EVALUATION OF THE RIME PHENOMENON IN THE REPUBLIC OF MOLDOVA

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Key words : rime, vulnerability, tendency, spacial modelling, risk, probability, Surfer, Radial Basis.

Abstract. Due to the relatively varied Moldova's relief and its extension from North to South, average and extreme data of rime production are different. The map shows that the most vulnerable territories to rime deposition are in the Central and North-Western regions: the Central Moldova and Northern-Moldova Plateau. The least vulnerable are the Balti and Southern Moldova Plains. The low frequency of the complex rime depositions in the above mentioned regions occurs due to the fact that their altitudes are lower than of that of the adjacent regions and thus they are better protected from cold winds.

Introduction

Rime *is a deposition of ice that generally derives from the freezing drops of fog or cloud in overcooled state, on objects with negative or slightly above 0°C surface temperatures.*

Practically, three types of rime can be distinguished: soft rime, hard rime and transparent rime. The most hazardous is the hard or granular rime. This hydrometeor is formed through the quick freezing of the water drops left in liquid state after the process of overcooling. It determines their more or less individual freezing while air can be found between them. Unlike the soft rime, hard rime adheres rather strongly to objects and can be only removed by breaking. It deposits on objects on the soil and parts exposed to wind.

The thickness of deposition can increase a lot in the wind direction and it can have the appearance of a feather or banner or broad blade. The form depends on the dimensions or diameter of the objects on which rime deposits. For example, granular rime deposited on aerial conductors can reach 20-30 cm in diameter. This fact leads to the increase of each conductor linear meter weight by 4-6 kg [1].

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Sometimes its diameter can reach 60 cm, thus the supplementary weight of a conductor meter increases by 50 kg. Though rime is fragile, it can detach from the conductor in fragments of 5-10 cm and 1-2 cm thick.

Sometimes in winter, due to different air masses influence, depositions of ice can have a mixed, combined structure that leads to the increase of pressure on the aerial conductors.

1. Results

Due to the relatively varied Moldova's relief and its extension from North to South, average and extreme data of rime production are different.

The average date of the first rime deposition is in November.

There were cases when the first rime deposition on conductors occurred in October but this occurs rarely. In Moldova's Southern districts, due to the Black Sea influence, the first deposition can take place in the first and second decades of December. On an average, the last rime deposition can occur in the first half of April. In the Northern and North-Eastern districts the last rime deposition can be recorded in the second half of April.

1.1. *Statistic data characterizing the rime phenomenon in the Republic of Moldova.* Temporal evaluation of rime in the R. of Moldova shows the maximum probability of its occurrence in January (38%) and in December (27%), whereas in February, March and November the probability is much lower. In April, the probability of rime formation is the lowest (less than 5 %)[3].

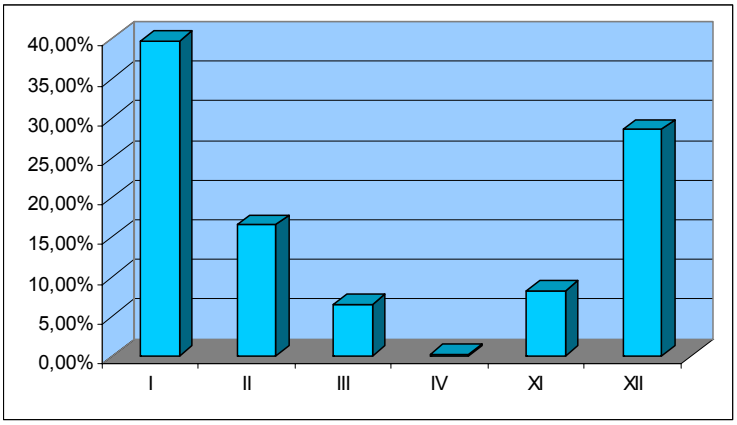

Fig. 1 - The probability of rime manifestation in the R. of Moldova

According to table 1, the highest number of days with rime is characteristic for Northern Moldova Plateau (14,6 days/year), Central Moldova Plateau (11,9 days/year). The lowest number of days with rime was recorded in Balti Plain (3,7 days/year).

Tab. 1 - Statistic data that characterize rime phenomenon in the R. Moldova

Statistic	**I r.f.g**	**II r.f.g.**	**III r.f.g.**	**IVr.f.g.**	**V r.f.g.**
$\bar{x}$	14,6	3,7	11,9	4,4	8,0
min	5,0	0,0	0,0	0,0	0,0
max	33,0	10,0	23,0	19,0	19,0
σ	6,2	2,2	5,5	3,7	4,6

Notă:I - I physical geographical region –Northern Moldova Plateaus and region Podişurilor; II* - II physical geographical region – Northern Moldova Plain; III* - III physical geographical region – Central Moldova Plateau; IV*-IV physical geographical region - Inferior Dniester Plain; V*-V physical geographical region - Southern Moldova Plain*

The lowest amount of rime can be recorded in the Southern and Central parts of the Republic (0 days/year) and in the Northern Moldova Plateau (Briceni) (5 days/year). The maximum number of days with rime is 33 days/year. In Balti Plain, the annual maximum number is of only 10 and in the Central Moldova Plateau – 23 days/year.

