

## DISTRIBUTION AND VARIATION OF CLOUDINESS IN THE AREA OF BIHOR COUNTY

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### Abstract

*The characteristics of cloudiness were studied based on climatic data collected at seven weather station in the area of Bihor county from 1970 to 2012.*

*In the area of Bihor county, total cloudiness is more pronounced in the mountains (Stâna de Vale), due to mountainsides rising against the main flow of air masses.*

*During a year, in the lowlands, the hilly and the depressed areas the highest values are recorded in wintertime, when the thermodynamic processes are weaker. In the mountains, the highest value is recorded in April, when the circulation of air from the west prevails, and thermal convection becomes stronger. The lowest values of total cloudiness are recorded at the end of summer.*

*The annual pattern of sunny days varies in inverse proportion to that of overcast days, thus the maximum number of sunny days in August coincides with the minimum number of overcast days, and in December the situation is reversed.*

*The highest annual frequency is that of Altocumulus clouds, with values between 26.5% in Borod and 45.8% in Stâna de Vale. The clouds with the lowest frequency are those of the Cirrocumulus genus.*

**Key words:** cloud genera, low cloudiness, total cloudiness.

### INTRODUCTION

Although clouds are observed visually, which means a certain degree of subjectivity, their analysis is still important in order to determine some summery weather characteristics. The stagnation of air masses and of weather fronts over Bihor county, and the western part of the country in general, results in the formation and development of important cloud formations, which show significant variations in time and space (Gaceu O., 2005; Măhăra Gh., 2001; Moza Ana, 2009).

The frequency of different cloud genera, their shape and height depend on altitude, latitude, physical-geographic factors, the type of air mass or of weather front, as well as on thermal or dynamic convection.

### MATERIAL AND METHOD

The aim of this study was to analyse the multiannual pattern of cloudiness in the area of Bihor county. The study was conducted based on multiannual average values of total cloudiness, and on frequency of cloudiness and of cloud genera data recorded at seven weather stations from the area of Bihor county, that is, Săcueni (125 m), Oradea (136 m), Holod

(163 m), Ștei (278 m), Borod (333 m), Dumbrăvița de Codru (586 m) and Stâna de Vale (1108 m).

## RESULTS AND DISCUSSIONS

### 1. Monthly and annual patterns of cloudiness

Analysing the multiannual average values of total cloudiness in Bihor county, it can be seen that, in general, there is an upward trend as the altitude increases, from 5.5 tenths recorded at the lowest altitude weather station included in the study (Săcueni) to 6.0 tenths at the highest altitude station (Stâna de Vale) (see Figure 1).

