



Rainfall Characteristics in the Câmpulung Muscel Depression (Argeş – România)

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ABSTRACT

The study of climatic factors in a given area presents a great importance as it allows a better assessment of the production potential in relationship to a crop or a crop system. The ultimate goal is to collect information that is particularly useful to the management and development of the farm and the rural environment in general. Rainfalls are meteorological elements of greatest variability, determined mainly by the general air circulation in the troposphere, as well as the local physical and geographic conditions. Air masses, directed to the territory of România in different contexts, have a very broad range, from Arctic to Saharan, generating large fluctuations in rainfalls. This paper presents an analysis of the rainfall characteristics in the Câmpulung Muscel Depression between 1961 and 2010. Research includes the annual, monthly, seasonal variation of the precipitation amounts, extreme rainfall amounts, frequency, number of dryness and drought periods, and their frequency. Precipitation amounts vary greatly from one year to other, from one season to other, from one month to other. Because the rainfall regime cannot be altered and for crops to become less dependent on the rainfalls, it is necessary to apply appropriate technical measures.

KEYWORDS: Deviation, Drought, Dryness, Frequency, Precipitation, Probabilities

1. INTRODUCTION

Understood as a long-term average atmospheric weather conditions, the climate is one of the limitative factors for plant growth and development, quality and agricultural productivity (Meinke et al., 2006). Climate variability often has a negative impact on agriculture (Doblas – Reyes et al., 2006) and natural ecosystems to spatial and temporal scale (Anav and Mariotti, 2011). This affects the whole rural community, ranging from incomes and general food security and environmental degradation (Lobell and Asner, 2003; Selvaraju et al., 2011).

It is known that agriculture is the sector that can respond the best to the economic effort if it is managed scientifically, which means knowledge of the climatic factors (Meinke and Stone, 2005) and their effects on the biological material, soil and cultivation technology applied (Marinică et al., 2012; Tao et al., 2006).

Climatic factors may be considered risk factors contributing significantly to the reduction of agricultural productions, when they manifest severely, particularly in critical periods of the development (Nikolova and Mochurova, 2012; Sandu et al., 2010).

Nowadays, in the context of global climate change, extreme phenomena are increasingly visible; their frequency and intensity are increasingly greater, characterized by abrupt transitions from one extreme to another (IPCC,

2007). Thus, cold waves are followed by heat waves, and severe droughts follow after strong floods (Allan and Sonden, 2008; Beniston and Stephenson, 2004; Lehner et al., 2006).

The dynamics of air masses, along with relief, plays an important role in the setting up of the climate, causing disturbances in the daily and annual cyclicity of the various elements and weather phenomena (Fernández-Montes et al., 2012; Goodess and Jones, 2002; Maheras et al., 1999).

The unstable relationship between the main baric centers determine important variations in maintaining the duration of a certain meteorological context (Jacques and Le Treut, 2004). Thus, it can record both durations marked by cyclonic circulation bringing abundant precipitation and significant periods with the specific manifestation of the anticyclonic phenomenon, drought and rapid crossings of the cyclonic circulation from the anticyclonic circulation and vice versa with changes in time (Brunetti et al., 2002; Maheras et al., 2004).

In România, the obstacle of the Carpathian Mountains and the concentric dam layout determine the changing direction of air masses, changes and transforms the physical properties of air, add or diminish their speed of movement (Bordei-Ion, 1983), which is reflected particularly in the precipitation regime (Tomozeiu et al., 2005).

Drought is a complex phenomenon with a slow manifestation on the all continents (Dai, 2011), which may cause adverse effects on the various components of the environment (Bruce, 1994), all the more visible as the duration and intensity are higher (Modarres, 2007), particularly on vegetation, soil and hidrography (Vicente-Serrano et al., 2011). In the last period, dryness and drought have become increasingly common so are now in the attention of specialists, being analyzed and quantified (Byun and Wilhite, 1999; Gutman, 1990; Kogan, 1998).

In climatological research worldwide, drought characterization is used for a variety of indices. Thus, in the United States in the last century, about 13 indexes have been used for the characterization of drought (Hayes et al., 1999; Heim, 2002; McKee et al., 1993; Wu et al., 2005).

In România, in order to highlight both the deficit and excess moisture, we use most commonly the general procentual deviation according to the Hellmann criterion, the standardised index rainfall ISP and the standardised anomaly in precipitation ASP (Cheval et al., 2003).

2. MATERIAL AND METHODS

The Câmpulung Depression is located in the northeastern part of the Argeş County, at the foothills of the Iezer Mountains, on the Târgului River, between the valleys of Bratiei on the West, and the Dâmbovița River on the East. Relief consists in the river valleys that run through the hills in the form of rolling hills, resulting in a typical aspect of depression which is relatively elongated in shape, resembling a "long field" (Geografia României, 1992).

According to the frequency and degree of the baric systems operating in the analyzed region, and the intensity of the local thermoconvective processes, precipitation amounts vary from one year to other, from one season to other, from one month to other.

This study used the data on the daily rainfalls between 1961 and 2010 for the Câmpulung meteorological station, using the archive database of Bucharest N.M.A.(National Meteorological Administration). The series of data were processed in MS Excel, determining the monthly variation, seasonal and annual rainfall amount, quantity, the frequency of extreme rainfall, the number of dryness and drought periods and their frequency.

