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EARLY BLIZZARD PHENOMENA IN SOUTHEASTERN ROMANIA. CASE STUDY: 2-3 NOVEMBER 1980

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Key words: early blizzard, cut-off, windchill.

Abstract: Extreme weather events are natural phenomena that occur frequently, but their appearance outside their happened season (late spring or early fall) may embarrass the natural cycles of vegetation or some economic activities of society. Blizzard is one of the most complex phenomena of cold season whose production can cause many social and environmental shortcomings of feature during the event, the more its appearance in season further disrupt both the environment and human society. November is seen speaking month of autumn, when the natural cycle of plant vegetation definitely not over yet, so the occurrence of phenomena such as blizzard (a cold season phenomenon), can cause damages especially in agriculture. Based on these considerations, in this paper is climatological analyzed the earliest blizzards in southeastern Romania for a period of 51 years (1961-2012) and a case study carried out during the blizzard of 2 to 3 November 1980. Meteorological data provided by the Database of National Meteorological Administration include the time period of the blizzard progres from 12 meteorological stations located in the reference area. For the case study are used synoptic maps from www.wetter3.de; www.noaa.org.com; www.weather.uwyo.edu; www.meteoromania.ro.

Introduction

National Weather Service defines a blizzard as a severe snowstorm characterized by low temperatures and strong winds bearing a great amount of snow, either falling or blowing. According to Environment Canada a blizzard must have winds of 40 km/h or more, have snow or blowing snow, visibility less than 1 km and a windchill of less than -25 degrees celsius. All of these conditions must last for 4 hours or more.

The blizzard is a natural phenomenon with a climatic risk that occurs on certain favorable synoptic conditions, especially during the cold season. But on

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certain conditions, blizzard happened early fall or late spring. One such extreme event was in southeastern Romania between 2 to 3 November 1980 (Fig.1).

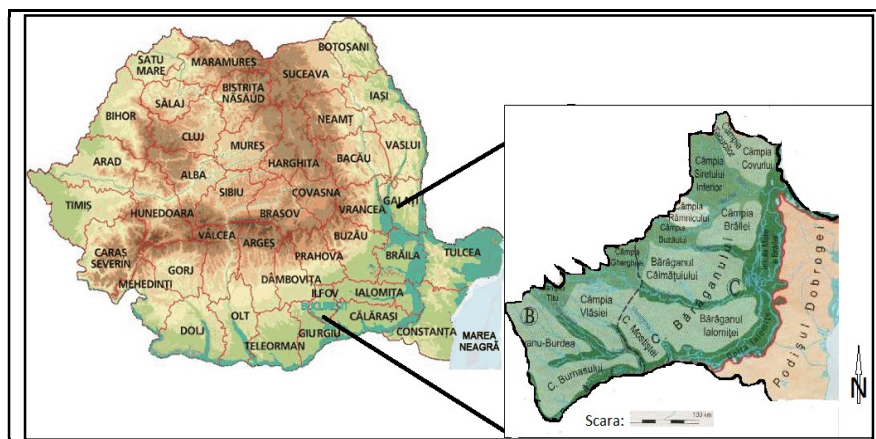


Fig. 1 Romania map (www.wikipedia.ro; *** Geografia României, vol V)

The occurrence of climatic risk phenomena, such as the blizzard during the late spring or early fall, creates difficulties to the environment and society. In România, over time were often blizzards phenomena during the late fall, the earliest date being on 25 to 27 October 1912 (Bălescu, Besleaga, 1962). The monthly distribution of the phenomenon in southeast Romania reveals that on November, the annual mean is 0.4 days with blizzard.

Based on these considerations, this paper analyzes blizzard during 2-3 Noiembrie 1980. At the same time there is an analysis of synoptic conditions that determined the production of this episode in southeast României.

In 1962 Bălescu and Beșleagă said that over time there were blizzards in November, some of them with loss of life (Sulina 15 to 17 November 1904) and the most affected two sectors of economy were the transportation and agriculture (especially grain autumn crops of germinating plant).

A complex climatologically analysis vs. one synoptically it is necessary and can have a practically importance, as well.

