THE WAVE OF SNOW WHICH COVERED THE NORTH OF MOLDAVIA IN THE INTERVAL 9-20TH OF DECEMBER 2012

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ABSTRACT. – The wave of snow which covered the north of Moldavia in the interval 9-20th of December 2012. This workpaper analyzes two episodes of blizzard snow, which affected the Northern part of Moldavia, the counties Suceava and Botoşani, in the half of December, 2012. It shows the violent beginning of the first episode of blizzard (9-12th of December 2012), which came after the first decade of a gentle December. It had consequences for the transport of Botoşani county (shuting down the traffic routes in the East and North of the county and in a proportion of 75 percent in the rest of the county) and also it affected the central and East part of Suceava county. Apart from transports, these episodes of blizzard leaded to blocking in case of old persons, deprived of power, and because of the traffic routes, lack medical crews to give them first aid, closing the schools, shops (lack of input raw materials supply) etc.
What is desirable to point out more in this article, apart from the risks mentioned earlier, it is the synoptic context, who favored the production of these two episodes of blizzard, amount of precipitation fallen on the average and maximum speed of the wind, temperature, maximum and minimum felt of the human body (cooling index) and the climatic risks resulted.

Keywords: blizzard, synoptic context, cooling index, climatic risk, Northern of Moldavia

1. INTRODUCTION

The blizzard is a phenomenon that occurs every winter at the level of Romania, and especially in the extracarpathian regions, having adverse effects on human and the activities undertaken by them. The formation of blizzard and its consequences in Romania have been studied by meteorologists, even from the beginning of romanian meteorology, important contributions giving Bălcescu, Beşleagă, 1959; Bălescu, Beşleagă, 1962; Milea et al, 1967; Bogdan Niculescu, 1999; Georgescu et al, 2009; Apostol, 2004; Apostol, L. et al, 2012; etc.

It is important to mention the fact that, from the beginning of 1961, there is a review in appreciation of the phenomenon of blizzard, which is assimilated to transport snow at height, actually followed, inherent in some discrepancies, in strings of data. The blizzards, which affect South-Eastern and Central-South-Eastern regions of Europe, implicitly Romania, are associated with baric couplings, as well as maximum baric over North-Eastern regions and Eastern part of the continent, here being the Siberian Anticyclon, Scandinavian Anticyclons or

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Azoric maximum (when the trend of migration is to the North) and the mediterranean depressions. In this way, and the jet streams are much meandered, they get up above the central basin of the Mediterranean Sea, the context in which it is transported and a cold air or polar or continental-polar, on a north-east part, from Eastern and North-Eastern of Europe.

The area studied is located in the Northern part of Moldavia (fig. 1), respectively, the counties Suceava and Botoșani, which spans on three major relief steps, namely: Moldavia Plain, in Eastern of the zone, The highland of Suceava, in center and the Northern Group of the Eastern Carpathians, at West.

The blizzard that characterized the Northern of Moldavia, during the period 9-20 December 2012, debuted quite violently, that, after an autumn and a begin of December characterized by warm weather compared to specific climatological values of the period. The debut episode of snow was in the evening of 8th of December, 2012, with a first manifestation of blizzards in the interval of 12-14th of December, 2012, in which, the majority of communications routes from Botoșani county, in particular, were impassable, the most striking example was the DN 24 C, as a result, towns such as Santa Mare or Stânca-Ștefănești have been isolated for several days in a row.

