CONSIDERATIONS ON CLIMATIC CONDITIONS IN OLTENIA DURING THE WINTER OF 2011-2012

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Abstract. The paper analyses the atypical climatic evolution during the winter of 2011-2012, caused by the radical weather change occurred on January 25, 2011. The excessively droughty autumn of 2011, and the warmish December, was followed by a warmish January in the first 25 days, and afterwards, the thermal time type has suddenly changed. The excessively cold interval January 26, 2011-February 15, 2012 caused the death of many people in the whole country and in the entire European continent, as well as significant material damages. Consequently, this short period of severe winter has been one of the coldest periods in the history of the climatic observations. The analysis is a continuation of some extended studies on the growing climatic oscillations and risks as a consequence of the climatic variability increase in the south-west of Romania. The paper is useful for a broad category of specialists interested in the climatic, climatic risks and agroclimatic field.

Keywords: atypical climatic evolution, monthly temperature means, Hellman criterion, severe winter phenomena, vegetative processes.

Rezumat. Consideraţii privind condiţiile climatice în Oltenia din iarna 2011-2012. În lucrare este analizată evoluţia climatică atipică din iarna 2011-2012, determinată de schimbarea radicală a vremii survenită în data de 25 ianuarie 2011. După toamna excesiv de secetoasă 2011, după luna decembrie în ansamblul său călduroasă, a urmat luna ianuarie călduroasă în primele 25 de zile, apoi schimbarea bruscă a tipului de timp termic. Intervalul excesiv de rece 26 ianuarie 2011-15 februarie 2012 a provocat numeroase victime umane în întreaga ţară şi la nivelul întregului continent Europa, ca şi însemnate pagube materiale, situând acest episod scurt de iarnă severă ca unul dintre cele mai reci din istoria observaţiilor climatice. Analiza este o continuare a unor studii extinse privind oscilaţiile şi riscurile climatice tot mai numeroase ca urmare a creşterii variabilităţii climatice în sud-vestul României. Lucrarea este utilă unei categorii largi de specialişti interesaţi de domeniul climei, riscului climatic şi agroclimatic.

Cuvinte cheie: evoluţie climatică atipică, medii lunare de temperatură, criteriul Hellmann, fenomene de iarnă severă, procese vegetative.

INTRODUCTION

The extremely warmish autumn of 2011 in the first half and excessively droughty in the second half was followed by the warm winter of 2011-2012 in December and in most of January. Then, the radical change of the thermal regime starting with December 26, 2011 marked an extreme climatic anomaly, during which (January 26, 2011 - February 15, 2012) not only in Romania, but also in the entire European continent, the excessive frost of 14 days caused the death of many people. This type of climatic evolution is an extremely dangerous climatic risk, because most of the population was caught unprepared from different points of view by the fast setting of the excessively cold weather. In consequence, there have been not only human victims, but also significant material damages, caused by the two snowstorms. Because of these snowstorms a thick snow layer was laid on the ground, the roads and access roads were blocked, and the schools and some important traffic arteries were closed. The aforementioned interval clearly stands out from most of the winter as a thermal and excessive anomaly, which occurred fast. The paper is a continuation of some extended studies on the growing climatic oscillations and risks as a consequence of the climatic variability increase in the south-west of Romania, as well as of their effects on the environment, society and bioclimate in general (BOGDAN *et al*., 2008, 2010; BOGDAN & MARINICĂ 2009; MARINICĂ & CHIMIŞLIU 2008; MARINICĂ *et al*., 2010, 2011).

MATERIAL AND METHODS

For this paper we analysed the data from Oltenia MRC Archive, the results of the daily processing with special software from the weather forecast, the current maps from the operative activity, and those provided by the analysis and forecast international centers and NAM Bucharest (National Administration of Meteorology). We used the facilities provided by Office for drawing the tables and charts. The paper analyses the climatic conditions during the winter of 2011-2012, on the basis of the thermal and pluviometric regime of December 2011, January and February 2012 and the thermal and pluviometric regime on the whole of the winter of 2011-2012.

RESULTS

1a. The thermal regime of December 2011. In December 2011, *air temperature means* were comprised between -1.2°C at Voineasa (the only negative mean excepting the mountainous area) and 3.6°C, and their deviations from the multiannual means were comprised between 0.7°C at Voineasa and 3.6°C at Calafat. According to Hellmann criterion, the thermal time type in December 2011 at the meteorological stations in Oltenia was comprised between

normal (N) at Voineasa and warm (W)[1]. The monthly temperature mean for the entire region was 1.8°C, and its deviation from the multiannual mean was 1.9°C, which classifies December as a warmish month for the entire region (Table 1). *The monthly minimum air temperatures* were comprised between -12.5°C at Voineasa registered on December 24 and -5.4°C registered at Caracal on December 1. In the area with the altitude ≤250 m the monthly minimum temperature values were registered during the episodic cooling in the first part of the month (the interval December 1-2, immediately followed by a weather warming), and those from the high area were registered during the episodic cooling in the interval December 24-27.

Table 1. The air thermal regime[2] and the minimum thermal values at the soil surface in December 2011, in Oltenia.
Tabel 1. Regimul termic al aerului şi minimele termice la suprafaţa solului în luna decembrie 2011, în Oltenia.

Weather station	Hm	NXII	M	ΔT=M-N	CH	minT		maxT		minT Soil	
						°C	Date	°C	Date	°C	Date
Dr. Tr. Severin	77	1.4	3.2	1.8	**WS**	-6.0	2	16.7	4	-7.8	2
Calafat	66	1.0	**3.6**	2.6	**W**	-6.2	2	19.8	4	-9.4	1
Bechet	65	0.4	2.2	1.8	**WS**	-8.2	2	19.9	5	-8.0	1;2;3
Băileşti	56	0.4	2.9	2.5	**W**	-8.2	2	**20.1**	5	-10	25
Caracal	112	-0.1	2.5	2.6	**W**	**-5.4**	1	17.9	4	-8.1	1
Craiova	190	0.1	2.3	2.2	**W**	-7.0	27	16.8	5	**-6.0**	1
Slatina	165	0.3	2.2	1.9	**WS**	-6.8	1	14.7	4	-6.7	2
Bâcleş	309	-0.4	2.5	**2.9**	**W**	-6.9	24	16.5	5	-	-
Tg. Logreşti	262	0.1	1.3	1.2	**WS**	-9.7	1	15.6	3	**-10.7**	1
Drăgăşani	280	0.6	2.8	2.2	**W**	-6.0	27	13.6	11	-8.2	27
Apa Neagră	250	0.1	1.2	1.1	**WS**	-10.2	1	15.0	4	-10.2	1
Tg. Jiu	210	0.1	1.7	1.6	**WS**	-8.9	24	14.8	4	-10.4	1
Polovragi	546	0.1	1.9	1.8	**WS**	-7.4	24	13.3	4	-9.6	1
Rm. Vâlcea	243	0.5	2.4	1.9	**WS**	-6.5	24	13.5	11	-7.0	1
Voineasa	573	-1.9	**-1.2**	**0.7**	**N**	**-12.5**	24	**11.2**	5	-	-
Parâng	1585	-3.7	-2.0	1.7	**WS**	-12.6	24	7.9	2	-	-
Media Oltenia	-	-0.1	1.8	1.9	**WS**	-8.0	-	15.5	-	-8.6	-
Obârşia Lotrului	1348	-4.9	-3.5	1.4	**WS**	-17.5	22	9.1	1	-	-

The maximum thermal values were comprised between 11.2°C at Voineasa registered on December 5 and 20.1°C at Băileşti on the same date. *The monthly minimum thermal values at the soil surface* were mostly registered in the first two days of the month and were comprised between -6.0°C at Craiova on December 1 and -10.7°C at Tg. Logreşti on the same date. In this interval the phenomenon of frozen soil occurred and then, starting with December 3, the thaw occurred. In figure 1 there are represented the air temperature variation, the daily means, daily minimum and maximum temperatures mean, calculated for the entire region in December 2011. There were registered 23 days in which the daily means were positive and only 8 days with negative means (Fig. 1).