Data and methods

Climatological analysis of the blizzard phenomenon could be done using meteorological data from 12 meteorological stations located in southeastern Romania over a period of 51 years (1961-2012) provided by the National Meteorological Administration. The data were carefully selected; covering periods only the blizzard phenomenon occurred and include data on blizzard

occurrence/nonoccurrence, minimum and maximum temperature, mean temperature, the amount of precipitation accumulated in 24h, the type of precipitation, snow depth, maximum wind speed, mean wind speed and the wind direction using the downburst, as well.

Synoptically analysis of the case study from 2 to 3 November 1980 is based on the 500 and 850hPa geopotential maps, 2m temperature, the Skew T-log P soundings (www.wetter3.de, www.weather.uwyo.edu, etc). At the same time, for analysis of weather conditions on the sea level during the blizzard episode it was used sea level real maps provided by NMA database.

Premises

Climatologically speaking, during the period between 1961 and 2012, 151 days with blizzard occurred in November at the 12 southeastern Romania meteorological stations. The annual mean of the days with blizzard in November (Table 1) ranged between 0.04 (Constanța) and 0.5 (Făurei). Year in which blizzard

Tabel.1 Number of days with blizzard phenomenon in November during the period between 1961 and 2012 in southeastern of Romania

Year/ Station	București Băneasa	Brăila	Buzău	Călărași	Constanța	Făurei	Focșani	Galați	Grișița	Râmnicu Sărat	Tulcea	Urziceni
1961											1	
1965						2		1	1			
1966						1						
1967						2						
1968	1											
1969	1											
1975		4	3	4	1	3		4		3		
1976			2						3			
1980			1					1		1		2
1981		5	1	2	1	4	2	7	1	3	1	
1983				1								
1984							3					
1985	3		1									
1988									1			
1993	5	2	6	3		6	5	4	6	3	1	7
1995		4					1					
1996												
1998		2	2				2	2	3	2		2
2001								1			1	
2005			1									
Annual Average	0.24	0.59	0.41	0.20	0.04	0.5	0.37	0.39	0.29	0.33	0.08	0.22

was best represented was in 1993 when blizzard occurred in 48 days in all 12 analyzed meteorological stations. The earliest blizzard was reported within 2 to 3 November 1980, an episode that will be characterized as the case study of this paper.

Discutions about the case study: 2-3 November 1980

The synoptic analysis. It has been analysed the sea level pressure for 1st of november 1980, 00:00UTC and was noted the existence of the Scandinavian anticyclon which had pressure values of 1040hPa in the center of it and a cold mass air transport on its east side was remarked (the dark blue areas in Fig. 2). Over Eastern Europe the cool advection towards mean latitudes (including our country) it has been seen for the entire half lower tropospheric column (TR 500-1000).

In Romania on November 1, 1980 hour 00:00 UTC (Fig. 2a), extended anticyclone regime prevailed over most of the European continent up in the Mediterranean. The Carpathian Mountains determined a strong western and eastern pericarpethian cool forcing first over Moldovia, Romanian Plain and Carpathian-Balkan sink and second over the Plains of Hungary, western Romania, Serbia and Bulgaria. At the same time the 500 hPa geopotential revealed the presence of a large anticyclon over Eastern Europe extended to the Arctic Circle, flanked by two deep trough. For Romania's geographical area has a good influence the trough extended from the Barents Sea over East European Plain up to Romania.

The next day, November 2, 1980 hour 00:00UTC (Fig. 2b), the anticyclonic regime intensifies and the sea level pressure had values of 1030hPa. Meanwhile, at the higher levels, the trough is moving southern.

For Romania, the November 3, 1980 hour 12:00UTC (Fig. 2c), the 544hPa isoline was situated western and caused the increasing pressure over the studied area. On the other hand, cold and dense mass air of the Scandinavian anticyclone developed a southern movement that caused increased pressure values over Romania of 1025 hPa to 1030 hPa, 36 hours later when occurred, over Romania, the blizzard phenomenon analyzed in this case study.

The maximum intensity of the phenomenon occurred on November 3, 1980 when the trough extended to the Mediterranean and even deepened forming a cut-off of 544 hPa, value close to the 545 hPa characteristic to winter.

This structure led to quite extensive rainfall areas in our country and cooling resulted in the 850 hPa (Fig. 3a and b) the presence of -10 and -8° C isotherms above our country generated the precipitation as snow. The accumulated snow cover was moderate (10-15 mm), including in region of interest (SE Romania).

Due to the negative thermal regime at the ground level (Fig. 3c and d), the new snow cover deposited was almost equivalent to the amount of water fallen (10-15 cm).

