IMPACT OF THE BLIZZARDS AND COLD WAVES OF 24 JANUARY - 18 FEBRUARY 2012 IN ROMANIA

L. APOSTOL[1], O. MACHIDON [1,2], L. SFÎCA[1], DANA MACHIDON [1]

ABSTRACT – IMPACT OF THE BLIZZARDS AND COLD WAVES OF 24 JANUARY - 18 FEBRUARY 2012 IN ROMANIA In the last decade of the month January 2012 and during the first two decades of the month February 2012, the penetration of the cold air over western and central Mediterranean has spurred genesis of some cyclones in this region, so there were cyclones formed headed to the Balkans and imposed between 24.01.2012 to 18.02.2012 characteristics of weather over the southern, southeastern and eastern Romania (heavy snow, blizzards, waves cold). This paper presents the evolution of the process, precipitation quantities and thickness of the snow registered by the meteorological stations and the rain-gauge stations and their impact on human activities in some localities from Romania.

Keywords: blizzard, cold wave, extreme temperatures, impact, Romania

1. INTRODUCTION

The geographic position of Romania in South-East of Europe, in an interference area of the main baric centers, the sequence and direction of air masses movement, the frequency and intensity of cooling processes facilitate during winter the penetration of anticyclonic arctic air masses in the country, especially polar continental, that produce intense cold waves, and the interaction with Mediterranean cyclones, regenerated over the Black Sea or with some local cyclons, intensifies the regional dynamics of the troposphere, creating icy northeast wind.

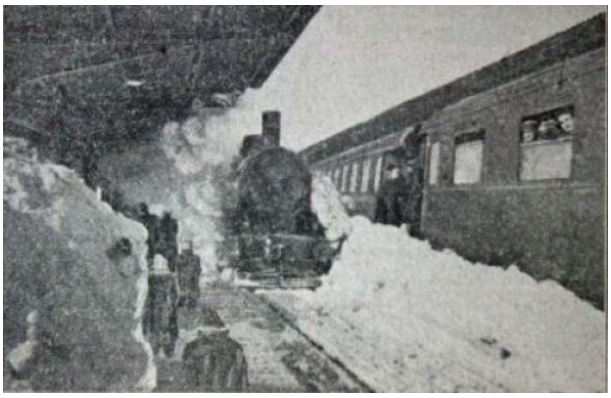
Defined as a shipment of snow above the earth surface, caused by strong and turbulent winds, accompanied or not by snow (Ţâştea şi colab, 1965), the blizzard is a phenomenon with negative impact on the socio-economic activity, as the snow is blown, uncovering the agricultural crops, which in the absence of snow are subjected to winter frosts. Also, the shipment followed by laid snow in sheltered places, forms drifts which hinder or interrupt road, railway, airport traffic and causing many other material damages and even human casualties. Being a phenomenon that occurs every winter in Romania the blizzard has been the subject of numerous analyzes. (Bălescu şi Beşleagă, 1959, 1962; Clima R. P. Romîne, vol. I, 1962; Milea et al, 1967, 1971; Geografia României, vol I, 1983; Bogdan, Niculescu, 1999; Clima României, 2008; etc.). Since 1961, due to changes in meteorological observations methodology, blizzard phenomenon is not revealed. In the tables appear only carried snow on the ground and carried high snow. Carried heigh snow means strong wind accompanied by snow or very strong wind and unconsolidated snow cover, which can be shattered and transported to the high. Currently, the term blizzard it means heigh carried snow. It seems that there is no precise line between blizzard and heigh carried snow.

In Romania, the negative thermic singularities are caused by the cold waves which carry the polar air, especially the continental arctic air from Greenland or the Eurasian continent. In many cases, the continental polar air from the northeastern Europe and northwestern Asia is colder than the arctic air. The predominance of the anticyclonic weather favors the appearance of radiative cooling which maintains or even increases the cooling. (Bogdan, 1999). In scholarly literature there are numerous references regarding the action of anticyclons that produce powerful cooling (Clima R. P. Romîne vol. I, 1962, Topor and Stoica, 1965, Bogdan, 1969; Donisă, Davidescu, 1972, Erhan, 1979 Geografia României, vol I, 1983, Cazacu et al, 1983; Bacinschi et al, 1990; Niculescu, 1993; Ciulache and Ionac, 1995, Bogdan Niculescu, 1999, Apostol, 2004, Mihaila, 2006, Clima României, 2008, etc.). The Carpathians' orographic dam has an important role in the territorial developing of cooling in Romania (Bogdan, 1999); it can be observed that the largest share, 47.3%, belongs to the massive cooling occurred in the regions located in southern, south-eastern and eastern

[1] "Al. I. Cuza" University, Faculty of Geography and Geology, Iasi, Romania, e-mail: apostolliv@yahoo.com, sfical@yahoo.com, danamachi@yahoo.com
[2] N.M.A. Romania - Moldova Regional Meteorological Center, Iasi, Romania, e-mail: ovidiumachidon@yahoo.com

Romania (subjected to direct influence of continental air), while cooling occurred in western, northwestern and central Romania (behind Carpathian's orographic dam) has a share of only 28.6%.