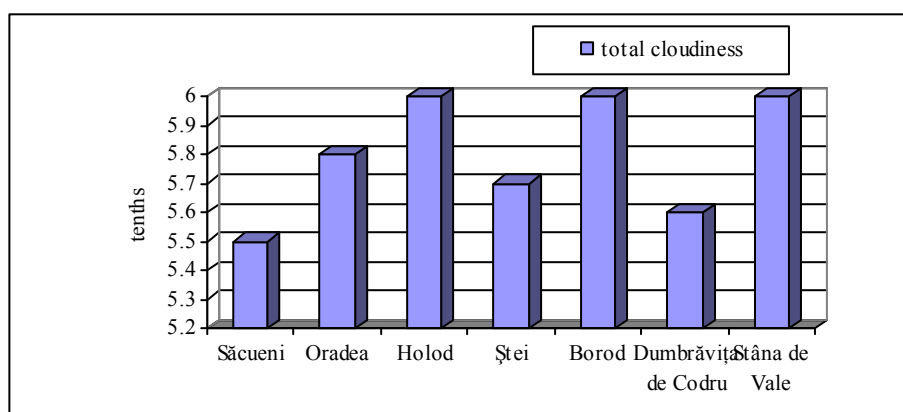


Figure 1. The annual pattern of total cloudiness in Bihor county

The character of cloudiness in the warm season is different from that in the cold season of the year. The trend of cloudiness from one month to another, during a year, shows that in the lowlands, the hilly and the depressed areas the highest values are recorded in wintertime, in December (between 6.6 and 7.5 tenths), when the thermodynamic processes are weaker. As a result, the air that is cooled on the ridges gathers at the foot of the mountains, where it causes thermal inversions, which will generate stratiform clouds and fogs. An intensification in the Mediterranean cyclonic activity, which brings wet, unstable air masses, with numerous condensation products, is added to this (Gaceu O., 2005).

In the mountains, in wintertime, the total cloudiness values are lower than those for the low areas (6.5 tenths), the maximum value here is recorded in April (6.7 tenths), when the circulation of air from the west prevails and the thermal convection intensifies.

The lowest values of total cloudiness are recorded at the end of summer, in August, and they are caused by the presence of tropical – continental air masses, which means warm and dry air masses, by the strong

insolation, which leads to the evaporation of condensation products, by the low air humidity.

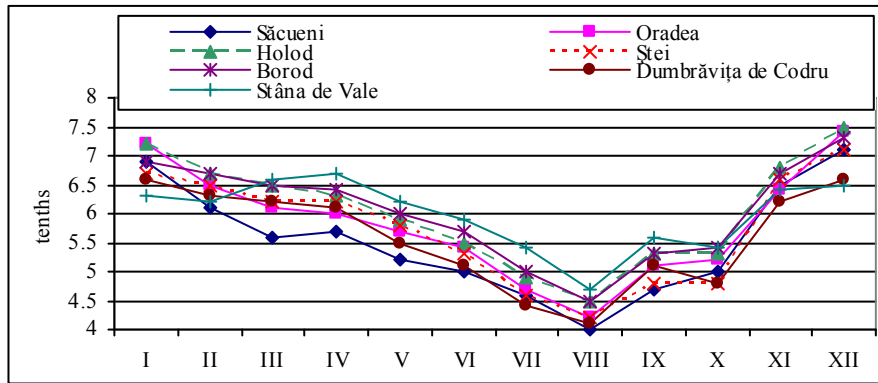


Figure 2. The monthly pattern of total cloudiness in Bihor county

These low values are also the result of the fact that in the warm season the clouds that are formed are mainly of cumuliform type, which develop predominantly vertically and less horizontally. Thus, the values are between 4.0 and 4.7 tenths (see Figure 2).

## 2. Cloudiness frequency

### Number of sunny days

The multiannual average number of sunny days has the highest value in Dumbrăvița de Codru (65.8 days) and the lowest one in Borod (49.9 days) (see Figure 3).

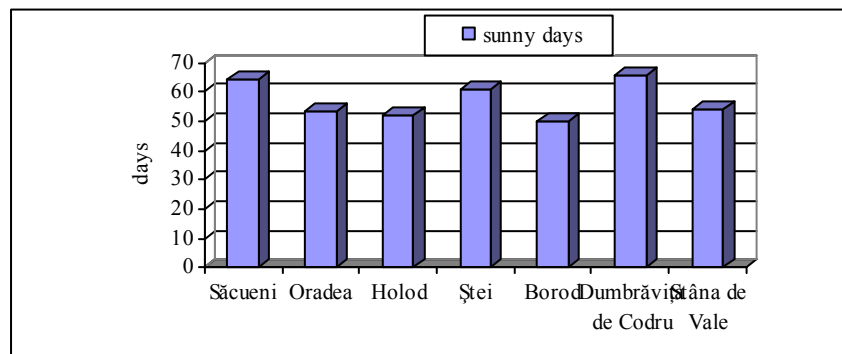


Figure 3. The annual average number of sunny days in Bihor county

From the multiannual monthly values of sunny days it can be seen that in the lowlands these averages are lower in the winter months, with the lower value in December (2.8 days in Oradea and 2.9 days in Săcueni), due

to the winter anticyclonic regime, and in the months of April-May for the hilly, depressed and mountainous areas (2.9 days in Holod and Ștei, 2.5 days in Borod, 2.7 days in Dumbrăvița de Codru and 2.2 days in Stâna de Vale), which is the result of intensified thermodynamic convection (see Figure 4).

