

FREQUENCY OF HAZARDOUS CLIMATIC PHENOMENA IN THE COLD SEASON OF THE YEAR IN THE AREA OF ORADEA, BIHOR COUNTY

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RESEARCH ARTICLE

Abstract

The research of long term climatic elements variation and, implicitly, of hazardous climatic phenomena are basic issues of climatology and this study focuses on them. Adverse weather conditions show great spatio-temporal variations, they can be dangerous and can seriously inflict all socio-economic sectors.

In our country, and implicitly in Oradea, due to the temperate continental climate with oceanic influences the most frequent hazardous climatic phenomena of the year's cold season are: hoarfrost, black ice, frost, snow gust, blizzard. This study was carried out using a rich amount of weather data recorded at the Oradea weather station over a long period of time, that is, 1970-2021.

Keywords: black ice, blizzard, frost, hoarfrost, snow gust.

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INTRODUCTION

One of the works on the climatic hazards of some phenomena in the area of Oradea is *Climatic Hazards in the Crișuri Hydrographic Basin*, in which Cristea, 2004, provides a study of climatic hazards in this area. In the paper *The Evolution Trend and the Probability of Frost in the Crișurilor Plain*, Dragotă, 1995, provides a study of frost.

Regional studies dealing with the area of Oradea have also been carried out by Dumiter, 2007, who provides a climatic monograph of Oradea. In the paper *The Climate and Air Pollution in the Crișul Repede Hidrographic Basin*, Moza, 2009, also includes aspects of the hazardous climatic phenomena, and in the paper *Aspects Related to the Risk Weather Phenomena from the Cold Season of the Year in Oradea Area*, Pereș, 2011, presents the hazardous phenomena in the area of Oradea.

The aim of this study is to analyse the aspects of climatic hazards in the area of Oradea, that is, we have tried to provide an analysis of their evolution, as well as of the factors which determine or generate them. The influence of the various physical-geographical conditions on the hazardous climatic phenomena in the area of Oradea was

highlighted along with that of the active surface structure, as well as the fact that Oradea is located at the contact point of low hills and plains climatic floors, being under the influence of the European continent's western and south-western climatic conditions.

MATERIAL AND METHOD

In order to present the aspects of climatic hazards in the area of Oradea, the data recorded at the Oradea weather station between 1970 and 2021 were used.

The analysis of hazardous climatic phenomena was carried out using data recorded in weather observation tables at the weather station included in the study. These data are kept in the archive of The National Meteorological Administration (A.N.M.) Bucharest. The study covered a period of 52 years.

The A.N.M. archive data were processed using statistical and mathematical methods. The results obtained were then graphed in order to clearly show the variation in time of hazardous climatic phenomena.

The purpose of using methods and means specific to climate research was to ensure an as

precise as possible processing of all data we had at our disposal.

RESULTS AND DISCUSSIONS

Hoarfrost

In certain weather conditions hoarfrost can become a climatic hazard due to the intensity of its coldness. Thus, it can occur in the transitional seasons, when cold air advections from the north alternate with warm air from the south (Măhăra, 2001).

The importance of studying this hydrometeor is given by the fact that late hoarfrost in spring and early in autumn has a negative effect on agriculture, which results in significant damage.

The multiannual average of hoarfrosty days in Oradea is 49.7 days/year, with variations between 17 days in 2010 and 93 days in 1998 (Figure 1).

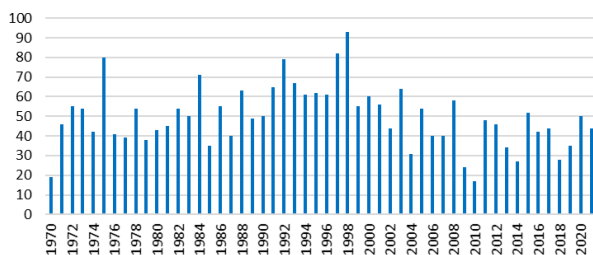


Figure 1. Annual variation of hoarfrosty days in Oradea, 1970 – 2021

In some years, the number of hoarfrosty days was above the multiannual average, while in others it was below it. Thus, in 50% of the years included in the study there were fewer hoarfrosty days than the multiannual average, while in 50% of the years the deviation was positive (Figure 2).

