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ASPECTS REGARDING THE RIME PHENOMEN IN DEVA AREA

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Abstract: The survey regarding the rime phenomenon in Deva area was carried out for the time between 1961 - 2010. Within the time surveyed, the number of days with rime halted between 75 days in 1965 and 16 days in 2010. The average number of days with rime is 44 days. In Deva area, the phenomenon of rime has a moderate condition.

Key words: phenomenon of rime, frost, Deva city area.

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INTRODUCTION

Rime is the phenomenon whose spatiotemporal action depends on the air temperature, wind and humidity. It can be seen when the air and earth's temperature drops under 0°C, air humidity is over 70%, calm weather or mild wind, reduced cloudiness or clear sky, high insolation during the day and high level of radiation during the night which determines the temperature to drop below the freezing point and the vapors sublimation (Măhăra, 2001). The appearance of rime is determined by three categories of causes in Deva: air masses circulation, the active surface and climatic elements characteristics (humidity, cloudiness, temperature, wind).

In Deva area, the greatest part of the freezing and rime phenomena are determined by the air masses that disperse out the Field of Pannonia, Northern Europe and North-Western Europe. The geosynoptical conditions presented cause the most numerous cooling because of the cool air masses in Greenland as far as the South-Eastern Europe. The low air pressure in the Romania area attracts the cool air with high air pressure in the Scandinavian Peninsula.

METHODOLOGY

The Deva Weather Base provided data collected between 1961 - 2010 for the analysis of the rime phenomenon. The data referring to the numer of days with rime in the cities Iaşi, Timişoara, Constanţa, Braşov and Câmpina were collected out of Clima României, 2008 the edition.

In this survey, we analyse the indicators referring to the multiannual average number of days with rime, the abnormality of the annual number of days with rime beside the multiannual average, the monthly average number of days with rime. The comparative analysis of the number of days with rime in certain cities placed in different parts in Romania emphasizes the importance of the geographical position and its relief in the rime phenomenon appearance on the Romanian territory.

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RESULTS

The multiannual fluctuation of the number of days with rime

This indicator has a crucial importance in the emphasis of the maximum and minimum number of days with rime between 1961 - 2010, as well as the negative and positive abnormalities compared to the multiannual average.

For an integrating analysis, we consider the annual average number of days with rime in the following cities: Iaşi, Timişoara, Constanța, Braşov and Câmpina placed in different parts on the Romanian territory and towards Deva city.

Table 1.The annual average number of days with rime (1961 - 2007)
(Data source: Clima României, 2008)

City	Iaşi	Timişoara	Constanța	Deva	Braşov	Câmpina
Annual average no. of days with rime	66.1	59.1	28.8	45.8	55.2	71.3

Analysing the situation within the context of the said cities, we notice certain differences among the annual average number of days with rime, differences caused by their geographical position towards the Carpathian Curve as well as certain characteristics of the air masses dynamics.

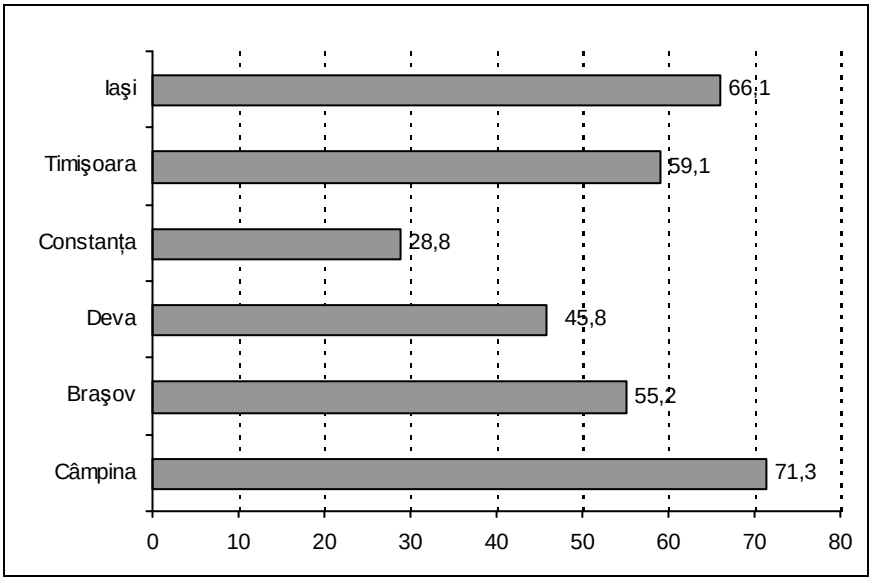

Figure 1. The annual average number of days with rime
(Data source: Clima României, 2008)

