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CRITICAL PRECIPITATION SPELLS IN THE TRANSYLVANIAN DEPRESSION

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ABSTRACT – The increased frequency of the climatic hazards requires more and more detailed studies on this issue. Thus, the present paper aims at identifying the critical precipitation spells for the Transylvanian Depression area. In this respect, statistical data from 1971-2000, recorded in 10 weather stations (Cluj-Napoca, Blaj, Sebeş, Tg. Mureş, Dumbrăveni, Sibiu, Făgăraş, Dej, Bistriţa, Odorheiu Secuiesc) were used. The main conclusions are the following: in the analyzed region, most of the days within the year (110...131 days) have a frequency of precipitation occurrence between 30...40 %; at the weather stations protected by the Apuseni Mountains and by the Southern Carpathians (Blaj, Sebeş, Sibiu), the "precipitation shadow" is felt and so, the number of rainy days with an occurrence frequency higher than 40% decreases if compared to the other analyzed weather stations within the studied area; the length of critical precipitations spells, common to most of the analyzed weather stations, ranges between one and 21 running days (for an occurrence frequency higher than 40%) and between one and 6 running days (with an occurrence frequency higher than 50%), respectively; critical precipitation spells, common for the entire region, are missing in March, while in August and October have a very low frequency (1-2 days).

Key words: critical precipitations spells (CPS), daily amount of precipitations, frequency, Transylvanian Depression.

INTRODUCTION

The increasing of climatic hazards frequency requires more and more detailed studies on this issue. The main aim of this paper is to identify the critical precipitations spells for the Transylvanian Depression area. In this respect, we used statistical data from 1971-2000, data recorded in 10 weather stations (Cluj-Napoca, Blaj, Sebeş, Tg. Mureş, Dumbrăveni, Sibiu, Făgăraş, Dej, Bistriţa, Odorheiu Secuiesc).

METHOD

Using the method called "critical spells", one can emphasize the distribution in time during a year of any climatic element. This method supposes to identify spells during a year, considered in running days, within which a climatic element (precipitations in this case) has average multiannual parameters (with different frequency limits) that transform it into a climatic hazard. So, the method identifies spells with a high occurring frequency for precipitation amounts above certain limits. Considering this element, we can identify both critical spells for precipitation persistence (number of running days with precipitations, without taking into account the daily amount) and quantitative critical spells, considering the daily or the total amount of fallen precipitations (Croitoru, 2003).

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For the first type of critical precipitation spells, that regarding the frequency, it has to be calculated the daily frequency of occurring or no-occurring precipitations:

$$F_x(\%) = \frac{NZP_x}{n} \times 100 \quad (1)$$

where,

F_x(%) – frequency of occurring/no-occurring precipitations for a certain day of the year;

x – day of the year for which the frequency of occurring/no-occurring precipitations is calculated; x = 1, 2,..., 366;

NZP_x – number of days with/without precipitations in the analyzed period (usually, minimum 30 years), for day x;

n – length of data range (number of years considered in the analysis or the total number of x days of the range).

After calculating the frequency of occurring/no-occurring of precipitations for each day of the year, running days spells with the same frequency[4] have to be identified. One can also choose frequency critical limits of occurring/no-occurring precipitations, as 30%, 50%, 80%, etc.

The second type of critical spells requires identifying during the year those spells within which the daily amounts of fallen precipitations overpass a certain limit (0.1 mm, 1 mm, 5 mm, etc.). For this purpose, the daily multiannual average amount is calculated for each day of the year and then, considering the chosen limit, critical spells are identified.

The multiannual average of the day is calculated as follows:

$$\overline{RR_x} = \frac{\sum_{i=1}^{n} x_i}{n} \quad (2)$$

where,

$\overline{RR_x}$ - daily multianual average amount for day x of the year;

x – day of the year for which the daily multiannual average amount is calculated;

n – length of data range (number of years considered for the analysis or the total number of x days of the range).

In this study, we have calculated both the frequency of precipitations occurring for each day of the year and the frequency of precipitations occurring on certain value classes (from 10 to 10%). Then, we have identified the critical precipitation spells which were simultaneously registered at the most of the analyzed weather stations. In the end, a calendar of the critical precipitation spells for the whole studied area was established.