For the determination of the deficitary and the excessive pluviometric periods, we used the procentual precipitation deviation over a multiannual mean by the Hellmann criterion, as follows: excessively wet (EW), very wet (VW), wet (W), moderate wet (MW), normal (N), moderate dry (MD), dry (D), very dry (VD) and excessively dry (ED).

The pluviometric regime was characterized by the monthly pluviometric index Angot. It represents the ratio of the mean daily rainfall in a month (q) and annual mean daily amounts (Q), although it would be evenly distributed throughout the year:

$$k = \frac{365 * q}{Q * n}, \quad \text{where } n \text{ is the number of days}$$

in the month.

The Angot index highlights the more or less rainy character of a month, according to the annual quantity of precipitation recorded. Thus, if $k = 1$, then evenly distributed precipitations fell during the respective month; if $k > 1$, then the month was rainy, as more precipitation fell than in the case of an annual uniform distribution; and if $k < 1$, then the month is less rainy, as less rainfall occurred than in the case of an annual uniform distribution.

To estimate the probability of exceeding the maximum quantities of rainfall recorded, we used the double exponential distribution, Gamma distribution method, and the software EasyFit.

3. RESULTS AND DISCUSSIONS

In the Câmpulung Depressions, due to the continuous fluctuations in the general air circulation caused by the frequency movement and the stationary duration and development of the baric systems, precipitation amounts vary widely from one year to other, from one month to other. Pluviometric fluctuations are due to the alternation of the years in which the cyclonic activity occurred significantly, compared with the years marked by blocked or persistent movement of the anticyclonic circulation.

At Câmpulung between 1961 and 2010, the multiannual mean of the annual precipitation amount was 808.1 mm, as the climatologic normal standard was 805.9 mm for the 1961-1990 period. The regression line equation had a negative coefficient (-0.1447), which highlighted a trend of slight decrease in the annual precipitation amounts (fig.1).

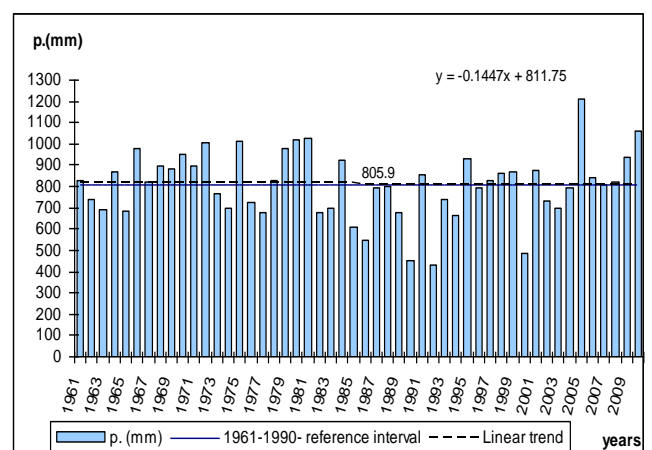


Fig.1 Annual variation of precipitations (mm), in the Câmpulung Depression (1961-2010)

The lowest rainfall amounts were recorded in: 1992 (429.6 mm), 1990 (452.9 mm) and 2000 (485.8 mm), while the highest in the following years: 2005 (1209.3 mm) 2010 (1063.3 mm), 1981 (1026.7 mm), 1980 (1016.7 mm), 1975 (1012.2 mm) and 1972 (1006.2 mm).

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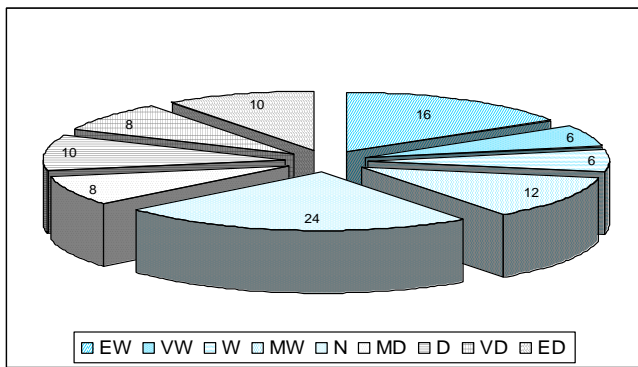


Fig.2 Frequency of the annual pluviometric character (%), according to the Hellmann criterion, in the Câmpulung Depression (1961-2010)

According to the Hellmann criterion, the analysis percentage deviation of the annual precipitation amounts recorded at Câmpulung during 1961-2010, compared to the climatological normal standard of 1961-1990, showed that, in the 50 years' study, 24% can be considered normal in terms of the rainfall regime, 12% moderately wet, 6% wet, 6% very wet and 16% excessively wet (fig.2). The moderately dry and dry years represent 8% and 10%, respectively. The frequency of the very dry and excessively dry years is 8% and 10%, respectively.

In order to remove the random fluctuations and highlight the general evolution trend, our study also used the method of sliding means on five years' intervals, successively lagging one year, the trend being characterized by a polynomial 5 degree function (fig.3).