In the past 100 years, in Romania, there have been numerous times when there were records of temperatures below -30C and many periods with blizzard phenomena. The scientific literature mentions some of the most powerful cooling, which occurred in 1893, 1907, 1909, 1927, 1929, 1935, 1937, 1940, 1942, 1943 , 1954, 1961, 1963, 1985 (eg, Bogdan, 1999, Climate RSR, II, 1966) Over the years, the thickest snow layer formed during blizzard periods from february 1954 (Bogdan, 1999), which reached at the end of may at the weather stations in Oltenia Plain 120-130 cm, respectively 80-170 cm in Baragan and 173 cm in the Danube Valley at Calarasi and was higher in the sheltered regions and the valleys from the areas with plains and hills from anterior part of the Carpathians. Because of the wind speed of 40-120 km/h the snow was blasted and drifted, reaching heights over 6 m mostly in eastern and south-eastern Romania (Bogdan, 1969). The most affected roads during this storm were those situated in Baragan, Moldova and Dobrogea, positioned perpendicular to the wind direction. The same thing happened with the national roads along them. These roads were impassable for 7-10 consecutive days due to heavy snowfall, breaking up the phone and telegraph lines, hard access to clear up the snow, which created difficulties in feeding the population. The drifted snow destroyed walls and roofs of homes or winter sheds (due to its weight and the amount of moisture absorbed by them), and through its mechanical action toward the objects on the ground, the blizzard broke the young branches, uncovered houses, broke the power lines, telephone and telegraph lines, etc.. Aspects of the February 1954 blizzard effects were captured in photographic images in newspapers from that time (fig. 1).



a) The arrival of a passenger train from Iasi in Bucharest, North Station

b) Military column wich carries food in Bucharest

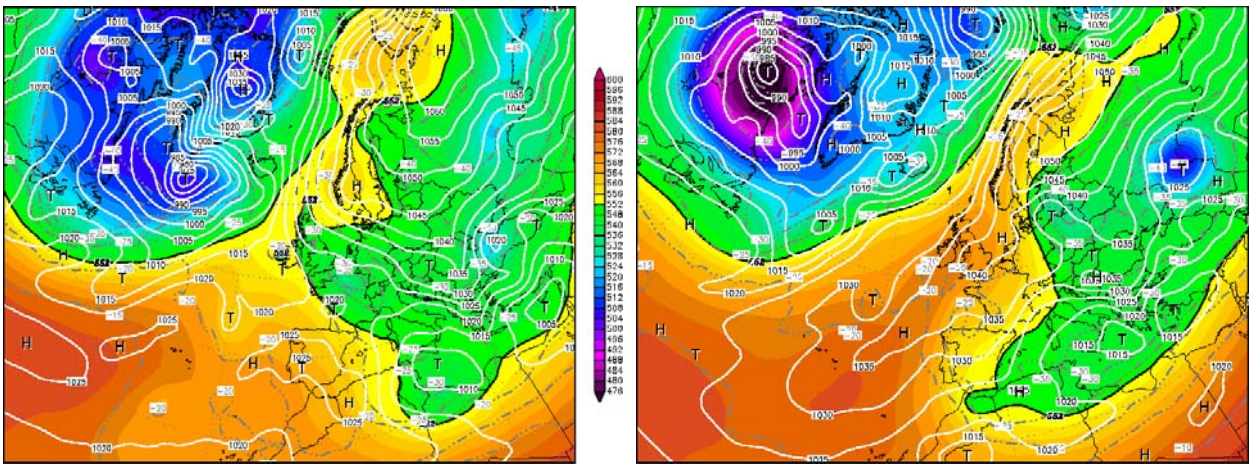
c) Tram going through a snow drift in Bucharest

d) Workers that clear of the snow a tramway Bucharest

Fig. 1 Photos of the blizzard's effects from February 1954 (source:http://www.cotidianul.ro/marele-viscol-din-februarie-1954-171663/)

2. GENETIC CAUSES

Cold waves produced from the end of January 2012 that continued the entire month of February 2012 are the result of total domination of Euro-Siberian anticyclone in the entire European continent, sometimes with a secondary center in Peciora basin. His extraordinary development (over 1060 hPa in the central region) has facilitated the advection of air masses, initially over the Ural Mountains, and afterwards from northeastern European Russia towards Central Europe. Thus, continental polar air covered most of the continent and the arctic air has advanced in the same direction causing extremely low temperatures in Eastern Europe (fig. 2.).



a) b)

Fig. 2. The distribution of temperature and geopotential at the isobaric surface level of 500 hPa and air pressure in the days of 31.01.2012 (a) and 9.02.2012 (b) (according to www.wetterzentrale.de)

The transported cold air, but also the air produced locally by the anticyclonic formation penetrated North Africa, causing snowfall even in Maghreb, in Northwest Africa, where snow is rare (fig. 3 and fig. 4).

Fig. 3. Snow in Magreb (source: http://www.youtube.com/watch?feature=endscreen&NR=1&v=catf1N6atyY, accessed on 1.04.2012)

Also, snow-covered beaches in Spain or the snowy Colosseum remained emblematic images of heavy winters in Europe. The penetrating cold air over western and central Mediterranean spurred cyclogenesis in this region, hence cyclones formed there headed to the Balkan Peninsula and determined in

the period between 24.01.2012-18.02.2012 the weather features in Romania (heavy snowfall, blizzards, waves cold) (fig. 5).

