THE SEASONAL NUMBER OF DAYS WITH PRECIPITATION BETWEEN 1961 AND 2016, IN MARAMUREŞ COUNTY

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Abstract

In this paper the mean, maximum and minimum seasonal number of days with precipitation has been analyzed, on the period 1961-2016, at 4 meteorological stations in Maramureş County. The frequency of these days, their spatial and temporal variability, and the trend of the seasonal number of days with precipitation were also analyzed.The result was thatmost of the days with precipitation occur in winter, at low stations Baia Mare and Sighetu Marmaţiei and in spring and summer seasons, at high stations Ocna Şugatag and Iezer.The fewest days are reported in autumn, at all stations. During the winter and summer seasons, the maximum seasonal values occurred especially in the first half of the analyzed period (1961-1988), while during the autumn they were reported in the second half of the period (1989-2016). The most rainy season was the spring of 1970 (70 days with precipitation at Iezer and 64 days at Sighetu Marmaţiei), and the driest season was the autumn of 2011 (12-17 days in Maramureş).

For the winter season, the linear trend of the number of days with precipitation is decreasing, at most stations. For the other three seasons, the linear trend is heterogeneous, at the 4 stations. The downward trends are more pronounced than the upward ones, during the years 1961-2016, in Maramureş County. Thus, the most prominent values of the trend are those of decreasing from high stations (Iezer and Ocna Şugatag), from the summer and spring seasons.

Key words:day with precipitation, seasonal number, frequency, trend

INTRODUCTION

Studying the number of days with a phenomenon is a method commonly used in climatology, both for the climatological characterization of a region and for other purposes, such as improving weather forecasting, studying the frequency and trend of climatic hazards, etc. Studying the seasonal number of days with precipitationalso finds its applicability in other fields, such as agriculture, energy, economics, hydrology, etc.

Maramureş County, by its geographical position in northern Romania, enjoys significant quantitative rainfall, given that this territory is under the Baltic and oceanic influences of the temperate-continental climate, but also due to the favorable exhibition of the mountain chains to the advections of the oceanic wet air masses, which come from Western Europe.

The highest altitudes are found in the eastern part of the county, in Rodna Mountains, so the precipitation increases from the west to the east, similar to the altitude of the landforms. In the intra-mountainous depressions, the rains are poorer due to the low altitudes, but also to the descent of air masses(Geography of Romania, vol.III, 1987).

MATERIAL AND METHOD

In this paper the daily precipitation data were used between 1961 and 2016 (56 years), from the meteorological stations in Maramureş County with a common period of analysis. The precipitation data were taken from the database of the National Meteorological Administration of Romania and from the database of Meteomanz.com (www.meteomanz.com).

The 4 meteorological stations whose data were analyzed are Baia Mare, Sighetu Marmaţiei, Ocna Şugatag and Iezer. They are located both in depression areas and high mountains areas, their altitudes ranging from 216 to 1785 m (Baia Mare: 216 m; Sighetu Marmatiei: 275 m; Ocna Şugatag: 503 m; Iezer: 1785 m).

Initially, the monthly number of days with precipitation was extracted from the daily precipitation data, after that the seasonal number was calculated. A "*day with precipitation*" means*the 24-hour period during which the measured precipitation amount was ≥ 0.1 mm*(Marin, 1986; Dragotă, 2006; Mihăilă, 2006; Croitoru, 2003; The climate of Romania, 2008; etc.). Subsequently, the mean, maximum and minimum seasonal number of days with precipitation has been analyzed, the frequency of these days, their spatial and temporal variability, and the trend of the seasonal number of days with precipitation.

RESULTS AND DISCUSSION

In Maramureş County, the mean multiannual amount of precipitation forthe period 1961-2016 ranged from 748.9 to 1261.4 mm (Baia Mare: 885.1 mm; Sighetu Marmaţiei: 772.4 mm; Ocna Şugatag: 748.9 mm; Iezer: 1261.4 mm), and the mean annual number of days with precipitation, from 157 to 194 days. The highest values are noted at the eastern station Iezer, located in the glacier cirque below Pietrosu Peak, the highest peak of Rodna Mountains (2303 m altitude). The smallest values are reported in Maramureş Depression (Ocna Şugatag and Sighetu Marmaţiei stations) and Baia Mare Depression.