1.b. The pluviometric regime of December 2011. The monthly quantities of precipitations registered in December 2011 were comprised between 12.0 l/m^2 at Bechet and 44.9 l/m^2 at Apa Neagră; the percentage deviation from the normal values were comprised between -69.7% at Bâcleş in Mehedinţi Hills and -25.7% at Polovragi in the Subcarpathian depression area, and in the submountainous area -77.5% at Voineasa (Table 2). In the mountainous area the smallest deviation (23.8%) was registered at Parâng. According to Hellmann criterion, the pluviometric time type at the meteorological stations in Oltenia was comprised between droughty (D) at Craiova, Polovragi and Parâng and excessively droughty (ED) at Bechet, Bâcleş, Tg. Logreşti, Polovragi and Voineasa. *The overall mean for the entire Oltenia region* was 25.2 l/m^2, and its percentage deviation from the normal value was -50.7%, which shows that for the entire Oltenia region December 2011 was a droughty month, thus confirming the extension of the excessive drought of the autumn of 2011, in the first month of winter. However, due to the low air thermal regime and the low water consumption by the vegetal carpet the *water soil reserve* in the layer of 0-50 cm on December 28, 2011 was almost satisfactory (AS)[3] in the central and south-west of Oltenia and almost optimum in the north-west and south-east (Fig. 2).

[1] The thermal time types according to Hellmann criterion are: excessively warm (EW), very warm (VW), warm (W), warmish (WS), normal (N), cool (CO), cold (CL), very cold (VC) and excessively cold (EC).
[2] Hm=altitude of the meteorological station, NXII=monthly multiannual air temperature means in December, M=monthly air temperature means in December 2011, ΔT=M-N is the deviation of December 2011 means from the monthly multiannual means, CH=Hellmann criterion, minT=the monthly minimum temperature; maxT=the monthly maximum temperature.
[3] PD=pedological drought, MD=moderate drought, AS=almost satisfactory, AlO=almost optimum, O=optimum (O) or very close of optimum (vcO)

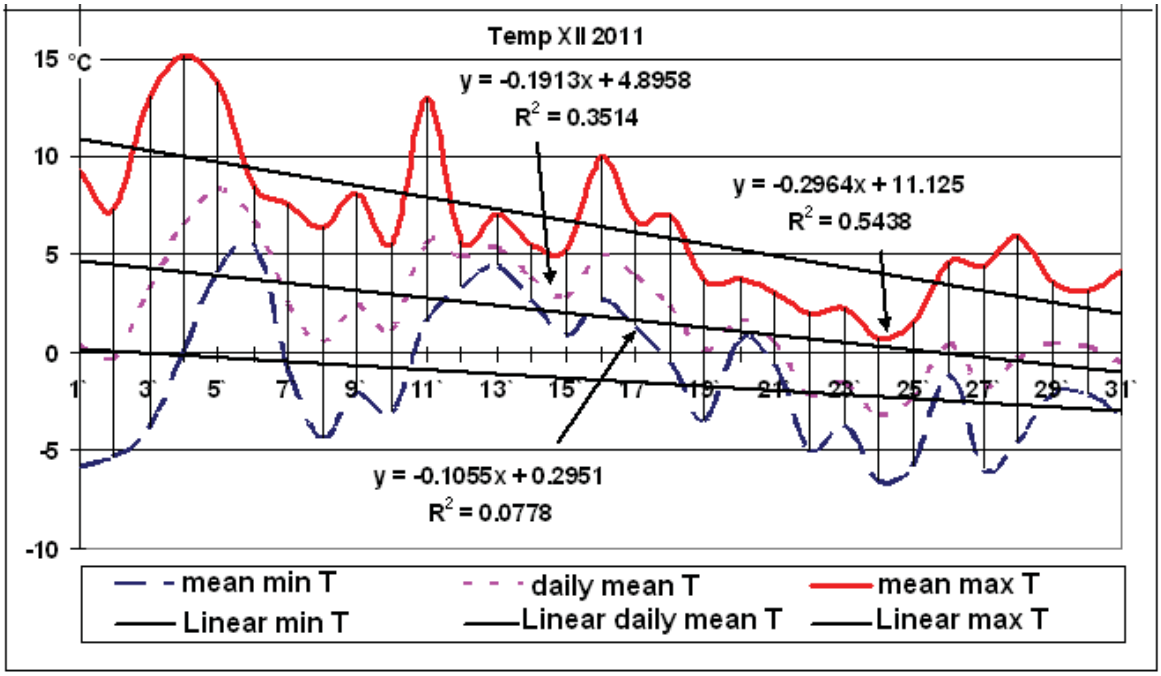

Figure 1. The air temperature variation, the daily means, daily minimum and maximum temperatures mean, calculated for the entire region in December 2011. / Figura 1. Variaţia temperaturii aerului, a mediilor zilnice, mediei minimelor zilnice şi maximelor zilnice, calculate pentru întreaga regiune în decembrie 2011.

Table 2. Quantities of precipitations registered during the winter of 2011-2012 (Σ), in comparison with the normal values.
Tabel 2. Cantităţi de precipitaţii înregistrate în iarna 2011-2012 (Σ), comparativ cu valorile normale.

Weather station	Hm	December 2011				January 2012				February 2012				Winter 2011 - 2012			
		ΣXII	N	Δ%	CH	ΣI	N	Δ%	CH	ΣII	N	Δ%	CH	ΣW	N	Δ%	CH
Dr. Tr. Severin	77	20.1	61.2	-67.2	**ED**	44.5	51.4	-13.4	**LD**	81.8	47.9	70.8	**ER**	146.4	160.5	-8.8	**N**
Calafat	66	24.8	45.5	-45.5	**VD**	64.2	40.4	58.9	**ER**	47.7	38.0	25.5	**R**	136.7	123.9	10.3	**LR**
Bechet	65	12.0	36.3	-66.9	**ED**	81.3	33.5	142.7	**ER**	29.9	34.8	-14.1	**LD**	123.2	104.6	17.8	**LR**
Băileşti	56	23.7	46.8	-49.4	**VD**	65.7	38.5	70.7	**ER**	47.0	36.1	30.2	**VR**	136.4	121.4	12.4	**LR**
Caracal	112	22.8	39.5	-42.3	**VD**	81.7	34.7	135.4	**ER**	35.2	34.5	2.0	**N**	139.7	108.7	28.5	**VR**
Craiova	190	29.7	41.8	-28.9	**D**	108.9	37.5	190.4	**ER**	48.1	30.4	58.2	**ER**	186.7	109.7	70.2	**ER**
Slatina	165	22.1	42.8	-48.4	**VD**	72.6	36.0	101.7	**ER**	52.9	38.4	37.8	**VR**	147.6	117.2	25.9	**R**
Bâcleş	309	16.6	54.7	-69.7	**ED**	-	50.5	-	**-**	-	44.1	-	**-**	-	149.3	-	**-**
Tg. Logreşti	262	16.0	44.8	-64.3	**ED**	55.0	35.9	53.2	**ER**	70.0	41.0	70.7	**ER**	141.0	121.7	15.9	**LR**
Drăgăşani	280	20.9	44.6	-53.1	**ED**	58.0	34.1	70.1	**ER**	45.1	35.4	27.4	**R**	124.0	114.1	8.7	**N**
Apa Neagră	250	44.9	82.3	-45.4	**VD**	81.8	70.9	15.4	**LR**	106.2	66.4	59.9	**ER**	232.9	219.6	6.1	**N**
Tg. Jiu	210	25.5	64.0	-60.2	**ED**	58.3	53.9	8.2	**N**	81.0	52.0	55.8	**ER**	164.8	169.9	-3.0	**N**
Polovragi	546	41.7	56.1	-25.7	**D**	31.4	48.9	-35.8	**VD**	50.8	48.4	5.0	**N**	123.9	153.4	-19.2	**D**
Rm.Vâlcea	243	27.9	46.2	-39.6	**VD**	46.0	35.5	29.7	**R**	64.3	38.4	67.4	**ER**	138.2	120.1	15.1	**LR**
Voineasa	573	12.4	55.1	-77.5	**ED**	-	42.7	-	**-**	-	44.0	-	**-**	-	141.8	-	**-**
Parâng	1585	41.6	54.6	-23.8	**D**	88.8	57.7	53.9	**ER**	31.8	47.7	-33.3	**VD**	162.2	160.0	1.4	**N**
Media Oltenia	-	25.2	51.0	-50.7	**ED**	67.0	43.9	52.7	**ER**	56.6	42.3	33.6	**VR**	148.8	137.2	8.5	**N**

Legend: ΣXII, ΣI, ΣII, ΣW – the monthly precipitations from December 2011, January 2012, February 2012 and the winter of 2011-2012; N- the normal value for the period 1901-1990, **Δ% the deviation** (%) and the pluviometric time type according to Hellmann criterion (CH).