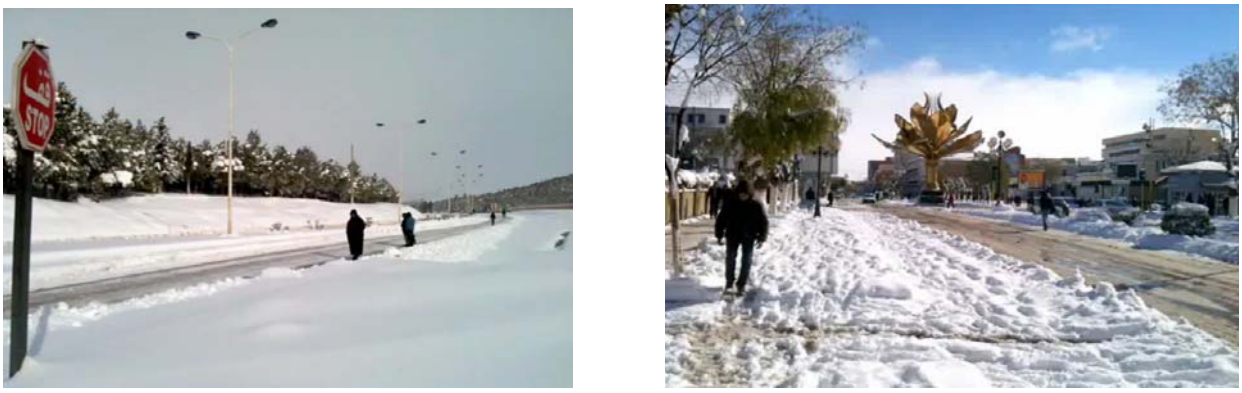
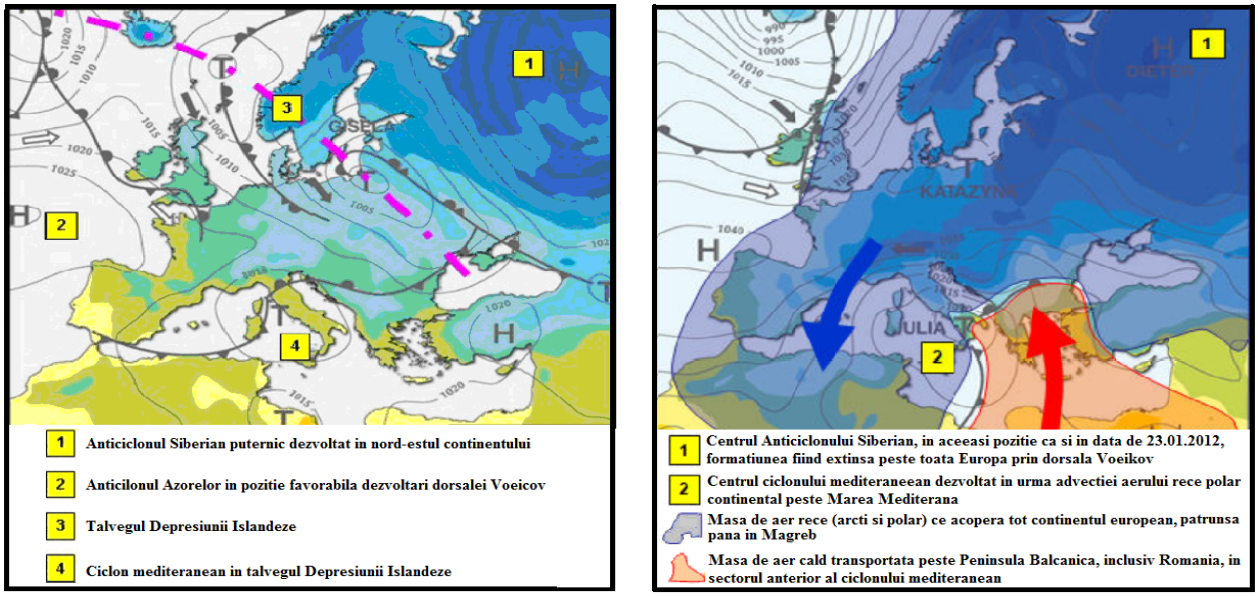


Fig. 4. Snow in Algeria (source: http://www.youtube.com/watch?feature=endscreen&NR=1&v=9sJMMRO0kL4 , accessed on 1.04.2012)



a) b)

Fig. 5. The synoptical situation corresponding European continent on 23.01.2012 (a), respectively 4.02.2012 (b) - adaptation on www.wetter.net

3. WAYS OF MANIFESTATION

Among the highlights of the 2011-2012 winter can be mentioned the very low temperature regime from late January until the first decade of March, which have conserved the snow layer; the frequency, duration and intensity of blizzards; high snow drifts etc.

Between 24.01.2012-18.02.2012 occurred three periods with blizzard, each one lasting from 3 to 5 consecutive days (24-27.01.2012; 3-7.02.2012 and 12-14.02.2012). Blizzards were accompanied by snowfall (fig. 6, 7, 8), the most significant amounts of precipitation occurring in Vrancea, Buzau and Braila counties, where during 3-7.02.2012 (fig. 7) there were records of precipitation over 80 mm (85 mm in Grădiştea, Braila County, 84 mm in Magura, Buzau County, 82 mm in Focsani, Vrancea county). These

values are 3 to 4 times higher than normal value in February and they set a record for maximum amount in 24 hours in February, values that are in many cases close to the maximum annual amount in 24 hours.

The study of the daily snow layer showed that its depth had risen continuously from late January until the second decade of February, when it peaked (fig. 9), and, afterwards began to decrease. Is this winter Vrancea and Buzau counties is the area with the largest amount of laid snow in the case of hilly areas and plains. In Vrancea county the depth of snow exceeded 80 cm at all weather stations and pluviometric stations. The smallest maximum snow depth was recorded in the eastern part of Baragan and in Dobrogea, ranging between 10 and 20 cm.

Due to the snowfall, wind speed of 50-90 km/h, the snow didn't fall evenly, being visibly influenced by the shelter provided by the Curvature Carpathians, microrelief, the position and orientation of traffic routes and the local shelter provided by human settlements. Under these conditions, the snow was storm swept and drifted, reaching heights of 2-4 m in northern and north-eastern periphery of many localities in Vrancea, Buzău and Brăila.

If we compare absolute maximum values of wind speed of about 130 km/h in Bucharest during the blizzard on 21-22.11.1998 and almost 200 km/h during the blizzard of 4-7.01.1966, in Iasi, mentioned in the scholarly literature (Erhan, 1979, Bogdan, 1999), in the winter of 2011-2012 the maximum wind speed was 90 km/h, which was reached on the night of 6 to 7/2/2012 in Urziceni, Ialomiţa county and Corugea, Tulcea county. Hence, the main cause of the high intensity blizzard in this case study, was mainly the big amount of snowfall that accompanied the snow blizzard. The highest wind speed values were recorded in the high mountains, namely at Călimani-Retitiş weather station 122 km/h, and at the Ceahlău Toaca over 144 km/h on 07.02.2012.