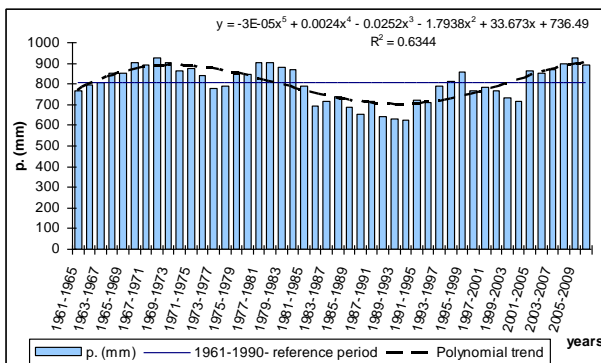


Fig.3 Sliding means and trend of rainfalls in the Câmpulung Depression (1961-2010)

The evolution curve designed for the sliding means highlighted two excedentary periods of precipitation and a deficitary period. The first period started with an oversupply in the 1963-1967 slide interval and lasted until the 1978-1982 slide interval, and the second period began with the 2000-2004 slide interval and extended until the last 2006-2010 slide interval. The deficitary period was recorded between the 1979-1983 and 1999-2003 slide intervals.

Grouping the annual rainfall on the value classes with 50 mm intervals from 400 mm to 1250 mm, we found that, at Câmpulung, the highest frequency or probability of

producing of 16% had a quantity between 650-699 mm, 800-849 mm and 850-899 mm (fig.4).

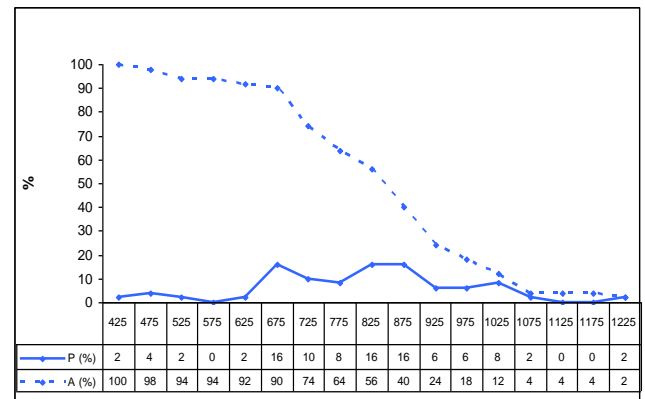


Fig.4 Probability (P %) and assurance (A%) of annual precipitations amounts for the 50 mm in the Câmpulung Depression (1961-2010)

Thus, the level of assurance was 90%, 56% and 40% respectively. The precipitation amounts under 650 mm and 1050 mm recorded a frequency range between 0 to 4%, the deficit higher with a 150 mm annually, compared with the multiannual mean amounts to 10% and with a surplus of more than 250 mm annually, accounting for 4%.

Seasonally reviewed from December and November between 1961 and 2010, rainfall amounts varied between 404.2 mm in 1989-1990 and 1166.1 mm in 2004-2005; their share was 16% in winter, 24% in spring, 39% in summer and 21% in autumn (fig. 5).

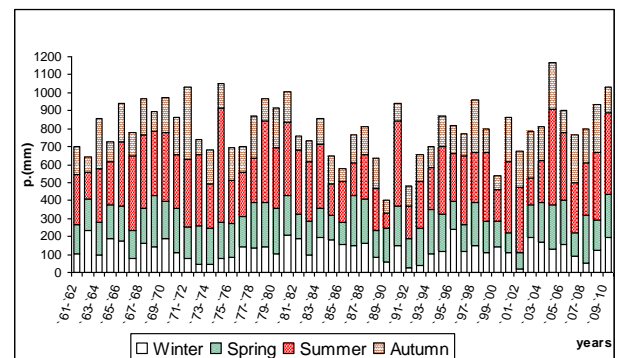


Fig.5 Seasonal variation of precipitation amounts (mm), in the Câmpulung Depression (1961-2010)

In 1961-2010 interval, the rainfall amounts in winter ranged between 21.0 mm and 237.1 mm, the multiannual mean being 127.8 mm. The lowest rainfall amounts in winter were recorded in the following years: 1991-1992 (24.0 mm) and 2001-2002 (21.0 mm), and the highest in: 1962-1963 (231.2 mm) and 1995-1996 (237.1 mm).

The analysis of the pluviometric frequency character in winter according to the Hellmann criterion revealed that, at Câmpulung, 33% of the winters were considered excessively dry, 10% very dry and 4% dry.

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Excessively wet and very wet winters recorded a share of 29% and 4% respectively. Wet and moderately wet winters recorded 6% and 8%, respectively, while the normal ones, according to this criterion, had a frequency of 6% (fig.6).

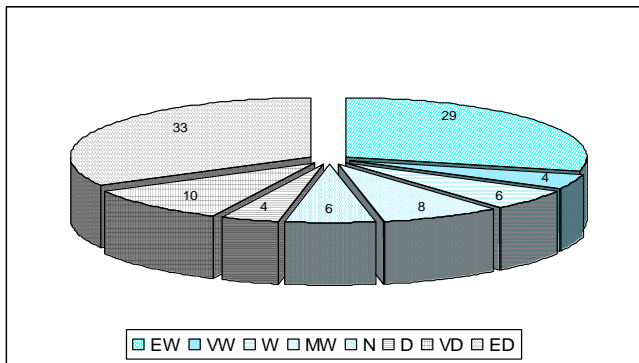


Fig.6 Frequency of pluviometric character (%) in winter, according to the Hellmann criterion, in the Câmpulung Depression (1961-2010)

At Câmpulung, spring precipitations were more abundant than winter ones on average, with about 66 mm (52%), the multiannual mean being 194.0 mm. The lowest rainfall amounts recorded were in spring, in the following years: 2000-2001 (113.9 mm) and 2001-2002 (90.8 mm). The most wet springs, with over 250 mm, were in the years: 1968-1969 (280.9 mm), 1977-1978 (255.0 mm), 1979-1980 (252.9 mm), 1986-1987 (280.6 mm) and 2007-2008 (267.1 mm).