Looking at the positive and negative deviations against the multiannual average, it can be seen that in the first half of the period included in the study, 1970-1989, the deviations were either negative or positive, which was followed by a period, 1991-2001, with only positive deviations. Between 2002 and 2008 there were both positive and negative deviations against the multiannual average (49.7).

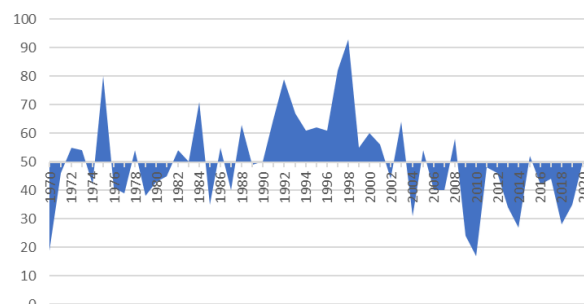


Figure 2. Deviations of the annual numbers of hoarfrosty days from the multiannual average in Oradea, 1970 – 2021

In the last period, 2009-2021, the annual number of hoarfrosty days decreased and except for 2015 and 2020, when the deviations were positive, in the other years they were negative (Figure 2).

During the year, hoarfrost occurs between September and May. The highest numbers of hoarfrosty days are recorded in the winter months, with the highest number of days in January, when the average of such days is 10, followed by December, with an average of 9.4 hoarfrosty days. (Figure 3).

In February, the multiannual average of hoarfrosty days is 8.9, while in November and March there are approximately 8 such days (Figure 3).

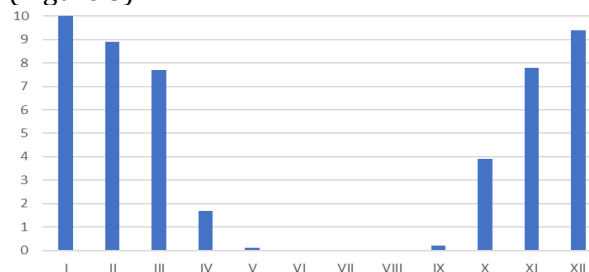


Figure 3. Multiannual monthly averages of hoarfrosty days in Oradea, 1970 – 2021

The lowest numbers of hoarfrosty days occur in the transition months, that is, the months which begin and close the cold season, with 0.1 and 0.2 days in May and in September respectively. Thus, the highest number of hoarfrost days are recorded in the winter months, when thermal inversions occur frequently, and the lower numbers in spring and autumn.

Black Ice

In the area of Oradea the multiannual average of black ice days is low, 2.8 days/year. This low figure is due to climatic influences from the west and south-west of the continent, which are rather strong in this part of the country.

In the 52 years included in the study the highest number of black ice days was recorded in 2002, when there were 13 such days altogether, 7 in December and 6 in January.

There were some years with no black ice at all, 1975, 1979, 1983, 1990, 1991, 1995, 2000, 2001, 2004, 2015, 2016, 2018 and 2020 (Figure 4), which means a frequency of 25% of the total number years included in the study.