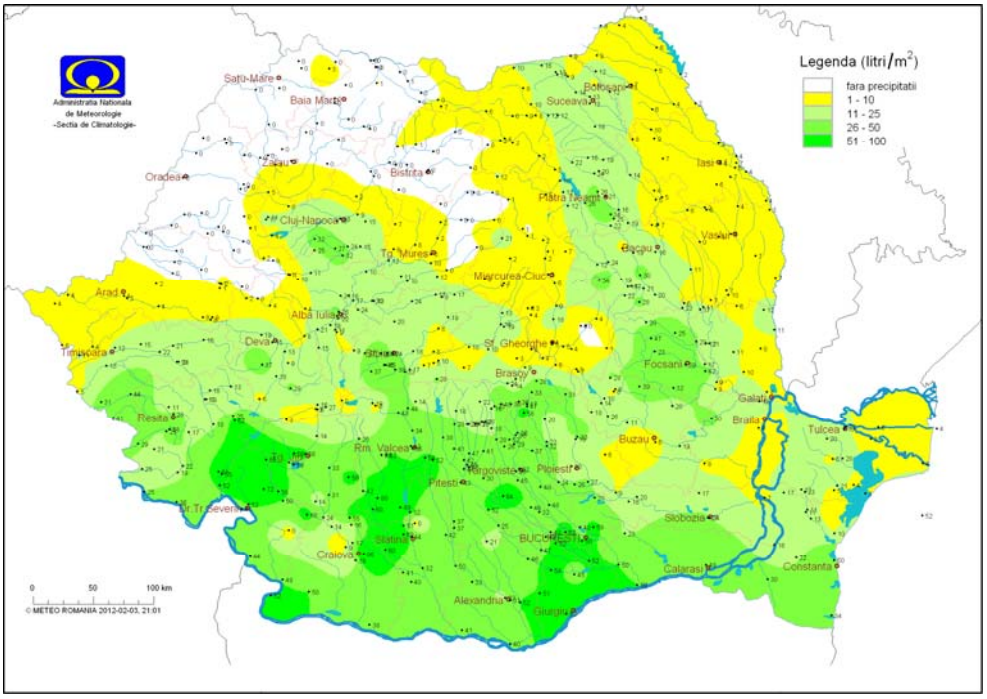


Fig. 6. The amount of precipitation recorded between 24-27.01.2012 at weather stations and the ones from the DESWAT network, pluviometric and hydrological stations

Persistent freezing temperatures in late January, February and early March, represent another feature of 2011-2012 winter, with a potential climatic risk. For the period starting with last decade of January and ending in the first decade of March, on 2, respectively 9.02.2012 were recorded the lowest values of daily average temperatures. The most intense cooling occurred in eastern and south-western Romania, where

average temperatures from the two days fell below - 16oC. In the same days there were daily records of the lowest daily maximum temperature (Table 1).

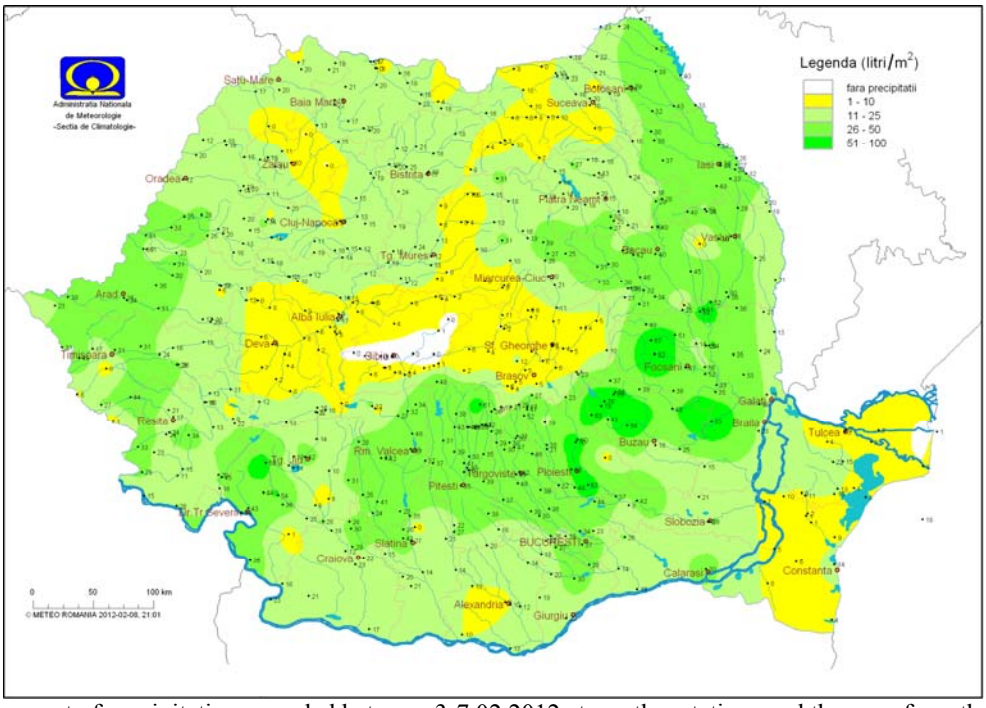


Fig. 7. The amount of precipitation recorded between 3-7.02.2012 at weather stations and the ones from the DESWAT network, pluviometric and hydrological stations