Assessing the frequency of the pluviometric character according to the Hellmann criterion, in the 50 The share years with moderately wet and wet spring was 6 %, and those excessively wet was 27 % (fig.7).

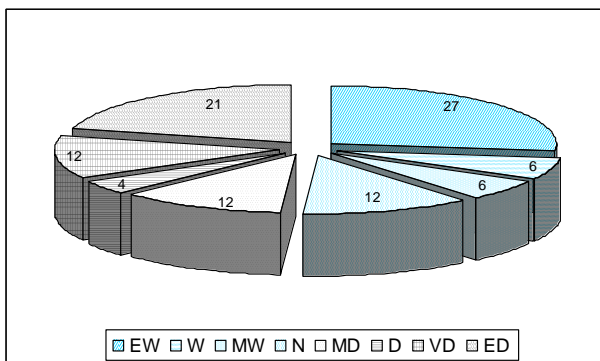


Fig. 7 Frequency of pluviometric character (%), in spring, according to the Hellmann criterion , in the Câmpulung Depression (1961-2010)

The precipitation amounts in summer were the highest, with a mean of 315.3 mm. The highest rainfall amounts were recorded in 1979 (455.5 mm), 2005 (531.1 mm) and 2010 (453.8 mm), while the lowest in the years: 1963 (146.6 mm), 1990 (88.7 mm). Pluviometric frequency highlighted the predominance of years with excessively dry summers (35%). The share of years with very dry summers was 4%,

those with dry and moderately dry by 6% and 2%, respectively, while the normal ones represented 4 % (fig. 8).

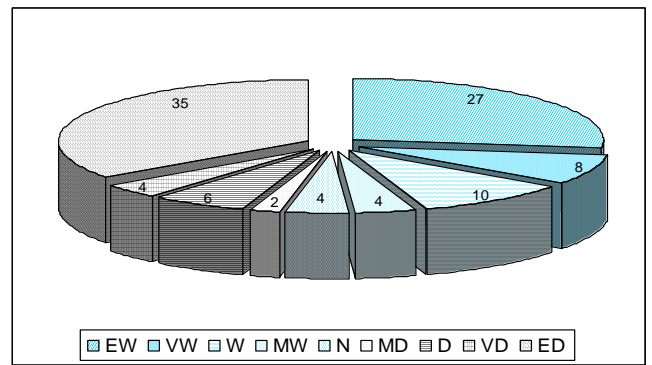


Fig. 8 Frequency of pluviometric character (%), in summer, according to the Hellmann criterion, in the Câmpulung Depression (1961-2010)

The proportion of excessively wet summers was 27%, the very wet 8%, and the wet and moderately wet 10% and 4%, respectively.

In autumn, the precipitation amount decreased considerably, as a result of the prevalence of anticyclonic circulation, with values between 68.1 mm and 400.7 mm, the multiannual mean being 168.0 mm. The highest precipitation amounts fallen in autumn were recorded in the following years: 1964 (276.4 mm), 1972 (400.7 mm) and 1998 (289.1 mm) and lowest in: 1986 (68.1 mm) and 1990 (71.6 mm).

Evaluating the pluviometric character according to the Hellmann criterion, it was appreciated that, in the Câmpulung Depression, 35% of autumns were considered excessively dry, 4 % very dry, 6% dry and 8% moderately dry. The frequency of years with excessively wet autumns was 25%, very wet and wet 6%, and moderately wet 2% (fig. 9).

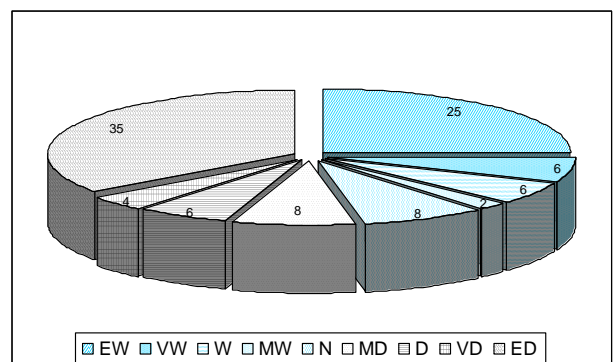


Fig. 9 Frequency of pluviometric character (%), in autumn, according to the Hellmann criterion , in the Câmpulung Depression (1961-2010)

In the Câmpulung Depression, in the interval 1961-2010, the month with the lowest rainfall amounts was February, the mean being 38.4 mm. Since March, rainfall amounts increased progressively until June, when the pluviometric maximum was recorded (113.9 mm); afterwards they started

to decrease towards the end of the year, the multiannual mean of December being 49.1 mm (fig. 10).

