

## CLIMATIC ASPECTS CONCERNING THE HUMIDITY SURPLUS IN THE WESTERN ROMANIAN PLAIN, NORTH OF MURES RIVER

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### **Abstract**

*As to emphasize the humidity surplus on the territory of the Western Romanian Plain, North of Mures River, positive deviations of the annual and monthly precipitation amounts have been calculated, comparing to the multi-annual average, considered „normal”. The studied period was 1961-2000. The result was that the highest positive deviations of the annual precipitation amounts exceeded 200 mm and even 250 mm. The highest precipitation surpluses occurred within the interval June-July and in October, sometimes in September-October and occasionally in March, May or August.*

**Key words:** humidity surplus, precipitation, deviation, frequency.

### **INTRODUCTION**

The humidity surplus is a climatic risk, which can occur anytime through the year and comes from rich rainfall as well as from abundant snowfall. It is generated by meteorological factors that are linked to the atmosphere dynamics and also to factors that depend on the characteristics of the terrestrial surface (Bogdan, Niculescu, 1999). In the western regions of our country, the abundant precipitation is owed to the western circulation, polar circulation to which thermo-convective processes are added during the warm season (Iliescu, Stăncescu, 1974). Along with the lasting droughts, the extremely abundant rainfalls are risks that produce the greatest material damages. That is why they are important to be studied.

### **MATERIAL AND METHODS**

In the present work, the annual and monthly amounts of precipitation have been studied, according to the archives of the National Meteorology Administration, along a period of 40 years (1961-2000). As to emphasize the presence of the humidity excess on the territory of the Western Romanian Plain, North of Mures River, positive deviations of the annual and monthly precipitation amounts have been calculated, comparing to the multi-annual average, considered „normal”. The calculation was made for a number of seven weather stations throughout the plain, more exactly the

ones with the longest observation period. The years and months with the highest precipitation surplus were emphasized.

## RESULTS AND DISCUSSIONS

### **The deviation of the annual precipitation amounts compared to the multi-annual average**

At most weather stations in the Western Plain – at the North of the Mureş River, records show a number of 8 years with positive deviations higher than 100 mm, except Oradea station with 9 years over 100 mm and Satu Mare with only 5 years. We can observe that in the areas situated at higher latitudes, the number of years with high positive deviations diminishes. Also at the same time as altitude increases the deviations value lowers as well. All these are due to the oceanic climatic influences, stronger in the North of the plain – Satu Mare station –, respectively to the higher amounts of precipitation recorded at the boundary of the Western Plain with the Western Hills, where the climate is more moderate.

The most important annual positive deviations exceed 200 mm, rising to 250.3 mm at Arad, respectively 272.4 mm at Oradea. We could notice that during those years (table 1), the precipitation amounts exceeded 800 mm at most stations, rising to almost 900 mm at Holod.

*Table 1*

The highest annual positive precipitation deviations recorded in the Western Romanian Plain, North of Mures River (1961-2000).

STATION	Deviation (mm)	Precipitation amount (mm)	Year
Satu Mare	243,5	841,1	1974
Săcueni	233,6	805,0	1974
Oradea	272,4	884,0	1996
Holod	204,4	896,5	1974
Chişineu-Criş	234,0	800,5	1999
Arad	250,3	827,5	1970
Sănnicolau Mare	220,3	743,5	1969

The rainiest years, with high positive deviations recorded at all stations were 1966, 1970, 1974, 1978, 1980, 1981, 1991, 1996, 1998 and 1999 (fig.1-4). In 1974, high amounts of precipitation occurred all over plain territory, with deviation values between 127-243 mm, with the richest precipitation amounts in the North. 1974 was the year with the richest precipitation at the stations Satu Mare, Săcueni and Holod (over 200 mm positive deviation).