The mean seasonal number of days with precipitation shows that most of the days occur in *winter*, at low stations Baia Mare and Sighetu Marmaţiei (45-46 days) and in *spring* and *summer* seasons, at high stations Ocna Şugatag and Iezer (43 and 54 days respectively) (Fig. 1). The winter rains from low stations are due to the higher frequency of stratiform clouds, with the lowered ceiling, while those at the end of spring and in summer from high stations are due to the high frequency of convective clouds, which generate high rainfall on the mountain slopes exposed to the air masses, due to the intense thermo-dynamic convection of these seasons.

The fewest days with precipitation are reported in *autumn*, at all stations(34-36 days and 40 days at Iezer, respectively), when the anticyclones persist over the territory of Romania, generating stable weather.

Figure 1 shows that in the spring and summer seasons, the mean seasonal number of days with precipitation increases as the altitude of stations increases.

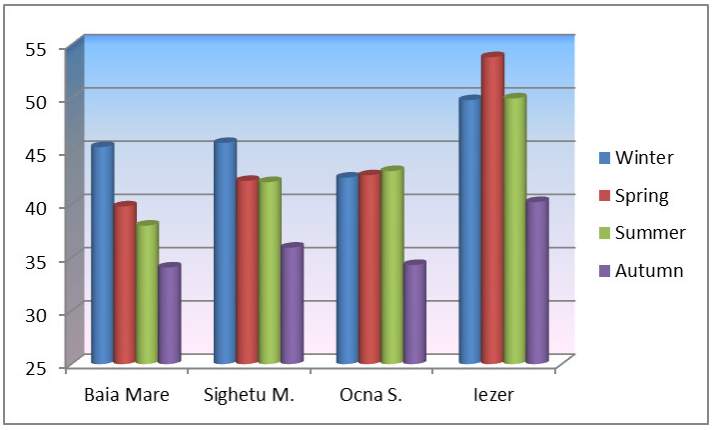

Fig.1. The mean seasonal number of days with precipitation in Maramureş (1961-2016)

The maximum seasonal number of days with precipitation varied between 50 days (at Baia Mare) and 70 days (at Iezer) (Fig. 2). The highest seasonal number occurred in the *spring* and *winter* seasons. Thus, in the spring of 1970, the maximum number was recorded at Iezer (70 days) and Sighetu Marmaţiei (64 days) stations (Fig. 4). In the spring of 2008, the maximum of the days with precipitation of Ocna Şugatag station (63 days)occurred, and in the winter of 1966, the maximum of Baia Mare station (63 days) (Fig. 3).

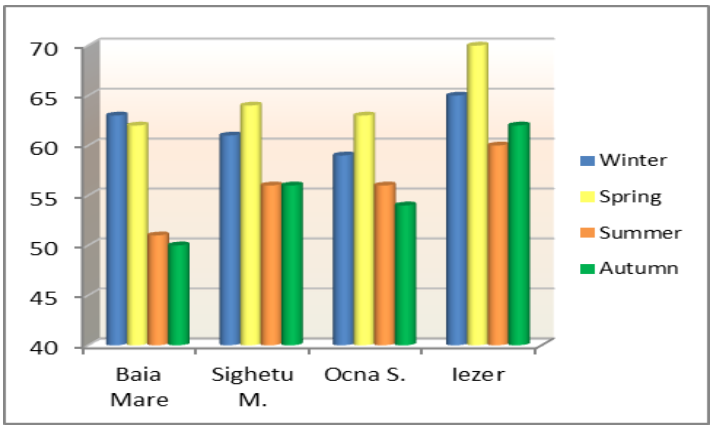

Fig. 2. The maximum seasonal number of days with precipitation in Maramureş (1961-2016)

Regarding the distribution of the maximum seasonal values of the days with precipitation during the analyzed period 1961-2016, we can say that *during the winter and summer seasons, the maximum seasonal values occurred especially in the first half of the analyzed period (1961-1988)*, while *during the autumnthey were reported in the second half of the period (1989-2016)*. In the spring season, the number of cases of the two periods of time was equal(Fig. 3-6).

