

WINTER ATMOSPHERIC PHENOMENA AND THEIR IMPACT ON THE ENVIRONMENT IN THE AREA OF ORADEA

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Abstract. The paper presents the manifestation of the main atmospheric winter phenomena in the area of Oradea. There have been studied, interpreted and analyzed daily, monthly and annual data regarding the hoarfrost, the ice coatings and the blizzard, during the period 1961-2003, in the area of Oradea, registered at the ANM network weather station, in addition, a study case regarding the ice coatings is presented.

Introduction

Together with the knowledge of the periodical and non-periodical variations of the climatic elements, the knowledge of the spatial and temporal variability of the weather phenomena has a great practical importance; most of these weather phenomena can be factors of natural risk for the human life and activity. The analysis and interpretation of these phenomena based on the data collected from the weather stations cannot be omitted from any climatic study because their influence, most of the times ill-fated, manifests on some aspects of human life, like the aspects of agriculture, transportation, construction and not lastly on human health.

1. Interpreting the data

The hoarfrost. Being a hydrometeorological phenomenon, the importance in studying it comes from the fact that hoarfrost has damaging effects on agriculture, when it comes in the early fall or late spring, making significant damage to the crops.

The average multi-annual number of days with hoarfrost in Oradea is 49.7 days/year. Comparing it to the average situation, the number of days with hoarfrost had different values from one year to another, varying between 10 days in 1964 and 93 days in 1998. The average annual number of days with hoarfrost suffered positive and negative exceptions from the multi-annual average. So, in 46.5% of the number of analyzed years, the annual number of days with hoarfrost presented negative exceptions from the multi-annual average, and in 51.2% of the cases there

were positive exceptions. The year 1989 registered a number of days with hoarfrost equal to the multi-annual average, representing 2.3%. (Fig. 1)

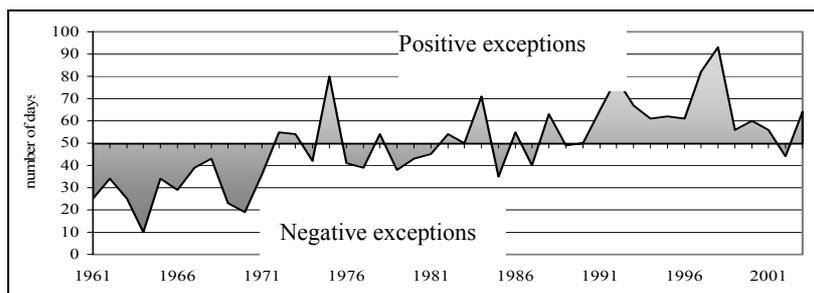


Fig. 1 - Exceptions from the multi-annual average of the annual number of days with hoarfrost, in Oradea, 1961-2003

Analyzing the temporal distribution of the positive and negative exceptions it was found that in the first part of the analyzed period, 1961-1971, there were only negative exceptions, the annual average number being smaller than the multi-annual average, and after that followed a period, 1972-1989, with both positive and negative exceptions. During the last period, 1990-2003, the annual number of days with hoarfrost increased having, except the year 2002, only positive exceptions.

Following the monthly values analysis of the number of days with hoarfrost it was found that this phenomenon takes place in Oradea, in the period September – May, varying from month to month. The highest number of days with hoarfrost is registered during the winter months, especially December – February, December being also the month with the highest number of days with hoarfrost 9.2 days on an average, representing 18.6% from the total number of days with hoarfrost. In January, the annual number of days with hoarfrost is 8.6, representing 17.2% the average number of days. In February the number of days with hoarfrost is higher than in January, averaging 9 days (18.2%). The lowest number of days with hoarfrost is in the months from the beginning and the end of the possible period, in May there are 0.1 days and in September there are 0.2, representing 0.2%, 0.4% respectively (Fig. 2).

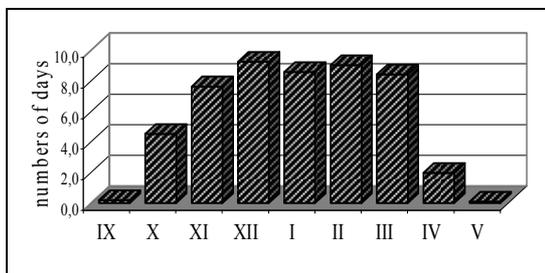


Fig. 2 - The average monthly number of days with hoarfrost in Oradea, (1961-2003)

Analyzing the data of the first and last day of the hoarfrost appearance in Oradea can be said that the average date of appearance of this hydrometeor is

in the second decade of October, but the earliest hoarfrost was in the second decade of September. The average date of the last day with hoarfrost is registered in the first half of April, but the latest hoarfrost was in the first decade of May. The early hoarfrosts of fall and the late ones of spring sometimes take place simultaneously with the first and last frost, but most of the times earlier, always on condition that there is an advection of some air masses from the North sector, arctic air masses, cold and humid.