For the year 1970, rich precipitation amounts were recorded especially in the southern part of the plain (deviations of 250 mm in Arad and almost 200 mm in Chişineu-Criş and Holod). The years 1996 and 1998-

1999 had also, high precipitation surpluses at many stations. In Oradea the entire period 1996-1999 was extremely rainy, with deviation values between 100-270 mm. The total surplus in this period was 806.8 mm in Oradea, rising above the multi-annual average.

The years with surplus can be grouped together, giving periods of consecutive exceeding years (fig.1-4). Most frequent such periods consist of 2 and 3 consecutive years, but periods of 5-6 years may also occur. At the southern stations Sănnicolau Mare and Arad, periods of 4 consecutive years also occur. The periods of 6 consecutive exceeding years are more frequent at northern stations, in the Someșului Plain, where the air humidity is higher due to the predominant oceanic influences of the climate, such as Săcueni, which has only periods of 5 and 6 consecutive years.

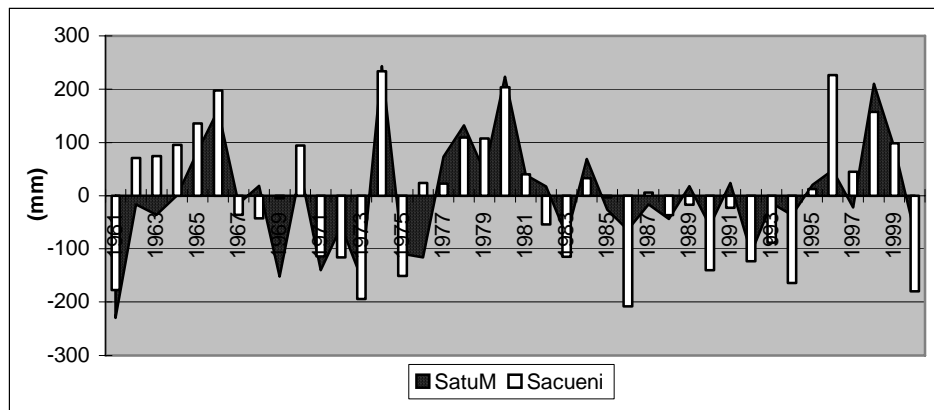


Fig. 1. The positive and negative deviations of the annual precipitation amounts compared to the multi-annual average, at Satu Mare and Săcueni stations (1961-2000).

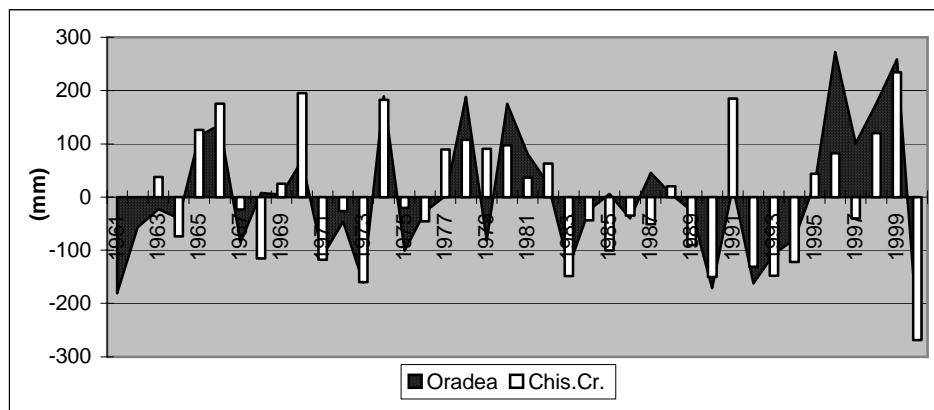


Fig. 2. The positive and negative deviations of the annual precipitation amounts compared to the multi-annual average, at Oradea (1961-2000) and Chișineu-Criș (1963-2000) stations.