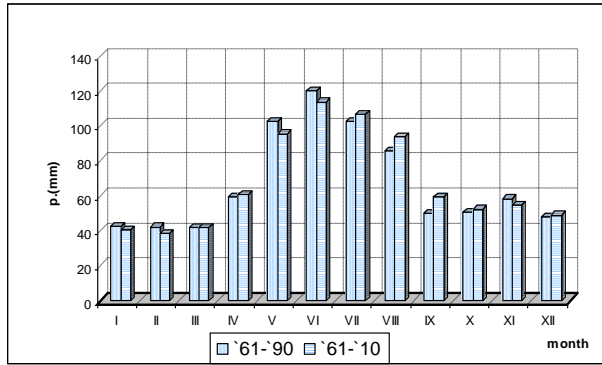


Fig. 10 Monthly variation of the mean precipitation amounts (mm), at Câmpulung (1961-2010)

The annual regime, highlighted on the basis of the monthly pluviometric values by the index Angot, classified the Câmpulung Depression within the type IV distribution of monthly precipitation amounts, with a maximum in June and a minimum in February (fig. 11).

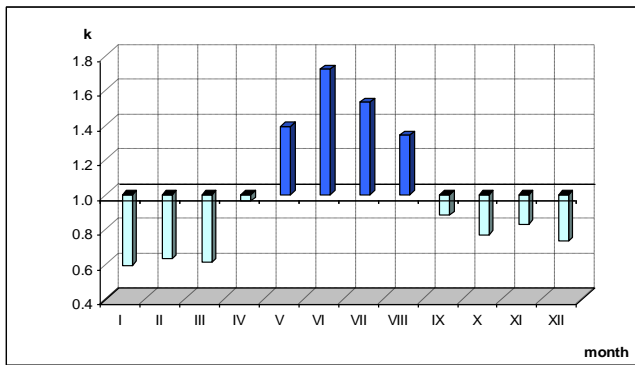


Fig.11 Values of Angot pluviometric index in the Câmpulung Depression (1961-2010)

Over the past five decades, the annual, seasonal and monthly precipitation amounts presented significant fluctuations at Câmpulung. Their high variability results primarily in the manifestation of the dryness and drought phenomena. The lowest monthly precipitation amounts were recorded during the cold season, being between 0.1 mm in December 1972 and 2.4 mm in October 2000. In the summer period, the minimum amounts of rainfall were recorded in June 2003 (21.2 mm), July 2007 (22.2 mm) and August 1990 (14.7 mm) (fig. 12).

The monthly maximum ranged between 96.5 mm in February 1984 and 277.2 mm in June 1975. It is noteworthy that the area recorded years when the monthly rainfall exceeded 300 mm in the cold season. Thus, extreme precipitation amounts were recorded in October 1972 (212.8 mm), November 1966 (134.8 mm), December 1981 (147.4 mm), January 1963 (113.7 mm), March 1962 (114.5 mm). In the warm season, the monthly amounts exceeding 200 mm were recorded in May 1961 (272.8 mm), June 1975 (277.2 mm), July 1975 (256.6 mm) and August 2005 (228.3 mm).

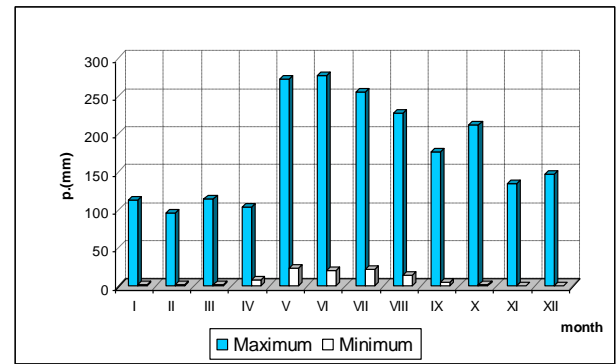


Fig.12 Monthly extreme precipitation amounts (mm), in the Câmpulung Depression (1961-2010)

The probabilistic calculation, after the Gamma double exponential distribution, highlights the possibility that these values may be exceeded. The quantity of precipitation forecast in June may reach at 284.3 mm every 100 years, can exceed 257.2 mm every 50 years and 219.8 mm every 20 years. For the highest rainfall amounts recorded in June, the assurance was 1.96% (277.2 mm), 3.92% (252.5 mm) and 5.88% (217.1 mm) (fig. 13).

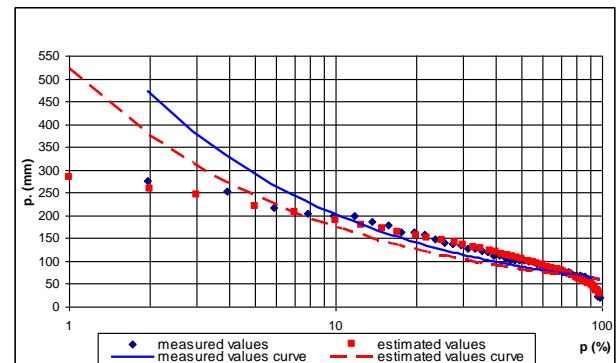


Fig.13 Highest precipitations measured and estimated in June, at Câmpulung (1961-2010)

The maximum precipitation amounts fallen in 48 hours ranged between 43.8 mm, recorded on 12-13 February 1981 and 133,7 mm in 27-28 July 1981; the maximum mean in these months was 16.8 mm and 39.8 mm, respectively (fig. 14).

