

STUDY OF THE SYNOPTIC SITUATION THAT FAVOR THE FREEZING RAIN IN NORTHWESTERN TRANSYLVANIA

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Abstract. - Study of the synoptic situations that favor the freezing rain in Northwestern Transvlvania. The paper discusses a study on the "freezing rain" and the spatio-temporal distribution of days with freezing rain in the northwestern region of Transylvania. For this study we have analyzed statistical data from 12 meteorological stations in the counties of northwestern Transylvania. The period for which the analysis is done is 36 years (1972-2008). There was a statistical processing of days with ice, analyzing the average number of monthly and annual distribution of areas with freezing rain and analyzing the thickness of the ice deposit, and also looking at the synoptic situation where was freezing rain on the relatively large spaces in the area studied. For this purpose we used data averaged NCEP-NCAR reanalysis. For an average circulation of the troposphere, since the winter air masses have a lower vertical development, geopotential surfaces were used at 700 hPa. To determine the average barrel near the ground rules have been used geopotential fields at 1000 hPa and the surface pressure field. Field analysis was also done at ground level pressure and temperature throughout the air column. The analysis of synoptic situation shows that this phenomenon occurs in most cases when there is a mass of hot air entering a cooler air mass and there is a corresponding trough for the one at the ground, favor the phenomenon on a wider range of northwest area.

Keywords: freezing rain, thermal inversion, Northwestern Transylvania

1. INTRODUCTION

In operational meteorology there is an interest for the present diagnosis and prognosis of severe weather of the cool season. Knowledge and understanding of the characteristics of the circulation, which promotes the freezing rain, has an important role in determining the areas where this phenomenon may occur frequently, and in the assessment of early onset. Also, regional climatology and local knowledge is another important factor in determining the extreme characteristics.

« The glazed frost is a weather phenomenon which consists in depositing an ice layer of dense, matte or transparent, which appears on the ground and objects, especially on the sunny side wind. This occurs due to freezing of water droplets falling on a highly cooled surface. The glazed frost occurs most frequently at temperatures between 0 and $-3^{\circ}C$ and is one of the most dangerous weather phenomena, having a negative impact on all transport » (Clima României, Editura Academiei Române, p. 340-341)

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2. DATA AND METHODS

The present paperwork discuss about the freezing rain, and the spatiotemporal distribution of days with glazed frost in Northwestern Romania. For this study we have analyzed statistical data recorded in 12 meteorological stations in the counties of Bistrita-Nasaud, Cluj, Maramureş, Satu Mare and Sălaj. The data were available for 36 years (1972-2008). In order to process the database were used the computing of Microsoft Excel progam, upon which were calculated sums, monthly average and annual average. Also, using the graphic representation features of Matlab program, version 6.0, was made the map of spatial distribution for cases with freezing rain in the analyzed period.

3. RESULTS

Analyzing the average number of monthly and annual distribution of areas with freezing rain and thickness of the ice deposit we could observe the following issues: in terms of distribution areas, most days with freezing rain have been recorded at weather stations Dej (99 cases) and Cluj-Napoca (60 cases) (Fig.1). The two stations are located in the corridor Somes, an area known as the "Gate of Somes" the penetration of more humid western air masses.



Fig. 1. A number of cases with freezing rain. Source: CMR archive data processed in North Transylvania

After statistical processing of the number of days with freezing rain several features may be revealed. Thus, analyzing the annual and monthly average number of days with glazed frost was found that, generally the month with more days of freezing rain is January, with 177 cases with freezing rain, followed by December, with 168 cases with freezing rain, and the year with the highest frequency of occurrence of this extremely dangerous phenomenon was 1989, with 32 cases, followed by the years 1996 and 1997, with 27 cases each.





Fig. 2. The frequency of freezing rain during 1972-2008

Further analysis was done in terms of the thickness of the ice on the conductors, there were 426 cases between 1-10 mm diameter, 5 cases between 11 to 20 mm in diameter and in 6 cases the diameter on the conductors was larger than 20 mm.