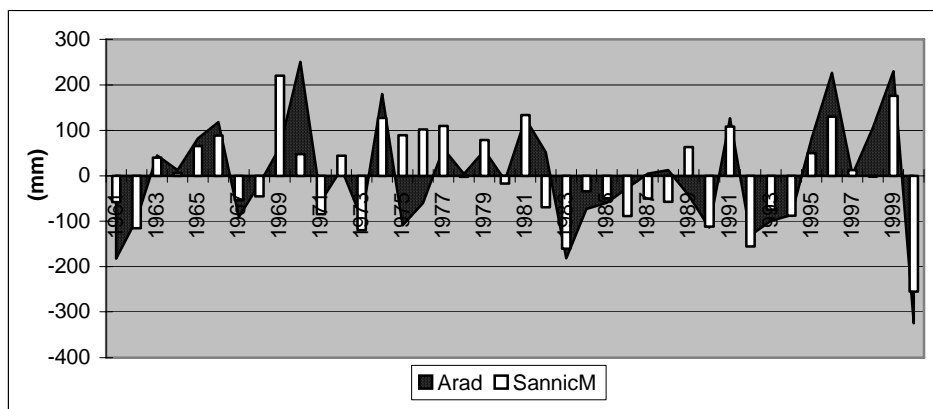


Fig. 3. The positive and negative deviations of the annual precipitation amounts compared to the multi-annual average, at Arad and Sannicolau Mare stations (1961-2000).

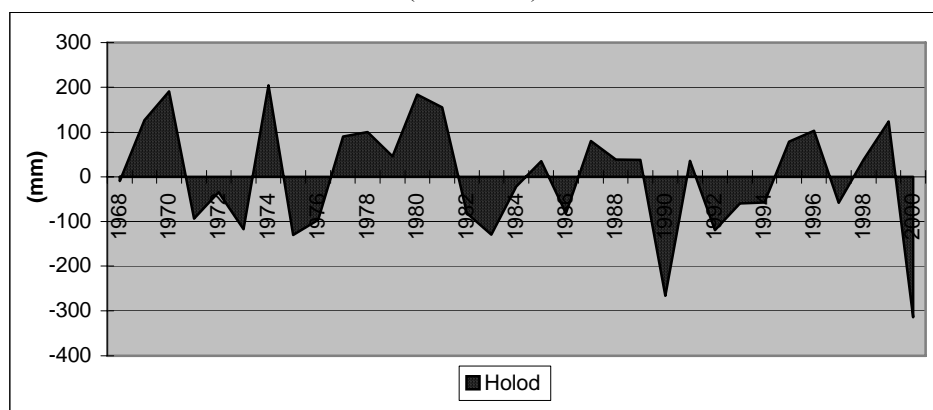


Fig. 4. The positive and negative deviations of the annual precipitation amounts compared to the multi-annual average, at Holod station (1968-2000).

The most periods of consecutive exceeding years are recorded at the stations in the Crișurilor Plain, where the precipitation amounts are also reduced. In the Someșului Plain, because of the temperate oceanic influences, there are fewer but longer periods with surplus.

Compared to the periods of consecutive exceeding years, the ones showing a deficit are very frequent when they last 2-3 years. Generally, the number of the exceeding periods and the one of the periods with deficit is about the same at the weather stations.

#### **The deviation of the monthly precipitation amounts compared to the multi-annual average**

The highest monthly positive deviations were recorded in *June-July* in the Western Romanian, North of Mures River. These are the months with

the highest amounts of precipitation, when dynamic and thermic convection superpose. In these months, at the weather stations throughout the plain, the maximum deviations were up to 100-147 mm. The highest deviations occur in June, the month of the pluviometric maximum.