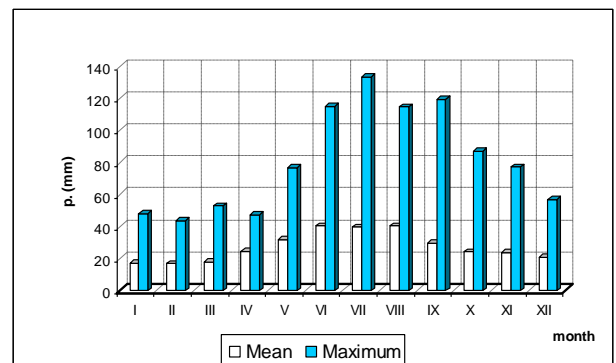


Fig.14 Mean maximum amounts and maximum precipitation in 48 hours, at Câmpulung (1971-2010)

In the period 1971-2010, the maximum rainfall of more than 75 mm, combined on two days, was recorded in 17 cases (42.5%), in the following months: June, 1973, 1975, 1979 and 1984, July 1975, 1981, 1998, 2008 and 2010, August 1997, 1999, 2005 and 2009, September 1983 and 2005, October 1972 and November 1989.

Estimates of maximum quantities of rainfall in 48 hours by using the double exponential Gamma function, show that they can reach 142.9 mm every 100 years, can exceed 141.7 mm every 50 years and 116.0 mm every 20 years. The highest amounts recorded an 2.44% assurance (133.7 mm), 4.88% (128.3 mm), 7.32% (119.8 mm) and 9.76% (115.0 mm) (fig. 15).

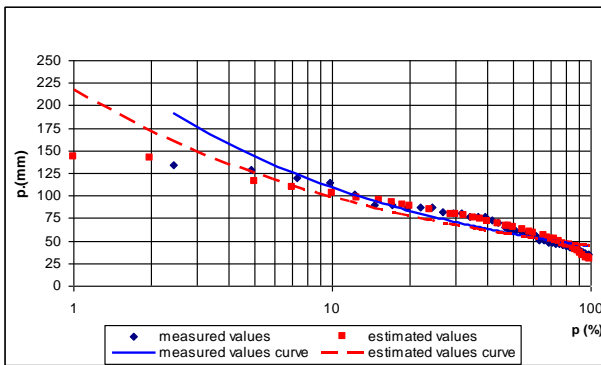


Fig. 15 Highest precipitations measured and estimated in 48 hours, at Câmpulung (1971-2010)

Throughout the year, the lowest average number of days with precipitation at Câmpulung was recorded in September (9.3 days) and October (9.2 days), and the highest in months May (16.7 days), June (15.6 days) and July (14.0 days). The maximum number of days per month varied between 19 days in October and November, and 25 days in February (fig. 16).

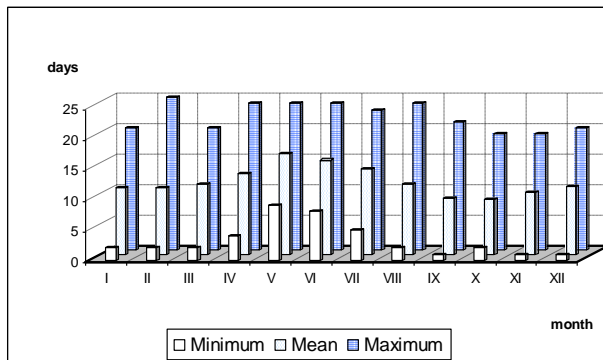


Fig.16 Monthly minimum, mean and maximum number of days with precipitation, at Câmpulung (1961-2010)

The annual number of days with precipitation ranged between 104 and 180, the multiannual average being 145.1 days. The years with the lowest days of precipitations were: 1961 (118 days), 1990 (117 days), 2000 (104 days), 2007 (117 days) and 2008 (113 days). Most days of precipitation were recorded in the years: 1976 (176 days), 1979 (180 days), 1984 (180 days) and 2010 (170 days) (fig. 17).

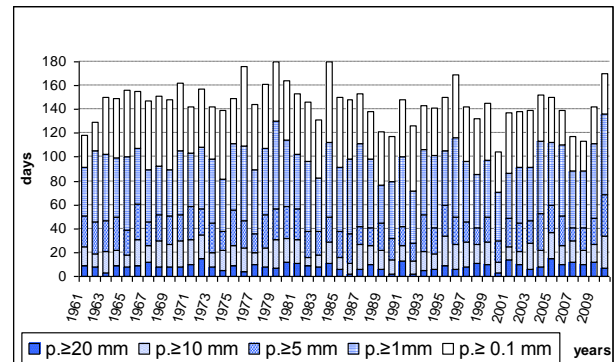


Fig.17 Annual number of days with precipitations over certain thresholds, at Câmpulung (1961-2010)

The variability of the precipitation regime was highlighted by the frequency of days in which the quantities of water fallen matched or exceeded the thresholds of 1.0 mm, 5.0 mm, 10.0 mm and 20.0 mm. The annual number of days with precipitations higher than or equal to 1.0 mm ranged between 71 days in 2000 and 136 days in 2010, the average multi-annual being 99.3 days, i.e. 68.4% of the annual number of days with precipitation. The frequency of days with precipitation higher than or equal to 20.0 mm (5.7%) is low, the average number in the last five decades was 8.3 days, with limits ranging from 2 to 15 days.