The extent of rime danger depends on how long it lasts; the ratio of rime duration and its deposits consequences is in direct ratio: the longer the duration, the more serious the negative effects are.

Average annual duration of rime deposition in the Republic goes from 70 to 380 hours. The duration of 50-70% of deposition cases is less than 12 hours. The duration of only 1-2% of rime deposition may exceed 48 hours. The higher the relief, the longer the duration of rime deposition is.

The maximum rime diameter depends on the atmospheric genetic conditions in contact with the objects' surface. The instrumental measurements of rime deposition parameters started in 1952 and they were done by a rime gauge.

This is an installation made of three metallic pillars of 425 cm length and 50 mm diameter. The pillars are connected by steel conductors forming different angles.

The maximum soft rime deposition diameter in the Republic is of 15-60 mm, the maximum hard rime deposition is of 30-75 mm.

In some extreme circumstances, the ice deposition diameter may be much bigger, thus leading to serious damages to aerial electrical conductors. For example, on the 15-18 of February 1969 (fig.2), the ice deposition on the electrical

conductors reached 140 mm (the route Chisinau-Calarasi, the Central Moldova Plateau). Telephone and high tension pillars brake; tree crowns bent down to the ground and brake under the weight of the ice. The break of electrical wires and trees went on even after the ice deposition melted.

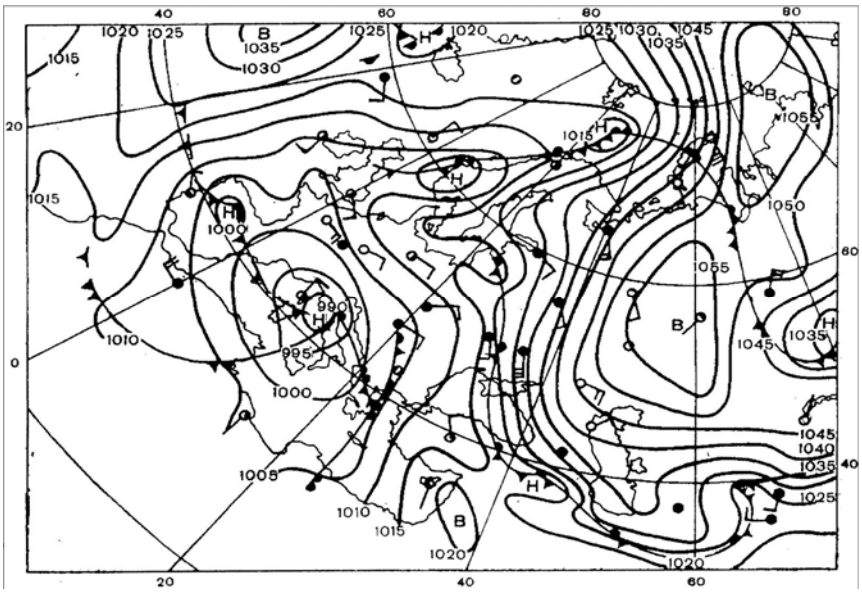

Fig. 2 - Weather map for the 15th of February 1969, 03 AM [2]

1.2. Spatial-temporal estimation of rime in the R. of Moldova. Taking into consideration the warming of winters in Moldova and the increase of temperature alternation proven by the latest results of scientific investigations, it is worth evaluating the regional tendencies of the rime regional manifestation.

The analysis of the data shows that this phenomenon has an increasing tendency, especially in the Northern and Central parts, where the temperature alternation is more significant.

The evaluation of the frequency of this phenomenon proves the above mentioned fact. Thus, in the I and III ph.g.r. approximately once every 20 years the annual number of rime days is of 13-14, while in the V ph.g.r. the number is of 7 days approximately.

A higher rime frequency has been recorded in the I and III ph.g.r., which can be explained by a frequent temperature alternation, humidity and the area's altitude.