3.1. Synoptic analysis

Analyzing all the cases with freezing rain during 1972-2008, in terms of temperature in which freezing rain began submitting the highest occurrence is for air temperatures between -5 and -2°C, while the temperature at which the phenomenon has ended, the highest frequency was for temperatures between 0 and $1^{\circ}C$ (table 1).

Thermal inteval (°C)	Number of cases		
	With freezing rain	Without freezing rain	
-2 <t≦-1< td=""><td>129</td><td>41</td></t≦-1<>	129	41	
-1 <t<0< td=""><td>123</td><td>89</td></t<0<>	123	89	
0≥T≥1	21	186	
T>1	2	51	
-5 <t≤ -2<="" td=""><td>134</td><td>56</td></t≤>	134	56	
T≤-5	23	11	

Table 1. The thermal range of appearance for cases with freezing rainin indentical synoptic situations

3.1.1. The 16th of January 1990; 22-23rd of December 1995

On 15th of January at the 850 hPa level, the temperature in the northwest was -5°C, and in the next two days has reached 2°C. The temperature shows that the average orientation of a mass penetration indicates warm air mass over a cold air mass, the geopotential isopleths and the 500 hPa level was increasing. On the previous day of glazed frost occurrence day, Romania has been under the influence



of an anticyclone field, and the next day the Northwest part of the country has been under the influence of a cyclone off Icelandic trough.









Fig. 3. Review media and pressure field average 700 hPa geopotential, 850 hPa temperature and sea level pressure

3.1.2 The 3rd of December 1993; 21st of January 1997

During the day of 2nd of December, $-2^{\circ}C$ temperature was recorded at 850 hPa level, following that over our country a warm air mass advanced, so the temperature have reached around 0°C. This thermal heating took place on the whole column. The surface is under the influence of a relatively high pressure field and the geopotential in altitude is increasing.







Fig. 4. Review media and pressure field average 700 hPa geopotential and sea level pressure

After analyzing the cases of freezing rain that took place on relatively large areas in the Northwest, in the period 1972-2008, we have gotten a few situation:

Date	Synoptic analysis
2-3/12/1985	Field anticyclone on the ground, back elevation, and takes of warm air entering a cooler air mass.
16/01/1990 22- 23/12/1995	Anticyclone over the ground field, entering a cyclone in trough elevation Icelandic cyclone and takes off from a warm air mass entering a cooler air mass.
3/12/1993 21/01/1997	Field anticyclone ground, geopotential slight increases in altitude and takes a load of warm air entering a cooler air mass.
28-31/12/ 2002 6/12/2003	Trough elevation short wave cyclone ground and take a cooled air mass over a warmer table.
18/12/2004	On the ground cyclone in trough elevation and penetration of cold air masses over a warmer table.

Table 2.	Synoptic	situations	for days	with fr	eezing	rain
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From the sounding data recorded at Cluj-Napoca the heights of 0 and - 10° C isotherms were extracted for cases where we had freezing rain on relatively large areas. In all cases there was thermal inversion near the ground level, this also promoting the freezing rain.



Date	Isotherm de 0°C (m)	Isotherm de -10°C (m)
2-3/12/1985	400	3000
16/01/1990	600	3500
3/12/1993	400	3000
22-23/12/1995	400	3800
21/01/1997	400	3500
28-31/12/2002 and 6/12/2003	No data	No data
18/12/2004	400	3700

 Table 3. Isotherms height of 0 and -10°C and height of thermal inversion

4. CONCLUSIONS

The month with the highest frequency in occurrence of freezing rain is January and the year with the highest frequency in occurrence of freezing rain was 1989, with 32 cases of freezing rain. The temperature with the highest frequency of occurrence of freezing rain is between -5 and -2° C.

Synoptic analysis of the situation where we had the largest expanse of freezing rain which occurred in the most of the cases shows that it take place when a warm air mass enter over a cold air mass. On the other side, there is a trough separated from the cyclone with corresponding ground Icelandic phenomenon favors a wider area in the Northwest, this is occurring at a rate of 62.5% from the cases. Freezing rain has been favorised by the existing thermal inversion at the ground level in most of the cases, the isotherm of 0° C being close to the ground level, at 400/600 m, and the level of -10° C at 3000/3800m.

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