CONSIDERATIONS ON THE CLIMATIC CONDITIONS IN OLTENIA DURING THE WARM WINTER OF 2012-2013

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Abstract. The paper analyses the climatic evolution during the warm winter of 2012-2013, caused by the radical weather change occurred on December 24, 2012. The excessively droughty autumn of 2012, and the cool December, was followed by a warm January and February. There was only one cold interval, December 10–23, 2012, which caused agricultural material damages, because autumn crops were not prepared for wintering conditions. 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: monthly temperature means, Hellman criterion, severe winter phenomena, vegetative processes.

Rezumat. Consideraţii privind condiţiile climatice în Oltenia din iarna caldă 2012-2013. În lucrare este analizată evoluţia climatică din iarna caldă 2012-2013, determinată de schimbarea radicală a vremii survenită în data de 24 decembrie 2012. După toamna excesiv de secetoasă 2012, după luna decembrie în ansamblul său răcoroasă au urmat lunile ianuarie şi februarie calde. S-a înregistrat un singur interval cu vreme rece 10-23 decembrie 2012 care a determinat unele pagube materiale în agricultură, ca urmare a surprinderii culturilor de toamnă neadaptate la condiţiile de iernat. 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: medii lunare de temperatură, criteriul Hellmann, fenomene de iarnă severă, procese vegetative.

INTRODUCTION

The extremely warmish summer and the droughty and extremely warmish autumn of 2012 in the first half was followed by the early and cold winter of 2012-2013 in December. Then, the radical change of the thermal regime, after the precipitations on December 5 – 6, 2012, starting with December 7, 2012 when the daily temperature means became negative, marked a sudden weather change, during which not only in Romania, but also in the entire European continent, the winter thermal regime arrived, and the snow layer extended in most of Europe. 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 significant material damages, especially in agriculture, caused by the early low temperatures and the frost at the soil' surface. The interval December 7-31 clearly stands out from most of the winter as a thermal and excessive anomaly, which occurred fast. Then, even from the beginning of January, the air temperature means became positive on long intervals of time.

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, 2012; MARINICĂ & MARINICĂ, 2012).

DATA AND METHODS

For this paper, we analysed the data from Oltenia MRC[1] 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 centres and NAM Bucharest (National Administration of Meteorology). We used the facilities provided by the Office for drawing the tables and charts.

The paper analyses the climatic conditions during the winter of 2012-2013, on the basis of the thermal and pluviometric regime of December 2012, January and February 2013 and the thermal and pluviometric regime on the whole of the winter of 2012-2013.

RESULTS

1a. The thermal regime of December 2012

In December 2012, *air temperature means* were comprised between -3.0°C in Voineasa and 0.1°C in Drobeta Turnu Severin, and their deviations from the multiannual means were comprised between -3.3°C in Bechet and -0.6°C in Bâcleş. According to Hellmann criterion, the thermal time type in December 2012 at the meteorological stations in

[1] MRC= Regional Meteorological Center Oltenia

Oltenia was comprised between cold (CL)[2] in the extreme south in Bechet, in the south Carpathian area in Apa Neagră and in the intra-Carpathian depression Voineasa and normal (N) in Râmnicu Vâlcea, with in the Olt Couloir and in the high mountainous area in Parâng. The monthly temperature mean for the entire region was -1.4°C, and its deviation from the multiannual mean was -1.3°C, which classifies December as a cool month for the entire region (Table 1).

The monthly minimum air temperatures were comprised between -19.6°C in Târgu Logreşti and Apa Neagră registered on December 14 and -9.5°C registered in Drăgăşani on the same date, and in the high mountainous area the minimum thermal value was -23.5°C in Obîrşia Lotrului. All the monthly minimum thermal values were registered in the middle of the second decade in the interval December 14-15.

The monthly minimum thermal values at the soil surface were mostly registered in the middle of the second decade of the month and were comprised between -12.1°C in Drobeta Turnu Severin on December 15 and -25.0°C in Apa Neagră on December 14. In the interval December 4-31, the phenomenon of frozen soil occurred. These values show that, in most of Oltenia, the critical biological limits of plants` resistance to the air temperature regime (-20 -15°C) were exceeded, the lowest values being registered in the Getic Plateau and the Subcarpathian area.