RESULTS

Frequency of precipitation occurrence

Analyzing the processed statistical data, one can remark that there is not any day of the year in the whole studied area when precipitation did not occur during the 30 years period (table 1, fig.1). Otherwise, precipitations were registered at least once in the thirty years period, somewhere in the area, for every day of the year.

[4] The same frequency means a range of 10%. For instance, days with a frequency of precipitations occurrence of 51 to 60% are considered to be in the same spell.

A precipitation occurrence frequency, higher than 30%, is specific to more than 200 days a year, and even more (222 days in Sebeş weather station, or 318 days in Dej weather station). At the same time, a frequency of more than 50% of precipitation occurrence characterizes a much lower number of days (23 days at Sebeş and 71 days at Dej).

The spatial distribution emphasizes that in the Northern and Eastern Transylvania (Dej, Bistrița, Odorheiu Secuiesc), most days are registered to have precipitation occurrence frequencies higher than 30%. The Cluj-Napoca weather station has a "composite behaviour", meaning that for average occurrence frequency (> 20% …>40%), the number of rainy days can be compared with that of the Northern and Eastern stations, while for high occurrence frequency (> 50%), the number of days is quite similar to that registered in the Southern and central areas.

Table 1. *Cumulated frequency of the rainy days number (1971-2000).*

Frequency (%)	Cluj-Napoca	Blaj	Sebeş	Tg. Mureş	Dumbră-veni	Sibiu	Făgăraş	Dej	Bistrița	Od. Secuiesc
> 0	366	366	366	366	366	366	366	366	366	366
> 10	364	361	363	365	364	364	365	366	366	365
> 20	354	334	334	348	348	347	353	359	360	355
> 30	290	224	222	263	269	264	276	318	305	279
> 40	161	97	95	133	146	133	150	189	180	169
> 50	52	35	23	37	50	52	62	71	73	69
> 60	8	4	6	6	6	14	11	17	20	14
>70	1	0	0	0	0	3	2	1	3	1

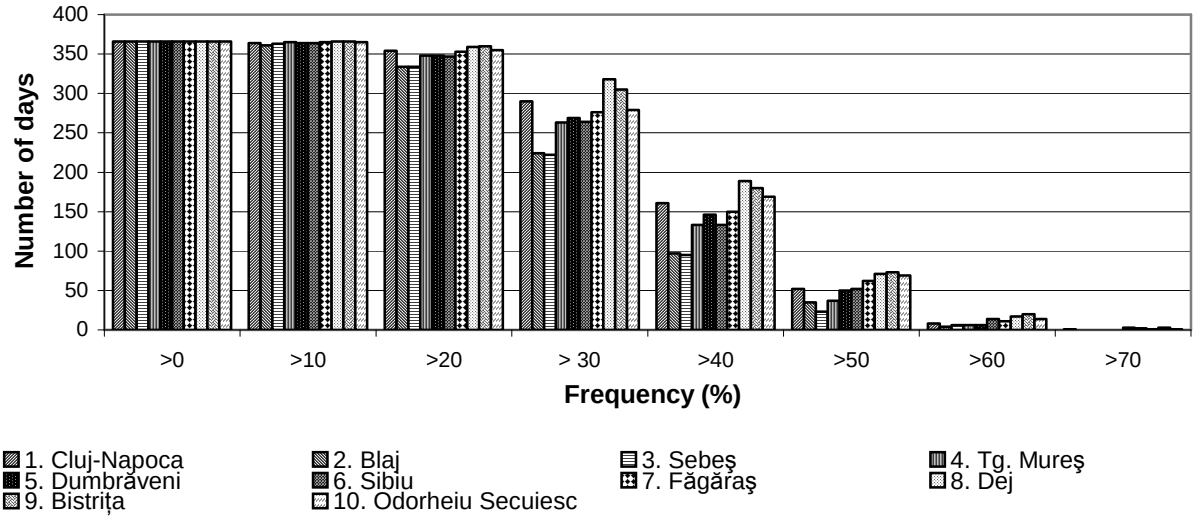

Figure 1. *Frequency of precipitation days (1971-2000).*

The analysis on **frequency classes from 10 to 10%**, shows that, in the whole area, about a third part of the year (more than 100 days) is characterized by a precipitation occurrence frequency of 30…40%. As extreme values, there could be mentioned the Odorheiu Secuiesc weather station, with 110 days/year and the Sibiu weather station, with 131 days/year. The next interval is that of 40.1…50.0 %, with values between 62 days/year at Blaj, and 118 days/year at Dej (table 2, fig. 2).

