SPATIAL DISTRIBUTION OF SUNSHINE DURATION IN BIHOR COUNTY

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Abstract

This study was conducted based on extensive meteorological data sets recorded at seven station in the area of Bihor county (Săcueni, Oradea, Holod, Ştei, Borod, Dumbrăviţa de Codru, Stâna de Vale) during a long period of time, that is, from 1970 to 2012.

In the area of Bihor county the annual average distribution of sunshine duration is influenced by the general circulation of the atmosphere, by cloudiness, by anthropic factors, which have an impact through pollution mainly in urban areas, as well as by fogs and stratiform clouds that form in intermountain depressed areas, where the presence of surrounding mountainsides also results in less sunshine duration. During the year, the Sun shines less in wintertime, as the days are shorter, cloudiness and the number of overcast days are higher, and thermal inversions occur more frequently, which favour the occurrence of fog and of stratiform clouds, as well as the persistence of pollutants in the lower atmosphere, all these result in a lower air transparency and, therefore, in lower sunshine duration.

Key words: actual sunshine duration, sunshine fraction

INTRODUCTION

Sunshine duration is the period of time, over a day, in which the Sun has shined on the sky and it is expressed in hours and minutes of insolation.

The annual pattern of sunshine duration and its territorial distribution are strongly connected to the cloudiness pattern and distribution, with a contrary behaviour of the former towards the latter. However, during a month, some deviations from the contrary behaviour of cloudiness might occur. The explanation for these deviations is that even though quite often there is high cloudiness, the Sun still shines as it is not covered by clouds. The opposite phenomenon can also occur, that is, although there is low cloudiness, the clouds in the sky cover the Sun (Măhăra Gh., 1977; Gaceu O., 2005; Moza (Pereş) Ana Cornelia, 2009; Pereş Ana Cornelia, 2012).

MATERIAL AND METHOD

The characteristics of sunshine duration on the area of Bihor county have been presented based on the values of climatic data collected over a period of 43 years. The variation of sunshine duration was followed at seven weather stations, Săcueni (125 m), Oradea (136 m), Holod (163 m), Ştei (278 m), Borod (333 m), Dumbrăviţa de Codru (586 m), Stâna de Vale (1108 m), all of them in the area of Bihor county.

RESULTS AND DISCUSSIONS

1. Monthly and annual pattern of actual sunshine duration

In Bihor county, sunshine duration, expressed in hours and tenths of an hour, has multiannual average values between 2581.3 hours in Ştei and 1560.4 hours in Stâna de Vale. In the case of the latter one the value can be explained with the presence of mountainsides that limit the horizon.

In the intermountain depressed areas, there is less sunshine duration due to the surrounding mountainsides that limit the horizon, the persistence of fog and of stratiform clouds (Gaceu O., 2005). As a result, at the weather stations located at the feet of mountains that are at altitudes similar to that of the weather station in Ştei, the values recorded vary only between 1960 and 2050 hours (1966.6 hours in Borod, 2041.3 hours in Holod, 2051.0 hours in Dumbrăviţa de Codru), compared to 2581.3 hours of average sunshine duration in Ştei (see Figure 1).

In Oradea, the average sunshine duration is 2094.7 hours, while in Săcueni the value is 2100.4 hours. The lower value for Oradea is the result of higher pollution, which is caused by the polluting sources of the urban area.

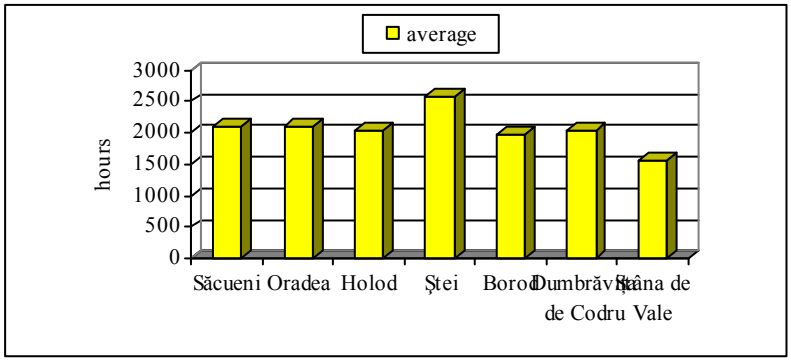

Figure 1. Annual average sunshine duration in Bihor county

As far as the monthly duration is concerned, the sunshine shows a normal distribution, with low values recorded in winter months, with the lowest ones in December, which can be explained with high cloudiness and short daytimes. The lowest values were recorded in Holod (51.9 hours) and in Stâna de Vale (52.8 hours), due to obstruction of the horizon by the surrounding mountainsides and to stratiform cloudiness, which is maintained by the circulation of air masses from the west and, sometimes, by thermal inversions. Lower values were recorded in the area of Oradea too

(53.5 hours), due to a higher air pollution in this part of the year, which is maintained by thermal inversions and a higher air humidity.