In the period 1971-2010, the amount of annual rainfall for the threshold of 1.0 mm varied between 407.5 mm in 1992 and 1193.8 mm, in 2005, the multiannual average being 783.4 mm, i.e. 97.8 % of the mean quantities total annual. Although the number of days with precipitations higher than or equal to 20.0 mm was reduced, the amount of the mean annual quantity of them was significant, 257.5 mm, i.e. 32.1% of the total annual quantity (fig. 18).

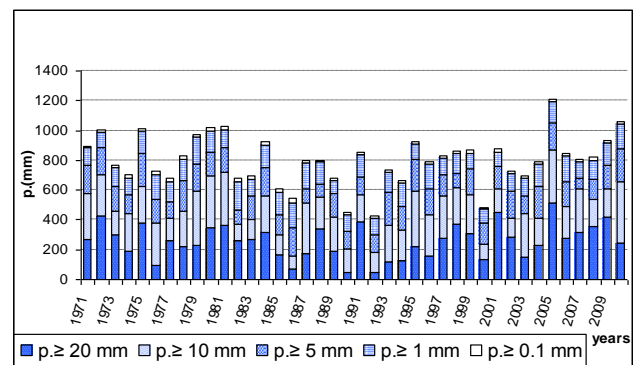


Fig.18 Annual amounts precipitations (mm) over certain thresholds, at Câmpulung (1971-2010)

Throughout the year, the same variation for each threshold was noted; consequently, the number of days and the amount of rainfall quantities was inversely proportional to the size of the threshold. Most days with rainfall exceeding 1.0 mm were recorded in the months of May and June, the average multiannual being 12.1 days and 11.2 days, respectively; the mean rainfall amount in the month of June

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was 115.4 mm. The number of days with precipitations over 20.0 mm was very low in the summer months of June, July and August, their average ranging between 1.3 and 1.5 days; the mean rainfall amount in June was 71.2 mm (fig.19).

In the Câmpulung Muscel Depression, the annual number of days without precipitation ranged between 185 and 260 days; the multiannual average was 220.2 days. The average monthly number of consecutive days without precipitations ranged between 2.5 and 4.3 days in summer, and between 4.6 and 5.0 days in the cold season. The maximum monthly number of consecutive days without rainfalls varied between 22 and 39 days in the cold season, and 14 days and 20 days in the hot season (fig. 20).

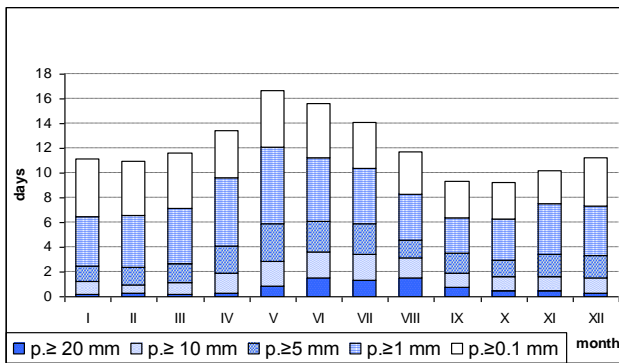


Fig.19 Monthly number of days with precipitations over certain thresholds, at Câmpulung (1961-2010)

In the Câmpulung Muscel Depression, the annual number of days without precipitation ranged between 185 and 260 days; the multiannual average was 220.2 days. The average monthly number of consecutive days without precipitations ranged between 2.5 and 4.3 days in summer, and between 4.6 and 5.0 days in the cold season. The maximum monthly number of consecutive days without rainfalls varied between 22 and 39 days in the cold season, and 14 days and 20 days in the hot season (fig. 20).

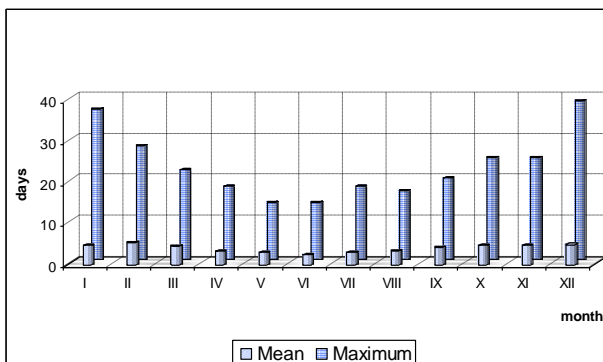


Fig.20 Monthly mean and maximum number of consecutive days without precipitations, in the Câmpulung Depression (1971-2010)

Absent rainfall at certain intervals generates phenomena of dryness whose persistence results in drought. Between 1971 and 2010, an average of about 12 periods of dryness were registered annually. The most periods of dryness were in the years: 1981, 1988, 1998, 2001 and 2003 (16 periods), 1990

and 2000 (17 periods) and 1999 (21 periods). The number of drought periods ranged between one period in 1977, 1980, 1995, and 1996 and five periods in 1989, 2000 and 2007 (fig. 21).