2.a The thermal regime of January 2012

The monthly thermal means were comprised between -3.9°C at Voineasa and +0.8°C at Dr. Tr. Severin and Calafat, and the deviations from the monthly multiannual means were comprised between 0.0°C at Apa Neagră and 2.6°C at Calafat. According to Hellmann criterion, the thermal time types in January 2012 at the meteorological stations were comprised between normal (N) in the hilly and Subcarpathian depression area (Tg. Logreşti, Apa Neagră, Tg Jiu, Polovragi) and warm (W) in the Oltenia Plain and Mehedinţi Hills (Calafat, Băileşti, Caracal, Bâcleş). The overall monthly mean for the entire region was -1.6°C, and its deviation from the normal mean was 1.2°C, which according to Hellmann criterion led to the conclusion that January 2012 was warm (W).

The monthly maximum air temperatures were registered in the first part of the month (2-4 January) and in the second decade (on January 23) and were comprised between 11.6°C at Drăgăşani and Apa Neagră and 16.1°C at Calafat, and the maximum temperatures mean was 12.4°C.

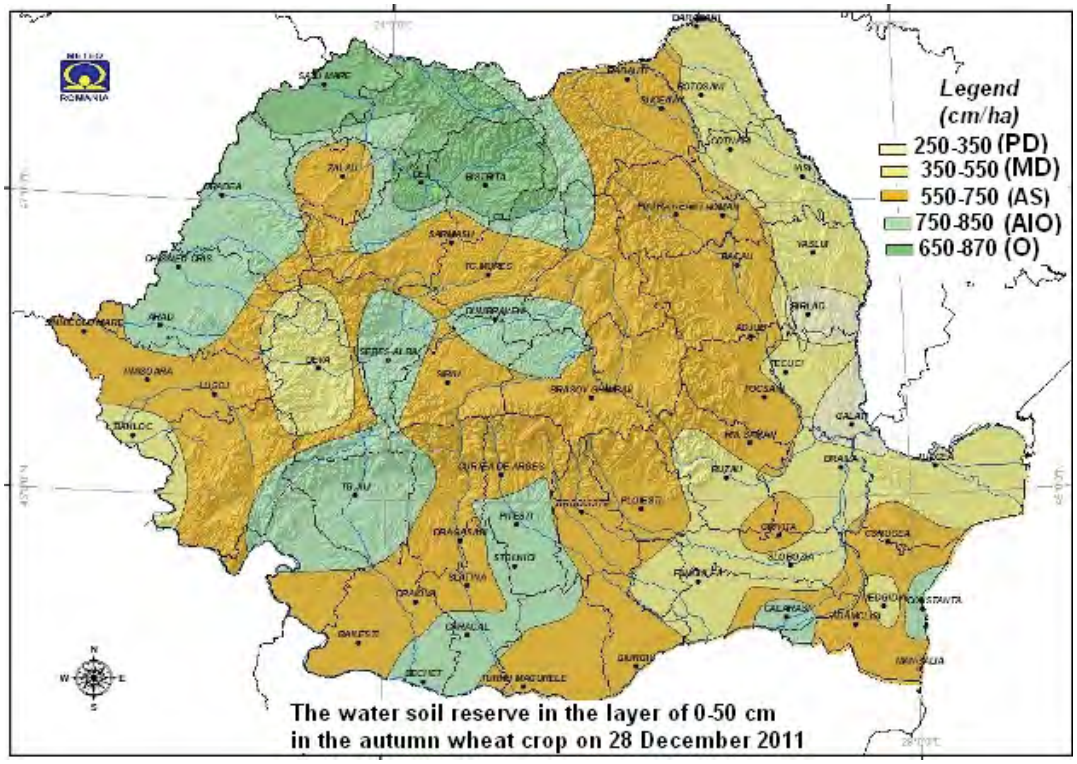

Figure 2. The water soil reserve in the layer of 0-50 cm in the autumn wheat crop on December 28, 2011 (according to NAM Bucharest). / Figura 2. Rezerva de apă din sol în stratul 0-50 cm în cultura grâului de toamnă la data de 28 decembrie 2011 (după ANM Bucureşti).

The monthly minimum air temperatures were registered in the last day of the month and were comprised between -24.6°C at Apa Neagră in the Subcarpathian depression and -16.6°C at Dr. Tr. Severin and Parâng, and the monthly minimum temperatures mean was -20.5°C. The thermal minimum temperatures were caused by the intense cold wave from the end of January and the first decade of February, and the cooling process started in the night of 26/27 January 2012 (Table 3 and Fig. 3).

The monthly minimum temperature values at the soil surface were comprised between -27.8°C at Caracal and -18.3°C at Rm. Vâlcea being registered on January 31 (with a single exception at Caracal). *The monthly minimum temperature mean at the soil surface*, for the entire region was -22.7°C.

Table 3. The thermal air regime and the thermal minimum temperatures at the soil surface in January 2012, in Oltenia. Tabel 3. Regimul termic al aerului şi minimele termice la suprafaţa solului în luna ianuarie 2012, în Oltenia.

Weather station	Hm	NI	M	ΔT=M-N	CH	minT		maxT		minT Soil	
						°C	Date	°C	Date	°C	Date
Dr. Tr. Severin	77	-1.1	0.8	1.9	**WS**	**-16.6**	31	14.2	3	-13.8	31
Calafat	66	-1.8	0.8	2.6	**W**	-19.2	31	**16.1**	3	**-27.8**	31
Bechet	65	-2.2	-0.5	1.7	**WS**	-24.4	31	15.1	23	-22.0	31
Băileşti	56	-2.3	-0.3	2	**W**	-24.0	31	14.5	23	-28.2	31
Caracal	112	-2.9	-0.8	2.1	**W**	-23.0	31	12.7	23	-22.5	30
Craiova	190	-2.6	-0.9	1.7	**WS**	-20.4	31	12.8	23	-26.0	31
Slatina	165	-2.4	-1.2	1.2	**WS**	-19.7	31	11.9	23	-23.3	31
Bâcleş	309	-3	-1	2	**W**	-17.7	31	12.4	3	-	-
Tg. Logreşti	262	-2.7	-2.6	0.1	**N**	-23.9	31	12.5	4	-23.6	31
Drăgăşani	280	-2.2	-0.8	1.4	**WS**	-16.8	31	***11.6***	23	-23.3	31
Apa Neagră	250	-2.6	-2.6	0	**N**	**-24.6**	31	***11.6***	4	-18.8	31
Tg. Jiu	210	-2.6	-1.7	0.9	**N**	-19.3	31	12.4	23	-21.6	31
Polovragi	546	-3.2	-2.5	0.7	**N**	-20.4	31	11.7	3	-26.2	31
Rm. Vâlcea	243	-2.2	-1.2	1	**WS**	-18.6	31	12.8	4	**-18.3**	31
Voineasa	573	-4.7	-3.9	0.8	**N**	-22.0	31	7.4	13	-	-
Parâng	1585	-5.9	-6.9	-1	**CO**	**-16.6**	31	8.2	2	-	-
Media Oltenia		-2.8	-1.6	1.2	**WS**	-20.5		12.4		-22.7	
Obârşia Lotrului	1348	-6.2	-7	-0.8	**N**	-27.3	31	5.6	3	-	-