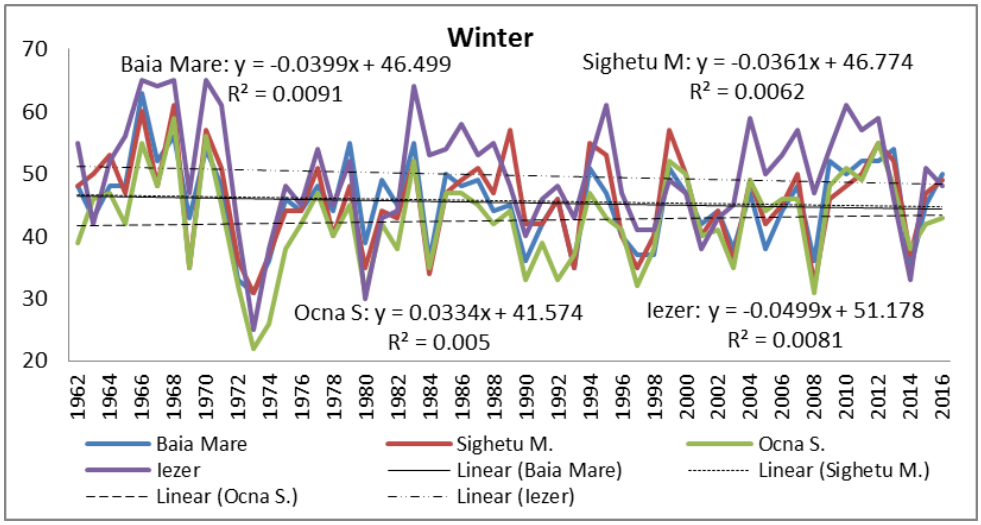

Fig. 3. The number of days with precipitation in winter and its linear trend, in Maramureș (1962-2016)

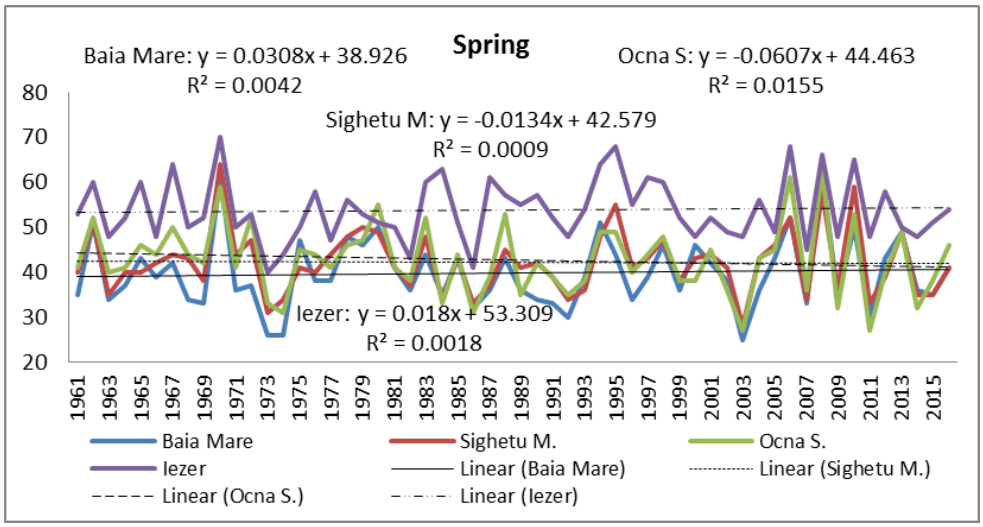

Fig. 4. The number of days with precipitation in spring and its linear trend, in Maramureș (1961-2016)