The frequency with values under 30% reaches the highest number of days at the Blaj and Sebeş weather stations, stations which also registered the lowest number of days/year, this time in the

case of average frequency, that is the 40.1%...50% and 50.1%...60% classes. High frequency of occurrence (over 70%) is missing at 4 of the 10 weather stations and characterizes the central and South-Western part of the depression.

Frequency lower than 30%, specific to Blaj and Sebeş weather stations, is characterized by the highest number of days (over 100 days/year), while average frequency steps, to the same weather stations, registered the lowest number of days/year in the area.

Table 2. *Frequency of rainy days on value classes (1971-2000).*

Frequency (%)	Cluj-Napoca	Blaj	Sebeş	Tg. Mureş	Dumbră-veni	Sibiu	Făgăraş	Dej	Bistrița	Od. Secuiesc
<20.1	12	32	32	18	18	19	13	7	6	11
20.1-30.0	64	110	112	85	79	83	77	41	55	76
30.1-40.0	**129**	**127**	**127**	**130**	**123**	**131**	**126**	**129**	**125**	**110**
40.1-50.0	109	62	72	96	96	81	88	118	107	100
50.1-60.0	44	31	17	31	44	38	51	54	53	55
60.1-70.0	7	4	6	6	6	11	9	16	17	13
>70.0	1	0	0	0	0	3	2	1	3	1

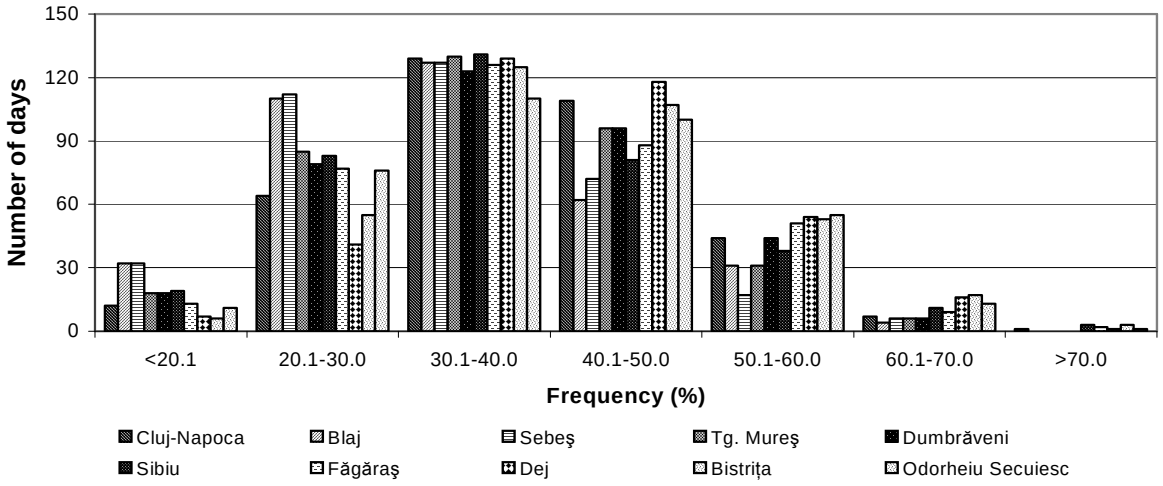

Figure 2. *Frequency of rainy days on value classes (1971-2000).*

The highest number of rainy days with an occurrence frequency of 40…70 % is specific to the Northern and Eastern areas.

The critical precipitations spells (CPS), for eight out of the ten weather stations, have an occurrence frequency higher than 40% or 50% and a calendar illustrating it was worked out (fig. 3).

The length of the CPS, when occurrence frequency is higher than 40%, varies from 1 to 21 running days with the most "exposed" period from April till July. Precipitations with a frequency higher than 40% may occur in 15 days in August, and in 28 days in June. For June, only days 10 and 27 are characterized by an occurrence frequency lower than 40 %. But, on the other hand, there are months when the critical spells that characterize the entire area are missing (March) or have a very low frequency (October). In this way, the general precipitation regime of the area is confirmed, with the main minimum during February-March and the second during October.

Winter and late-autumn months have between 6 and 9 rainy days.