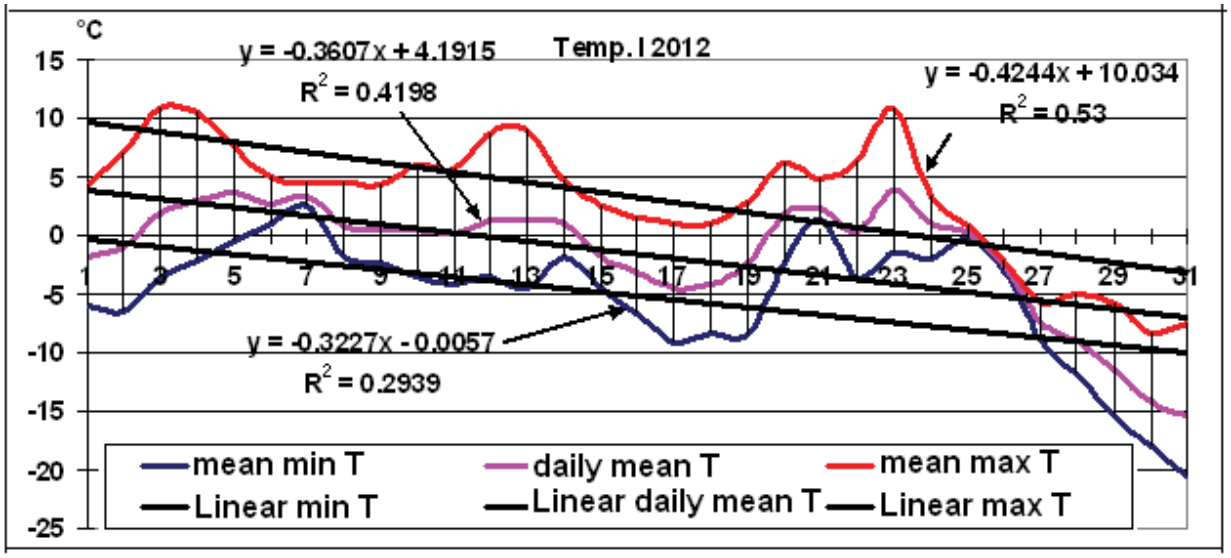

Figure 3. Air temperature variation, the daily means, daily minimum and maximum temperatures mean, calculated for the entire region in January 2012. / Figura 3. Variaţia temperaturii aerului, a mediilor zilnice, mediei minimelor zilnice şi maximelor zilnice, calculate pentru întreaga regiune în ianuarie 2012.

2.b. The pluviometric regime of January 2012.

The monthly quantities of precipitations were comprised between 31.4 l/m^2 at Polovragi and 108.9 l/m^2 at Craiova in the central part of the region, and the percentage deviations from the multiannual means were comprised between -35.8% at Polovragi and 190.4% at Craiova (Table 2). According to Hellmann criterion, the pluviometric time type at the meteorological stations in Oltenia was comprised between very droughty (VD) at Polovragi and exceedingly rainy (ER) in most of the region. The quantities of precipitation mean for the entire region was 67.0 l/m^2, and its percentage deviation was 52.7%, which classifies January as an exceedingly rainy (ER) month for the entire region.

In the interval January 1-24 the precipitations were liquid, mixed on January 25, and snowfall starting with January 26.

As *climatic risk phenomena* we record the fact that for the interval January 25, 2 a.m.-January 26, 6 p.m., a *yellow code warning for dangerous meteorological phenomena* was remitted. Thus, in the aforementioned interval, weather got worst in the south and east of the country and in the Southern and Eastern Carpathians area. In these regions it snowed abundantly and the snow layer was dense. The wind had unceasing intensifications, with wind gust speeds that exceeded 60…70 km/h, especially in the counties from the south-east of the country where there was a snowstorm. In Dobrogea and in the south and east of Muntenia, in the first part of the interval, the precipitations were mixed and glazed frost occurred. After the aforementioned interval weather became frosty mainly in the night and morning, notably in the eastern, southern and central part of the country.

The snow layer was formed starting with January 25, and its maximum thickness in January was registered on 27 and was comprised between 3 cm at Dr. Tr. Severin and 64 cm at Craiova, and in the mountainous area 106 cm at Parâng.

On January 30 *the water reserve in the soil layer of 0-100 cm*, was close to optimum (ClO) in most of the region and optimum (O) in the central part (Fig. 4).

3.a. The thermal regime of February 2012. *The monthly average air temperature values* were comprised between -6.6°C at Caracal in the south-east of Oltenia and –3.9°C at Rm. Vâlcea in the Olt Couloir, and their deviations from the multiannual means were comprised between –6.2°C at Bechet in the south of the region and -2.7°C at Voineasa, in the submountainous area. According to Hellmann criterion the thermal time types in Oltenia were comprised between very cold (VC) in most of Oltenia plain at Tg. Logreşti and in the Subcarpathian Depression Apa Neagră and cold (CL) in the high hilly and mountainous area (Table 4).

The minimum air temperature values were comprised between –28.9°C at Băileşti and –17.9°C registered at Drăgăşani, both of them being registered on February 1, and the monthly minimum temperature mean was –23.1°C, lower than that of January.

The minimum temperature values at Calafat (–26.1°C), Bechet (–24.0°C), Băileşti (–28.9°C) Tg. Logreşti (–28.1°C), Apa Neagră (–28.4°C) and Obârşia Lotrului (–28.6°C), represent *climatic records* for these stations, being the lowest values of the whole existing data series (Table 4 and Fig. 5).

In winter, in the area with a low altitude from the south of Oltenia, the phenomenon of thermal inversion and the flow of the cold air from the Prebalkan Plateau towards the low relief region of Oltenia are frequent, which justify the low minimum thermal values (from Băileşti, Calafat and Bechet) in comparison with those from the north of the region, where a similar phenomenon occurs, but there the flow of the cold air takes place from Parâng Massive. Consequently in the *conditions of exceedingly frost in winter* the cold air enters in Oltenia from three directions:

northerly from the mountainous area, southerly from the Prebalkan Plateau and north-easterly from the East Europe plain, the nocturnal cooling and the thermal inversion highlighting the temperature fall. In consequence, on February 1 and 9, in Oltenia there were registered the lowest minimum thermal values in the country[4] (Fig. 6).

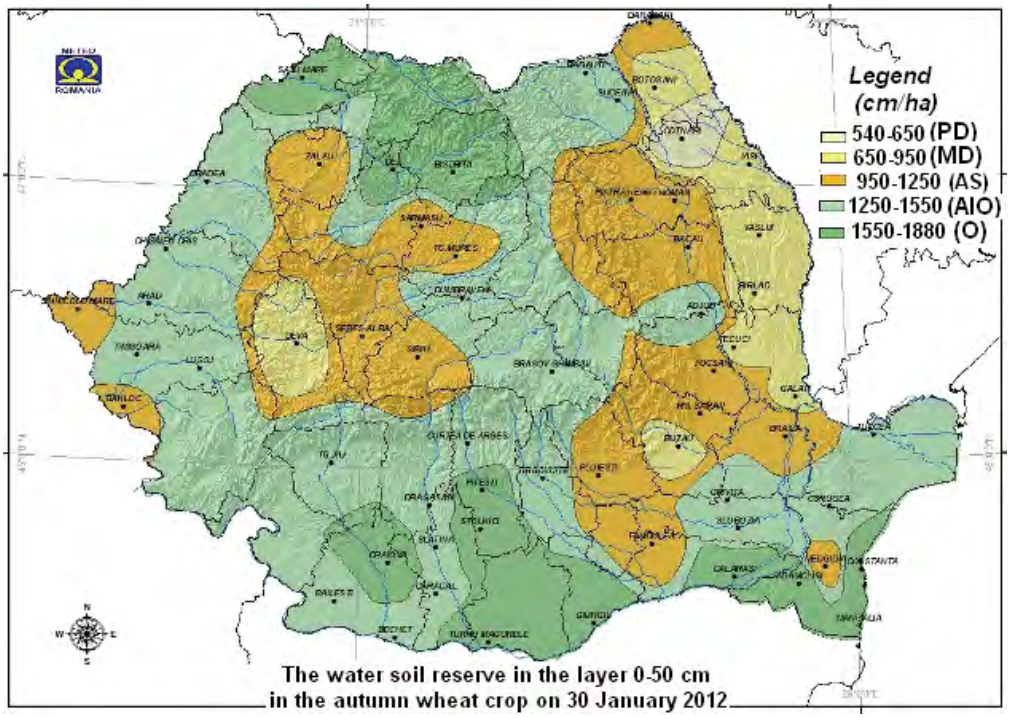

Figure 4. The water soil reserve in the layer 0-50 cm in the autumn wheat crop on January 30, 2012 (according to NAM Bucharest). / Figura 4. Rezerva de apă din sol în stratul 0-50 cm în cultura grâului de toamnă la data de 30 ianuarie 2012 (după ANM Bucureşti).

Table 4. The air thermal regime and the minimum thermal values at the soil surface in February 2012, in Oltenia[5].
Tabel 4. Regimul termic al aerului şi minimele termice la suprafaţa solului în luna februarie 2012, în Oltenia.