Within the plain area, the highest monthly positive deviation was recorded at the southern station Sânnicolau Mare in June 1969, a month with 147.1 mm precipitation over the multi-annual average. This month's precipitation amount was 220.3 mm, which is almost half of the annual average precipitation amount recorded at this station, namely 3 times higher than the multi-annual average for the month of June. As a matter of fact, 1969 was the year that toted up the highest annual precipitation amount of the period 1961-2000, at this station. Other high precipitation surpluses were recorded at Oradea in July 1998 (140.8 mm precipitation over the multi-annual average) and Satu Mare in June 1974 (140.7 mm deviation). These months toted up 214 mm at Oradea and 221.1 mm at Satu Mare, which is more than 1/3 of the annual average precipitation amount recorded at these stations.

High monthly positive precipitation deviations are also recorded in autumn, in *October* and sometimes in the interval *September-October*. Within the territory of the Western Romanian Plain, North of Mures River, the maximum deviations for October were between 95-140 mm. The highest deviation, 140.6 mm, was reported at Arad in October 1974. This month toted up a precipitation amount of 178 mm, which is almost 5 times higher than the multi-annual average amount for October.

High precipitation surpluses may also occur at some of the stations during the spring months *March* or *May*, and sometimes in summer – *August* – because of the strong thermic convection. In these months, the high surpluses are typical for the Someșului Plain and also, for the boundary between the plain and the hills regions (Oradea and Holod). So, the highest surpluses were recorded at Holod and Săcueni and toted up about 100-125 mm over the multi-annual average.

Other times, high surpluses may occur even in December, the month of the secondary pluviometric maximum, with rich rains due to the influence of the Mediterranean cyclones, more frequent in this month. This was the case in December 1969 at the southern station Sânnicolau Mare, which recorded a surplus of 92 mm precipitation over the multi-annual average, namely a precipitation amount of 139.3 mm, 3 times higher than the multi-annual average for December.

Thus, on the territory of the Western Romanian Plain, North of Mures River, the highest precipitation surpluses occur within the interval June-July and in October, sometimes in September-October and occasionally can also occur in March, May or August.

The most numerous periods of consecutive exceeding months are recorded at the northern stations, due to the predominant oceanic influences of the climate, namely to the persistence of the damp weather. Over the territory of the Western Romanian Plain, North of Mures River, the number of the periods with consecutive months with surplus *decreases from the North to the South, once the latitude decreases*, and that Mediterranean climatic influences manifest towards the southern limit of the analyzed territory. The highest frequency is recorded for the periods of 2-4 consecutive months with surplus.

The longest intervals with consecutive months with surplus were 9 months at Arad, 8 months at Chişineu-Criş, Holod, Oradea and Satu Mare, 7 months at Săcueni and 5 months at Sânnicolau Mare (table 2). Generally, the periods longer or equal of 6 consecutive months are very few: 1-2 periods at a station, maximum 3 periods (Oradea) or none (Sânnicolau Mare). The southern station Sânnicolau Mare has no records of long periods of surplus because of the high frequency of dryness and drought phenomena in this part of the plain, that reduce by their presence the length of the periods with surplus.

The year 1970 had the highest precipitation surplus at Arad station. The longest period of consecutive months with surplus on the territory of the Western Romanian Plain, North of Mures River was recorded here. It lasted 9 months – December 1969-August 1970 – and totaled up a precipitation surplus of 354.7 mm over the multi-annual average of those months, namely a total precipitation amount of 809.9 mm. The maximum deviation, 100.7 mm, occurred in June 1970. At the other stations, this period with surplus was shorter. It lasted 8 months, respectively 5 months, within the interval November 1969-June 1970 or November 1969-March 1970. The precipitation surplus totaled up about 110-185 mm and it was rising at 260 mm at Holod station. The maximum deviations were recorded for the months June 1970 or February 1970.

According to Topor (1970), the months of May, June and July 1970 were excessively rainy almost all over the country, the rains generated flash floods which, especially in Transylvania, drove to great destruction by catastrophic floods (like those on 13-18 May). Violent rains occurred, accompanied by electric discharge, heavy winds, hail and in the mountains even sleet. The cause of these exceptional rains was the persistence of a polar front extremely active all over Europe, from the beginning of the year to the last summer month, due to the extremely severe winter in the North of Europe and to the abnormally warm winter in the North of Africa (Topor, 1970).