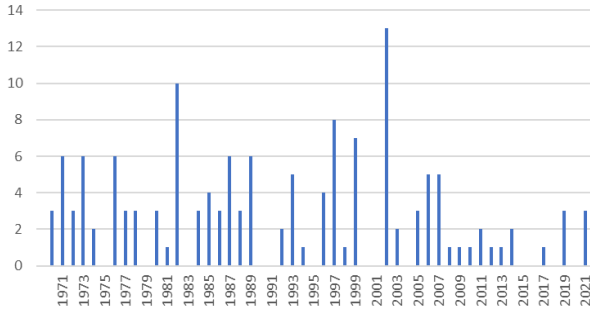


Figure 4. Annual variation of black ice days in Oradea, 1970 – 2021

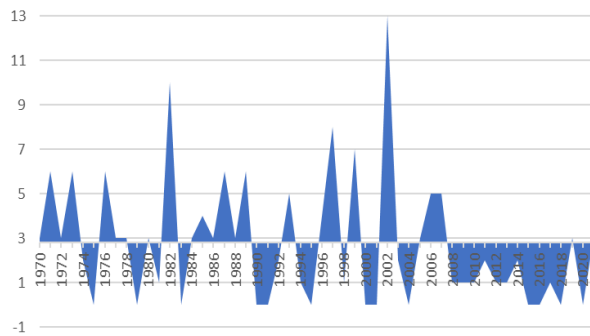


Figure 5. Deviations of the annual numbers of black

ice days from the multiannual average in Oradea, 1970 – 2021

Looking at the deviations of the annual numbers of black ice days against the multiannual average, it can be seen that the positive deviations make up 48.1% (25 years), while the frequency of the negative ones is 51.9% (27 years) (Figure 5).

In the area of the study black ice occurs from November to March. The month with the highest multiannual average of black ice days is January, 1.4 days/month.

In December, the average is 0.8 days/month, while the lowest number of such days are recorded in the month at the end of the period when this phenomenon occurs, that is, March, when the average is 0.1 days, as well as in the month at the beginning of the period when it may occur, that is, November, 0.2 days.

The highest occurrence probability of this phenomenon is in January, when the highest frequency of black ice days is recorded, that is, 50.3%. In December the frequency of black ice days is 28.7%. The lowest frequency and, thus, the lowest probability of the occurrence of this phenomenon is in March, with 2.1% (Table 1).

Table 1
Multiannual and monthly averages, monthly and multiannual totals and percentages of monthly values of black ice days in Oradea, 1970 – 2021

Month	I	II	III	XI	XII	Multiannual
Average	1.4	0.3	0.1	0.2	0.8	2.8
Total	72	18	3	9	41	143
Frequency (%)	50.3	12.6	2.1	6.3	28.7	100

Source: ANM Archives

The month with the highest number of black ice days was January 1982, when there were 10 such days, followed by December 2002, when there were 7 days.

Frost

The multiannual average of frosty days in Oradea is 7.9 days/year, but there were rather significant variations from one year to the other.

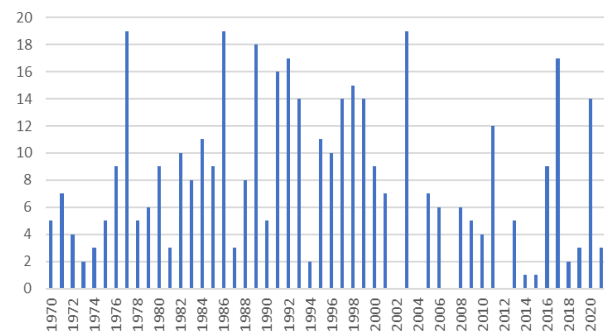


Figure 6. Annual variation of frosty days in Oradea, 1970 – 2021

Thus, in 1977, 1986 and 2003 the highest number of such days was recorded, 19 days,

while in 2002, 2004, 2007 and 2012 this phenomenon did not occur at all (Figure 6).

The years with positive deviations from the multiannual average make up 46.2% of the total number of years, while the years with negative deviations 53.8% accordingly (Figure 7). It can be seen that in the last period of the study the annual number of frosty days was lower, except for the years 2003, 2011, 2016, 2017 and 2020, which means a low frequency of this phenomenon between 2002 and 2021 and there were even four years when it did not occur at all (2002, 2004, 2007, 2012).

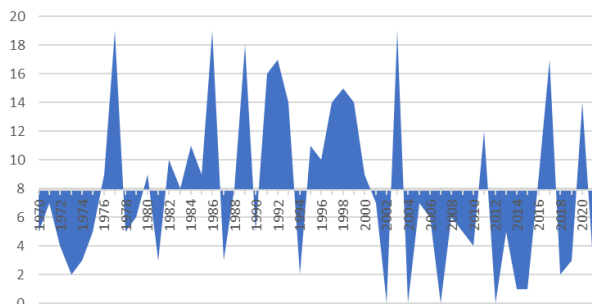


Figure 7. Deviations of the annual numbers of frosty days from the multiannual average in Oradea, 1970 – 2021

Frost occurs in Oradea between November and March. The month with the highest multiannual average of frosty days is January, 3.3 days, followed by December with 2.8 days. In the months at the end of autumn and at the beginning spring the phenomenon

occurs rarely, the averages are 0.4 days and 0.2 days respectively.