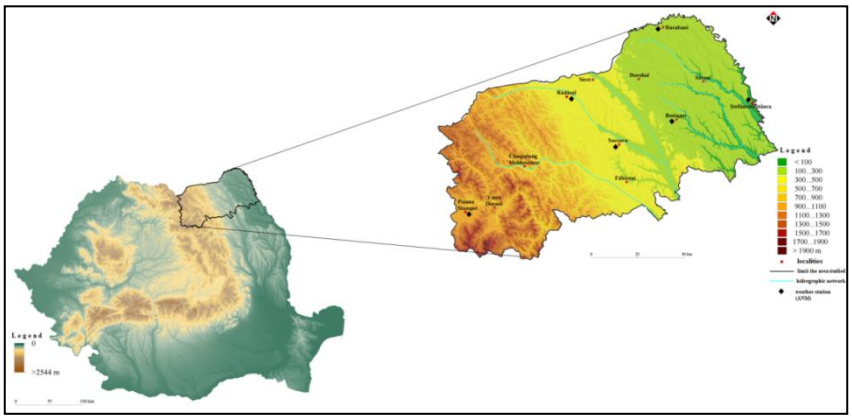

Fig. 1. ***Physico-geographical framing of the area studied***

2. METHODOLOGY

For this material, it has been used meteorological data for observations at every 3 hours, from ogimet.com, mundomanz.com, rp5.ru. They were centralized in a database in Microsoft Office 2007, and these should be processed for graphic and interpretation. It has been used cartographic materials, here referred to SRTM (Shuttle Radar Topography Mission) at the level of Romania, it has a pixel size of 80 x 80 m, they were processed using the software GIS TNT Mips, v. 6.9 and Global Mapper, v. 13.0, with these were processed vector boundaries, the distribution network of meteorological stations, taken from http://geo-spatial.org/.

For the achievement of the synoptically part, were used maps from http://www.wetter3.de/ with the distribution of baric field from 1000 hpa to 500 hpa for the interval 9-20th of December 2012.

3. RESULTS AND DISCUSSIONS

3.1. The temperature

The distribution of temperature values respected, somewhat, the layout of the stations after altitude, which translates into average thermal values of the interval between -6° and -9°C. The lowest values where in the low area, -8,3°C at weather observation station Darabani and -7,4°C at Suceava. Near Stânca-Ștefănești lake the influence of a big volume of water, which has a higher latent heat compared to inland areas, the temperatures were a little bit high, -6,2°C.

Cooling index represents a combined factor between thermal temperature and wind (R. G. Steadman, 1971):

$$T_{IR}=13,12+0,6215T_a-11,37V^{0,16}+0,3965T_aV^{0,16}$$

Where: Ta-air temperature (° C);
V-wind speed in km/h.

On the base of this mathematical relationship it was determined the amount of cooling index for existing weather stations in the area studied. It was observed the most pronounced differences between the recorded temperature thermometer and felt by the human body, in the first part of the interval studied, when the dynamic atmosphere was more active.

For the area studied, in the interval studied, the coldest day, characterized by average thermal values, that were located less than the limit of frost, was 14th of December, day after episode followed by blizzard from the interval 9-11th of December, with one exception, the meteorological station of Suceava, here being the most frosty day on 19th of December,

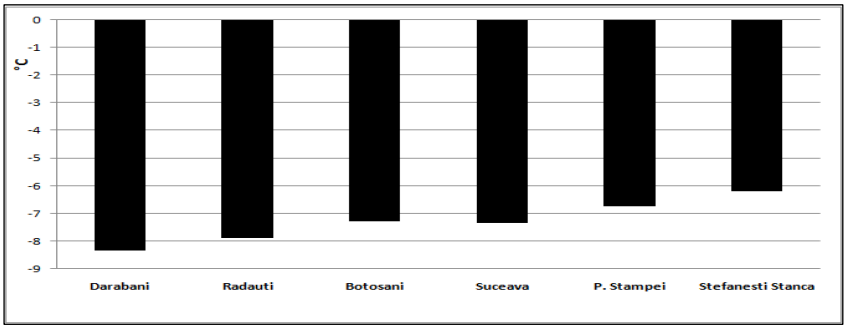

Fig. 2. ***The distribution of average values of temperature for the interval 9-20 December 2012***

which is linked to a second wave of cooling, followed after an episode of blizzard that took place between 17-18th of December. The lowest average dayly temperature for the analysed interval was between -11 °C, at Poiana Stampei, on 14th of December and -17,9°C, at Botoşani on the same data. In the most frosty days, cooling index variated between -14,2 °C at Poiana Stampei and -21,3 °C at Darabani. The biggest difference between average temperature and cooling index in the most frosty days of the stations, for the studied period were 7,1°C at Darabani, and the minimum, 0,1°C, at Rădăuţi (Fig. 3).