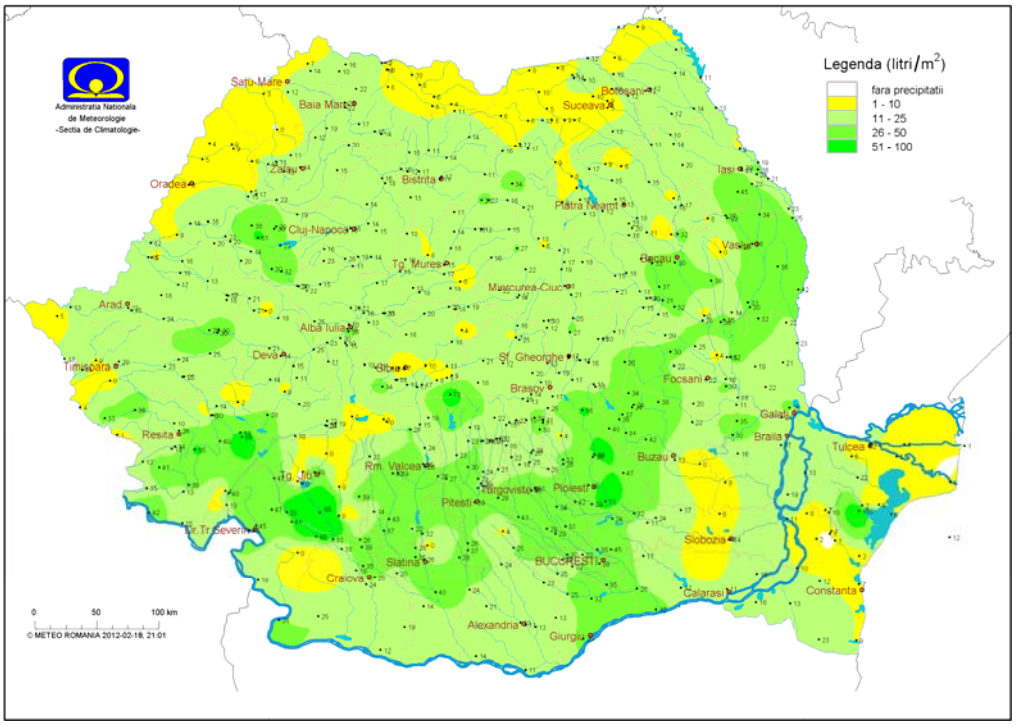


Fig. 8. The amount of precipitation recorded between 12-14.02.2012 at weather stations and the ones from the DESWAT network, pluviometric and hydrological stations

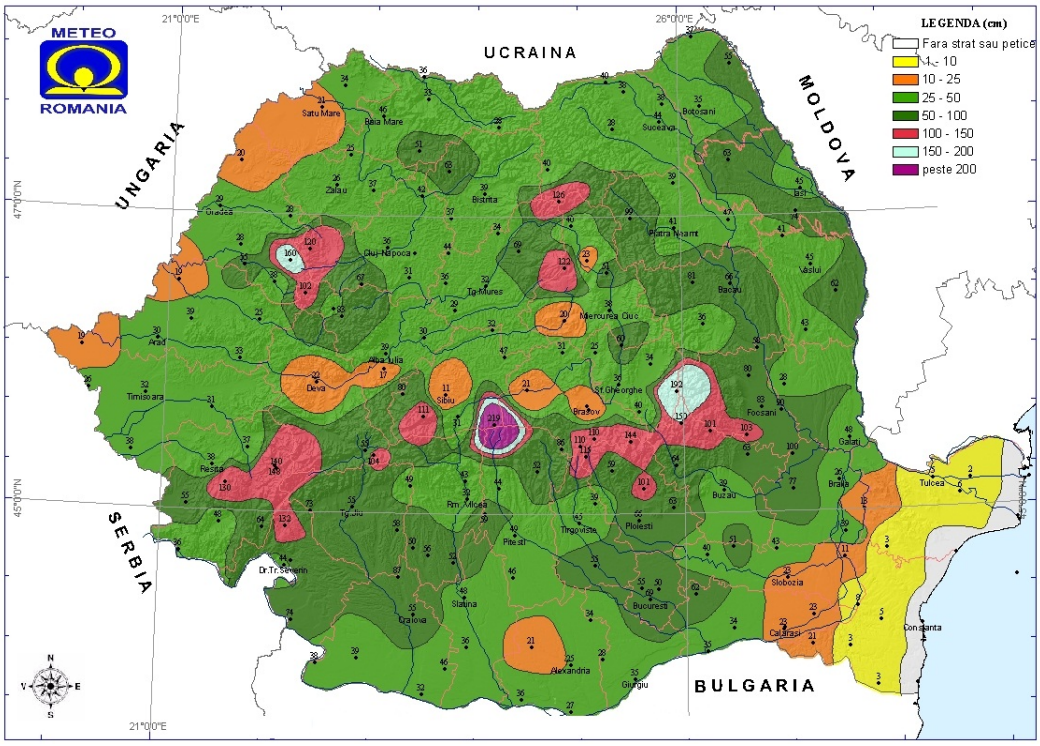


Fig. 9. Snow depth on 17.02.2012 at weather stations and pluviometric stations

In the case of minimum temperatures, the lowest daily values for these data from the entire string of observations were recorded. (Table 2). Thus, on 02.02.2012, in Romania, 8 weather stations recorded the lowest values of the maximum temperatures from that day, and 13 stations recorded the lowest minimum values. On 09/02/2012, four weather stations measured the lowest maximum temperatures and 10 stations recorded the lowest minimum temperatures, on that day of the month, from the entire string of existing observations.