In almost the entire area of Bihor county the highest frequency of sunny days occurs in August, being between 6 and 10 days (9.7 days in Săcueni, 8.1 days in Oradea, 8.7 days in Ștei, 7 days in Borod, 10 in Dumbrăvița de Codru and 6.3 days in Stâna de Vale), and in October for Holod (7.6 days), which is the result of the end of summer and beginning of the autumn anticyclonic regime (see Figure 4).

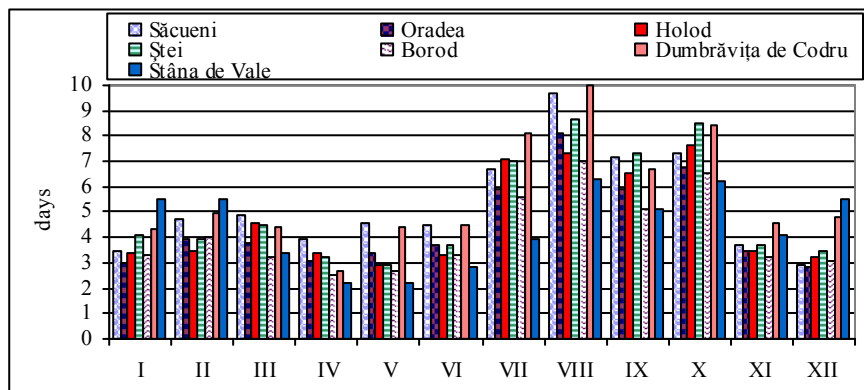


Figure 4. The monthly average number of sunny days in Bihor county

### The number of overcast days

The number of overcast days is much higher than that of sunny days. In general, the annual number of overcast days increases with altitude, thus, the lowest value is recorded in Săcueni (94.7 days), and the highest in Holod (122.4 days) and Stâna de Vale (120.9 days) (see Figure 5). The high number of overcast days recorded in Holod is due to the depressed zone, which favours the occurrence of thermal inversions which will maintain a stratiform cloudiness, while the high number in the mountains is, on the one hand, due to altitude, which favours the development of thermal convective processes, and, on the other hand, to the mountainside that rises against the flow of air masses from the west.

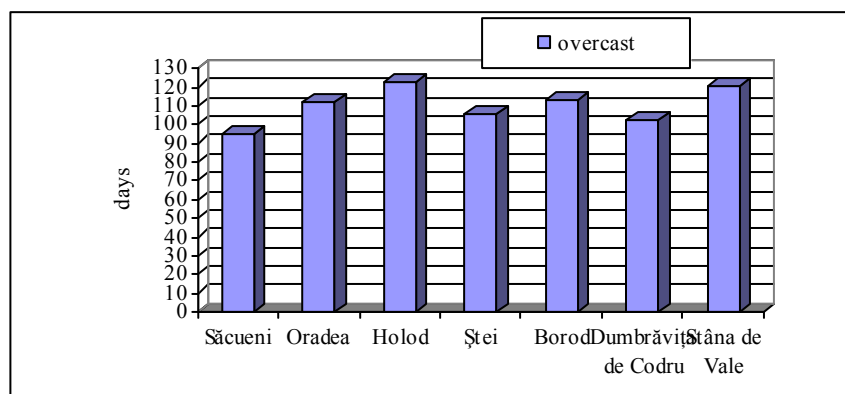


Figure 5. The annual average number of overcast days in Bihor county

During the year, the highest number of overcast days is recorded in the winter months, thus, in December there are 15.1 such days in Săcueni, 16.0 in Oradea, 17.6 in Holod, 15.4 in Ștei, 15 in Borod, 13.2 in Dumbrăvița de Codru, and in Stâna de Vale the maximum number of overcast days, approximately 13 days, is recorded both in December and in January. The lowest number of overcast days is recorded in August over the entire area of Bihor county, with the minimum number in Săcueni (3.0 days) and the maximum in Stâna de Vale (5.5 days) (see Figure 6).