CPS with an occurrence frequency higher than 50% are specific to April, May and June, and their length varies from one to 6 running days. These spells are not isolated, but they are included, antecede or continue spells, with frequency higher than 40%.

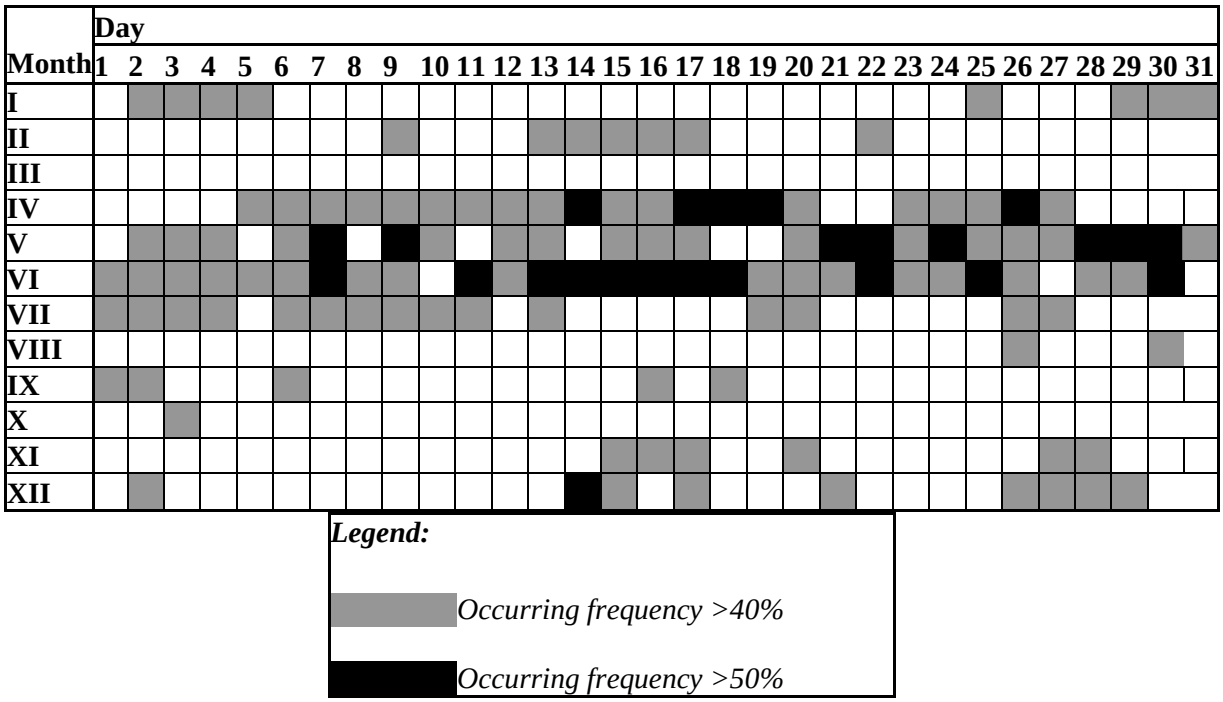

Figure 3. The calendar of the critical precipitations spells in the Transylvanian Depression.

CONCLUSIONS

After analyzing the data, some conclusions came out:

- in the studied area, most days of the year (110...131 days) have a frequency of precipitation occurrence between 30...40 %;
- at the weather stations protected by Western and Southern Carpathians (Blaj, Sebeş, Sibiu), the "precipitation shadow" is felt and so, the number of rainy days with an occurrence frequency higher than 40% decreases if compared to the other analyzed weather stations;
- the length of CPS, that are common to the most part of the area, ranges between one and 21 running days for occurring frequency higher than 40%;
- CPS are missing or have a very low frequency in March, August and October.

REFERENCES

CROITORU ADINA-ELIZA (2003), *Determinarea intervalelor critice în climatologie*, în Indici şi metode cantitative utilizate în climatologie, Editura Universității din Oradea, Oradea, p.68-70.

CROITORU ADINA-ELIZA, MOLDOVAN, F., DRAGOTĂ, SOFIA (2007), *Intervalele pluviometrice critice la vest de Munții Apuseni*, în Riscuri şi catastrofe, An VI, Nr. 4, Editura Casa Cărții de Ştiință, Cluj-Napoca., p. 121-126.

*** (1971-2000), Arhiva Administrației Naționale de Meteorologie, Bucureşti.