Advection of cold and wet arctic maritime air masses leads to a high frequency of frosty days in the cold period of the year. The hydrometer can also appear at the contact point of two air masses of Mediterranean origin with different thermal characteristics, one warm and the other dry. In the contact zone of the two air masses fog occurs along with frost and this is an often present phenomenon in the area of Oradea in the cold period of the year.

The highest probability occurrence of this phenomenon is in January, the month when the highest number of frosty days were recorded (173 days), which means a frequency of 42.1% of the total number of such days. The lowest probability of this phenomenon to occur is in March, when there were only 8 such days in the period included in the study and that means a frequency of 1.9% (Table 2).

The month with the highest number of frosty days was December 1986, when there were 16 days with appropriate conditions for this phenomenon to occur. In January the highest number of frosty days was recorded in 2020, 14 days altogether. In March and November the highest number of frosty days were 2 and 4 respectively.

Table 2
Multiannual and monthly averages, monthly and multiannual totals and percentages of monthly values of frosty days in Oradea, 1970 – 2021

Month	I	II	III	XI	XII	Multiannual
Average	3.3	1.3	0.2	0.4	2.8	7.9
Total	173	65	8	20	145	411
Frequency (%)	42.1	15.8	1.9	4.9	35.3	100

Source: A.N.M. Archives

Snow gust

The multiannual average of snow gust days in Oradea is 2.7 days.

In the period included in the study (1970-2021) the highest numbers of snow gust days were recorded in 1985, 2003 and 2005, 11 days in each year.

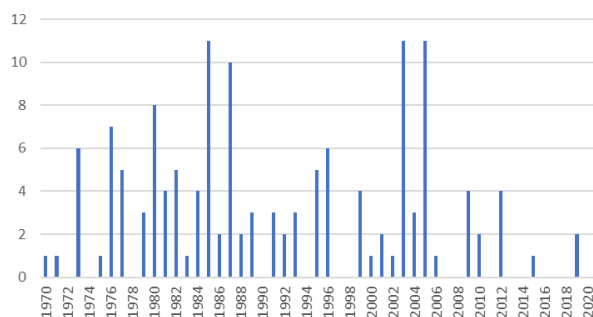


Figure 8. Annual variation of snow gust days in Oradea, 1970 – 2021

There were 17 years in which this hydrometer did not occur, in 1972, 1974, 1978, 1990, 1994, 1997, 1998, 2007, 2008, 2011, 2013, 2014, 2016, 2017, 2018, 2020 and 2021,

and they make up 32.7% of the total number of years included in the study (Figure 8).

The variation in time of snow gust days shows that there were more years with negative deviations from the multiannual average, they made up 59.6% of the total number of years, while the positive deviations made up 40.4% (Figure 9).

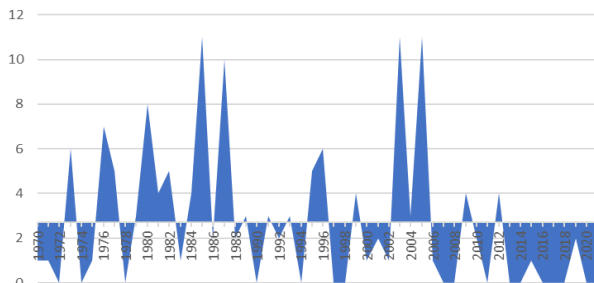


Figure 9. Deviations of the annual numbers of snow gust days from the multiannual average in Oradea, 1970 – 2021

During the year snow gust occurs between November and March. The highest values are recorded in January because this is the month with the greatest snow depth. Thus, in January the multiannual average was 1 day and the highest number, 7 days, occurred in 2003. In February, the highest number of snow gust days was 5 days, in 1985, and the multiannual average of this month was 0.8 days. The highest number of snow gust for December was 4 days, in 1973, 1980 and 2005, the average for this month being 0.6 days.