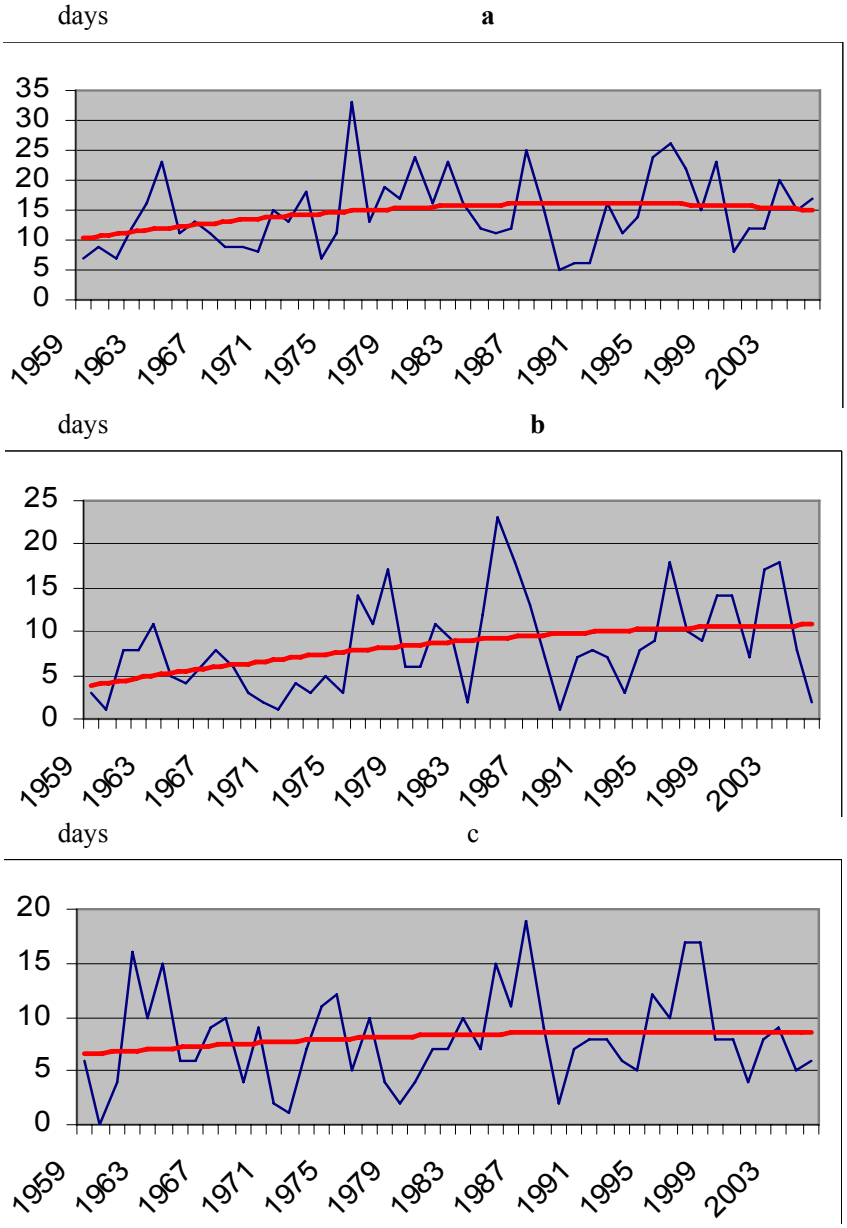

Fig. 3 - Temporal evolution and the tendency of rime manifestation in different ph.-g.-r. of the R. of Moldova (a- I ph.-g.-r.; b-III ph.-g.-r.; c-V ph.-g.-r.)

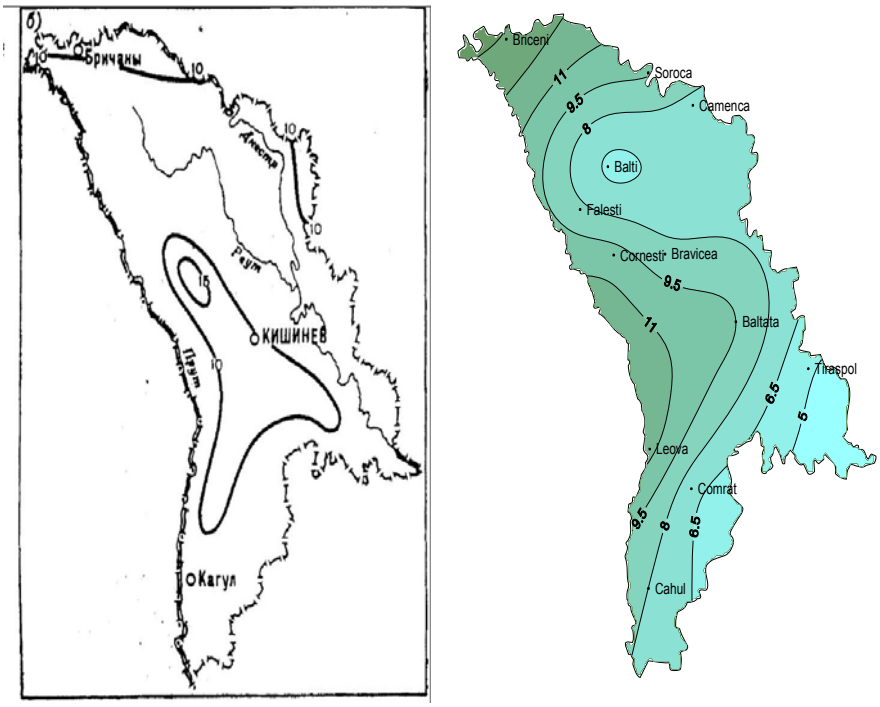

Fig. 4 - The distribution of the annual number of rime days (left – according to data Lasse G.F., 1978; right - 1960-2005)