In the Western Romanian Plain, North of Mures River, we can also observe, among the long periods with surplus, the 7 months interval

between October 1966-April 1967, recorded at Săcueni and Oradea, that even though it was long, did not tote up a very high precipitation surplus (table 2). There are though short periods with surplus, which totalize a very high surplus, like the one of May-August 1974 (180-240 mm deviation), more rainy in the Someşului Plain, or the interval August-October 1996, with records of very high surpluses at Săcueni and Oradea (225-255 mm deviation). In this last interval, the amount of precipitation recorded at Săcueni, during these 3 months, was almost 400 mm.

Table 2

The longest and the rainiest periods with surplus recorded in the Western Romanian Plain, North of Mures River (1961-2000).

STATION	Period	Number of months	Total surplus (mm)	Maximum deviation (mm)/month
<i>Satu Mare</i>	Nov.1969-June 1970	8	167,2	63,0/May 1970
	March-July 1980	5	215,8	119,1/July 1980
	April-July 1998	4	183,7	73,7/July 1998
	May-July 1974	3	241,9	140,7/June 1974
<i>Săcueni</i>	Oct.1966-April 1967	7	164,8	50,8/Nov.1966
	Nov.1961-April 1962	6	220,6	126,7/March 1962
	May-August 1974	4	236,8	119,7/June 1974
	August-Oct.1996	3	255,6	125,1/Sept.1996
<i>Oradea</i>	Nov.1969-June 1970	8	170,6	43,1/June 1970
	Oct.1966-April 1967	7	106,8	29,4/Nov.1966
	Febr.-July 1978	6	214,6	101,2/July 1978
	May-August 1974	4	178,8	120,1/June 1974
	August-Oct.1996	3	227,2	125,5/Sept.1996
<i>Holod</i>	Nov.1969-June 1970	8	261,8	67,3/June 1970
	Oct.1987-March 1988	6	147,3	102,2/March 1988
	March-July 1980	5	188,1	123,3/July 1980
	May-August 1974	4	190,9	119,0/June 1974
<i>Chişineu-Criş</i>	Febr.-Sept.1978	8	135,2	32,3/Sept.1978
	July-Nov.1998	5	176,0	60,4/Sept.1998
	July-Oct.1991	4	243,1	91,7/July 1991
	May-July 1974	3	180,1	136,0/June 1974
<i>Arad</i>	Dec.1969-August 1970	9	354,7	100,7/June 1970
	April-Nov.1998	8	204,0	59,9/July 1998
	Sept.1964-Jan.1965	5	113,7	43,3/Oct.1964
	August-Dec.1996	5	171,8	52,2/Sept.1996
<i>Sănnicolau Mare</i>	May-Sept.1975	5	241,8	99,2/July 1975
	Nov.1969-March 1970	5	184,2	92,0/Dec.1969
	July-Nov.1991	5	120,0	95,8/Oct.1991
	August-Dec.1996	5	117,0	42,3/Sept.1996

## CONCLUSIONS

In the Western Romanian Plain, North of Mures River, the highest positive deviations of the annual precipitation amounts surpass 200 mm and even 250 mm. The rainiest year was 1974. The most frequent periods of consecutive years with surplus are those of 2 or 3 years, but periods of 5-6 or 4 consecutive years may also occur.

The highest precipitation surpluses occur within the interval June-July and in October, sometimes in September-October and occasionally in March, May or August. The monthly maximum positive deviations were up to 100-145 mm. The number of periods with consecutive months with surplus decreases from the North to the South, once the latitude decreases, due to the higher air humidity in the North of the plain and to the droughty Mediterranean climatic influences, which manifest towards its southern limit. The highest frequency is recorded for the periods of 2-4 consecutive months with surplus.

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