The lowest number of days with rime is reported to be in Constanța due to the Pontic influence which has the role of a regulator on the climate. The highest number of days with rime is reported to be in Câmpina, Iași, Timișoara that is in the extra-Carpathian regions due to the cool air advections out North, North-West and East (figure 1). The air advection is produced by the anticyclones located in the Western and Central part of Europe when the regions in the Northern half of Romania are affected by rime while, when these advections are generated by the anticyclones located in the Scandinavian Peninsula and the Russian Field, the rime affected regions are the Eastern and South-Eastern parts of the country (Bogdan and Niculescu, 1999).

In Deva, the lowest number of days with rime is conditioned by its specific mild climate. For the interval between 1961 - 2010, the annual average number of days with rime in Deva fluctuated between 75 days in 1965 and 16 days in 2010 (figure 3). For the analysed interval of time, high values of the number of days, with rime were recorded in 1998 (73 days) and 1997 (68 days). We have to mention that the high number of days with rime in the above-said years was conditioned by either the early invasion of anticyclonic air masses out Europe in the context of a region with low pressure in Romania, or the persistence of the anticyclonic condition during the cold season combined with the appearance of the mobile Mediterranean cyclones which raises the level of humidity.

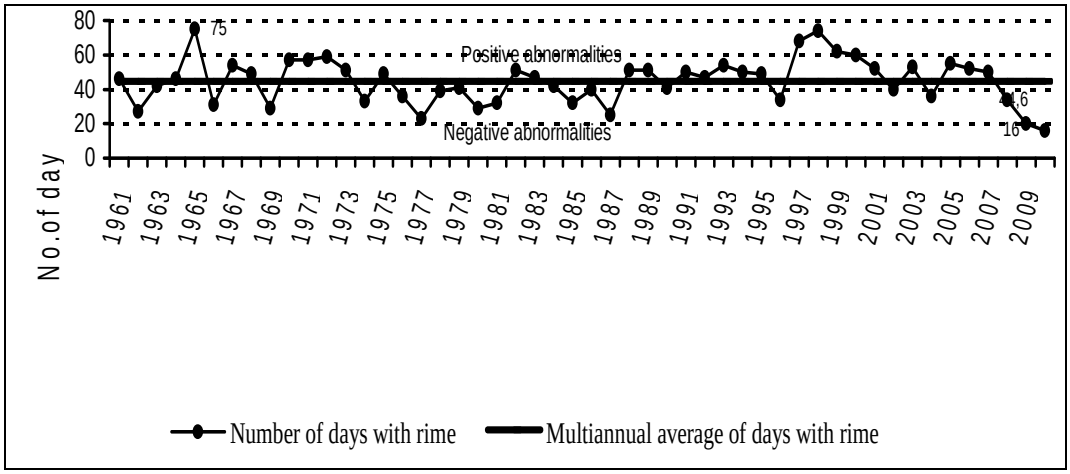

Figure 2. Abnormalities of the annual number of days
with rime beside the multiannual average in Deva (1961 - 2010)
(Data source: Administrația Națională de Meteorologie)

Between 1961 - 2010, the multiannual average number of days with rime is 44.6 days. Beside this multiannual average, there were noticed positive and negative abnormalities.

The highest number of days with rime was recorded in 1965 (75 days) and the lowest number of days with rime - in 2010 (16 days with rime). The high number of days with rime recorded in 1965 is due to certain early cooling on autumn which was caused by the invasion of arctic masses of air in the context of the mobile polar anticyclones appearance in the Northern part of Europe. Over the year of 1965, the high number of days with rime in October the 7th can be noticed.