Weather station	Hm	NII	M	ΔT=M-N	CH	minT		maxT		min TSoil	
						°C	Date	°C	Date	°C	Date
Dr. Tr. Severin	77	0.9	-3.9	-4.8	**CL**	-21.7	9	13.6	25	-23.4	9
Calafat	66	0.4	-5.2	-5.6	**VC**	-26.1*	9	12.6	25	-28.6	9
Bechet	65	-0.1	-6.3	**-6.2**	**VC**	-24.0*	1	11.8	25	-24.0	1
Băileşti	56	-0.1	-5.9	-5.8	**VC**	**-28.9***	1	9.6	25	-31.6	9
Caracal	112	-0.7	**-6.6**	-5.9	**VC**	-23.2	1	**7.2**	25	-23.2	2
Craiova	190	-0.4	-5.9	-5.5	**VC**	-22.6	9	8.9	25	-27.0	1
Slatina	165	-0.2	-6.0	-5.8	**VC**	-23.9	9	10.4	25	-25.7	2
Bâcleş	309	-0.9	-5.9	-5.0	**VC**	-19.5	1	8.5	25	-	-
Tg. Logreşti	262	-0.7	-5.9	-5.2	**VC**	-28.1*	9	12.6	25	**-32.2**	9
Drăgăşani	280	-0.2	-4.6	-4.4	**CL**	**-17.9**	1	11.5	25	-24.0	1;2
Apa Neagră	250	-0.6	-6.0	-5.4	**VC**	-28.4*	9	12.4	24	-29.6	9
Tg. Jiu	210	-0.4	-4.7	-4.3	**CL**	-22.6	9	**16.9**	24	-29.4	9
Polovragi	546	-1.4	-5.0	-3.6	**CL**	-20.6	2	12.0	25	-26.7	9
Rm. Vâlcea	243	0.0	**-3.9**	-3.9	**CL**	-19.4	9	17.1	25	**-23.0**	9
Voineasa	573	-2.5	-5.2	**-2.7**	**CL**	-22.7	1	12.2	24	-	-
Parâng	1585	-5.6	-9.1	-3.5	**CL**	-21.7	2	5.6	23	-	-
Media Oltenia		-0.8	-5.6	-4.9	**CL**	-23.1		11.4		-	-
Obârşia Lotrului	1348	-5.5	-8.8	-3.3	**CL**	-28.6*	1	5.4	23	-	-

[4] In the Balkan Peninsula, in the north of Bulgaria there were registered extremely low minimum thermal values on February 1 and 2, representing thermal records for Bulgaria in February.
[5] The values marked with * are the new absolute minimum thermal values of February for the concerned meteorological stations.

The cold wave of the winter of 2011-2012, started from January 31, lasted until February 11 with some temperature increase in some days and *presented three days with extremely low minimum thermal values: January 31, February 1 and 9, registering a long time, 12 consecutive days*, thus being one of the longest frost wave ever registered in Romania.

As a consequence of this *intense long-standing frost wave*, in Romania, until February 14, officially there were 79 victims, and on February 10 about 60,000 persons were continuingly blocked due to the banks of frozen snow formed because the wind scattered and transported the snow. Note that on the continent there have been more than 600 victims until that date.

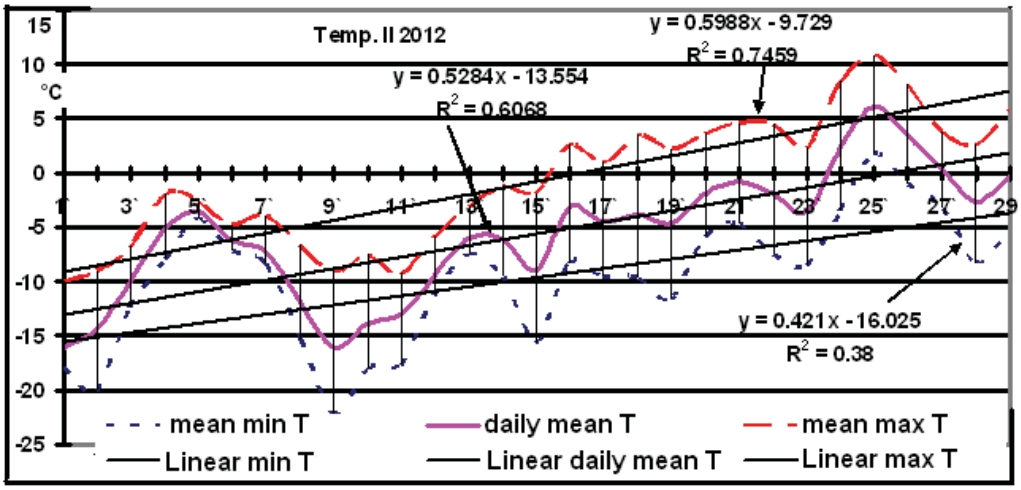

Figure 5. The air temperature variation, the daily means, daily minimum and maximum temperatures mean, calculated for the entire region in February 2012. / Figura 5. Variaţia temperaturii aerului, a mediilor zilnice, mediei minimelor zilnice şi maximelor zilnice, calculate pentru întreaga regiune în februarie 2012.

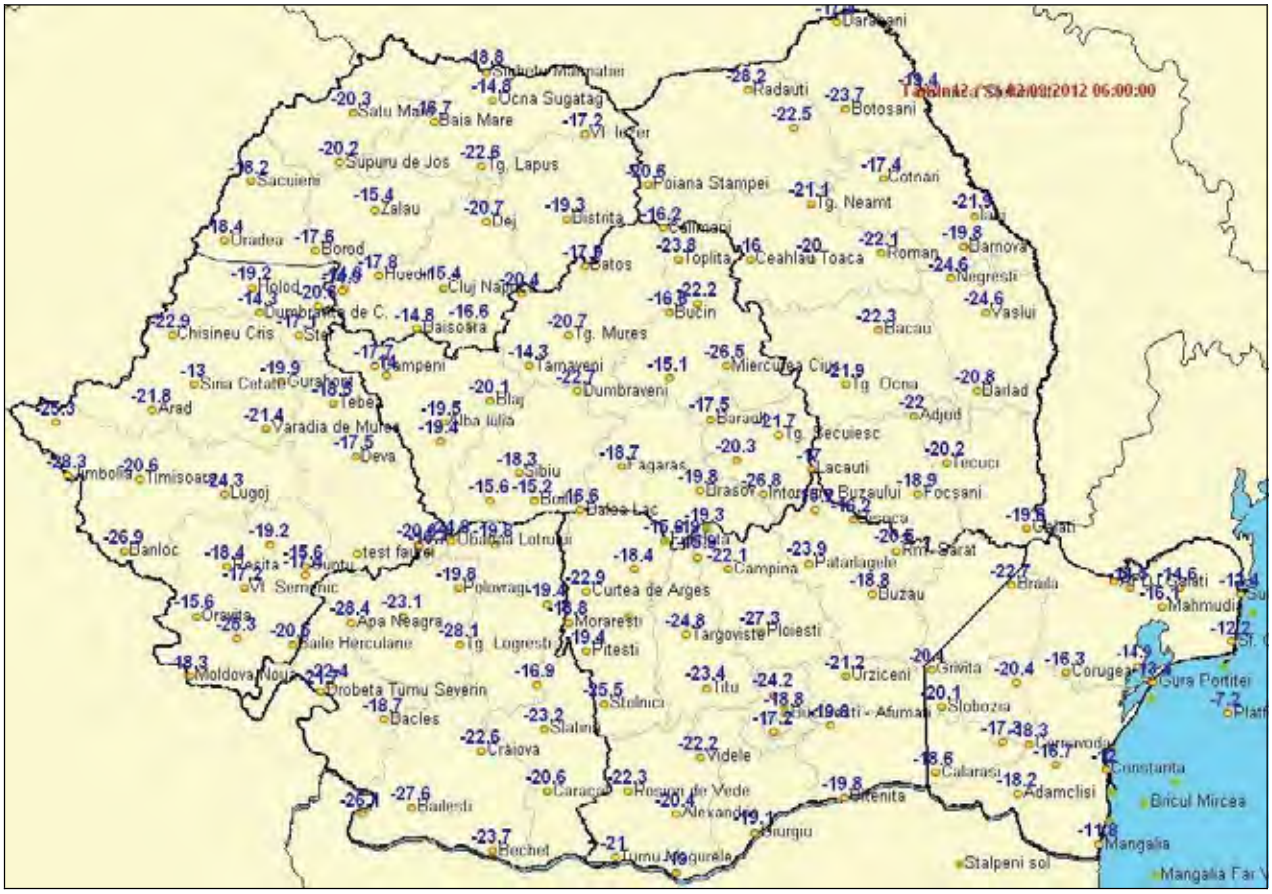

Figure 6. Minimum air temperature values registered in the night of February 8/9, 2012 (according to NAM Bucharest). / Figura 6. Valori minime de temperatură a aerului înregistrate în noaptea de 8/9 februarie 2012 (după ANM Bucureşti).

