THE MONTHLY RAINFALL REGIME
IN THE AREA OF ORADEA CITY

Pereş Ana Cornelia*, Costea Monica*

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea, Romania, e-mail: peresana35@yahoo.com

Abstract
When looking at the monthly rainfalls, it can be seen that there are significant differences from one month to another. The highest rainfall amounts are recorded in the warm months of the year, from May to September. These high amounts are due, on the one hand, to a more intense frontal activity, generated by the advection of wet air masses coming from the ocean or the Mediterranean Sea, and, on the other hand, to stronger thermal convective processes, which result in heavy downpours.
The lowest rainfall amounts are recorded in the January-March period. This is due mainly to predominantly anticyclonic motion, which prevents thermal convection.

Key words: highest rainfall, lowest rainfall

INTRODUCTION

In the warm semester of the year, the dynamics of air masses is very active, of those coming from the West in particular, and thermal and dynamic convection reaches the highest annual levels, which results in heavy rainfalls (Gaceu O., 2005; Dumiter Aurelia Florina, 2007; Moza Ana Cornelia, 2008, 2009; Pereş Ana Cornelia, Köteles N., 2013).

In the cold semester, the anticyclonic conditions are frequent, thermal convection is much weaker, and atmospheric dynamics is dominated by dry and cold continental air masses coming from the North and the Northeast of Europe or the Northwest of Siberia. The result of all these phenomena is low rainfall amounts (Gaceu O., 2005; Dumiter Aurelia Florina, 2007; Moza Ana Cornelia, 2008, 2009; Pereş Ana Cornelia, Köteles N., 2013).

MATERIAL AND METHODS

In order to study the monthly rainfall regime in the area of Oradea city, data recorded at the Oradea weather station in the 1970-2014 period were used.

RESULTS AND DISCUSSION

Averages of monthly rainfalls

The average of January monthly rainfalls is 35.0 mm, with fluctuations from one year to another between 84.9 mm, the highest monthly

total, recorded in 1979, and 6.5 mm, the lowest total, recorded in 1973 (see Table 1 and Figure 1).

Highest and lowest monthly rainfalls in Oradea, in the 1970-2014 period

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Highest (mm)	84.9	107.3	122.3	102.1	142.4	206.5	214.0	142.3	171.8	173.0	112.4	135.4
Year	1979	1999	2013	2001	1985	1974	1998	1996	1996	1974	1977	1999
Lowest (mm)	6.5	0.3	3.0	3.2	17.6	11.4	4.4	0.0	0.0	2.7	0.0	0.1
Year	1973	1976	1974	2007	2001	2000	2013	2003	1986	1995	2011	1972

Source of data: A.N.M. Archives

February represents the *principal low* of rainfall amounts, the multiannual average being 30.9 mm. The highest total recorded in February was 107.3 mm, in 1999, while the lowest total for this month was as low as 0.3 mm, recorded in 1976, which gives an amplitude of 107.0 mm.
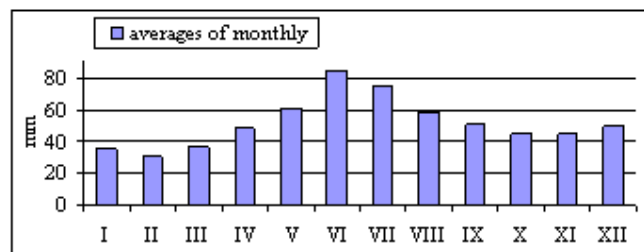

Fig. 1. The averages of monthly rainfalls in Oradea, 1970-2014

From March, the rainfall totals grow progressively until June, when the principal high of multiannual averages is recorded.

Along with the increase in cyclonic activity and in air temperature, which determine intense convective processes, rainfall totals begin to increase significantly from April, when the multiannual average reaches 47.7 mm, they grow further to 61.3 mm in May, after which the *highest value* is reached in June, when the average is 84.0 mm. In June, rainfall totals varied between 206.5 mm in 1974 and 11.4 mm in 2000. The rains of this month are generated by the high frequency of ocean cyclones that move on the northern dorsal of the Azores anticyclone, and bring cold and wet air masses, which favour precipitations, as well as by convective processes that destabilize the atmosphere by thermal and dynamic convection.

From June, the rainfall amounts drop until October, when a *secondary low* value is recorded. This is due to the prevalence of anticyclonic conditions from the end of summer and beginning of autumn. The average

of the rainfall totals for this month is 44.2 mm, with variations between 173.0 mm in 1974 and 2.7 mm in 1995.

In November, the rainfall totals increase slightly, which is the result of intense frontal activities generated by the contact of air masses of different thermal characteristics and origins, and which determine an increase in cloudiness, of the low-level and middle-level in particular, as November is the month with a high frequency of Stratus clouds. Thus, the average of the monthly rainfalls is 44.9 mm, with values between 112.4 mm, highest value, recorded in 1977, while in 2011 there was no precipitation at all in November.
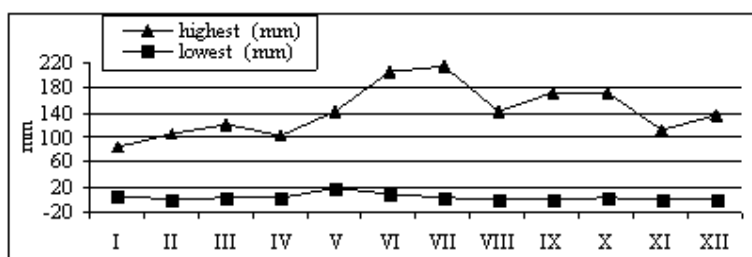

Fig. 2. Highest and lowest monthly rainfalls in Oradea, 1970-2014

The rainfalls continue to increase in December as well, when the *secondary high* is recorded. This is due to the advection of wet air masses coming from the Mediterranean basin and to the high frequency of mobile cyclones coming from the North Atlantic, which generate abundant precipitations. Thus, the multiannual average is 49.1 mm, with a highest value of 135.4 mm in 1999, and a lowest one going as down as 0.1 mm, in 1972 (see Table 1).