The Sun shines more in the summer months, thus, in the lowlands and the depressed areas the highest number of sunshine hours occur in July, and in the mountains in August. The highest July average was recorded in Ştei (350.6 hours), followed by Dumbrăviţa de Codru (291.7 hours), then, Săcueni (291.2 hours) and Oradea (289.2 hours). The stations located in depressed areas surrounded by mountainsides have the lowest sunshine duration values, with 267.6 hours in Borod. In Stâna de Vale the highest value of the year was recorded in August (218.4 hours) (see Figure 2). The lower sunshine duration hours recorded in Borod and in Stâna de Vale are due to the surrounding mountainsides, which limit the horizon of the station.

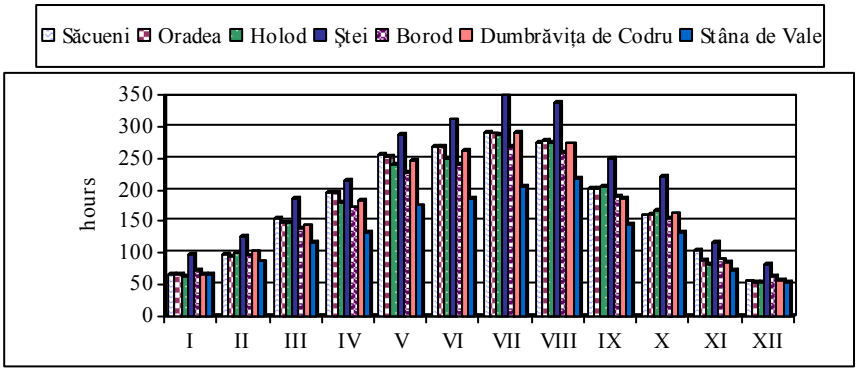

Figure 2. Monthly average sunshine duration in Bihor county

2. Sunshine fraction

Sunshine fraction is the ratio between actual duration and possible duration. It shows the drop in the actual duration against the possible one as a result of cloudiness.

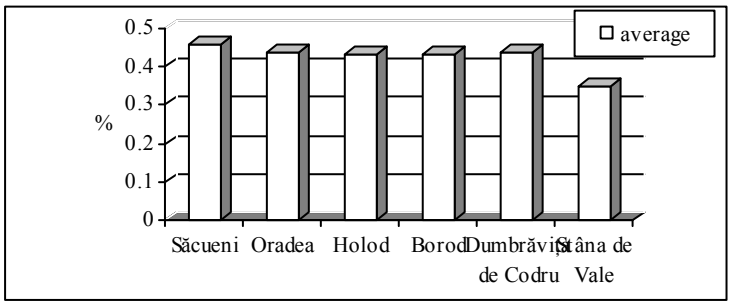

Figure 3. Annual variation of sunshine fraction in Bihor county

The annual pattern of sunshine fraction has a maximum in Săcueni (0.46%) and a minimum in Stâna de Vale (0.35%), while at the other

stations the values are between 0.43 and 0.44% (see Figure 3). The low values in the mountainous area are due to the mountainsides that shade these regions and decrease the actual radiation.

The monthly pattern shows maximum values in the entire area of Bihor county in the summer months, that is, in August 0.63% in Oradea and in Săcueni, 0.62% in Holod, 0.58% in Borod, and the lowest value in Stâna de Vale, 0.50%. In Dumbrăvița de Codru the maximum value of sunshine fraction is recorded in July, that is, 0.64%.

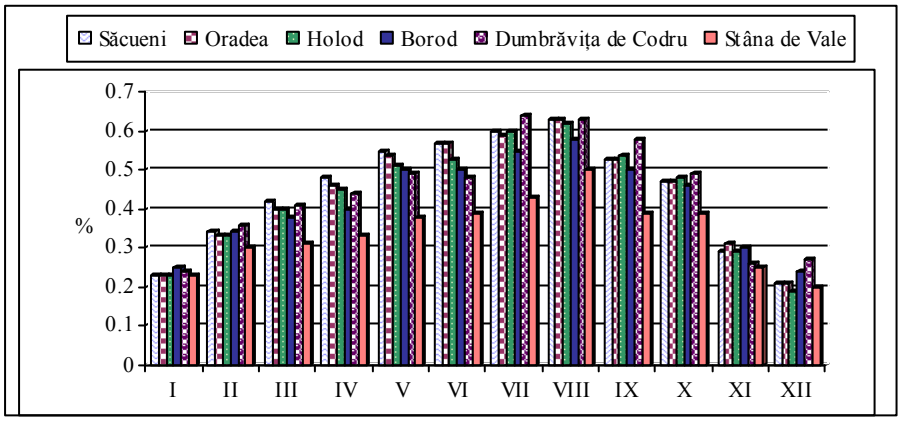

Figure 4. Monthly variation of sunshine duration in Bihor county

The minimum values over the year are recorded in the winter season, with the lowest values in December. Thus, these values are 0.20% in the mountainous area, 0.21% in the lowlands, while in Borod and Holod 0.24% and 0.19% respectively (see Figure 4).