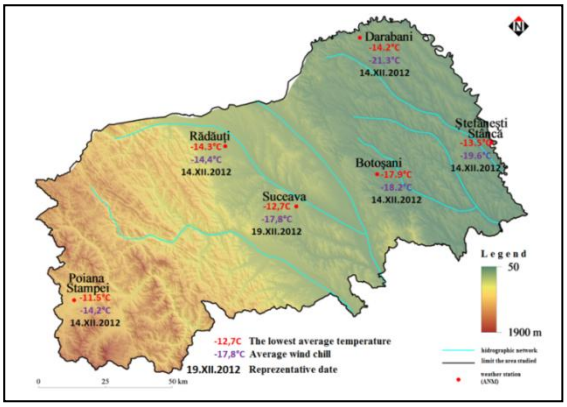

Fig. 3. ***The coldest day into 9-20.XII.2012***

The most pronounced differences between the real temperature and the one felt by the body in that day were: 8,0°C at Darabani, on 15th of December (as a difference between average cooling index of 13,2°C and the average temperature of -5,2° C); 7,3°C at Rădăuţi, on 12th of December (as difference between the average cooling index of 12,6° and the average temperature of -6,1°C); 8,0°C at Suceava on 15th of December (as a difference between average cooling index of -14,1°C and the average temperature of -6,1°C); 5,4°C at Poiana Stampei on 19th of December (as a difference between average cooling index of -12,4°C and the average temperature of -7,0°C, Fig. 4), amid a refrigeration with more radiative base, what happened after 17-18th of December and following an intensification of air movement, but this time, from the prevailing Northwest sector. For this period, average cooling index were -10,2°C, at Poiana Stampei,-10,9°C at Rădăuţi, 11,2°C at Stânca-Ştefăneşti, -11,9°C at Botoşani, -12,9°C at Suceava and -15,0°C at Darabani.

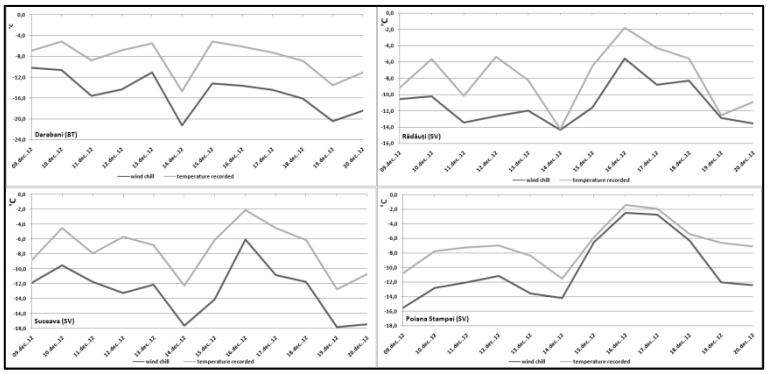

Fig. 4. ***Average temperature registered and cooling index for day 9-20 December 2012***

3.2. Wind and snow layer

A.) The wind. For the interval studied, the predominant wind directions on most weather stations in the area studied were in the Northwestern sector, followed by those from South-Eastern Europe. The only exception was at Poiana Stampei, here, because of the relief; the predominant directions were those from the East-North-East, followed by the South-East and South-West (Fig. 5). These cases were due to, as a first step, the existence of an anticyclone area over the north-western regions of Europe and areal activation depression over the Balkans. This barometric conjuncture favored Northern movements, these transforming into predominantly North-Western movements, because of its existence, the Carpathian chain, the existence of this type of movement through the emergence of the „Coandă effect". The movement that resulted, in particular, during the days of 10-13th of December, to strengthen themselves in the last day, 20th of December, predominant conditions on the type the Northwestern in cyclonic regime.