Table 1. Weather stations that recorded on Romanian territory the smallest maximum values of air temperature from the entire string of observations on the days of 2.02.2012 and 9.02.2012 respectively

Date	MAXIMUM air temperature		Date	MAXIMUM air temperature	
	Station	Air temperature (^{0}C)		Station	Air temperature (^{0}C)
2.09.2012	Roşiori de Vede	-12,9	9.02.2012	Bârlad	-11,7
	Tulcea	-11,8		Galaţi	-11,7
	Craiova	-11,7		Oraviţa	-7,6
	Turnu Măgurele	-11,2		Drobeta Tr. Severin	-8,0
	Ploieşti	-10,4			
	Buzău	-9,7			
	Drobeta Tr. Severin	-9,1			
	Târgu Jiu	-8,8			

Table 2. Weather stations that recorded on Romanian territory the smallest minimum values of air temperature from the entire string of observations on the days of 2.02.2012 and 9.02.2012 respectively

Date	MINIMUM air temperature		Date	MINIMUM air temperature	
	Station	Air temperature (^{0}C)		Station	Air temperature (^{0}C)
2.09.2012	Rădăuţi	-30,8	9.02.2012	Rădăuţi	-28,2
	Botoşani	-28,5		Buzău	-18,8
	Braşov	-26,5		Ploieşti	-27,3
	Roman	-25,8		Piteşti	-19,4
	Bacău	-25,5		Rm. Vâlcea	-19,4
	Tg. Secuiesc	-24,8		Târgu Jiu	-23,1
	Iaşi	-24,7		Drobeta Tr. Severin	-21,7
	Bârlad	-23,9		Timişoara	-20,6
	Ploieşti	-22,7		Bucureşti Băneasa	-24,2
	Parâng	-21,7		Turnu Măgurele	-21,0
	Călăraşi	-19,6			
	Craiova	-19,1			
	Sf. Gheorghe	-14,8			

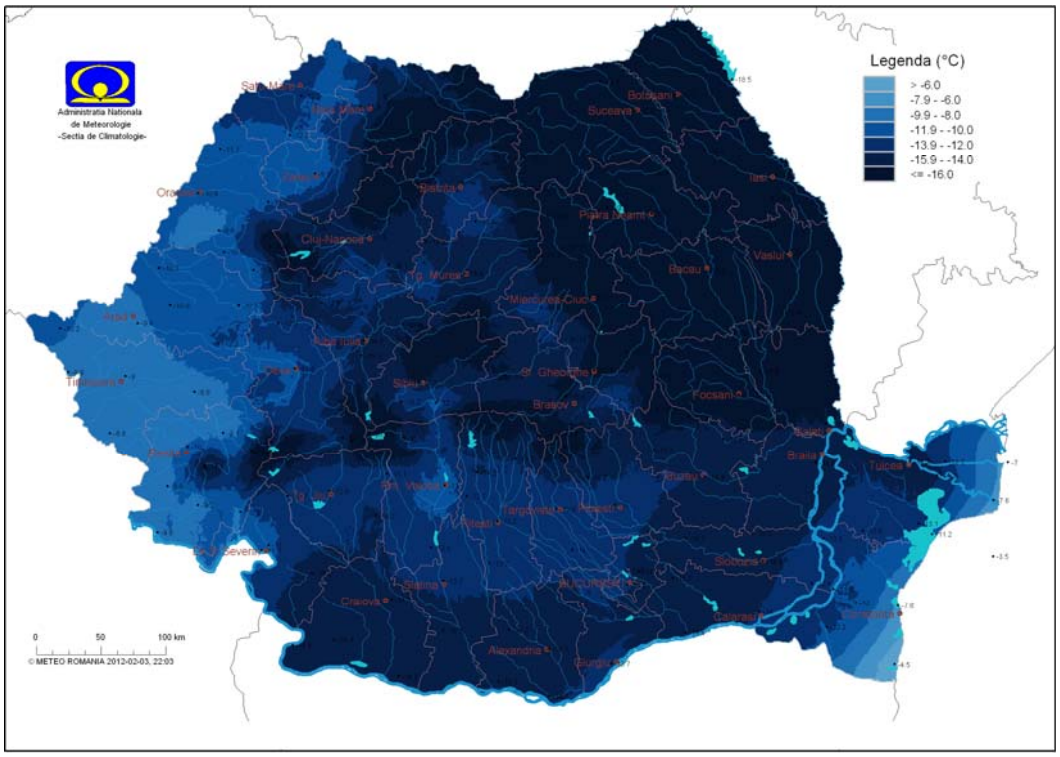


Fig. 10. The average air temperature recorded at the weather stations on 2.02.2012