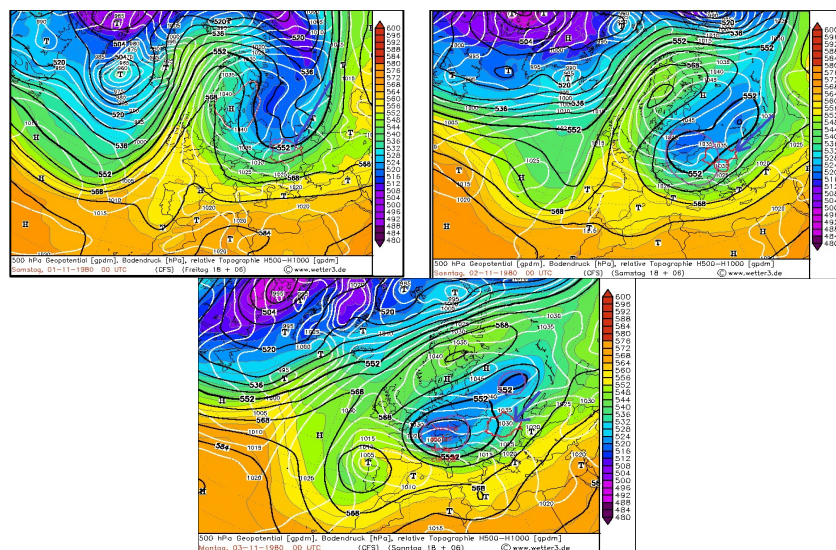


Fig. 2 Geopotential at 500hPa, 00:00 UTC for 1.11.1980 (up left); 2.11.1980 (up right) and 3.11.1980 (down) (www.wetter3.de)

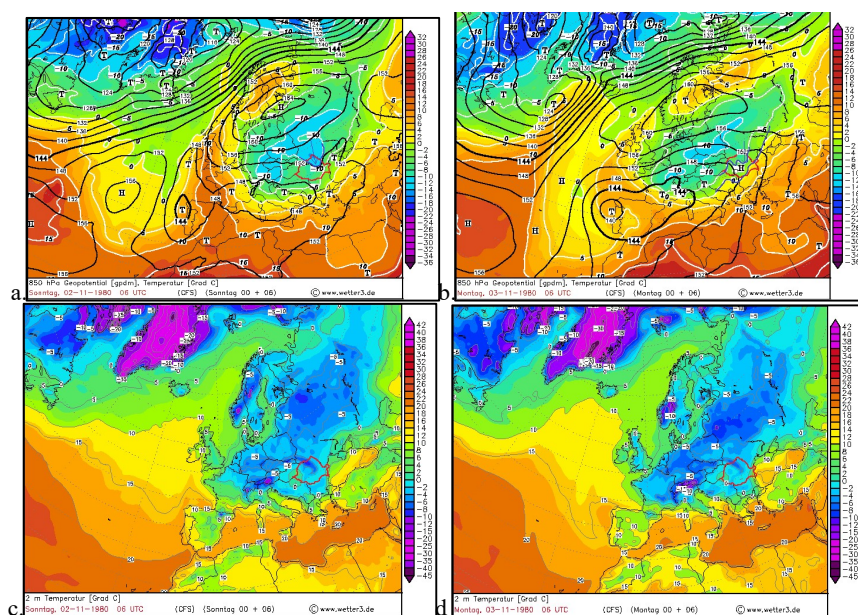


Fig. 3 Air temperature and geopotential at 850 hPa, 06:00 UTC for 2.11.1980 (a); 3.11.1980 (b) and air temperatura at 2m, 06:00UTC for 2.11.1980 (c); 3.11.1980 (d); (www.wetter3.de)

The coupling between snowing and strong wind was determined by increased pressure on the anticyclones over Romania which led to the blizzard phenomenon in the geographical area of our country and hence in south-eastern Romania.

The weather conditions at the sea level. Between 1 and 4 November 1980 (Table 2), the weather conditions were worse day by day and the air temperature was very low for this period, the mean air temperature is between 4.6 ° C at Urziceni (11/01/1980) and -1.6 ° C to Rîmnicu Sărat (02/11/1980). The minimum temperature ranged from 2.4 ° C to Urziceni (01/11/1980) and -4.3 ° C in Galați (11/04/1980).