The appearance of the phenomenon was favoured by the advection of cold air masses in the Northern and North-Western parts of Europe, being attracted by the minimum barometric temperature in the Black Sea pond. The maximum expansion of such masses towards our territory took place on October the 20th, 1965, as it can be noticed on the baric and geopotential field at 500 hPa (figure 3). We have to mention that at Deva Meteorological Base, the minimum

Temperature at soil level on October the 23th, 1965, was -6.2°C. On the 25th of October, 1965, the minimum temperature at soil level was -5°C. These temperature values combined with a raised value of humidity created favourable conditions for the appearance of the rime phenomenon in the second part of October, in 1965, in Deva.

In 1965, the rime phenomenon lasted until late in the spring, so that in May there were two days of rime ere recorded. We have to mention that the map of baric and geopotential field at 500 hPa highlights that on 11th of May, 1965, there was an arctic air mass on the territory of Romania. Such a situation happened because certain cold and humid air masses moved towards Central Europe, being attracted by the minimum pressure values that were determined by the Mediterranean cyclones in the Southern Europe (figure 4).

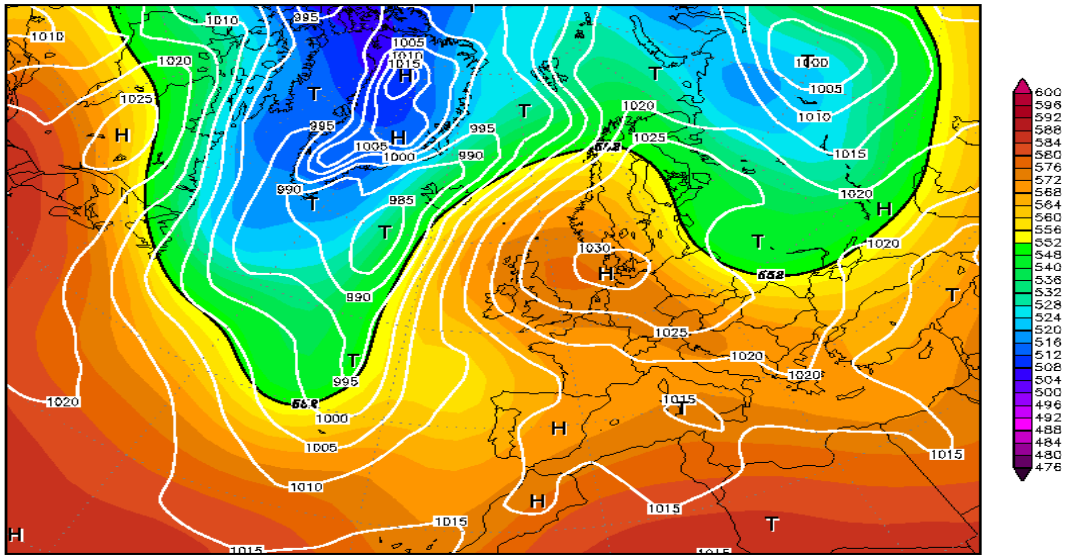

Figure 3. The map of baric and geopotential field at 500 hPa, on 20th October, 1965
(Data source: www.wetterzentrale.de)

