rises over this value at the other stations, holding to 30-40 as latitude grows.

Compared to the annual average number of 30-35 rainy spells, the annual maximum number totaled a value of 38-44 spells. The years with the most numerous rainy spells were **1970, 1965, 1980, 1993, 1996**, etc (Figures 2 and 3). The greatest number of rainy spells was 44 spells at Săcueni and 43 at Oradea, both recorded in 1970. They represented a value 1/3 times higher than the annual average. As a matter of fact, the year 1970 recorded great floods all over the country. That year's rainfall generated heavy water flows which drove to great destruction by the catastrophic floods they produced, especially in Transylvania (Topor N., 1970).

The annual minimum number of rainy spells was 20-24 and it was recorded especially in the years 2000 and 1961, when the most intense droughts occurred (Șerban E., 2005). So, the annual minimum number of 20 spells was recorded in the southern part of the plain, at the station Sânnicolau Mare, in 2000. The drought has the maximum intensity here.

2. The number of rainy days

Due to the different lengths of the rainy spells recorded at the weather stations in the Western Plain, the analysis of the number of rainy spells is not conclusive enough as to show which years or months from the studied period (1961-2002) were the rainiest. In this case, an analysis of the number of rainy days is necessary, as a more convincing method (Bogdan O., 1980).

In the Western Plain at the North of the Mureș, **annually** occur on the average between **119-141 rainy days**. Namely, this territory has **on the average, about 4-4.5 months a year with rainfall**. The average annual number of rainy days *increases from the South to the North*, once with the growth of latitude. So, in the Crișano-Someșană Plain, about 132-141 rainy days are recorded yearly while right to the South of the Mureș, there are about 119 days a year (Table 4). Most of the rainy days occur at the North of the plain, at the station Satu Mare. It seems that this method also emphasizes the climatic differences between the South and the North parts of the studied area.

Graphs in the figures 4 and 5 show the annual number of rainy days in the period 1961-2002, at the 5 stations in the West of the country. We can notice that the annual number of rainy days was under the value of 150 days at the southern station Sânnicolau Mare and over it in some years at the rest of the stations, during the 42 analysed years.

Table 4. *The average annual number of rainy days in the Western Plain (1961-2002).*

Station	Sânnic.Mare	Arad	Oradea	Săcueni	Satu Mare
No. rainy days	119	133	132	133	141

Remarkable is the path of the graphs, which is similar for all 5 stations. The graphs show the same curves up and down, which can be explained by the fact that over a small territory like the Western Plain at the North of the Mureș, the precipitation occurred as results of the same synoptic situations. So, we can observe the top of 1970, the longest rainy spell 1976-1981, the droughty decade 1982-1992, the drought of the year 2000 etc.

The greatest annual number of rainy spells goes over 140 days, at all stations. Differences occur though between the South and the North of the analysed territory. So, the years that tote up a number ≥ 140 days are 2 at the station Sânnicolau Mare, 15 years at Arad, 12 years at Oradea, 14 years at Săcueni and 25 years at Satu Mare. We can notice the great number of rainy days of the years 1965-1966, 1970, 1974, 1977-1981, 1984-1985, 1998-1999, 2001 (Figures 4 and 5).

We can observe that at all stations except Satu Mare the most numerous years with a high number of rainy days occurred during *the first half of the analysed period, which is 1961-1981*. In the second half, the number of these years decreases a lot. The cause might be linked to an increased number of convective rains in the period 1982-2002, on the background of the global warming.

The annual maximum number of rainy days was between 143-175 days. The years in which these high values occurred were: **1970**, 1965, 1980, 1993, 1996, namely the years with the most numerous rainy spells. The greatest number of rainy days was recorded in 1970: 175 days at Săcueni and 170 days at Arad stations, both having almost half a year of rainfall that year.

The annual minimum number of rainy days oscillated between 88-102 days. The years with these small values correspond to the driest years: 2000, 1961, and 1986. The minimum annual number of 88 days corresponds to the year 2000 and to the weather station Sânnicolau Mare, where as it was stated before, the drought was at its top intensity (Șerban E., 2005).

Monthly, the greatest number of rainy days occurs during winter and spring as well as at the end of autumn and the beginning of summer (Figures 6 and 7). More exactly, most of the rainy days occur in the intervals **November-January** (with an average of 10-15 days/month) and **April-June** (11-13 days/month). The fact is due to the higher frequency of the baric depressions arriving over our territory country in these months.

The maximum number of the rainy days is recorded in **December** (with an average of 13-15 days/month). That is, the stations in the West of the country have on the average half a month of rainfall. This is due to the fact that December is the month of secondary pluviometric maximum, when precipitation occurs as a result of the higher frequency of the Mediterranean cyclones that are present over our country. Also December is the month with maximum nebulosity. So, the stations Sânnicolau Mare and Săcueni have on the average 13 rainy days, Arad and Oradea have 14 rainy days and Satu Mare 15 rainy days in this month.