The weather warming, due to the spring arrival, as a consequence of some macroprocesses at the level of the entire northern hemisphere and of the continent was more obvious starting with February 16, when the daily maximum temperatures became positive (Fig. 5), and starting with February 24 the daily thermal temperature means became positive too. There has been an increasing general air temperature trend.

The minimum temperatures at the soil surface were extremely low and were comprised between -23°C at Rm. Vâlcea and -32.2°C at Tg. Logreşti, registered on February 9, and at some meteorological stations on February 1 and 2, which shows the cooling intensity not only in the air and soil, but also at the surface of rivers and lakes, causing an in-depth soil frost and a thick ice layer at the surface of rivers and lakes. This phenomenon of strong frost blocked the ships and caused navigation interruption on the Danube.

The thick ice layer brake into pieces at the end of February and in the beginning of March, causing the blocking up of the fluvial circulation, the damaging of ships caught in the ices and of the harbour installations on the Danube.

3.b. The pluviometric regime of February 2012.

The monthly quantities of precipitations in February were comprised between 29.9 l/m^2 at Bechet and 106.2 l/m^2 at Apa Neagră the Subcarpathian depression, and their deviations from the multiannual means were comprised between -14.1% at Bechet (in the mountainous area -33.3% at Parâng) and 70.8% at Dr. Tr. Severin, and according to Hellmann criterion, the pluviometric time types at the meteorological stations in Oltenia were comprised between little droughty (LD) at Bechet and exceedingly rainy (ER) at Dr. Tr. Severin, Craiova, Tg. Logreşti, Tg Jiu, Polovragi and Rm. Vâlcea, and very droughty (VD) in the mountainous area at Parâng.

The monthly quantities of precipitations mean for the entire region was 56.6 l/m^2, and its percentage deviation from the multiannual mean was 33.6%, which classifies February as a very rainy (VR) month for the entire region.

As climatic risk phenomena, besides the *extended frost wave* we record the fact that *an orange code warning for dangerous meteorological phenomena* was remitted *in the interval February 5-8*. Thus, in the interval February 5, 6 p.m. – February 8, 10 a.m., there have been some storm-swept snowfalls in Oltenia, in the south of Moldavia, Dobrogea and Muntenia, the wind gust speed exceeding 70- 80 km/h, and the visibility decreasing under 50 m in some areas affected by the snowstorm. The snowstorm manifested in the night of 5/6 February in the south of Moldavia and in Bărăgan, then extended in the other aforementioned regions, reaching *the maximum intensity in the period February 6-7 at 2 p.m.*. The snowstorm buried in snow some roads and railways in Oltenia interrupting the road and railway traffic, and in Buzău country, at the Carpathians Curvature it snowed in many villages, covering a great number of houses and outbuildings. The highways as well as the cross-border roads from the south and south-east of the country were closed, for a period of almost 2 weeks, mostly because of the blocking up of the road traffic from the neighbouring countries.

For the interval February 12, 6 p.m.-February 14, 2 a.m., an orange code warning for abundant snowfalls: "it will snow abundantly in the south-west of the country, and the wind gust speed will reach 55 km/h, temporarily burying in snow and scattering the snow. A new snow layer will cover the ground, which will locally exceed 30 cm. In the southern regions, there will be snowfalls and some wind gusts during February 11, as well as in the first part of February 12, but their intensity will be low."

The snow layer reached the maximum thickness after the snowfalls from the interval February 11-13, when in Oltenia the snow layer thickness was comprised between 40 cm at Rm. Vâlcea and 135 cm at Balta in Mehedinţi county (69 cm at Craiova), *Oltenia* being the area with *the thickest snow layer* (Fig. 7).

The snow layer started to melt when the maximum positive temperature values were registered (February 16) and continued until March 6. On March 4, the snow layer with a low thickness was present only in the Subcarpathian area from Gorj County.

The water soil reserve at the end of February (at the end of winter) was optimum in all the region (Fig. 8), which shows the water reserve restoration at the optimum level due to the winter precipitations, after the exceeding autumn drought. Snow melting was slow, lasted 19 days and there were no floods.

4.a. The overall thermal regime of the winter of 2011-2012.

The seasonal temperature means for the winter of 2011-2012 were comprised between -3.4°C at Voineasa in the submountainous area and 0.0°C at Dr. Tr. Severin, and their deviations from the multiannual means were comprised between -1.5°C at Voineasa and -0.2°C at Calafat. According to Hellmann criterion applied to seasonal means the thermal time types for the winter of 2011-2012 were comprised between cold (CL) at Tg. Logreşti and Apa Neagră (spatial-temporal extension of 12.5%) and normal (N) in most of the region (at 11 of 16 meteorological stations) having a spatial-temporal extension of 68.8%. Cool weather (CO) according to the seasonal means was registered at 3 meteorological stations (Bechet, Slatina and Tg. Jiu) and in the mountainous area, namely on all the relief forms, but with a spatial-temporal extension of 25.0% (Table 5).

The seasonal thermal mean was -1.8°C, and its deviation from the normal was -0.6°C, which according to Hellmann criterion classifies it as a cool winter (CO) on the whole. This general aspect, just below the normal value is due to the compensation of the overall mean with the lower values from December and January.

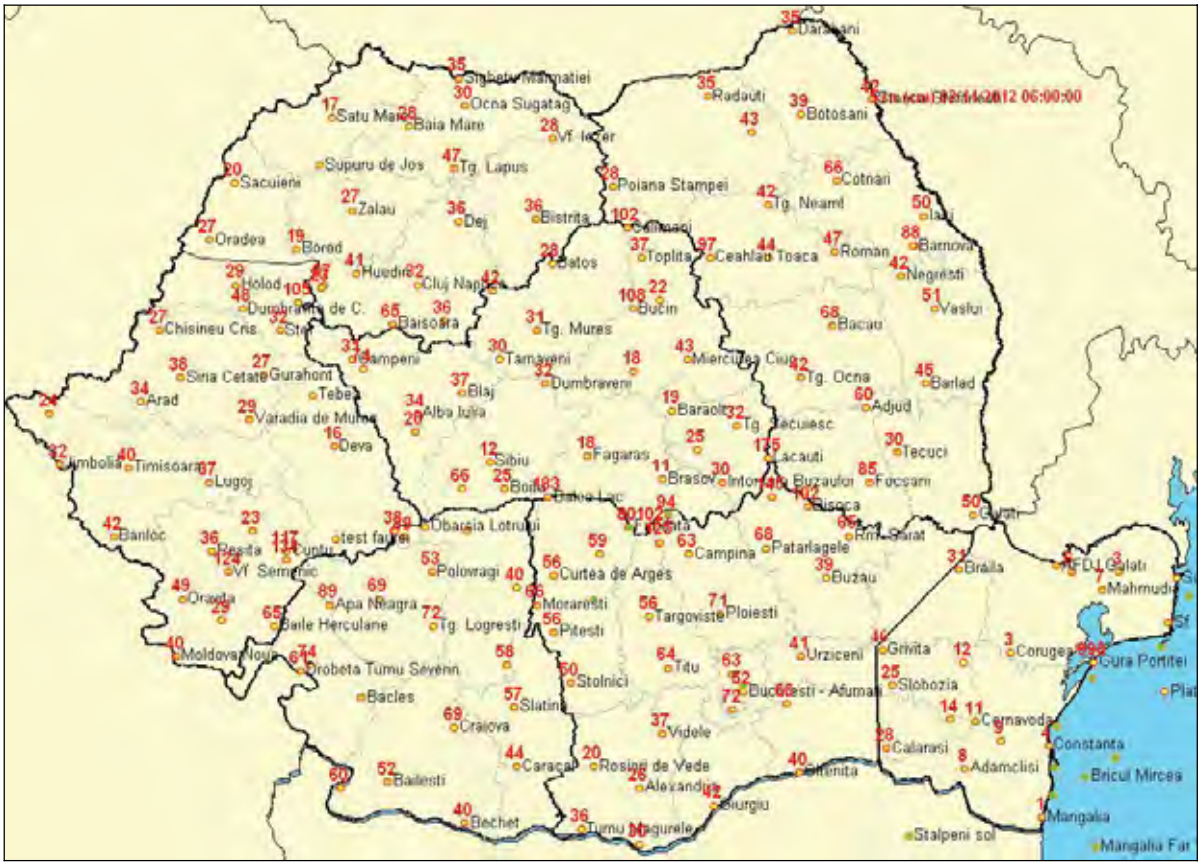

Figure 7. The snow layer on February 14, 2012 at 8 a.m. (according to NAM Bucharest). /
Figura 7. Stratul de zăpadă la data de 14 februarie 2012 ora 08 (după ANM Bucureşti).