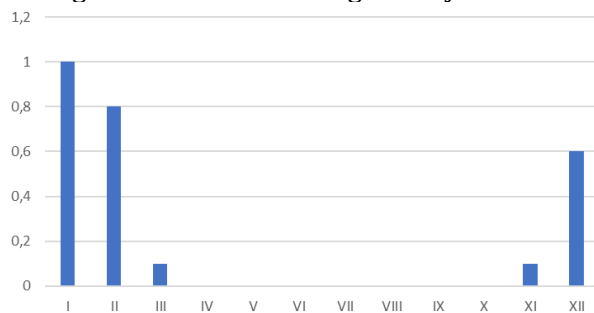


Figure 10. Multiannual monthly averages of snow gust days in Oradea, 1970 – 2021

The lowest values are recorded in the month at the end of the snowy period, that is, in March, as well as in the month when the snow starts to fall, in November, when the multiannual average of the months is 0.1 days (Figure 10).

Blizzard

In the area of Oradea the frequency of blizzards is low. The multiannual average of this phenomenon is 1.0 day and it can occur between November and February.

The low number of blizzardy days in Oradea is the result of the characteristics of the atmospheric dynamics in this part of the country, which shows the weak influence of the eastern and north-eastern European continent climate which generates such phenomena.

In the period included in the study (1970 – 2021) the highest annual number of blizzardy days occurred in 1987, when 7 such days were recorded, all of them in January. It is worth mentioning that in Oradea in 30 years (57.7%) from the 52 years included in the study blizzard did not occur at all (Figure 11).

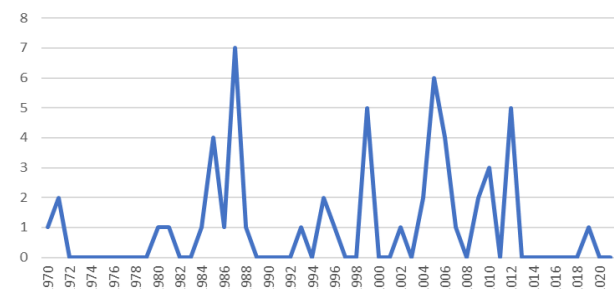


Figure 11. Annual variation of blizzardy days in Oradea, 1970 – 2021

The annual numbers of blizzardy years fluctuated around the multiannual average, the negative deviations made up 57.7% of the total number of years, while the positive ones 21.2%, and in 21.2% of the years there were no deviations from the average (Figure 12).

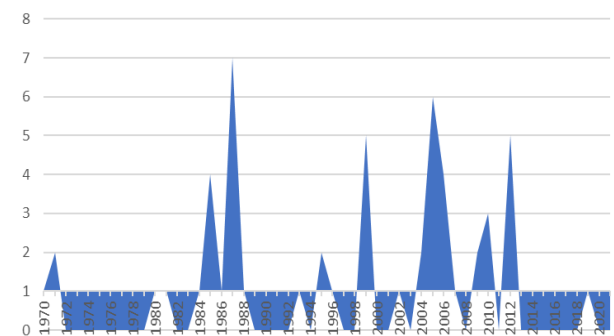


Figure 12. Deviations of the annual numbers of blizzardy days from the multiannual average in Oradea, 1970 – 2021

During the year, the highest multiannual averages of blizzardy days are recorded in January and February, 0.4 days in each case. Both in November and December the multiannual average was 0.1 days (Figure 13). The highest number of blizzardy days was recorded in January 1987, when 7 such days occurred, followed by February 1999, with 4 days.



Figure 13. Multiannual monthly averages of blizzardy days in Oradea, 1970 – 2021

CONCLUSIONS

The most frequent hazardous climatic phenomenon is hoarfrost, which in certain conditions can become a climatic hazard due to the intensity of its coldness, the moment in the year when it occurs and due to its consequences. In the period included in the study the multiannual average of hoarfrosty days is 49.7 days/year. This phenomenon can occur between September and May, with highest values in the winter month (9 – 10 days), when thermal inversions occur.

Ice becomes a hazardous climatic phenomenon both when it covers the ground (it hampers or even prevents transport) and when it coats wires or tree branches, which can break.

Snow gust and blizzard are not too frequent due to a weak influence of the eastern and north-eastern European continent climate which generates such phenomena.

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