The maximum thermal values were comprised between 8.3°C in Voineasa registered on December 1 and 14.1°C in Caracal on the same date, and in the mountainous area the maximum thermal value was 14.2°C in Parâng registered on December 25 (Table 1).

Table 1. The air thermal regime in Oltenia and the minimum thermal values at the soil surface in December 2012.

Meteorological Station	Hm	NXII	M	ΔT=M-N	CH	MinT		MaxT		MinsoilT	
						(°C)	Date	(°C)	Date	(°C)	Date
Drobeta Turnu Severin	77	1.4	**0.1**	-1.3	**CO**	-10.1	14	11.8	1	**-12.1**	15
Calafat	66	1.0	-0.8	-1.8	**CO**	-12.7	15	12.1	1	-19.0	14
Bechet	65	0.4	-2.9	**-3.3**	**CL**	-16.9	14	13.5	1	-20.5	14
Băileşti	56	0.4	-1.3	-1.7	**CO**	-14.5	15	11.8	1	-19.5	14
Caracal	112	-0.1	-1.2	-1.1	**CO**	-13.4	15	**14.1**	1	-16.0	15
Craiova	190	0.1	-1.1	-1.2	**CO**	-13.5	15	13.4	1	-15.0	15
Slatina	165	0.3	-1.0	-1.3	**CO**	-14.5	14	13.8	1	-20.1	14
Bâcleş	309	-0.4	-1.0	**-0.6**	**N**	-9.9	14	11.0	1;26	-	-
Târgu Logreşti	262	0.1	-1.5	-1.6	**CO**	**-19.6**	14	13.7	1	-21.1	15
Drăgăşani	280	0.6	-0.4	-1.0	**CO**	-9.5	15	13.4	1	-14.8	14
Apa Neagră	250	0.1	-2.1	-2.2	**CL**	**-19.6**	14	12.5	1	**-25.0**	14
Târgu Jiu	210	0.1	-1.0	-1.1	**CO**	-15.4	14	13.3	1	-21.2	13
Polovragi	546	0.1	-1.0	-1.1	**CO**	-15.2	13	12.8	26	-22.3	14
RâmnicuVâlcea	243	0.5	-0.2	-0.7	**N**	-12.2	14	13.8	1	-22.6	13
Voineasa	573	-1.9	**-3.0**	-1.1	**CO**	-17.4	14	**8.3**	1	-	-
Parâng	1585	-3.7	-4.0	-0.3	**N**	-13.6	13	14.2	25	-	-
Media Oltenia	-	-0.1	-1.4	-1.3	**CO**	-14.3		12.7		-19.2	-
Obârşia Lotrului	1348	-4.9	-5.7	-0.8	**N**	-23.5	14	4.3	1	-	-

(Source: processed data)

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 2012. There were registered 23 days in which the daily means were negative (in the intervals December 6-16, December 19-26, December 28-31) and only 8 days with positive means. There were registered *22 days* with air and soil temperatures of 0°C (frost and thaw phenomena).

The number of frost units in December 2012 was comprised between 33.9 in Drobeta Turnu Severin in the west of the region and 111.5 in Bechet in the south of the Romanian Plain, designating a soft month on average from an agrometeorological point of view.

The number of frost units[3] was comprised between 0 on extended areas in Oltenia and 7.6 in Târgu Logreşti, designating an insignificant phenomenon from an agrometeorological point of view. *The sums of the active daily average temperatures* were comprised between 19.0°C in Voineasa and 42.7°C in Râmnicu Vâlcea, and in the mountainous area 17.4°C in Parâng.

[2] The thermal time type 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).

[3] ***The degree of winter bitterness*** in agrometeorology (winter type) classifies according to the sum of frost units (∑ differences between the daily minimum temperature values <-15°C and the agroclimatic critical threshold of -15.0°C, in the interval December - February). Therefore, ***a frost unit*** is the difference of 1°C between the critical threshold of -15.0°C and an air minimum thermal value ≤ -15°C (for example for T min = -16.0°C then the difference -15.0°C - (-16.0°C) = 1, namely a frost unit, (SANDU et al., 2010).