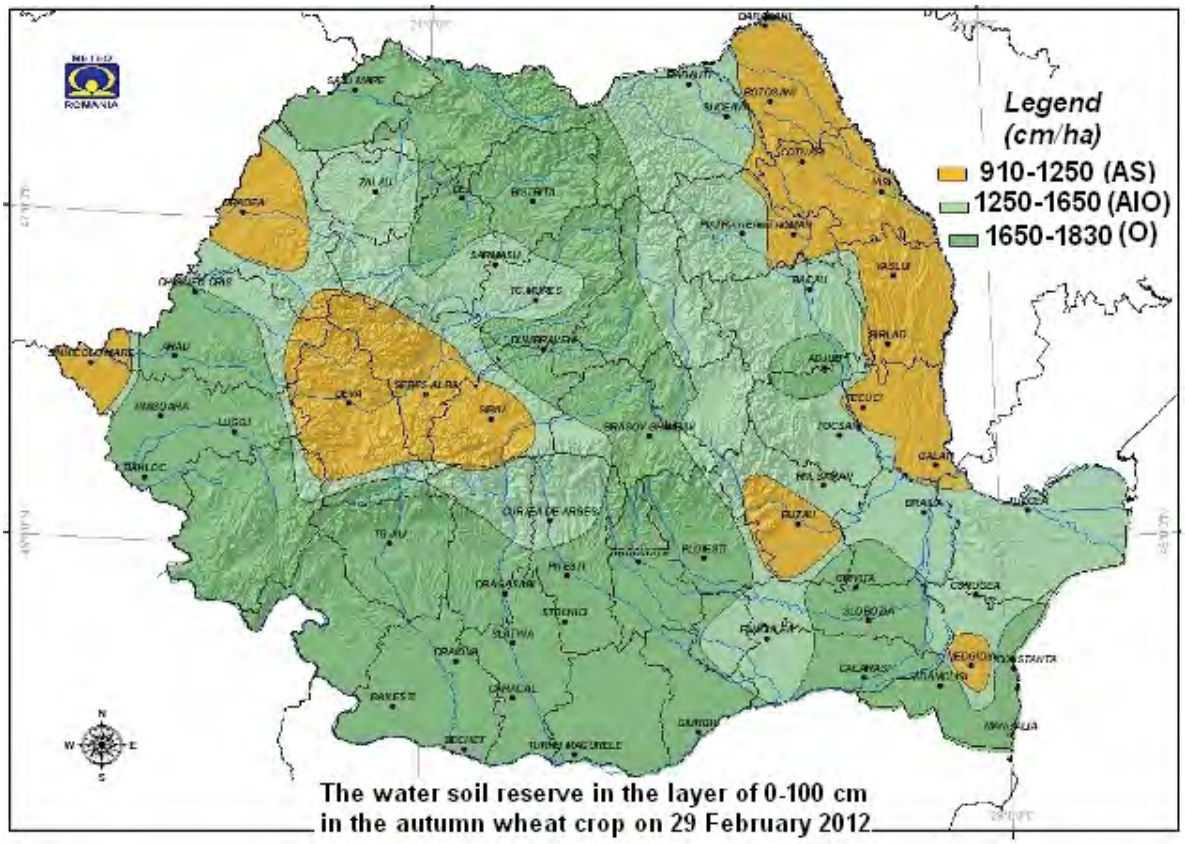

Figure 8. The water soil reserve in the layer of 0-100 cm in the autumn wheat crop on February 29, 2012 (according to NAM Bucharest). / Figura 8. Rezerva de apă din sol în stratul 0-100 cm în cultura grâului de toamnă la data de 29 februarie 2012 (după ANM Bucureşti).

Table 5. Overall average thermal characteristics of the winter of 2011-2012.
Tabel 5. Caracteristici termice medii de ansamblu ale iernii 2011-2012.

Weather station	Hm	Tmed N winter	Med winter 2011-2012	Δ=Tmed-N	CH
Dr. Tr. Severin	77	0.4	**0.0**	-0.4	**N**
Calafat	66	-0.1	-0.3	**-0.2**	**N**
Bechet	65	-0.6	-1.5	-0.9	**RC**
Băileşti	56	-0.7	-1.1	-0.4	**N**
Caracal	112	-1.2	-1.6	-0.4	**N**
Craiova	190	-1.0	-1.5	-0.5	**N**
Slatina	165	-0.8	-1.7	-0.9	**RC**
Bâcleş	309	-1.4	-1.5	-0.1	**N**
Tg. Logreşti	262	-1.1	-2.4	-1.3	**R**
Drăgăşani	280	-0.6	-0.9	-0.3	**N**
Apa Neagră	250	-1.0	-2.5	***-1.5***	**R**
Tg. Jiu	210	-1.0	-1.6	-0.6	**RC**
Polovragi	546	-1.5	-1.9	-0.4	**N**
Rm. Vâlcea	243	-0.6	-0.9	-0.3	**N**
Voineasa	573	-3.0	***-3.4***	-0.4	**N**
Parâng	1585	-5.1	-6.0	-0.9	**RC**
Media Oltenia		-1.2	-1.8	-0.6	**RC**
Obârşia Lotrului	1348	-5.5	-6.4	-0.9	**RC**

The interval January 26 and February 15 is that of *severe winter* during which the air temperature decreased at extremely low temperatures and the climatic risk phenomena: snowfalls, snowstorms, snow layer with a significant thickness occurred, which shows that the severe winter lasted only 20 days.

This *"episode" of severe winter* shows that winter should not be underestimated, even if during extended periods weather is warmer than usual, because the climatic phenomena of severe winter can occur anytime in the interval December 1-February 28-29, with extremely damaging effects.

4.b. The overall pluviometric regime of the winter of 2011-2012. The seasonal quantities of precipitations were comprised between 123.2 l/m^2 at Bechet in the extreme south and 232.9 l/m^2 at Apa Neagră, and their percentage deviations from the normal values were comprised between -19.2% at Polovragi and 70.2% at Craiova. According to Hellmann criterion applied to the seasonal quantities of precipitations, the pluviometric time types at the meteorological stations in Oltenia were comprised between droughty (D) at Polovragi and exceedingly rainy (ER) at Craiova in the central part of the region. The spatial-temporal extension of the normal (N) + little rainy (LR) types was of 66.7%, and of rainy (R) + very rainy (VR) and exceedingly rainy (ER) was of only 20.0% which shows that on the whole, pluviometrically, the winter of 2011-2012 was normal (N). This aspect is also sustained by the overall precipitations mean for the entire region of 148.8 l/m^2 whose percentage deviation from the normal values is of only 8.5%, and according to Hellmann criterion on the whole the winter was pluviometrically normal (N) (Table 2).