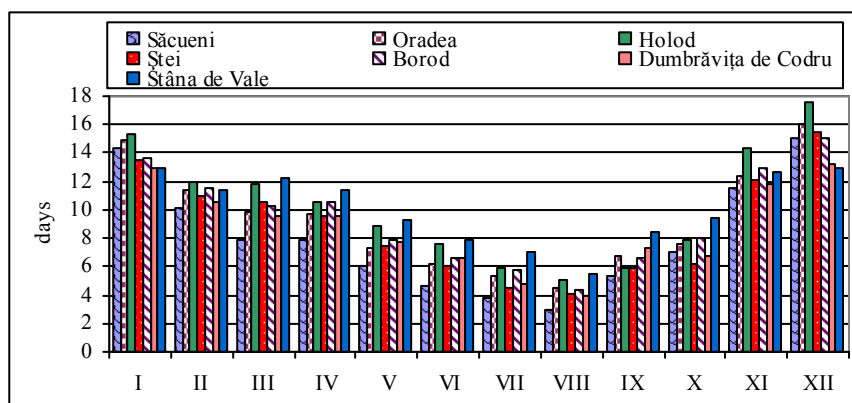


Figure 6. The monthly average number of overcast days in Bihor county

### 3. Frequency of cloud genera

Analysing the annual values of the various cloud genera from the area of Bihor county, it can be see that the highest frequency is that of *Altostratus* clouds, with values of 26.5% in Borod and 45.8% in Stâna de Vale. The clouds with the lowest frequency are those of the *Cirrocumulus* genus, the values being between 0.1% in Ștei and 0.3% in Stâna de Vale (see Figure 7).

From the high-level clouds, in the area included in the study, those with the highest frequency are the Cirrus ones, with values of 8.7% in Săcueni, Oradea, Holod and Borod, 10.6% in Ștei and 15.1% in Stâna de Vale (see Figure 7).

From the medium clouds, the highest frequency is that of the Altocumulus clouds, followed by Altostratus ones with frequencies of 13.6% in Săcueni, 13.7% in Oradea and Holod, 15.7% in Ștei, 20.8% in Borod, and with the highest value in Stâna de Vale, that is, 23.7%.

The low clouds with the highest frequency are those of the Stratocumulus genus, with frequencies between 11% in Oradea, Săcueni and Holod, 14.4% in Ștei, 10.9% in Borod, and in Stâna de Vale the highest value, that is, 22.1%. The rarest clouds in this level are the Stratus ones, with values between 1.3% in Borod and 4.4% in Săcueni (see Figure 7).