Tabel 2 The weather conditions for the time period between 1 and 4 November 1980

Station	Date	Meteorological elements								
		Air temperature (°C)		Rainfall (mm)	Snow cover (cm)	Wind speed (m/s)		Maximum wind speed direction	Characteristic phenomenon	
		Minimum	Average			Average	Maximum		Ground snow transport	Blizzard
Buzău	1	2.0	4.1			10.3	20	NE	0	0
	2	-2.0	-0.9	1.6		10.8	14	NE	0	0
	3	-2.2	-0.3	10.9	10	9.8	20	NE	0	1
	4	-1.4	0.4		7	0.5	4	NE	0	0
Galați	1	0.2	3.6			6	9	NNV	0	0
	2	-2.7	-1.3	2.4		6.3	8	NNV	0	0
	3	-2	-1.2	13.8	12	8	14	NNV	0	1
	4	-4.3	-1.4	0	15	2.8	10	NNV	0	0
Rîmnicu Sărat	1	0.5	3.4			5.2	8	N	0	0
	2	-2.5	-1.6	2.3		5.5	8	N	0	0
	3	-2.5	-0.9	14.9	11	6.5	9	N	0	1
	4	-1.7	-0.4		15	0	4	N	0	0
Urziceni	1	2.4	4.6			10.2	14	NE	0	0
	2	-2	-0.8	1.4		12	14	NE	1	0
	3	-2.5	-1	2.6	10	11	16	NE	1	0
	4	-0.3	0.2		3	12	12	NE	0	0

Have been recorded rainfall (Fig. 4a and b) as rain in the beginning and then turned into frost, sleet and snow. Accumulated quantities ranged from 1.4 mm to Urziceni (11/02/1980) and 14.9 mm in Rîmnicu Sărat (03/11/1980). Snow cover ranged from 10 cm (Buzău and Urziceni) and 15 cm (Rîmnicu Sărat). Wind suffered major intensification of the gust reached 20 m/s at Buzău, the dominant direction was north and north-eastern, except in Galați where the north-western dominant direction was.

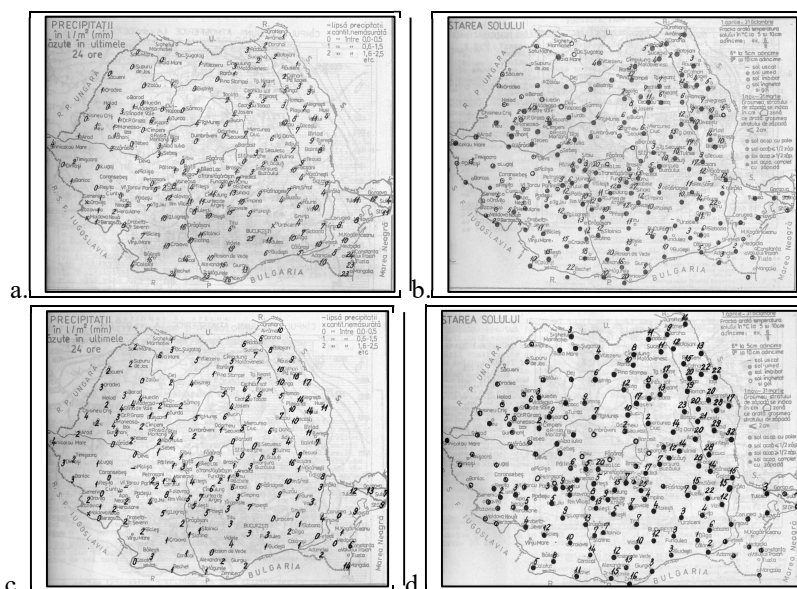


Fig.4 Precipitation for 2-3 November (a) and 3-4 November (c) and Snow Cover for 2-3 November (b) and 3-4 November (d); National Meteorological Administration

Results

Synoptic analysis of this episode shows a nonclassic blizzard for south-eastern Romania, just because this phenomenon often occurs during the cold season due to the coupling between the Mediterranean cyclone and the Eastern European anticyclone over Romania that causes the weather cooling. The blizzard described in this case study occurred due to the cut-off which caused severe weather.