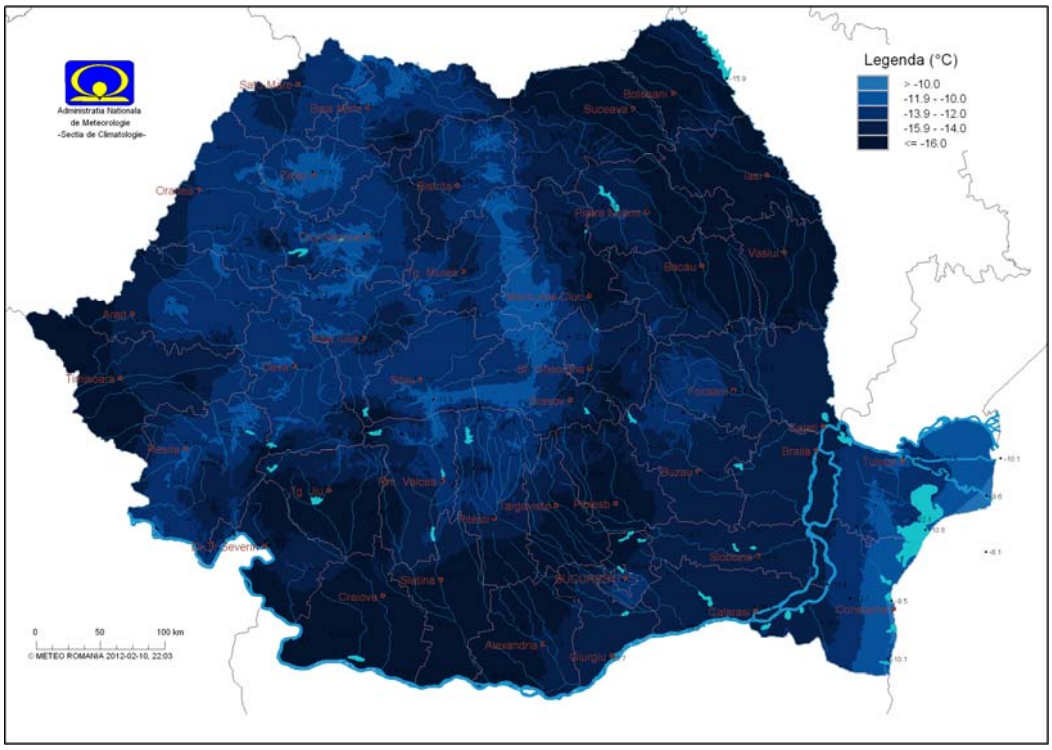


Fig. 11. The average air temperature recorded at the weather stations on 9.02.2012

Moldova was the most region affected by cold waves. If at level of winters are on average produced a 15-20 coldest nights in the southern and central Moldova and between 20-30 days in northern region (Clima României, 2008), in winter 2011-2012 were recorded between 20 and 30 days in the Southern half of Moldova and between 24 and 35 days in the Northern half. Special was the fact that all of the 20 meteorological stations from Moldavia region (except those 3 of the mountains that form a total of 23 stations) were recorded between 26.01.2012-18.02.2012 at least 18 consecutive coldest nights and on 11 of the 20 stations were recorded 24 consecutive coldest nights.

4. RISK ASPECTS

Due to the blizzard, the snow didn't lay evenly, a process visibly influenced by the shelter provided by the Curvature Carpathians, microrelief, wind speed, the position and orientation of traffic routes, and especially by the shelter provided by human settlements, lack of forest belts and snow shields.

Snow deposited in urban areas in eastern, southeastern and southern Romania, often exceeded 40 cm, and produced especially during days with snow and blizzard, but also in the following 2-3 days, heavier road traffic, damages to buildings with less resistance at the snow layer's weight (Fig. 12). In northern and north-eastern periphery of some rural localities situated in Vrancea, Buzau and Braila counties, large snow drifts were formed (2-4 m) which covered the fences, houses and animal shelters; and, people made tunnels to leave the house (fig. 13, 14, 15). Some flimsy houses collapsed under the weight of snow.

Due to high atmospheric pressure and persistent cold, there were cases of mortality and morbidity of the population, mainly among cardiac people. The media reported that at least 12 people died in isolated localities from Vrancea, Buzau and Braila counties, and some could not be buried because of snow drifts that reached several meters. Sometimes the dead people were kept in the house more than a week, and in other cases the coffins were pulled with ropes to the cemetery.

Fig. 12. The roof of a supermarket downed by snow (left) and cars blocked in lots of snow (right) in Iaşi city on 16/02/2012 (photo by O. Machidon)

Fig. 13. Houses covered with snow after blizzards of February 2012 in Jirlau village, Braila County (left) and Obrejiţa village, Vrancea County (right) (source: http://www.hotnews.ro/stiri-esential-11500836-foto-cele-mai-bune-imagini-suprinse-presa-locala-satele-aflate-sub-zapezi.htm; http://www.rtv.net/vrancea-inghitita-de-zapezi_15384.html, accessed on 1.04.2012)

Fig. 14. House (left) and road (right) covered by snowdrifts after the blizzards of February 2012 in Cîrligele village, Vrancea County area hooks (source: http://www.hotnews.ro/stiri-esential-11500836-foto-cele-mai-bune-imagini-suprinse-presa-locala-satele-aflate-sub-zapezi.htm, accesed on 1.04.2012)

Fig. 15. 102 H County road covered by snowdrifts in Glodeanu village, Buzău County (source: http://www.realitatea.net/dezastru-in-buzau-si-vrancea-de-ce-nu-se-declara-stare-de-urgenta-foto-video_912737.html, http://www.hotnews.ro/stiri-esential-11500836-foto-cele-mai-bune-imagini-suprinse-presa-locala-satele-aflate-sub-zapezi.htm, accessed on 1.04.2012)

In Buzau county over 23.200 inhabitants from 20 localities remained isolated because of the blizzard and around 26.000 families remained without electricity (source: www.relitatea.net). Ministry of Health from Romania, following analysis of autopsy reports for all cases of death from severe hypothermia recorded until 15.02.2012 has confirmed that number of 79 deaths.

5. CONCLUSIONS

The 1953-1954 winter had various highlights, which have set a multiple record. Some aspects are noteworthy: the decreased temperatures regime and heavy snowfall which allowed the formation of snow layer with the biggest time duration of the twentieth century (80 - 100 days, that is 40-50 days more than the annual average); absolute maximum depth of snow layer, which at some weather stations in the Romanian Plain were the highest in the period of observation; also the duration and intensity of blizzards, snow drifts' height, amount of water from the snow layer. Maximum wind speed that struck during the blizzards of February 1954 was of 125 km / h, which is a very high speed, but which was exceeded during the blizzard of January 1966, which reached 200 km / h, being the record speed for the period of observation. In fact, the 1965-1966 winter was the hardest in the eastern Romania, with the strongest blizzard, the thickest and most drifted snow (Erhan, 1979).

Taking into consideration that parameters recorded at the weather stations in 2011-2012 winter did not exceed the values recorded in 1953-1954 winter, and the impact on the environment and socio-economic activities was much lower, we believe that 1953-1954 winter is still the worst winter since weather observations have been made in Romania. Number of victims and the damage caused at this time could not have been precisely known.

The weather situation of the 2011-2012 winter should be marked as a reference point for what real winter could be in Europe. The baric configuration of these days, the highly developed Euro-Siberian anticyclone, extended towards the west of the continent and joined with the Azores anticyclone through Voeikov dorsal, represents the typical model of the big cold waves that can affect the whole of Europe, and hence Romania.