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The minimum of the rainy days is recorded in *October* (with an average of 8-9 days/month) or in the interval *August-October* (also with an average of 8-9 days/month). The cause is the persistence of the anti-cyclonic regime in this time of year.

The highest number of rainy days recorded within a month lasted 13-26 days for all 5 stations. So, *December 1981* toted between 20 days at Săcueni and 26 days at Satu Mare. So, the station Satu Mare had precipitation almost the entire month. Also *March 1962* had between 18 rainy days at Sănnicolau Mare and 24 days at the stations Arad, Săcueni, and Satu Mare.

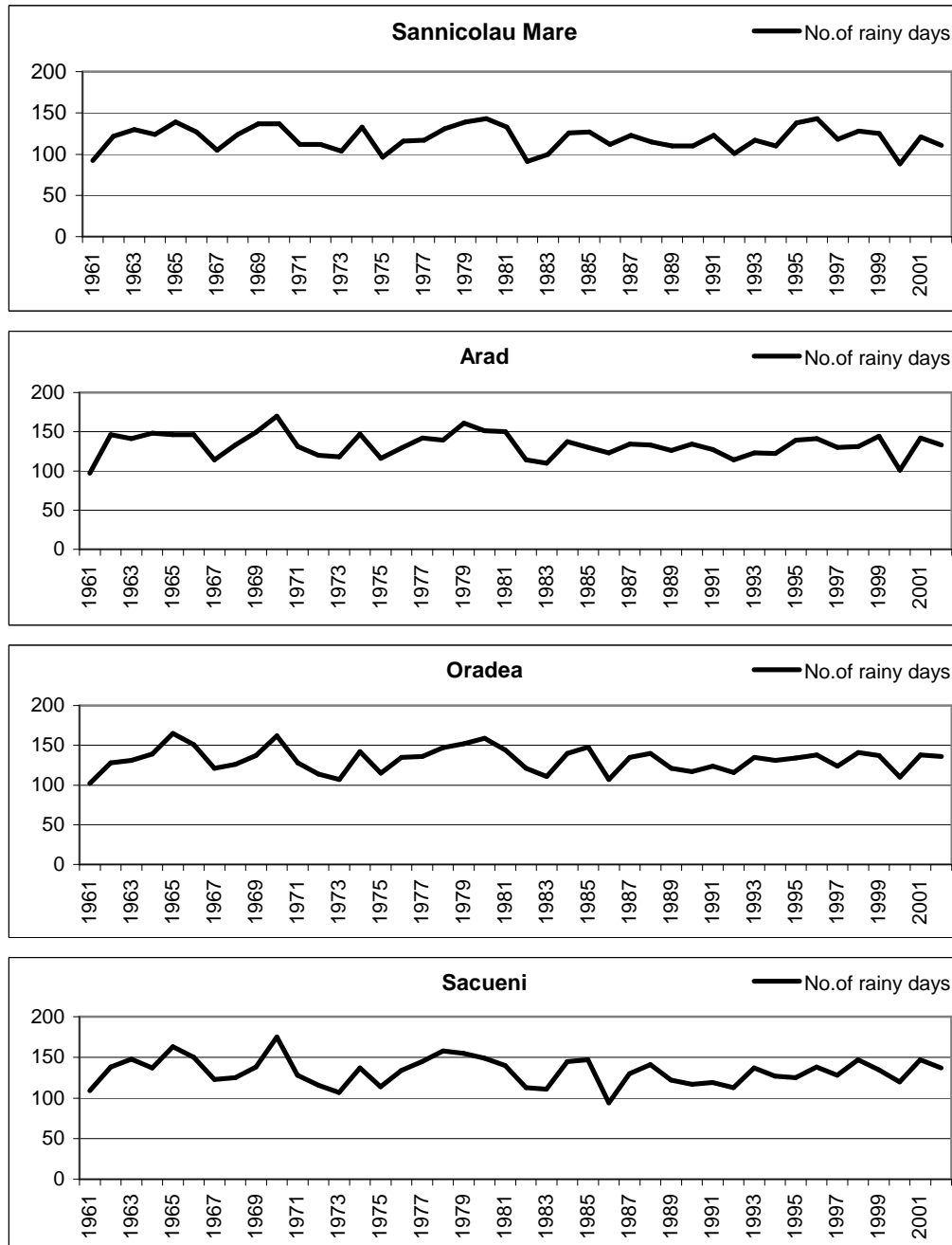


Figure 4. The distribution of the annual number of rainy days in the Western Plain (1961-2002).