1.b. The pluviometric regime of December 2012

The monthly quantities of precipitations registered in December 2012 were comprised between 31.4 l/m^2 in Băileşti in the Oltenian Plain and 118.0 l/m^2 in Apa Neagră in the Subcarpathian area; the percentage deviations from the normal values were comprised between -32.9% in Băileşti and 50.3% in Polovragi in the Subcarpathian depressions area, and in the submountainous area -27.5% in Parâng (Table 2). According to Hellmann criterion, the pluviometric time type at the meteorological stations in Oltenia was comprised between very droughty (VD) in Băileşti and excessively rainy (ER) in Polovragi.

Table 2. Quantities of precipitations registered during the winter of 2012-2013 (Σ), in comparison with the normal values.

Meteorological Station	Hm	December 2012				January 2013				February 2013				Winter 2012 – 2013			
		ΣXII	N	Δ%	CH	ΣI	N	Δ%	CH	ΣII	N	Δ%	CH	ΣW	N	Δ%	CH
Drobeta Turnu Severin	77	69.2	61.2	13.1	**LR**	45.7	51.4	-11.1	**LD**	141.2	47.9	194.8	**ER**	256.1	160.5	59.6	**ER**
Calafat	66	54.4	45.5	19.6	**LR**	27.7	40.4	-31.4	**VD**	78.5	38.0	106.6	**ER**	160.6	123.9	29.6	**VR**
Bechet	65	32.9	36.3	-9.4	**N**	18.5	33.5	-44.8	**VD**	38.8	34.8	11.5	**LR**	90.2	104.6	-13.8	**LD**
Băileşti	56	31.4	46.8	-32.9	**VD**	34.4	38.5	-10.6	**LD**	57.3	36.1	58.7	**ER**	123.1	121.4	1.4	**N**
Caracal	112	34.5	39.5	-12.7	**LD**	20.2	34.7	-41.8	**VD**	51.4	34.5	49.0	**VR**	106.1	108.7	-2.4	**N**
Craiova	190	44.9	41.8	7.4	**N**	33.9	37.5	-9.6	**N**	61.0	30.4	100.7	**ER**	139.8	109.7	27.4	**VR**
Slatina	165	44.4	42.8	3.7	**N**	33.5	36.0	-6.9	**N**	57.6	38.4	50.0	**VR**	135.5	117.2	15.6	**LR**
Târgu Logreşti	262	66.8	44.8	49.1	**VR**	36.5	35.9	1.7	**N**	77.2	41.0	88.3	**ER**	180.5	121.7	48.3	**ER**
Drăgăşani	280	59.0	44.6	32.3	**VR**	41.2	34.1	20.8	**R**	57.0	35.4	61.0	**ER**	157.2	114.1	37.8	**VR**
Apa Neagră	250	**118.0**	82.3	43.4	**VR**	65.9	70.9	-7.1	**N**	200.1	66.4	201.4	**ER**	384.0	219.6	74.9	**ER**
Târgu Jiu	210	64.8	64.0	1.3	**N**	53.3	53.9	-1.1	**N**	115.6	52.0	122.3	**ER**	233.7	169.9	37.6	**VR**
Polovragi	546	84.3	56.1	50.3	**ER**	54.1	48.9	10.6	**LR**	60.7	48.4	25.4	**R**	199.1	153.4	29.8	**R**
Râmnicu Vâlcea	243	68.6	46.2	48.5	**VR**	48.4	35.5	36.3	**VR**	48.1	38.4	25.3	**R**	165.1	120.1	37.5	**VR**
Parâng	1585	39.5	54.6	-27.7	**D**	58.2	57.7	0.9	**N**	40.2	47.7	-15.7	**LD**	137.9	160.0	-13.8	**LD**
Media Oltenia	-	58.1	50.5	15.0	**LR**	40.8	43.5	-6.1	**N**	77.5	42.1	84.0	**ER**	176.4	136.1	29.6	**VR**

(Source: processed data)

The overall mean for the entire region of Oltenia was 58.1 l/m^2, and its percentage deviation from the normal value was 15.0%, which shows that for the entire region of Oltenia December 2012 was a little rainy month on average, thus confirming the interruption of the excessive drought from the autumn of 2012, in the first month of winter. However, due to the low thermal air regime and the poor water consumption of the vegetal canopy, *the water soil reserve* in the layer of 0-100 cm on December 28, 2012 was satisfactory (S)[4] close to optimum and optimum, within the entire the territory of Oltenia.