The comparative analysis of the scheme, which represents the spatial distribution of the number of the rime days, proves that in the recent years (1960-2005), this number has increased in the Northern and Central Western regions [2].

Using the „***Surfer***" program and the „***Radial Basis***" interpolation method it was possible to locate this phenomenon in detail. According to the map we obtained, the smallest number of the rime days/year is observed in the South-Eastern extremity and in the Balti steppe.

1.3. Moldova's vulnerability to rime manifestation. The analysis of Moldova's vulnerability shows that the most vulnerable regions are the Central Moldova Plateau and North-Western extremity.

The Southern Moldova Plain, inferior Dniester and Balti Plains are the least vulnerable to rime territories. The low frequency here can be explained by the fact that their altitudes are lower than that of the adjacent regions and, thus they are better protected from cold winds. (fig.5).

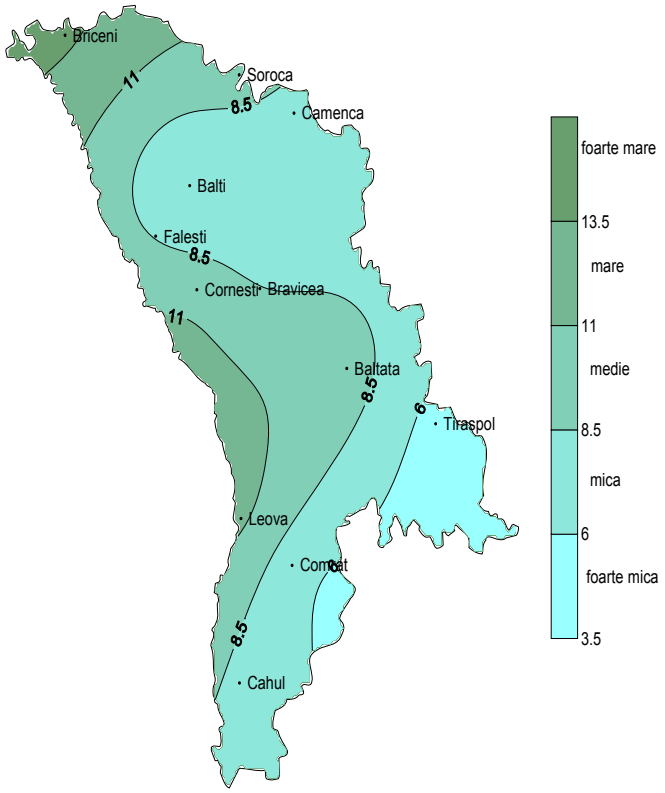

Fig. 5 - Republic of Moldova's vulnerability to rime

When elaborating the territories vulnerability map to rime deposition, data concerning the average number of rime days were used. As a result, 5 levels (degrees) of vulnerability to rime deposition were delimited:

- Very low (3,5-6 days/year);
- Low (6-8,5 days/year);
- Average (8,5-11 days/year);
- High (11-13,5 days/year);
- Very high (> 13,5days/year).

The map shows that the most vulnerable territories to rime deposition are in the Central and North-Western regions: the Central Moldova and Northern-

Moldova Plateau. The least vulnerable are the Balti and Southern Moldova Plains. The low frequency of the complex rime depositions in the above mentioned regions occurs due to the fact that their altitudes are lower than of that of the adjacent regions and thus they are better protected from cold winds.

The designing and construction of communication lines demand the use of financial means and expensive materials. In order to increase the strength of the electrical wires it is necessary to increase the diameter of the conductors (the thickness of the depositions is lower on conductors with a bigger diameter) and to strengthen the supporting pillars.

In the same time, if these measures are inadequate they will lead to a considerable increase of the construction and exploitation expenses. If the necessary measures are not taken, frequent accidents with very negative consequences will occur. Evidently, it is necessary to construct telephonic and electrical conductors with minimum costs.

Conclusions

The hard and granular rime presents a real hazard which should be taken into consideration when designing the high frequency and other conductors (TV, Internet, etc.) or when planting different species of fruit trees. The damages caused by frequent breaking of too thin aerial conductors, of pillars or tree branches should not be neglected.

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