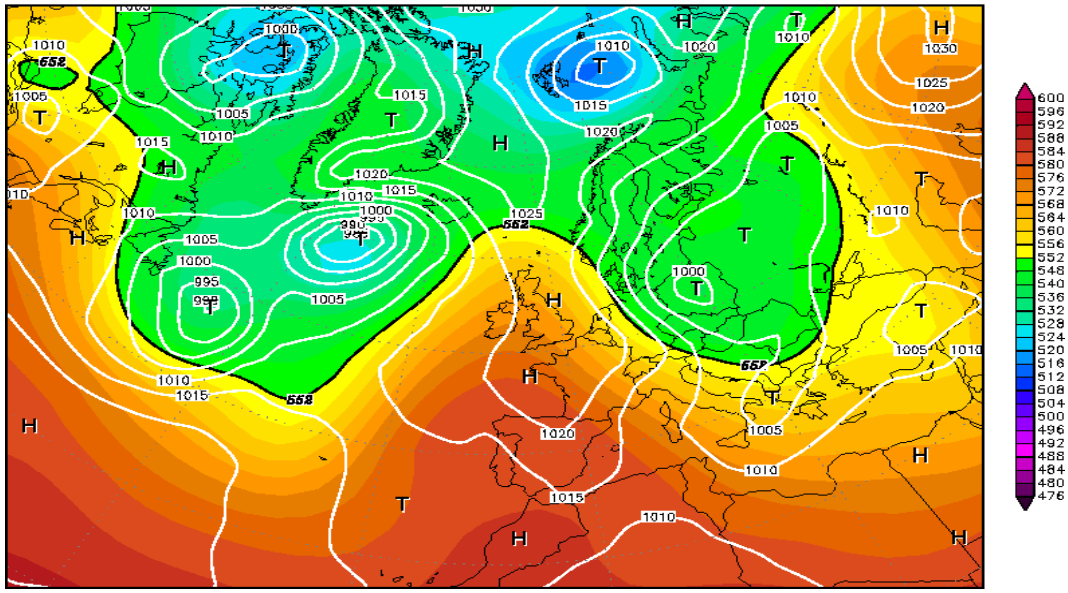

Figure 4. The map of the baric and geopotential field at 500 hPa in 11th May, 1965
(Data source: www.wetterzentrale.de)

Over 70 days with rime were recorded in 1998, as well. In 1999, over 60 days with rime were recorded, while, in 2000, the number of days with rime was 60. The low number of days with rime was caused by the predominance of a stressed cyclonic condition in Deva because the mobile Mediterranean cyclones moved to East. A number of less than 30 days with rime was recorded in 1962 (27 days), 1978 (23 days), 1980 (29 days). In 1987, there were 25 days with rime and 20 days in 2009. Between 1961 – 2010, in Deva, the lowest annual number of days without rime was recorded in 1965, 290 days, followed by 1998 with 292 days without rime. The highest annual number of days without rime was recorded in 2010, 249 days, followed by 2009 with 345 days.

Beside the multiannual average of 44.6 days with rime in Deva, 26 years of positive abnormalities were recorded, which represents 53% of the total of years taken into account, and 23 years with negative abnormalities, which represents 47% (figure 5). The highest positive abnormality was recorded in 1965, 30 days, while in 1961 and 1964 the least positive abnormality was recorded, 1 day. The negative abnormalities varied between 29 days in 2010 (the highest) and 2 days in 1968 (the least).

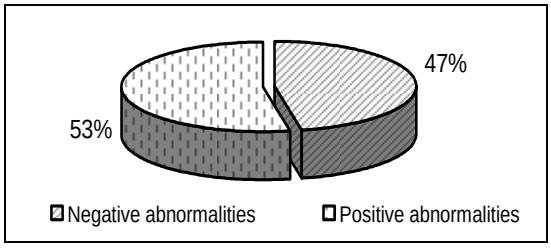

Figure 5. The abnormality frequency beside the multiannual average in Deva, between 1961 - 2010
(Data source: Administrația Națională de Meteorologie)

The annual variation of the number of days with rime

Over a year, certain favourable conditions for the rime appearance in the interval September - May can be created. The analysis of the monthly average values of the days with rime for the interval 1961 - 2010 stresses the fact that March is the month with the highest number of days with rime - 8.14 - followed by November with 7.9 days, while the minimum days for the suitable time for rime appearance are recorded in May and September, when the monthly average is less than 1 day (figure 6). After the analysis of the monthly average values, we can notice that the monthly average number of days with rime is spring and autumn, not winter. In Deva, the earliest date the rime can appear is in the first part of September, and the latest is in the first part of May.

Table 2. Average monthly number of days with frost and their frequency in Deva, 1961 - 2010
(Data source: Administrația Națională de Meteorologie)

Month	IX	X	XI	XII	I	II	III	IV	V	Annual
No. days	0,2	4,9	7,9	7,2	6,6	7,4	8,14	2,1	0,16	44,7
Frequency	0,4	11,0	17,8	16,1	14,8	16,5	18,2	4,8	0,4	100