In these conditions, the vegetative sleep continues in crops, fruit and wine growing species. Therewith, as a consequence of the drifting snow on fields with a discontinuous, superficial (below 10 cm) or even absent snow layer, of the low minimum air temperatures which were below the critical biological thresholds of plants` resistance (Tmin < -10-15-20°C), damages of the foliar apparatus occurred through scalds and scorches of the leaves margin.

The maximum snow layer thickness, for the entire winter of 2012-2013, was registered on December 12, 2012 after the abundant snowfalls in the interval December 11-12, 2012 (Fig. 2), when it was comprised between 11 cm in Halânga and 76 cm in Balta in Mehedinţi County. Subsequently, the snow layer thickness has decreased, and on December 31, 2012 there was a snow layer in the Subcarpathian and mountainous area.

The snowfalls, winter thermal regime and wintry climatic phenomena started in the night of December 4/5, 2012, thus registering an ***early winter*** for Oltenia and a fast passing from positive to negative temperature values. This fast variation of the air and soil thermal regime caught unprepared for winter many crops, because the agricultural works of setting up the crops as well as the germination and spring processes occurred late as a consequence of the autumn excessive drought. Consequently, the most significant damages of crops and vineyards occurred in December, since January and February were warm.

2.a. The thermal regime of January 2013

The monthly thermal means were comprised between -2.6°C in Voineasa and +1.3°C in Drobeta Turnu Severin and Calafat, and the *deviations* from the monthly multiannual means were comprised between 1.2°C in Apa Neagră and 3.1°C in Polovragi.

According to Hellmann criterion, the thermal time types in January 2013 at the meteorological stations were comprised between warmish (WS) in the extreme south in Bechet, in the Subcarpathian depression area (Apa Neagră) and in the mountainous area and warm (W) in most part of Oltenia (Table 3).

The overall monthly mean for the entire region was -0.5°C, and its *deviation* from the normal mean was 2.3°C, which according to Hellmann criterion led to the conclusion that January 2013 was warm (W).

[4] SP = pedological drought, SM = moderate drought, AS = almost satisfactory, ApO = almost optimum, AO = optimum (O) or very close of optimum (AO).

The monthly maximum air temperatures were mostly registered in the third decade of the month (January 22-31) and in the second decade (most of them on January 22) and were comprised between 7.2°C in Drăgăşani and 13.5°C in Craiova, and the maximum temperatures mean was 11.3°C.