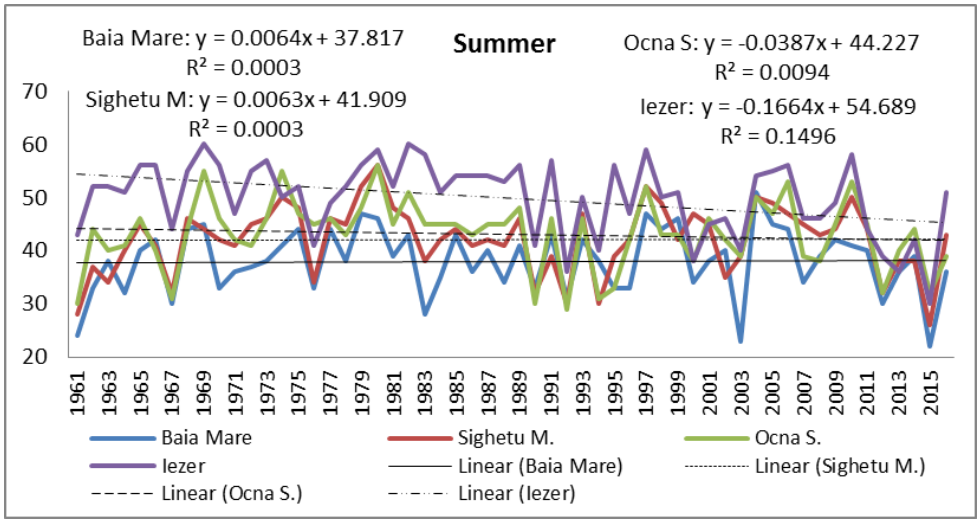

Fig. 5. The number of days with precipitation in summer and its linear trend, in Maramureş (1961-2016)

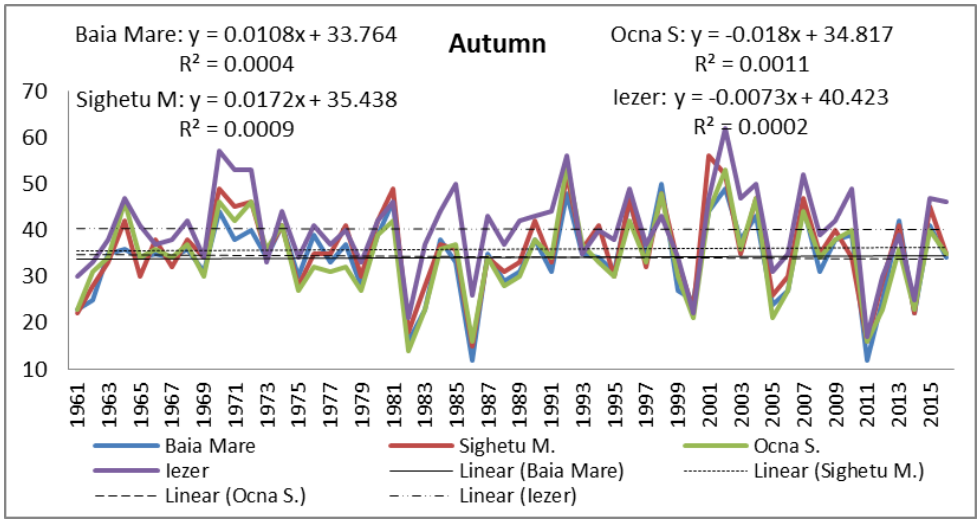

Fig. 6. The number of days with precipitation in autumn and its linear trend, in Maramureş (1961-2016)

The minimum seasonal number of days with precipitation ranged from 22 to 40 days (less in autumn: 12-17 days) (Fig. 7). So, the smallest seasonal number occurred in the *autumn* season. Thus, the driest autumn seasons in Maramureş County were: autumn 2011, which totalized between 12-17 days with precipitation; autumn 1986, when it rained between 12-16 days (and 26 at Iezer); autumn 1982, which totalized between 14-21 days(Fig. 6).