Ice depositions. The ice depositions are phenomena that take place in the cold season, they are from the same category as the white frost and the glazed frost.

The white frost can be seen in Oradea during the period November-March, with a higher frequency in the winter months. When the quantity of the white frost deposited on the trees or the air conductors is of high density, leading to a higher weight, the white frost becomes a risk factor generating significant damages, for under its weight the trees and the air conductors can break. When it's associated with other weather phenomena, like very low temperatures, high humidity and fog, it represents a danger even for human health.

The average multi-annual number of days with white frost in Oradea is of 4.2 days/ year, but this number varied from year to year. The highest number of days with white frost was registered in 1991, when were registered 15 such days. By analyzing the annual number of days with white frost, one can notice that in the first part of the analyzed period, the number was lower, at the beginning of the period there were 4 years without any of these types of phenomena, and in the last years their number increased. The increased frequency of the number of days with white frost in the last years results even by analyzing the negative and positive exceptions from the multi-annual average of the annual number of days with white frost. Even though the negative exceptions represented 65.1% of the total of the cases, the majority of them are being registered in the first part of the period, while the positive exceptions represented 34.9%. (Fig.3)

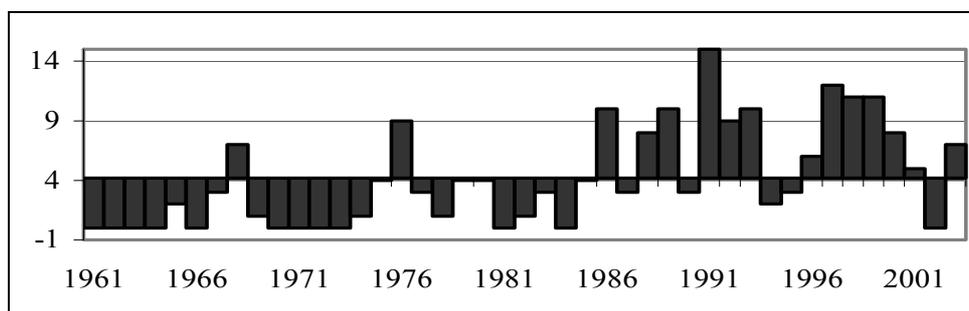


Fig. 3 - The variation of the negative and positive exceptions from the multi-annual average in Oradea (1961-2003)

The number of days with white frost varies not only from year to year, but also from month to month. The average monthly number of days with white frost has the highest values in January and December, these being 1.6 days a month, 1.5 days respectively. In the months from the end of the fall and the beginning of the spring the number of days with white frost decreases, the minimum being in March, 0.3 days. (Fig. 4)

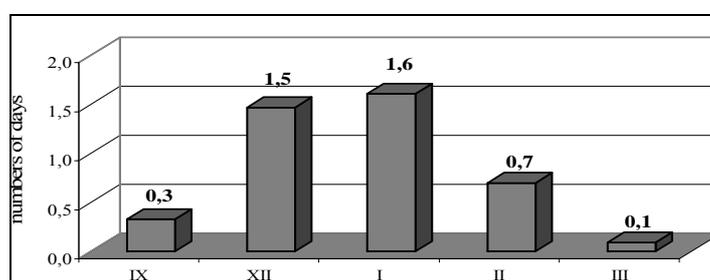


Fig. 4 - The average number of days with white frost in Oradea, 1961-2003

High frequency of number of days with white frost in the cold season is in a close interdependence with the advection of some cold and humid air masses, of arctic maritime origin. Also, the white frost can appear when there is contact between two air masses with different thermal characteristics, a cold one and a dry one, of polar-arctic origin, and the other one, warmer and humid, of Mediterranean origin. The contact between the two air masses is accompanied by the formation of fog and white frost deposition, a frequently encountered phenomenon in the area of Oradea, during the cold season. As a condition for the formation of the white frost in the winter months can be mentioned intense processes of radiative cooling, that under the circumstances of high air humidity can determine the appearance of this phenomenon.