DISCUSSIONS

A short history of the intense cold waves during the winter peak interval. It is widely known that the interval January 15-February 15 is winter peak period in Romania, when, usually there occur the most intense coolings and the most abundant snowfalls associated with snowstorms, which produce a thick snow layer, burying in snow the communication routes and often causing the death of people and material damages. *The interval February 1-12 is the interval of maximum risk* at the winter climatic phenomena for February. *In Oltenia the cooling from February 1929* (the night of February 9/10, 1929), was weaker than in other regions of the country, from the few existing data in that time, we can quote the minimum temperature values: -26.6ºC at Drobeta-Turnu Severin, -26.0ºC at Corabia. In west at Băile Herculane -22.0ºC, and in the eastern neighbour counties -26.2ºC at Câmpu Lung. In Bârsa Country, at Bod, *in the morning of February 11, 1929 there was registered -38.5ºC* (equal with the absolute minimum temperature of January registered also here on January 25, 1942). There was a whisper than that at Vatra Dornei the minimum thermal value was of -45.0 ºC, but that value was not homologated[6].

In the north-east of Europe, in Poland, the frost was terrible and at Warsaw in order to protect the population, huge fires were lighted in the streets on February 11, 1929, which burnt all day, and in the night were extinguished for

[6]Gazeta de Transilvania February 1929.

avoiding the fires. The history thus records the first modality of fighting against the intense frost. We consider that an efficient way of fighting against the frosts from the winter peak period is the sound preparation of the population and in general of the society, by ensuring the material and economic conditions for weathering winter, regardless what the weather long-standing forecasts could remit.

This severe winter interval **was caused** by the appearance and development of some Mediterranean cyclones which evolved in the intervals: January 30-31, February 1-5, February 6-8, February 24-28, and in interaction with the anticyclone field that had covered most of the continent led to abundant snowfalls associated with wind gusts (snowstorm). The snowfall was followed by weather intense cooling because of the advection of the northern, north-eastern and eastern extremely cold air advection, and the local phenomena of thermal inversion and intense nocturnal cooling in conditions of sunny sky and thick snow layer worsened the cooling.

Economic and bioclimatic effects on the environment of the winter of 2011-2012

The severe winter episode was surprising because of the cooling intensity and of the snow layer thickness. It caused the death of 79 people (according to the official statistics), the main traffic arteries and some railways were buried in snow and blocked, some roofs and outbuildings as well as some greenhouses for vegetables were destroyed. According to a Draft Government Decision on granting compensatory amounts to the farmers affected by the snowfalls of January – February 2012, the Ministry of Agriculture allotted the amount of 8.52 million lei (about 1.9 million euros) from the national budget. As a consequence of the massive snowfalls of January – February 2012, the significant surfaces of protected areas, namely greenhouses and solariums, were damaged in what the resistance and cover materials are concerned. After data centralization, it resulted that more than 2950 agricultural producers were affected, among whom 79 were greenhouses owners. There were damaged greenhouses and solariums from 31 counties and at the level of the cover material for greenhouses and solariums the following damages were registered: 1,356,699 m^2 greenhouses broken glass and 2,556,512 m^2 torn plastic sheet for solariums. The aid was granted in accordance with the EC reregulation no. 1535/2007, and the maximum amount did not exceed the equivalent in lei of 7,500 euros per beneficiary, namely 33,000 lei.

The abundant snowfall broke many trees and branches, and the frost and the thick snow layer caused the starvation of the wild animals which had to be fed.

Significant damaging effects were noticed in general on all the biotopes[7].

Significant surfaces of rape crops were damaged and destroyed due to the fact that plants were caught unprepared for winter because of the autumn severe drought which delayed their spring (MARINICĂ & MARINICĂ, 2012).

As a consequence of these effects the early spring vegetables sprung later and had an inferior quality.

The fluvial circulation on the Danube was interrupted, and the thick ice and subsequently the icicles caused significant material damages because of the damages of the ships and harbour installations.

On 6 April trees' blossoming was estimated to occur three weeks later than normal.

CONCLUSIONS

After a warm winter beginning in the interval December 1, 2011-January 25, 2012, in the south-west of Romania weather radically changed in the night of January 25/26, following an extremely severe winter episode in the interval January 26 – February 15.

In this interval of 20 days, the severe climatic phenomena caused the death of 79 people in the entire country, many destructions and damages of over 2,000,000 de euro.

This severe winter interval was caused by the appearance and development of some Mediterranean cyclones which evolved in the intervals: January 30-31, February 1-5, February 6-8, February 24-28, and in interaction with the anticyclone field that had covered most of the continent led to abundant snowfalls associated with wind gusts (snowstorm). The snowfall was followed by weather intense cooling because of the advection of the northern, north-eastern and eastern extremely cold air advection, and the local phenomena of thermal inversion and intense nocturnal cooling in conditions of sunny sky and thick snow layer worsened the cooling.

The winter of 2011-2012 marked an important climatic oscillation not only in the south-west of Romania, but also in the entire European continent, where on extended areas, severe winter phenomena occurred.

Weather cooling in the first part of February was extremely intense, and the minimum temperature values registered at Calafat (–26.1°C), Bechet (–24.0°C), Băileşti (–28.9°C), Tg. Logreşti (–28.1°C), Apa Neagră (–28.4°C) and Obârşia Lotrului (–28.6°C), represent climatic records for these stations, being the lowest values of the whole existing data series, thus becoming absolute thermal values of February.

The intense weather cooling as well as the snowstorms and snowfalls occurred not only in Oltenia and Romania, but also on extended areas on the continent.

The abundant snowfalls as well as the rains of December and January restored the water soil reserve at the optimum level ensuring the good development of crops and vegetal carpet in the first part of spring.

We conclude that the phenomenon of global climatic warming is not uniform, although the increasing trend continues, leading to the climatic variability increase and surpassing of the thermal and pluviometric extremes in both senses.

[7] BIOTOPE, biotopes, (Biol.) The natural environment in which a group of plants or animals lives in homogenous conditions. [Pr.: bi-o-] – (DEX).

REFERENCES

BOGDAN OCTAVIA, MARINICĂ I., MIC LOREDANA-ELENA. 2008. *Consideraţii asupra „fenomenului de iarnă caldă" din România*. Universitatea din Bucureşti. Facultatea de Geografie. Comunicări de Geografie. Edit. Universităţii din Bucureşti. **12**: 139-144.

BOGDAN OCTAVIA & MARINICĂ I. 2009. *Caracteristici climatice ale iernii 2007-2008 în Oltenia*. Revista Geografică Serie Nouă. ARS DOCENDI. Universitatea din Bucureşti. **16**: 73-81.

BOGDAN OCTAVIA. MARINICĂ I., MARINICĂ ANDREEA FLORIANA. 2010. *Frequency of warm winters within Oltenia in 1999-2008 decade*. In: Aerul şi Apa, Componente ale Mediului dedicat Conferinţei Ştiinţifice cu acelaşi titlu, 19-20.III.2010 Cluj-Napoca. Universitatea „Babeş-Bolyai" Facultatea de Geografie. Catedra de Geografie fizică şi tehnică în colaborare cu Direcţia Apelor Someş. Eds. Gavril Pandi şi Florin Moldovan. Edit. Presa Universitară Clujană. Cluj-Napoca: 45-54.

MARINICĂ I. & CHIMIŞLIU CORNELIA. 2008. *Climatic Changes on regional plan in Oltenia and their effects on the biosphere*. Oltenia. Studii şi comunicări. Ştiinţele Naturii. Muzeul Olteniei Craiova. **24**: 221-229.

MARINICĂ I., CHIMIŞLIU CORNELIA, MARINICĂ ANDREEA FLORIANA. 2010. *The cooling bioclimatic index in Oltenia and the thermal risk at low temperatures during the cold season.* Oltenia. Studii şi comunicări. Ştiinţele Naturii. Muzeul Olteniei Craiova. **26**: 235-246.

MARINICĂ I., CHIMIŞLIU CORNELIA, MARINICĂ ANDREEA FLORIANA. 2011. *Consideration upon climatic conditions characteristic to the winter 2010-2011, in Oltenia.* Oltenia. Studii şi comunicări. Ştiinţele Naturii. Muzeul Olteniei Craiova. **27**(1): 148-154.

MARINICĂ I. & MARINICĂ ANDREEA FLORIANA. 2012. *Excessively droughty autumn in the south-west of Romania during 2011*. Aerul şi apa componente ale mediului / Air and water components of the environment, Conferinţa 23-24 martie 2012 Cluj Napoca. Edit. Presa Universitară Clujană, http: aerapa.conference.ubbcluj.ro/: 351-358.

***. http://www.meteoromania.ro/. (accesed March 21, 2012).

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Received: March 23, 2012
Accepted: June 12, 2012