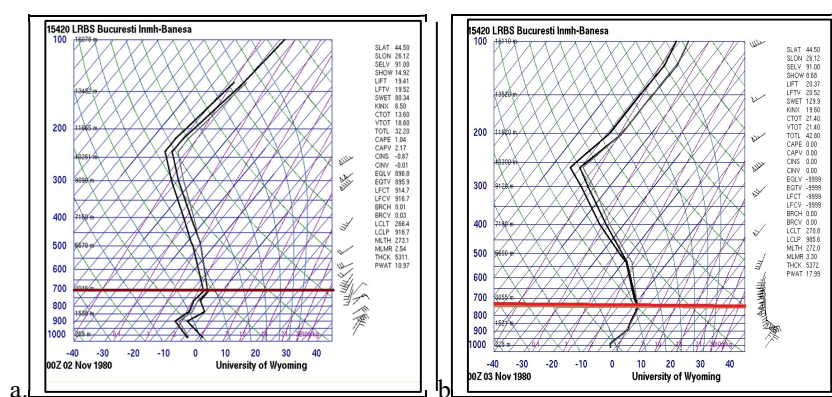


Fig. 5 SkewT-logP soundings Bucharest Băneasa, 00:00 UTC for 2.11.1980 (a) and 3.11.1980 (b) www.uwyo.edu.com

Reading the Skew T-log P soundings from Bucharest Băneasa it can be seen in the lower levels the cold air mass shown by the inversion at the 700 hPa level (Fig. 5a and b). At the same time the wind vertical profile indicate a north-east air mass circulation in conjunction with the anticyclonic regime in the lower levels (alignment Bucharest-Buzău), corresponding to the specific flow deviation from the northern Carpathian curvature especially in land area adjacent layers. Using the same sounding, for the middle and high altitude, it can be seen the rotation in the vertical wind profile, the dominant direction for the middle troposphere being west-southwest.

Consequences

1-4 November 1980, cooling. The blizzard episode was occurred over a long period before and that's why the access to the database of National Systems of Emergency Situation Management (NSESMS) for knowing the phenomenon consequences on the economy and society is not yet permitted.

In this paper are analyzed: the air mean, minimum and maximum temperatures. The values of these being quite low for that time period, have caused some difficulties particularly in the agriculture (winter crops in the germinating plant stage).

Table 3 The mean, minimum and maximum air temperature deviation due to the climatological norms (1961-2012), for 1-4 November 1980

Station	Date	Average air temperature (°C)			Maximum air temperature (°C)			Minimum air temperature (°C)		
		Measured average temperature	The calculated climatological norm (1961-2012)	Deviation from the normal	Measured maximum air temperature	The calculated climatological norm (1961-2011)	Deviation from the normal	Measured minimum temperature	The calculated climatological norm (1961-2011)	Deviation from the normal
Buzău	1	2	3,6	-1,6	4,1	8,1	2,6	9,8	13,7	-3,9
	2	-2	4	-6	-0,9	7,9		2,2	13,3	-6
	3	-2,2	4,6	-6,8	-0,3	8,1	9,8	2,6	13,1	-6,8
	4	-1,4	4	-5,4	0,4	7,8	9,4	2,2	13,4	-5,4
Galați	1	0,2	3,9	-3,7	3,6	7,8	4,7	8,5	12,9	-3,7
	2	-2,7	4	-6,7	-1,3	7,8	8,7	2,8	12,8	-6,7
	3	-2	4,6	-6,6	-1,2	8,1	9,6	0,2	12,8	-6,6
	4	-4,3	4	-8,3	-1,4	7,6	12,3	0,5	12,5	-8,3
Râmnicu Sărat	1	0,5	3,8	-3,3	3,4	8,5	4,3	9,3	14,6	-3,3
	2	-2,5	3,6	-6,1	-1,6	8,5	8,1	0,6	14,2	-6,1
	3	-2,5	4,1	-6,6	-0,9	8,2	9,6	2,8	14,1	-6,6
	4	-1,7	3,8	-5,5	-0,4	8	9,5	1,8	14,1	-5,5
Urziceni	1	2,4	3,3	-0,9	4,6	8	1,9	11,7	14,2	-0,9
	2	-2	3,3	-5,3	-0,8	7,7	7,3	3,3	13,7	-5,3
	3	-2,5	3,5	-6	-1	7,8	9	0,9	13,5	-6
	4	-0,3	3,2	-3,5	0,2	7,6	7,5	1,8	17,1	-3,5

For the period between 1961 and 2011 were calculated climatological norms and air mean, minimum and maximum temperature deviation in relation to the climatological norms.