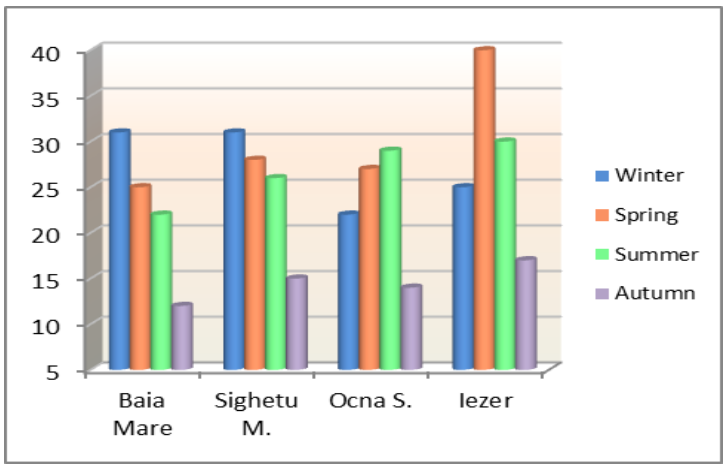

Fig.7. The minimum seasonal number of days with precipitation in Maramureş (1961-2016)

Figures 3-6 show the variability of the seasonal values of days with precipitation, at the 4 weather stations in Maramureş County, during 1961-2016 (1962-2016 for the winter season, respectively). The same periods with increases and decreases in values are noted, at all stations, a sign that on a small territory like that of Maramureş County, the rainfalls are due to the same synoptic situations.

Figures 3-6 also show the linear trend of the seasonal number of days with precipitation, during the 56 analyzed years. Thus, for the winter season, the linear trend is *decreasing*, at most stations. An exception is the Ocna Şugatag station, which has an increasing trend. For the other three seasons, the linear trend is heterogeneous, at the 4 stations. Thus, in the spring season, the trend is decreasing at the stations in Maramureş Depression and increasing to the other stations. The summer and autumn seasons show a downward trend at high stations and a slightly upward trend at low stations.

The most prominent values of the trend are those of*decreasing* from Iezer, from the summer season, then from Ocna Şugatag from spring and summer, followed by those of the stations Baia Mare and Iezer, from winter (R^2 between -0.1496 and -0.0081). The most pronounced *upward* trends are those from Ocna Şugatag from winter and Baia Mare from spring (R^2 between +0.0050 and +0.0042). The autumn season has the smallest values of the trends. It can be noticed that *the downward trends are more pronounced than the upward ones*, during the years 1961-2016, in Maramureş County.

In conclusion, the winter has becomemore droughtyin recent years, in Maramureş County, as a consequence of the climate changes occurring over the southern part of Europe and the basin of Mediterranean Sea, where the effects of the positive anomalies of atmospheric pressure in the winterseason

are felt more and more, leading to the decrease of precipitation amounts and the occurrence of droughts (Hurrell, 1995, quoted by Boroneanţ, Rîmbu, 2003; Maheras, 2000; Türkeş, 2003; Luterbacher, Xoplaki, 2003; Palutikof, 2003 etc.). The decreasing trends of the precipitation amounts of winter have been found, also, by the author for the territory of the WesternPlain of Romania, north of MureşRiver (Șerban, 2010).

The more prominent decreasing trends of the number of days with precipitation in the summer and spring seasons, from high stations (Iezer and Ocna Şugatag), are due to the increase in the frequency of convective cloudy formations in recent years,attributed to the increase in air temperature, which generates large amounts of precipitation, but in short intervals.

CONCLUSIONS

The mean seasonal number of days with precipitation shows that most of the days occur in winter, at low stations Baia Mare and Sighetu Marmației and in spring and summer seasons, at high stations Ocna Şugatag and Iezer. The fewest days with precipitation are reported in autumn, at all stations.

During the winter and summer seasons, the maximum seasonal values occurred especially in the first half of the analyzed period (1961-1988), while during the autumn they were reported in the second half of the period (1989-2016).

For the winter season, the linear trend of the number of days with precipitation is decreasing, at most stations. For the other three seasons, the linear trend is heterogeneous, at the 4 stations. The downward trends are more pronounced than the upward ones, during the years 1961-2016, in Maramureş County. Thus, the most prominent values of the trend are those of decreasing from high stations (Iezer and Ocna Șugatag), from the summer and spring seasons.

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