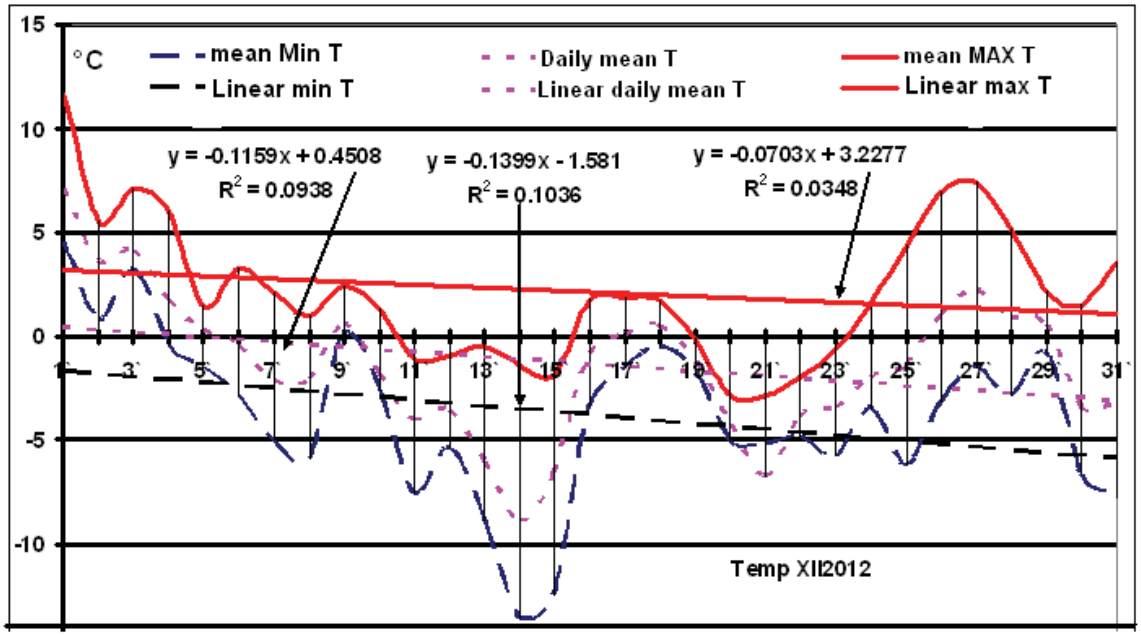

Figure 1. The air temperature variation, the daily means (daily mean T), daily minimum (mean Min T) and maximum temperatures mean (mean MAX T), calculated for the entire region in December 2012.

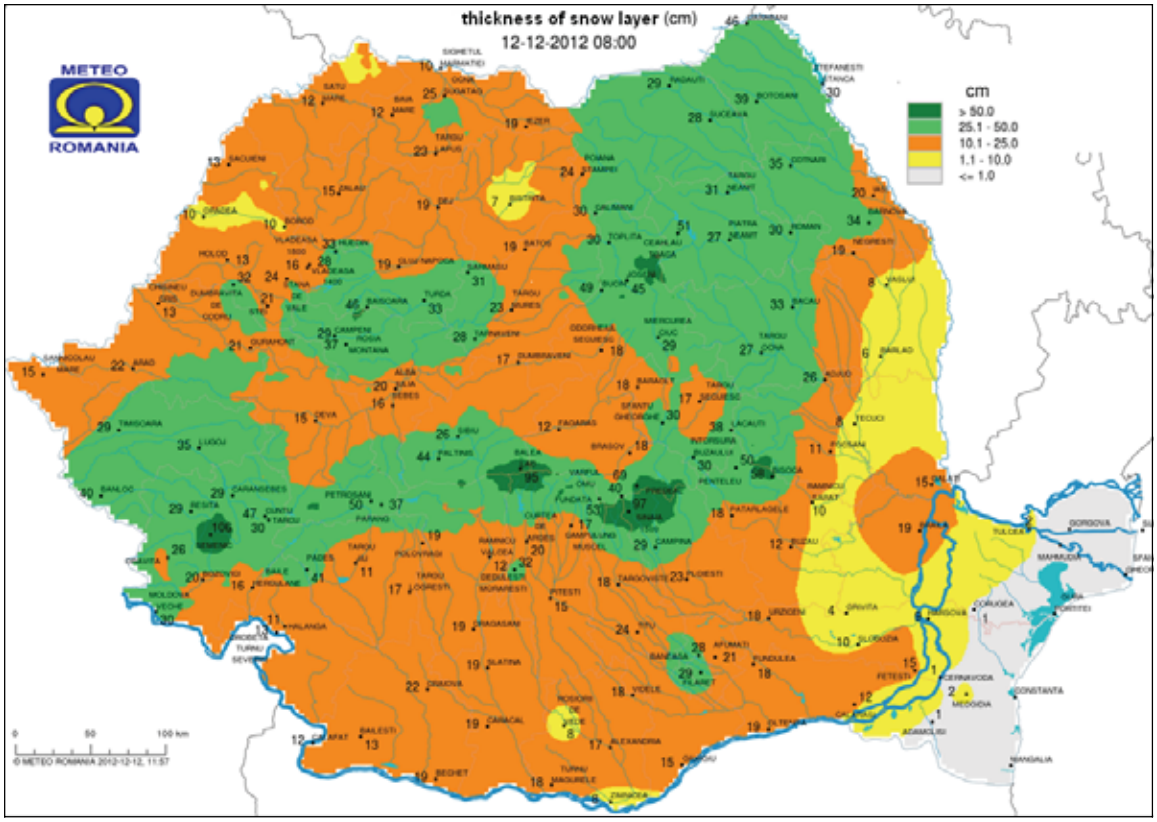

Figure 2. The maximum snow layer thickness in the winter of 2012-2013 registered on December 12, 2012 (according to NAM Bucharest).

The monthly minimum air temperatures were mostly registered in the first decade of the month, and in the south of Oltenia Plain in the last five days and were comprised between -15.8°C in Voineasa in the intra-Carpathian depression (registered on January 9) and -7.5°C in Calafat (on January 28), and in the mountainous area -16.0°C in Parâng (on January 8).