These directions of wind, in conjunction with the layout of the valleys on a NW to SE component (incidentally, this being a general feature of the entire highland area of Moldavia), favored a sewage of currents over the valleys, it's resulted in a strong blizzard snow.

The highest wind speeds are specific to locality Darabani, here, the average speed of 4,9 m/s, the whole duration of this analysis, and high speed, being mediated of 7,7 m/s. Daily level, the highest value of this parameter is characteristic on 15th of December, being of 8,5 m/s. The position of the meteorological station, on the Jijia-Prut interfluve, favored these high speeds; high speeds, registering at all stations on the highland, due to their location in areas open to the atmospheric circulation.

At the opposite pole, with the lowest wind speeds, due the position of shelter, is the weather station Poiana Stampei, with an average over the entire observation period of 2,2 m/s. The lowest dayly average was of 0,55 m/s, on 19th of December (Table 1).

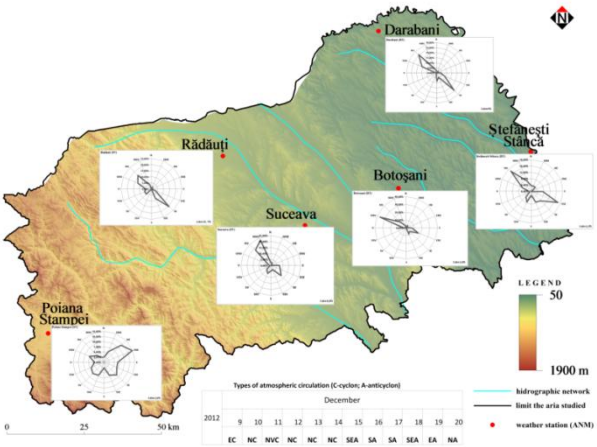

Fig. 5. ***Predominant wind's movement on directions in the range studied (9-20th of December 2012)***

Table 1. ***Average and maximum speeds of wind***

Station	Type caracteristic wind (km/h)	9.XII	10.XII	11.XII	12.XII	13.XII	14.XII	15.XII	16.XII	17.XII	18.XII	19.XII	20.XII
Darabani	average speed daily	6,7	14,4	16,7	23,4	14,9	11,3	30,6	25,2	20,3	18,9	13,1	16,7
	max speed daily	10,8	23,8	21,2	35,6	24,3	15,8	47,4	43,2	36,5	32	18	23,4
Radauti	average speed daily	3,1	10,8	5,7	24,8	7,2	1,8	12	10,8	11,7	5,9	2	4,5
	max speed daily	7,7	16,6	9	38,3	13,1	5,4	24,6	18	20,3	11,7	3,1	7,7
Botosani	average speed daily	5	11,3	5,4	20,3	9,9	1,8	14,4	21,6	19,4	17,1	7,7	12,2
	max speed daily	8,6	19,4	8,6	34,7	17,1	3,2	23,7	32,4	29,3	27	14	22,1
Suceava	average speed daily	5,5	13,3	7,6	26	12,5	9,4	28	11,2	19,7	14,3	8,5	14,8
	max speed daily	9,6	21,2	10,7	41,8	17,5	12,5	35,7	25,6	26,9	19,3	13,9	21,1
Poiana Stampei	average speed daily	8,6	11,2	10,7	8,9	11,2	4,4	2,8	4	3,5	3,1	13,4	12,5
	max speed daily	12,7	15,5	15,2	14,3	17,9	6,2	4	7,6	6,2	5,3	17,9	16,1