Tab. 1 - The average and total, monthly and annual number, and the frequency of the white frost cases in Oradea, 1961-2003

Month	Jan.	Feb.	Mar.	Nov.	Dec.	Annual.
Average number of cases	1,6	0,7	0,1	0,3	1,5	4,2
Total number of cases	69	30	4	14	63	180
Frequency (%)	38,3	16,7	2,2	7,8	35,0	100

Source: A.N.M. Archive

Calculating the frequency of the number of white frost days in Oradea one can see that, taking into consideration the percentage, January has the most of these types of cases and implicitly the highest probability, followed by December and February, and the smallest percentage is registered in March, which presents the lowest probability for the white frost to appear. The highest number of days with white frost was registered in January 1999, 11 days; a close number of such days were in December 1986, 10 days. In March and November, the maximum number of days with white frost is 1, and 3 respectively. (Table 1)

The glazed frost deposits as compact start of transparent or opaque ice, when precipitations formed of very cold raindrops fall on the terrestrial surface, which crossed beforehand air layers of very low temperatures, below 0°C. (Gh. Măhăra, 2001) The conditions for the formation of the glazed frost are also met when the rain falls on a very cold terrestrial surface on which the temperature is also very low, below the frost limit.

In the area of Oradea the glazed frost can appear, like the white frost, with which it associates sometimes, in the period November-March. The average multi-annual number of days with glazed frost is reduced, 3 days/ year, due to the climatic influences from the Western part and the South-West part of the continent. To make a comparison we can mention the fact that the number of days with glazed frost, in the Eastern part of the country, in Vaslui, is higher than the one in Oradea, with an average of 5.3 days/ year, and a higher possible duration in time in October – March, as proof of the climatic influences from Eastern Europe, which bring here masses of air a lot colder (Daniela, Larion, 2004).

The annual number of days with glazed frost varied in Oradea from one year to another, reaching a maximum of 13 days/ year. But there were years when this phenomenon didn't register, the frequency being higher, 28% than the total of years taken into consideration for the study. The positive exceptions from the multi-annual average had a frequency of 32.6%, the negative exceptions represented 46.5%, and in 20.9% of the cases, the annual number of days with glazed frost was equal with the multi-annual average.

The highest annual number of days with glazed frost was registered in Oradea in 2002, when 13 cases were signalled, 7 in December and 6 in January. In January 2002, the average monthly temperature was -0,8°C, with 20 days of negative temperatures. Along the entire month there was a rainfall of 8.6 mm, that determined the formation of the glazed frost because of the low temperatures. Also in December the average monthly temperature had negative values, -0.3°C, and 17 days with temperatures below 0°C, and the quantity of precipitations had values over the monthly multi-annual average (52 mm): 63.3mm. In both months the high advection of the cold and humid air masses from the Northern and North-Western

part of the continent over the studied area determined the already mentioned atmospheric phenomena.

The highest monthly average number of days with glazed frost is in January, 1.5 days/ month, in December 1.0 days/ month, and the lowest number of such days is registered in the months at the beginning and the end of the period with a possibility for this phenomenon to appear in November 0.2 days, and in March 0.1 days. (Table 2)

Tab. 2 - The average annual and monthly number of days with glazed frost in Oradea, 1961-2003

Month	Jan.	Feb.	Mar.	Nov.	Dec.	Annual
Average nr.of days	1,5	0,3	0,1	0,2	1,0	3,0
Frequency (%)	47,3	11,6	2,3	5,4	33,3	100

Source: A.N.M. Archive

The highest frequency of number of days with glazed frost is registered in January (47.3%), thus determining the highest probability for this phenomenon to occur in this month. The lowest probability for this phenomenon to occur is in March, when its frequency decreases (2.3%).

To find the total number of days, in a year, with glazed and white frost, one has to take into consideration the number of days with ice deposition in the respective year. When these phenomena are associated, like most of the times, it becomes a dangerous weather phenomenon, especially when it occurs in the transition seasons, but also in the cold season, when it can bring serious damages in transportation, constructions and agriculture

3. Study case – The ice depositions in Oradea on the 5th of February 1993

On the February the 5th 1993 there were registered in Oradea the most consistent ice deposition on the air conductors from the period taken into consideration in this study. The ice deposition started on the 5th of February at 18:20 and lasted until the second day, on the 6th of February, at 23:10, lasting 28 hours and 50 minutes. The ice deposition occurred in the circumstances of the existence of a cold air above the studied area, which came from the North-Eastern part of the continent, air mass that persisted several days above Romania, and implicitly above Oradea, continuing the cooling process by terrestrial radiation even after the mass of cold air, belonging to the Siberian Anticyclone, started to retract, due to the presence of a compact 4 cm snow layer. At the already mentioned date, above this air mass there is an advection with another air mass, warmer and humid from the South-Western part of the continent. The union of these two air masses is distinguished by the significant increase of the average

daily air temperature, which was on the 5th of February – 10,3⁰C, and the next day were measured “only” - 4,2⁰C. The persistence of the cooling process through terrestrial radiation and the reduced height of the mass of cold air above the Western part of Romania is also emphasized by the barometric maps, which show that at the equivalent altitude for 500hPa, the warm air mass penetrates from February the 1st 1993, while on the ground the increase of temperature can be felt only from February the 6th (Fig. 6). During the already mentioned period there was also signalled out snow that led to the increase of the snow layer thickness up to 9 cm.