Table 3 represents the air mean, minimum and maximum temperature deviation and it can be observed that were negative values in all four days of the time period.

The air mean temperature deviation versus climatological norms ranged between -3.4°C (Urziceni) and -10.1°C (Rîmnicu Sărat), the air minimum temperature deviation was between -0.9°C (Urziceni) and -8.3°C (Galați), while air maximum temperatures deviation was between -2.5°C at Urziceni (01/11/1980) and -13.6°C to Rîmnicu Sărat (02/11/1980).

Table 4 Windchill for 1-4 November 1980, southeastern of Romania

Station	Date	Cooling index depending on ambient temperature and average wind speed		Cooling index depending on minimum air temperature and maximum wind speed	
		P.r.	T.p.r. ($^{\circ}\text{C}$)	P.r.	T.p.r. ($^{\circ}\text{C}$)
Buzău	1	1076.2	-9.29	1043.35	-16.73
	2	1083.96	-17.03	1088.38	-20.99
	3	1077.12	-15.3	1047.55	-23.47
	4	644.82	-7.82	955.13	-8.35
Galați	1	1015.46	-5.62	1069.4	-13.94
	2	1027.5	-12.53	1060.02	-16.91
	3	1058.52	-14.71	1088.38	-20.99
	4	894.07	-5.07	1082.6	-21.45
Rîmnicu Sărat	1	993.61	-4.69	1056.82	-12.44
	2	1007.43	-11.6	1059.82	-16.63
	3	1031.55	-12.3	1072.1	-17.8
	4	401.19	17.17	955.43	-8.71
Urziceni	1	1075.06	-8.49	1083.98	-14.21
	2	1087.8	-17.76	1088.38	-20.99
	3	1084.97	-17.33	1080.9	-22.74
	4	1086.8	-16.26	1087.3	-17.17

The dominant index for highlighting the air cooling is the windchill that is calculated using the formula developed by Ionac and Ciulache (Ionac&Chiulache, 2008). This index is based on the air mean temperature and wind speed, the association of the two parameters amplify the sensation of cold in the body.

The index lowest values were for the time period between 3 and 4 November 1980, when the felt temperature had values between -11 and -18 ° C.

In terms of extreme values (air minimum temperature and maximum wind speed), the temperature felt by the human body was between -8 and -22 ° C, values that characterizes the weather climate as *very cold, even slightly hypocaloric stress* (Ionac&Chiulache, 2008).

Conclusions

From the point of view of total annual number of days with blizzard and of multiannual mean of days with blizzard, November is the least representative in terms of blizzard phenomenon, and that's why blizzard creates many difficulties for human society.

From previous studies (Bălescu&Beșleagă, 1962), may be noticed that over the time occurred blizzards in November with intensity that caused loss of life (Sulina 15-17 November 1904);

During the analyzed period (1961-2012), multiannual mean of days with blizzard, November ranged from 0.04-0.6. Most days were in Făurei and Galați (20) and fewest in Tulcea (4) and Constanța (2).

1993 is the best represented year in terms of blizzard presence (42).

The earliest blizzard episode in southeastern Romania was in the time period between 2 and 3 November 1980, which is analyzed as a case study in this paper.

The 2-3 November 1980 blizzard was not caused by a classical structure coupling cyclone-anticyclone, but the cut-off structure in the geopotential field that led to moderate precipitation quantity, while strong wind gusts were due to the pressure fluctuations at the ground level, where it was mostly an anticyclone system.

Blizzard time duration was about 10 hours.

The maximum intensity of the phenomenon was on November 3, 1980 at Urziceni and Buzău (the maximum wind speed reached 20m/s).

The snow cover was between 7 and 15cm (Galați)

The maximum precipitation quantity was 14.9mm (Râmnicu Sărat)

For November, the air temperature had lower values with deviations to the climatological norms about -15°C (Urziceni 4.11.1980).

Blizzards are potentially very dangerous storms and should never be taken lightly. In an average year, as many people are killed by blizzards as die during tornadoes (Abbott, 2004). The majority of these deaths can be attributed to heart attacks suffered by people shoveling and dealing with the heavy snowfall, traffic fatalities, and walkers losing traction on slick surfaces and people getting lost and freezing to death. Blizzards can also amass a staggering amount of property damage.

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