The monthly minimum thermal values mean was -11.0°C. The low thermal minimum temperatures were caused by the cold wave from the end of the first decade of January, and the cooling process started in the night of January 7/8, 2013 (Table 3 and Fig. 3).

The minimum temperature values at the soil surface were comprised between -17.6°C in Apa Neagră (registered on January 10) and -9.0°C in Craiova, which were registered in the same interval as the minimum thermal air values.

The monthly minimum temperatures mean at the soil surface, for the entire region was -12.2°C. There were registered 27 days when the air and soil temperature reached the *critical threshold of 0°C* and 27 days with frost and thaw, and the great number of days with average and maximum positive temperature values led to the slow continuation of the vegetative processes in certain periods.

Table 3. The thermal air regime and the thermal minimum temperatures at the soil surface in January 2013, in Oltenia.

Meteorological Station	Hm	NI	M	ΔT=M-N	CH	MinT		MaxT		MinsoilT	
						(°C)	Date	(°C)	Date	(°C)	Date
Drobeta Turnu Severin	77	-1.1	**1.3**	2.4	**W**	-7.6	9	11.9	31	-10.0	9
Calafat	66	-1.8	0.6	2.4	**W**	-7.5	28	11.7	31	-9.2	28
Bechet	65	-2.2	-0.3	1.9	**WS**	-12.6	28	12.4	22	-11.0	28
Băileşti	56	-2.3	-0.2	2.1	**W**	-9.6	28	11.2	31	-14.5	28
Caracal	112	-2.9	-0.4	2.5	**W**	**-9.2**	10	13.2	22	-9.1	9
Craiova	190	-2.6	-0.3	2.3	**W**	-9.6	9	**13.5**	22	**-9.0**	9
Slatina	165	-2.4	-0.2	2.2	**W**	-10.4	10	12.7	22	-12.3	10
Bâcleş	309	-3	-0.1	2.9	**W**	-9.5	9	11.1	22	-	-
Târgu Logreşti	262	-2.7	-0.6	2.1	**W**	-12.8	8	11.6	22	-14.4	9
Drăgăşani	280	-2.2	0.3	2.5	**W**	-9.7	10	12.3	22	-13.4	10
Apa Neagră	250	-2.6	-1.4	1.2	**WS**	-15.0	8	11.8	22	**-17.6**	10
Târgu Jiu	210	-2.6	-0.1	2.5	**W**	-10.1	9	12.3	31	-11.6	8
Polovragi	546	-3.2	-0.1	3.1	**W**	-10.8	10	10.5	3	-15.8	9
Râmnicu Vâlcea	243	-2.2	0.5	2.7	**W**	-9.8	9	12.7	22	-10.3	10
Voineasa	573	-4.7	**-2.6**	2.1	**W**	**-15.8**	9	**7.2**	4	-	-
Parâng	1585	-5.9	-4.5	1.4	**WS**	-16.0	8	4.6	21	-	-
Media Oltenia	-	-2.8	-0.5	2.3	**W**	-11.0		11.3	-	-12.2	-
Obârşia Lotrului	1348		-5			-23.1	8	4.5	22	-	-

(Source: processed data)

The negative temperatures and the frost at the soil surface, which occurred again, caused the vulnerability of plants to frost in the cultivated areas.

The frost was insignificant from an agrometeorological point of view. In January, *the frost units*[5] were comprised between 66.4 in Drobeta Turnu Severin and 181.3 in Apa Neagră, and the mean for the entire region was 114.7, designating a "mild" month from an agrometeorological point of view.

The sums of the daily active temperature means were comprised between 12.6°C in Voineasa and 63.5°C in Drobeta Turnu Severin, while in the mountainous they are 3.6°C in Parâng.

2.b. The pluviometric regime of January 2013

The monthly quantities of precipitations were comprised between 18.5 l/m^2 in Bechet and 65.9 l/m^2 in Apa Neagră in the Subcarpathian area, and the percentage deviations from the multiannual means were comprised between -44.8% in Bechet and 20.8% in Drăgăşani (Table 2). According to Hellmann criterion, the pluviometric time type at the meteorological stations in Oltenia was comprised between very droughty (VD) on extended areas in the Oltenia Plain (Calafat, Bechet and Caracal) and very rainy (VR) in the Olt Couloir in Râmnicu Vâlcea.