Averages of semestrial rainfalls

In the warm semester, the multiannual average rainfall on a square meter in Oradea is 376.3 mm, which makes up 61% of the multiannual average of annual rainfalls (617.1 mm) (see Table 2).

In the cold semester, the multiannual aveage rainfall on a square meter in Oradea is 240.8 mm, that is 39% of the multiannual average of annual rainfalls (617.1 mm) (see Table 2).

Table 2
Multiannual averages of annual and semestrial rainfalls in Oradea, 1970-2014

Weather station	Multiannual average of annual rainfalls	Multiannual average of the cold semester (1 Octomber - 31 March)		Multiannual average of the warm semester (1 April - 30 September)	
	mm	mm	%	mm	%
Oradea	617.1	240.8	39.0	376.3	61.0

Source of data: A.N.M. Archives

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Highest 24-hour rainfall amounts

When the analysis of rainfall patterns of an area is done, not only the number of days with certain rainfall amounts is of significant practical importance, but also the highest rainfall amounts during a certain time interval.

The multiannual average of 24-hour highest rainfall amounts in Oradea is 43.9 mm, which makes up 7% of the multiannual average of annual rainfalls.

In the area of Oradea city, the highest 24-hour rainfall amounts were recorded in the warm season, with the highest values in June. The highest amount in this month was 62.4 mm, recorded on 30 June 1986, which makes up 74% of the average for this month (84.0 mm) and 47.6% of the total rainfalls of the month in which it was recorded (131.0 mm).

The amounts are also high in August, with a highest value of 60.5 mm in 24 hours recorded on 11 August 2009, a value which makes up 103.6% of the average for this month (58.4 mm) and 67.7% of the total rainfalls of the month in which it was recorded (89.4 mm). The high 24-hour rainfall amounts in the warm season are due to dynamic and thermal convective processes, as well as to intense frontal activities, the abundant precipitation being mainly the result of the cold fronts which reach the area of Oradea city in this time of the year.

Table 3

The highest 24-hour rainfall amounts (mm) in Oradea, in the 1970-2014 period

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
24-hour amt.	25.6	27.8	41.9	38.5	46.8	62.4	58.2	60.5	45.1	48.3	35.0	36.4	62.4
Date	01.10	05.03	25.04	16.77	29.82	30.86	30.11	11.09	09.01	13.09	23.89	17.84	30.VI.1986

Source of data: A.N.M. Archives

It can be seen that the 24-hour precipitation amounts are lower in the cold season than in the warm one, which is due to the higher frequency of continental anticyclonic conditions, which are characterized by a high atmospheric stability, low air temperature and humidity.

In the period included in the study (1970-2014), there were three cases in Oradea when the 24-hour rainfall amount was higher than the multiannual average of that month. Thus, in March, the average is 36.7 mm, while the 24-hour amount was 41.9 mm. The second case was recorded in August, when the average is 58.4 mm, and the 24-hour amount was 60.5 mm. The last case occurred in October, when the multiannual average of monthly rainfalls is 44.2 mm, while the highest 24-hour rainfall amount reached the value of 48.3 mm (see Figure 3).
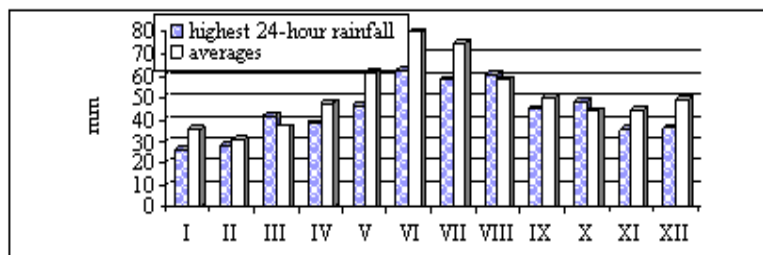
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Fig. 3. The highest 24-hour rainfall amounts (mm) and the averages of
monthly rainfalls at the Oradea weather station, in the 1970-2014 period

CONCLUSIONS

The analysis of the yearly pattern of rainfall amounts shows that the climate of Oradea is a continental one with oceanic influences, which is characterized by a principal high rainfall in *June* (84.0 mm) and a secondary one, with a lower average, in *December* (49.1 mm). At the other extreme, there is a principal low in *February* (30.9 mm) and a secondary low in *October* (44.2 mm).

The highest 24-hour rainfall amount, 62.4 mm, occurred on 30 June 1986, a value which makes up 74% of the average for this month (84.0 mm) and 47.6% of the total rainfalls of the month in which it was recorded (131.0 mm).

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