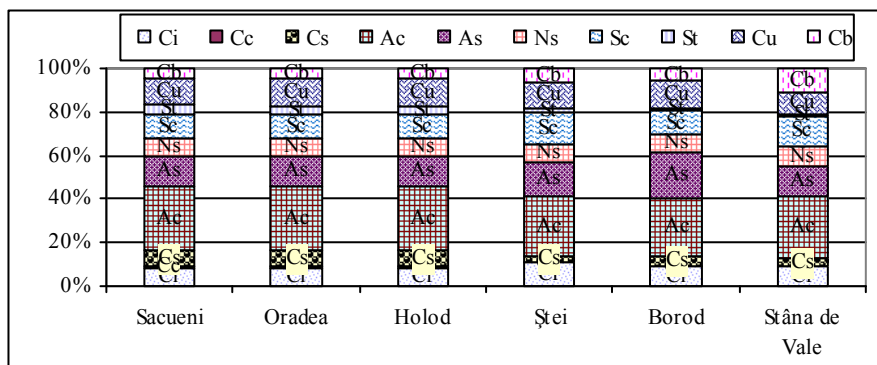


Figure 7. The annual frequency of cloud genera (%) in Bihor county

From the vertically developed clouds, the most frequent ones are the Cumulus clouds, their frequency is between 12.1% in Oradea, Săcueni and Holod and 16.8% in Stâna de Vale. Cumulonimbus clouds can be found with a frequency of 4.8% in Săcueni, 4.9% in Oradea and Holod, 5.6% in Borod, in Ștei 6.6% and in Stâna de Vale 18.2%. The frequency of vertically developed clouds increases with altitude, the highest values being recorded in the high areas (see Figure 7).

Analysing the monthly frequency of cloud genera, it can be seen that in the summer months the vertically developed clouds prevail, thus in July the Cumulus clouds are more frequent with 22.9% cases in Săcueni, Oradea and Holod, 20.9% cases in Borod, 19.9% cases in Ștei, and in Stâna de Vale there are 35.1% cases. The Cumulonimbus clouds have a high frequency in June in the lowlands and the depressed zones, while in the mountains the highest values are recorded in July. Thus, in June there are 11.8% cases in Săcueni, 11.7% in Oradea and Holod, 13.2% in Borod, 15.7% in Ștei, and in

Stâna de Vale there are 38.2% cases, which is the maximum of the year, recorded in July.

From the low-level clouds, the Stratocumulus clouds have the highest values, thus, the maximum values are in Stâna de Vale, between 28.0% in October and 18.6% in June. In the depressed zones the maximum value is recorded in Ștei, with 17.3% in November, and the minimum in Holod, with 6.6% in July. In the lowlands, the maximum values are recorded in November, with 15.8% cases both in Oradea and in Săcueni, and the minimum values in July, that is, 6.6% cases. The Stratus clouds have a much lower frequency everywhere in Bihor county, with more frequent occurrences in the winter months.

From the medium level clouds, the Altocumulus clouds have a higher frequency. These ones have a uniform distribution over the whole year and in the entire area of the study, but in Stâna de Vale the values are higher. In the entire area of Bihor county the maximum values are recorded in October. In the lowlands, the Holod depressed area and in the mountains the minimum values are recorded in January, while in Borod and Ștei the minimum values occur in June.

The maximum values of Cirrus clouds are recorded in August, and the minimum values in December.

## CONCLUSIONS

In general, the multiannual values of cloudiness increase with altitude. During the year, in the mountainous areas the maximum value is recorded in April, while in the other regions total cloudiness has the highest values in winter time.

The multiannual average number of sunny days has the highest value in Dumbrăvița de Codru (65.8 days) and the lowest value in Borod (49.9 days), while the annual number of overcast days usually increases with altitude, thus, the lowest value is recorded in Săcueni (94.7 days) and the highest in Holod (122.4 days) and Stâna de Vale (120.9 days).

The sunny days have the highest frequency in August, and the lowest in December, in the lowlands, due to the winter anticyclonic regime and in April-May in the other zones, due to the intensification of thermodynamic convection. The highest number of overcast days occurs in December, and the lowest in August.

As far as the monthly pattern is concerned, in the summer months the vertically developed clouds prevail, thus, the Cumulus clouds are more frequent in July, with a frequency between 19.9 to 35.1% cases. The Cumulonimbus clouds have a high frequency in the lowlands and the

depressed zones in June, while in the mountains the maximum values are recorded in July.

The Altocumulus clouds have a uniform distribution over the whole year and the entire area of the study, with higher values in Stâna de Vale.

The Cirrocumulus clouds are the rarest clouds in the area of Bihor county, with a monthly frequency of 0.0% - 0.6% cases.

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