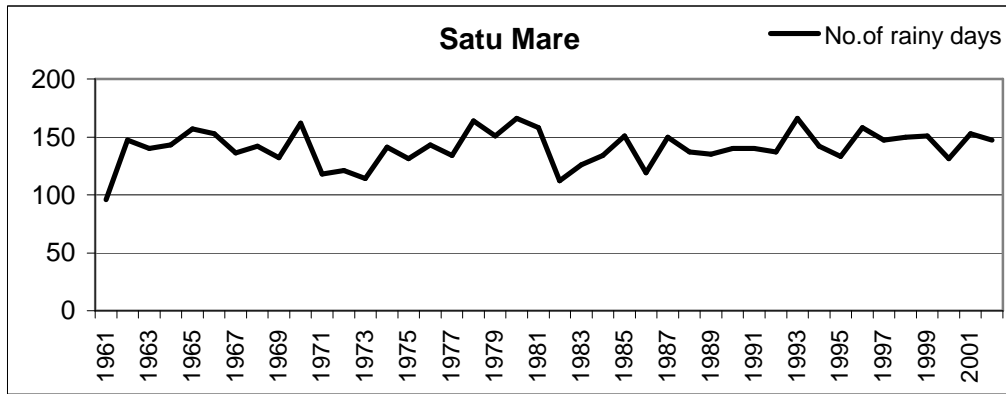


Figure 5. The distribution of the annual number of rainy days in the Western Plain (1961-2002).

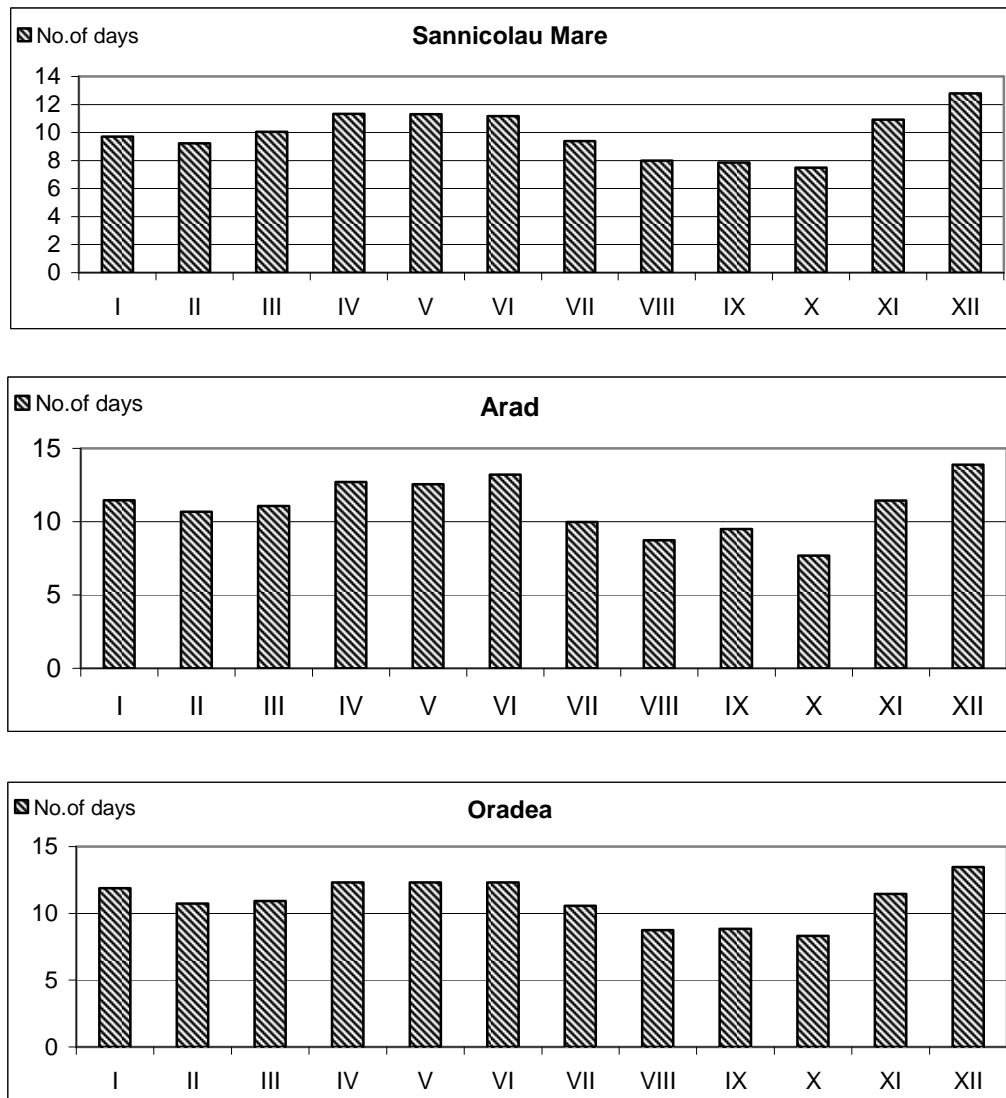


Figure 6. The average monthly number of rainy days in the Western Plain during 1961-2002.