These values of sunshine fraction show that in the cold season insolation is lower, due to the prevalence of stratiform clouds in that period, which cover the sky for day on end, and it is higher in the warm season, when the thermal convective movements result in cumuliform clouds, that is, clouds that develop mainly vertically (Gaceu O., 2002).

3. Monthly and annual number of sunny days

The annual average of sunny days varies from one station to the other, thus, the highest number of sunny days is recorded in the depressed areas, 300.8 days in Borod, in Dumbrăvița de Codru 299.7 days, and in Ştei there are 299.1 days, while the lowest numbers are recorded in Holod (288.2 days) and Stâna de Vale (289.2 days), these last ones are the result of cloudiness and frequent fog (see Figure 5).

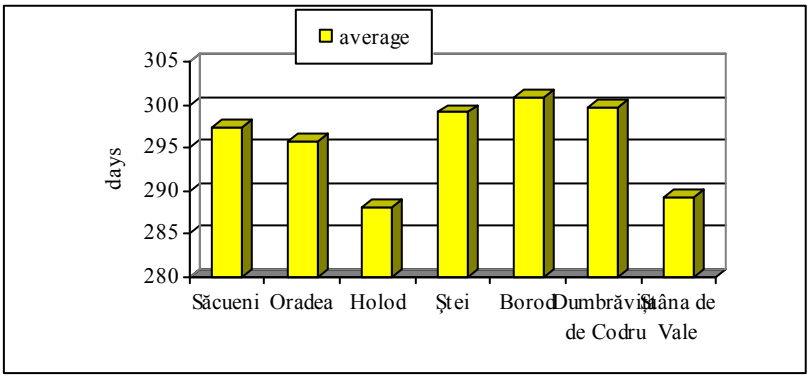

Figure 5. Annual average number of sunny days in Bihor county

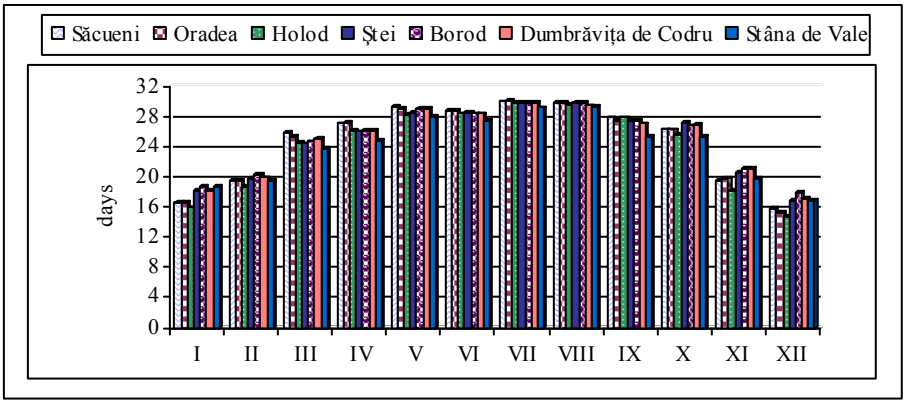

Figure 6. Monthly average number of sunny days in Bihor county

The monthly pattern of sunny days number shows that it follows the pattern of sunshine duration. Thus, the maximum values are in July and in August, and the minimum values occur in December. The highest values are recorded in Oradea and in Săcueni, with numbers of 30.3 days and 30.1 days respectively, and the lowest value is recorded in Stâna de Vale, that is 29.4 days. In the entire Bihor county the lowest monthly average sunny days number occurs in December, due to fog and to stratiform cloudiness that block the sun rays, to which the shorter daytime is also added. Thus, the numbers are 14.9 days in Holod, 15.3 days in Oradea, 15.9 days in Săcueni, 17.0 days for Ştei and Stâna de Vale, 17.2 days in Dumbrăviţa de Codru and 17.9 days in Borod (see Figure 6).

CONCLUSIONS

In Bihor county, sunshine duration is lower in Stâna de Vale, where the station is surrounded by mountainsides that limit the horizon. The

monthly sunshine duration shows normal distribution, with low values in the winter months and high ones in the summer months.

The annual pattern of the sunshine fraction shows a maximum in Săcueni and a minimum in Stâna de Vale, which is due to the mountainsides that shade these areas and reduce the actual radiation. The monthly pattern of sunshine fraction shows that the maximum values are recorded in the summer months, due to the thermal convective movements, while the minimum values occur in the cold season, when insolation is lower due to prevailing stratiform clouds that cover the sky for days on end.

The monthly pattern of sunny days number shows that it follows the pattern of sunshine duration.

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