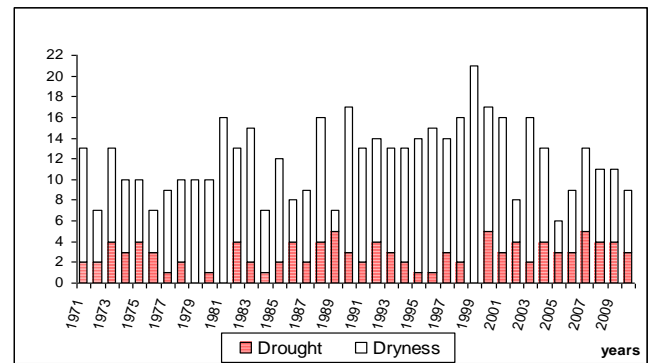


Fig.21 Annual number of periods with drought and dryness, in the Câmpulung Depression (1971-2010)

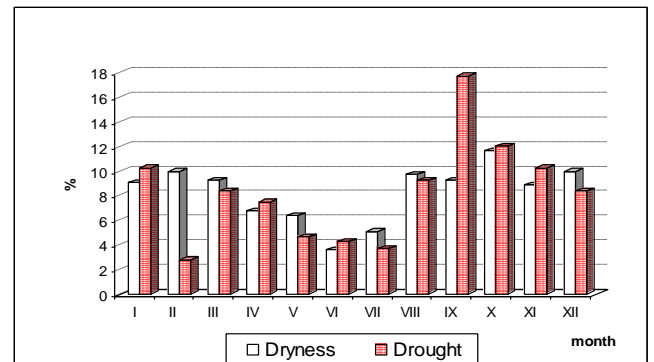


Fig.22 Monthly frequency of periods with dryness and drought, at Câmpulung (1971-2010)

Throughout the year, most periods of dryness were recorded since August throughout the cold season until March, their monthly frequency being 9.1% in January and 11.7% in October (fig. 22).

The study of the data on rainfall frequency in the past four decades highlighted that September was the driest month. Throughout the 40 years, there were 19 periods of drought at a monthly rate of 17.8 %. The lowest frequency of the drought periods occurred in February (2.8%).

In the Câmpulung Depression, during the past four decades, there was a total of 107 periods of drought, of which 56 (52%) in the cold season and 51 (48%) in the hot season. In the cold season, the longest drought periods were recorded between 27 November 1972 and 15 January 1973 (50 days), between 8 January and 13 February 1989 (37 days), and between 2 January and 18 February 2002 (48 days). In the warm season, the longest drought periods were between 4 and 24 September 1982 (21 days), between 31 August and 18 September 1986 (19 days), and between 31 August and 19 September 2006 (20 days).

4. CONCLUSIONS

In the Câmpulung Depression, the precipitation amounts varies from one year to other, from one season to other, and

from one month to other, depending on the frequency and development of the baric systems operating in the area.

Between 1961 and 2010, rainfalls ranged between 429.6 mm in 1992 and 1209.3 mm in 2005, the climatological normal standard being 805.9mm.

Deviations from the annual precipitation amount, according to the Hellmann criterion, revealed that, in the 50 years under the study, 44% could be regarded as normal in terms of pluviometric regime, while 28% were deficitary and 28% with surplus.

In Câmpulung area, the highest frequency (16%) recorded a rainfall of 650-699 mm, 800 mm and 850-899 mm, with a degree of assurance of 90%, 56% and 40% respectively.

The lowest precipitation amounts were recorded in winter (16%), and the highest in summer (39%), spring and autumn; their share were 24% and 21%, respectively.

The winter deficitary pluviometric regime represented 47%, while surplus was registered in 39%.

Spring frequency with a normal rainfall was 28%, deficitary 37%, and with surplus 39%.

In the past 50 years, only 10% of summers may be regarded as normal in terms of the pluviometric regime, those with deficit and surplus recording a rate of 45%.

Autumns were generally dry, the frequency of the normal regime was 45%, and with surplus 37%.

The annual rainfall regime recorded different values from one month to another, due to the influence of the baric systems operating in the interference area of the tropical air masses with the polar ones. The lowest amounts of precipitation occurred in the January-March period, due to the prevalence of the anticyclone that prevented the development of the thermal convection.

According the Angot index, the Câmpulung Depression falls within type IV of distribution of the monthly precipitation amounts, with a maximum in June and a minimum in February.

Monthly extremes ranged between 0.1 mm in December 1972 and 277.2 mm in June 1975.

The probabilistic calculation shows that the quantity of precipitation forecast in June can reach 284.3 mm every 100 years.

The production of the highest precipitation amounts in a short span of time was favoured by certain synoptic situations, and by less physical and geographical conditions.

The maximum precipitation amount recorded in 48 hours was 133.7 mm; it is estimated that it can reach 142.9 mm every 100 years.

The frequency of days with rainfall amounts over certain thresholds was different from one year to other, the highest being at the threshold of 1.0 mm and the lowest at 20.0 mm, the multiannual average of 99.3 days and 8.3 days, respectively.

The annual mean precipitation amount for the two thresholds was 783.4 mm and 257.5 mm respectively,

representing 97.8% and 32.1%, respectively, of the total quantities.

The average number of days without precipitation was about 220 days, the absence of rainfall at certain intervals resulting in dryness and drought phenomena.

During the past four decades, there were 471 periods of dryness (about 12 periods per year), the highest frequency being recorded during the month of October (11.7%).

The number of periods drought within the same time frame was 107, of which 52% during the cold season and 48% in the hot season.

In the Câmpulung Depression, the duration and intensity of the phenomena of dryness and drought was reduced, owing to the moderate climate character of the area.

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