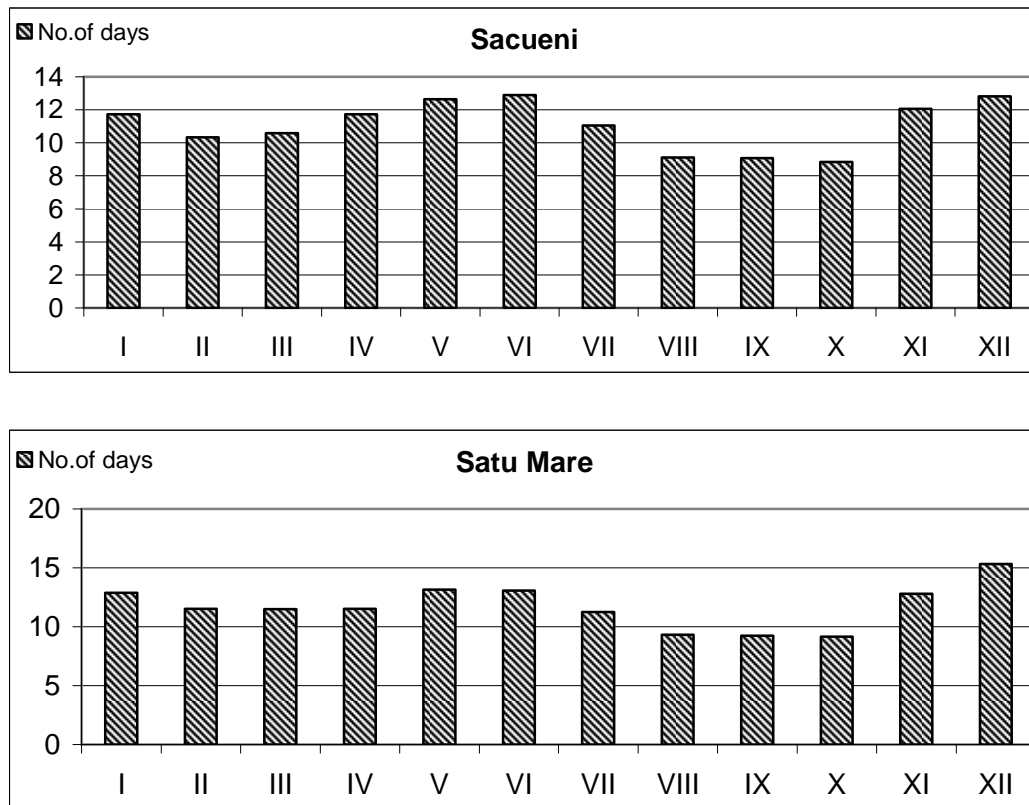


Figure. 7. The average monthly number of rainy days in the Western Plain during 1961-2002.

CONCLUSIONS

The present work has a practical purpose, as it is very useful for drawing up the weather forecasts. After the analysis of the number of rainy spells, respectively the number of rainy days, a few important conclusions arises.

In the Western Plain at the North of the Mureş River, the number of rainy spells rises from the South to the North, once with latitude growth, but also from the West to the East, once with altitude growth. The causes are the various influences of this territory's climate: Mediterranean influences in its southwestern part and oceanic influences predominant on most of the plain's territory.

Within a year may occur, on the average, about 30-35 rainy spells with an average duration of 4 days. The length of the rainy spells varies between 2-19 days. Most frequent spells are the 2 days long ones (43-50%) and 3 days long (24-26%). The more frequent the rainy spells, the shorter they are.

In the analysed territory, annually produce on the average, 119-141 rainy days. Namely, this territory has on the average, about 4-4.5 months a year with rainfall. The annual maximum number of rainy days was between 143-175 days. The most numerous years with a great number of rainy days occurred within the first half of the analysed period, which is 1961-1981. Monthly, most of the rainy days are recorded for the intervals November-January (with an average of 10-15 days/month) and April-June (11-13 days/month).

Accordingly, on the Western Plain at the North of the Mureş, precipitation may occur any month of the year, with values between 8-9 days to 13-15 days/month, according to the season and the latitude the weather station is located at. Most rains occur during winter and spring.

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