B.) Snow layer. The characteristics of snow layer is generated by the activity of the atmospheric depressions, that have enabled over the geographical area of the Balkans, a regeneration in the Western of Black Sea and a slightly retrograde trend of depression that interval 12-14th of December, included in its entirety and the northern part of the Moldavia. As a result of these retrograde movements of the mediterranean depression, resulted and the most significant snowfall, they were accompanied by the increase of the wind, which had led to blizzard snow. The biggest thickness of the layer of snow was in regions with a large opening, from the highland and especially in Moldavia Plain, with an average value for the studied interval of 49,11 cm at Darabani, followed by Stânca-Ştefăneşti here, with an average thickness of 35,3 cm. At Poiana Stampei, due to the orographic shelted condition, the average thickness of the layer of snow reached only 24,6 cm. (Fig. 6 a)

a) b)

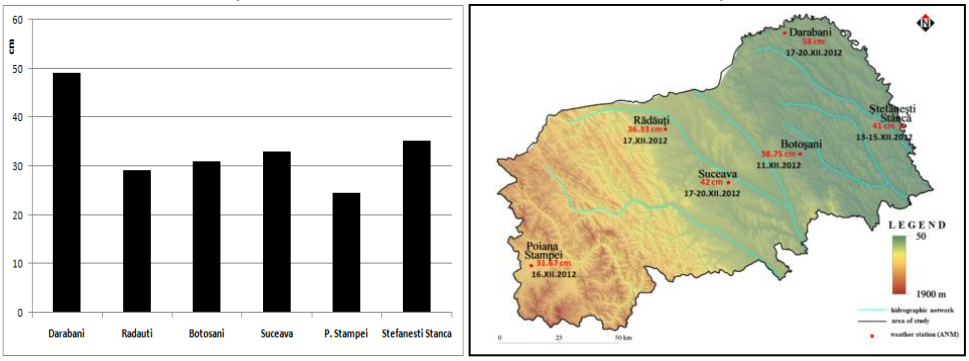

Fig. 6. ***a) The thickness of snow layer at the weather stations from Northern of Moldavia; b) The maximum thickness of snow layer and the registered data***

The maximum thickness, in the eastern part of the area studied, were in the period 13-15th of December 2012, of 41cm at Stânca-Ştefăneşti, and the rest of the region, in the days 15-17th of December, at Suceava 42 cm and at Darabani 58 cm. The maximum thicknesses of the snow layer were preserved until the end of the studied interval (Fig. 6 b).

Following these episodes of blizzard was almost entirely affected, Botoşani county. The most affected parts of the road of severe weather events were those between Coțușca-Viișoara-Păltiniș (DJ 293A); Havârna-Mileanca-Coțușca (DJ 293); Dorohoi-Șendriceni-Dersca-Mihăileni (DJ 291B); Dorohoi-Oroftiana (DJ 291D); Dângeni-Mihăileni (DN29); Santa Mare-Ştefănești (DN 24 C).Also, the blizzard snow also created problems and on the eastern half of the county Suceava, and here, the most affected roads being Vulturești-Hîrtop (DJ 208 C); Vereşti-Fântânele (DJ 290); Suceava-Păltinoasa (DN 17); Păltinoasa-Berchisești (DN 2); Ciprian Porumbescu-Dragoiesti, Baia-DN 2E.

4. CONCLUSIONS

The period 9-20th of December 2012 was a hard winter period in Northern of Moldavia. For this period it was analyzed the synoptic context generated in addition to active surface. The effects materialized with low temperatures, abundant snowfall, winds with high speeds and blizzard they produced negative effects on infrastructure, population and activities carried out by it. It was a period when the climate risks specific to winter season have come forward in the two analyzed counties Botoșani and Suceava, the mountainous area being less exposed. Low temperatures have been analyzed in terms of thermal comfort index, through cooling. On the interfluves of the highland area, due to wind, the sensation of cold is intense, as the asses of the valleys have large values due to the low temperatures of the intense thermal inversions.

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