ACKNOWLEDGMENTS

Ovidiu-Miron Machidon is supported by a POSDRU grant no. 89/1.5/S/49944 "Developing the innovation capacity and improving the impact of research through post-doctoral programs", Alexandru Ioan Cuza University, Iasi. Climatic data were kindly provided by N.M.A. Romania - Moldova Regional Meteorological Centre from Iaşi.

REFERENCES

1. Apostol, L., (2004), *Clima Subcarpaţilor Moldovei*, Edit. Univ. Suceava.
2. Bacinschi, D., Alexandru, Gabriela, Dăneţ, Aurelia, Rădulescu, Ecaterina (1990), *Praticularităţi ale regimului temperaturii aeruluiîn sezonul rece (noiembrie-martie) în ultimul secol în România, cu posibilităţi de evaluare calitativă a tendinţelor,* Stud. şi cercet. de meteorolog., vol 4, I.M.H., Bucureşti.
3. Bălescu, O. I. , Beşleagă, N. (1959), *Cantităţile de precipitaţii în timpul viscolelor,* Meteorolo., Hidrolog. Şi Gosp. Apelor, nr. 2.
4. Bălescu, O. I. , Beşleagă, N. (1962), *Viscolele din R.. P. Romînă,* CSA, IM, Bucureşti.
5. Bogdan, Octavia., (1969 a), *Contribuţii climatologice asupra iernii din anii 1953-1954 în Câmpia Română*, Com. Geogr. VII, SSNG: 119-133.
6. Bogdan, Octavia, Niculescu, Elena, (1999), *Riscurile climatice din Romania*, Academia Română, Inst. de Geogr., Bucureşti.
7. Donisă, I., Davidescu, D. (1972), *Le role du relief carpatique dans la determination de quelques particularities thermiques du territoirede la Roumanie,* Lucr. Celei de a V-a Conf. de Meteorologie a Carpaţilor, 1971, I.M.H., Bucureşti.
8. Cazacu Gabriela, Dincă, Ileana, Cotariu, R. (1983), *Repartiţia pe teritoriul R. S. R. a valorilor medii lunare şi anuale ale temperaturii aerului corespunzătoare unor anumite asigurări,* Stud. şi Cercet. de Meteorolog., I.M.H., Bucureşti.
9. Ciulache, S., Ionac, Nicoleta (1995 a), *Fenomene geografice de risc,* Edit. Universitatii, Bucureşti.
10. Ciulache, S., Ionac, Nicoleta (1995 b), *Fenomene geografice de risc şi catastrophe climatice,* Edit. Ştiinţifică, Bucureşti.
11. Erhan, Elena (1979), *Clima şi microclimatele din zona oraşului Iaşi*, Edit. Junimea, Iaşi.
12. Mihăilă, D. (2006), *Câmpia Moldovei – Studiu Climatic*, Edit. Univ. Suceava.
13. Milea, Elena, Iliescu, Cornelia, Belcin, V. (1967), *Studiul condiţiilor aero-sinoptice care au generat viscolul din intervalul 5-7 ianuarie 1966,* Culeg. de lucr. ale I. M. /1965, Bucureşti.
14. Milea, Elena, Iliescu, Viorica, Doneaud, A., Stoica C. (1971), *Unele corelaţii între singularităţile termice în R.S. România în perioada 1920-1960 şi tipurile de circulaţie atmosferică,* Culeg. de lucr. ale I. M. /1968, Bucureşti.
15. Niculescu, Elena (1993), *Răciri şi încălziri masive în ultimul secol în România, SCGG, t. XL, Edit. Academiei, Bucureşti.*
16. Topor, N., Stoica, C. (1965), *Tipuri de circulaţie atmosferică deasupra Europei,* CSA, IM, Bucureşti.
17. Ţâştea, D., Bacinschi, D., Radu, N., (1965), *Dicţionar meteorologic*, CSA, IMH, Bucureşti.
18. * * * (1961), *Clima R.P.R., vol II,* C. S. A, I. M. H., Bucuresti.
19. * * * (1961-2012), *Tabelele meteorologice TM1-1M*, Centrul Meteorologic Regional „Moldova", Iaşi.
20. * * * (1962), *Clima R. P. Romîne., vol I,* C. S. A., I. M. H., Bucuresti.
21. * * * (1983), *Geografia României,vol I, Edit. Academiei, Bucureşti.*
22. * * * (2008), *Clima României,* ANM, Bucureşti.
23. * * * (2012) *Hărţi privind precipitaţiile atmosferice, grosimea stratului de zăpadă şi temperatura aerului*, Administraţia Naţională de Meteorologie, Secţia Climatologie, Bucureşti.
24. * * * Ministry of Health from Romania, *Analysis of autopsy reports for all cases of death from severe hypothermia*, Press release, Bucharest, 15.02.2012
25. www.meteomoldova.ro;
26. http://www.cotidianul.ro/marele-viscol-din-februarie-1954-171663/;
27. www.wetterzentrale.de;
28. http://www.youtube.com/watch?feature=endscreen&NR=1&v=catf1N6atyY;

29. http://www.realitatea.net/dezastru-in-buzau-si-vrancea-de-ce-nu-se-declara-stare-de-urgenta-foto-video_912737.html;
30. http://www.hotnews.ro/stiri-esential-11500836-foto-cele-mai-bune-imagini-suprinse-presa-locala-satele-aflate-sub-zapezi.htm;
31. http://www.rtv.net/vrancea-inghitita-de-zapezi_15384.html;
32. http://www.realitatea.net/dramatic--peste-23-200-de-locuitori-din-judetul-buzau--izolati-complet-video_912616.html;
33. http://www.youtube.com/watch?feature=endscreen&NR=1&v=9sJMMRO0kL4.