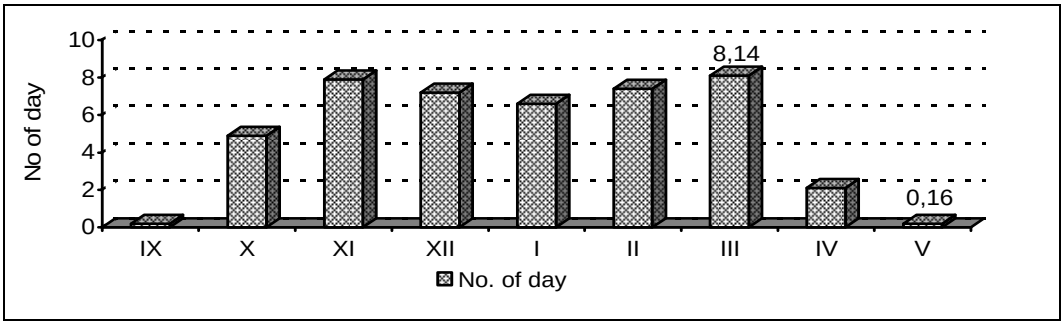

Figure 6. The monthly average number of days with rime in Deva, 1961 - 2010
(Data source: Administrația Națională de Meteorologie)

During the winter months, the number of days with rime in Deva varies between 6.6 days with a frequency of 14.77% in January and 7.36 days with a frequency of 16.47% in February. The highest frequency of the days with rime over the winter is recorded in February - 16.47% - followed by December with a frequency of 16.15%.

Analysing the monthly frequency of the days with rime within the interval with probability for rime, we can notice that the highest frequency is recorded in March - 18.21% - followed by November with 17.80%. The lowest frequency is recorded in May - 0.35% - followed by September, with a frequency of 0.44% (figure 2).

The high number of days with rime in March is caused by the action of the anticyclones located in the Western and Central part of Europe (Bogdan and Niculescu, 1999). The relief composition in Deva and the presence of Mureș couloir favour the cold and humid air masses to remain there, which explains the high number of days in spring and autumn months. In this respect, we mention the fact that the highest number of days with rime is not recorded during the winter months, but in March and November, that is in spring and autumn. The lowest frequency is recorded in September and October due to the cold and humid air masses receding towards the Northern Europe and activating the anticyclones formed in the Arabic Peninsula and Northern Africa.

The earliest rime in Deva was recorded on 14th September and the latest on 13th May (Clima României, 2008). These pieces of data have a crucial importance in agriculture because on the specified dates, a part of the culture is in vegetation and, under these circumstances, rime causes damages in culture. The average date of the first rime appearance is 16th October, but it can be slow in coming under certain conditions until 16th November. The average date of the last rime is 17th April, but, over the years, it can disappear after 17th March (Clima României, 2008).

The risk interval represents the interval between the average and extreme date of rime appearance. Thus, between the average date of the first frost and the earliest frost in autumn represents the autumn risk interval; and between the average date of the last frost and the latest frost in spring represents the spring risk interval (Bogdan and Niculescu, 1999). In Deva, the autumn risk interval for rime is between 14th September and 16th October. The spring risk interval is between 17th April and 13th May.

Rime appearance in Deva outside the average dates of happening for either the first rime or the last one is favoured by a certain aerospace configuration, as well as the local relief conditions.

RISK ASPECTS

The study on this phenomenon has a crucial importance when it happens either too early in autumn, or too late in spring. This importance comes from the negative implications in agriculture, causing serious damage in culture if it occurs during plant vegetation.

Rime becomes a risk climatic phenomenon for the economy if:

- it occurs 2 - 3 weeks earlier in autumn or later in spring, compared with the average dates (Gaceu, 2005);
- frost appears simultaneously on the soil and in the air (Gaceu, 2005);
- rime occurs at the same time with other meteorological phenomena (slush, snow, fog);
- the anticyclonic condition representative for rime occurrence favours the pollutant factors persistence in the atmosphere;
- the high level of humidity in the air causes discomfort for human organisms.

REFERENCES

Bogdan Octavian, Niculescu Elena (1999), *Riscuri climatice din România*, Editura Sega-Internațional, București;
Gaceu O. (2005), *Clima şi riscurile climatice din Munții Bihor şi Vlădeasa*, Editura Universității din Oradea, Oradea;
Măhăra Gh. (2001), *Meteorologie*, Editura Universității din Oradea, Oradea;
*** (2008), *Clima României*, Editura Academiei Române, București.
*** www.wetterzentrale.de
*** www.inm.ro

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