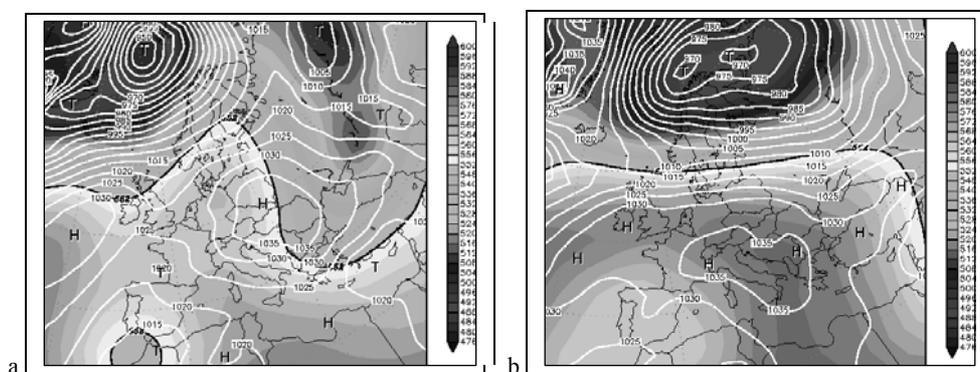


Fig. 6 - Map with the baric and geo-potential field up to 500hPa, on February 1st 1993 (a) and on February the 5th 1993 (b)

The thermal and baric equalization between the two air masses on the ground takes place during the ice deposition period, as it is emphasized by the speed of the gust of wind from South-West, registering a maximum speed of 9 m/s.

The ice depositions from the mentioned period had a maximum thickness of 19 mm, their weight being 24g/cm³. They started to disappear even in the evening of February the 6th, by shaking, due to the high speed of the wind.

The blizzard is another weather phenomenon that can be encountered in

Oradea during the winter season, although its frequency is very scanty

The average multi-annual number of days with blizzard in Oradea is 1.3 days, and the possible appearance period of this phenomenon is November-March.

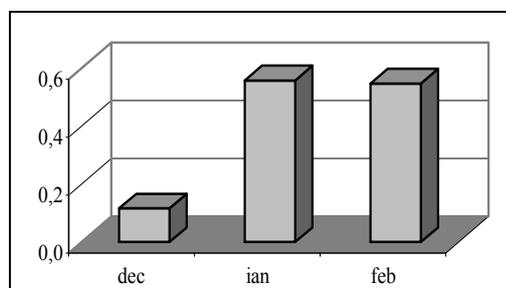


Fig. 7 - The monthly evolution of the number of days with blizzard in Oradea

The small number of days with blizzard in Oradea is explained both by the position in the Western part of the country, and by the characteristics of the atmospheric dynamics in this part, that points out the small influence of the climate in the Eastern and the North-Eastern part of the European continent generating such phenomena. By comparison, in the Eastern part of the country, at Vaslui, the average multi-annual number of days with blizzard is 5.2 days/ year, and the period for this phenomenon to occur is October-April. (Daniela Larion, 2004), and in Iași, the number of blizzard days is even higher 7.55 days/ year (Elena, Erhan, 1979).

The highest annual number of days with blizzard is registered in Oradea in 1964, when there were 10 days of blizzard. It is worth mentioned the fact that in Oradea, in over 50% of the total of analyzed years it wasn't registered any case of blizzard.

The monthly number of days with blizzard varied in the period 1961-2003 (Fig. 7), the highest number of days with blizzard was registered in January 1987, when there were 7 of these types of days; the multi-annual average of this month was 0.6 days/ month. The maximum number of blizzard days in February was 6, in 1964, the average of the month was 0.5 days, and in December the highest number of days with blizzard was 1 day, in several years. One has to point out the fact that in November and March, in the analyzed period there were two days of blizzard, in March 1964 and in November 1969 and 1995.

Conclusions

The most frequent atmospheric winter phenomena are the white frost, the average multi-annual number of days with white frost is 49.7 days.

The winter atmospheric phenomena that present a high degree of risk on the environment when they manifest with high intensity are: the blizzard and the ice depositions on the conductors.

In the area of Oradea the winter atmospheric phenomena have a moderate characteristic, only in exceptional circumstances the affect negatively the state of the environment, producing damages to the goods and landscape alterations.

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