The quantities of precipitations mean for the entire region was 40.8 l/m^2, and its percentage deviation was -6.1%, which classifies January as a normal month (N) from a pluviometric point of view for the entire region.

There were registered 21 days with precipitations, 15 (71.4%) days with liquid precipitations and 8 days with snowfall[6] representing 38.1%.

[5] **"Frost" units**, a specific notion of agrometeorology, is calculated with the formula ΣTdaily mean <0°C, and their values are established for the entire cold season (1 November-31 March);

[6] The number of days with sleet is added not only to the number of days with liquid precipitations, but also to the number of days with solid precipitations, according to the meteorological instructions.

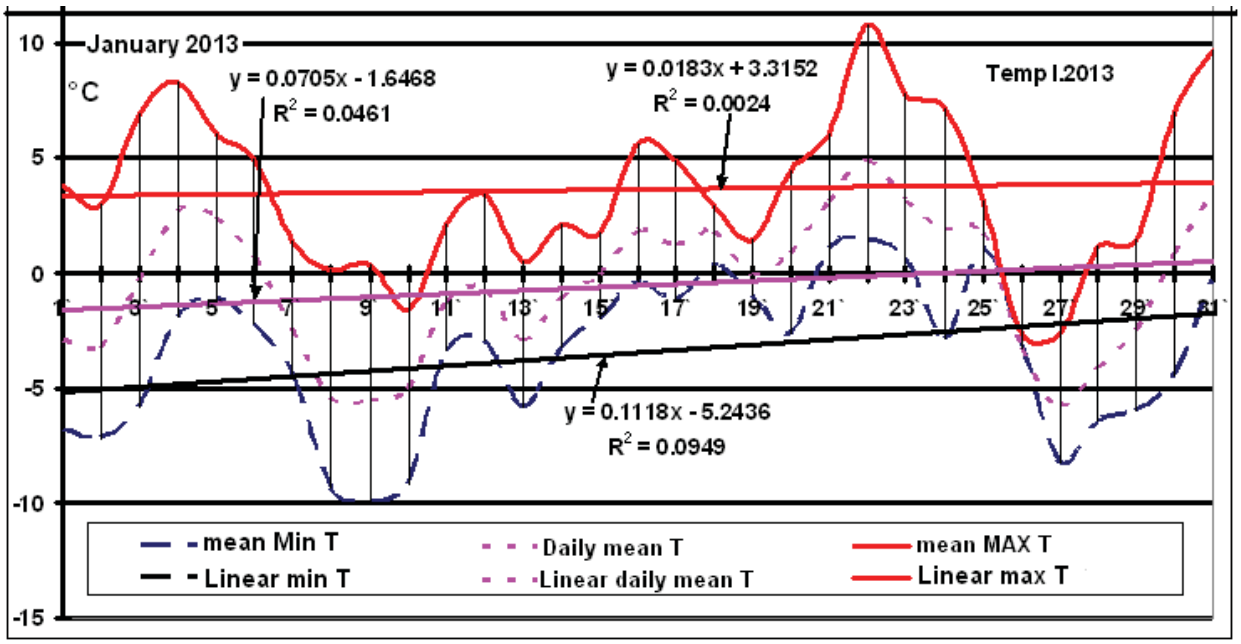

Figure 3. The air temperature variation, the daily means (Daily mean T), daily minimum (mean min T) and maximum temperatures mean (mean MAX T), calculated for the entire region in January 2013.

As *climatic risk phenomena* we record that on January 17, for the interval January 18, between 6 a.m. and 6 p.m., a *yellow code warning* for dangerous meteorological phenomena was remitted, related to significant quantities of precipitations in Mehedinţi County, in the mountainous area of Gorj and the northern half of Vâlcea County, and for the interval January 24, 6 p.m. January 26, 8 p.m., for abundant rain, sleet and snowfall. Thus, in the aforementioned interval, in the south and south-east of the country there were significant precipitations, locally exceeding 25 l/square meters, predominantly in the form of rain in the southern half of Muntenia and Dobrogea, mixed in the first hours and then snowfall in the south of Banat, Oltenia and northern Muntenia (Fig. 4).

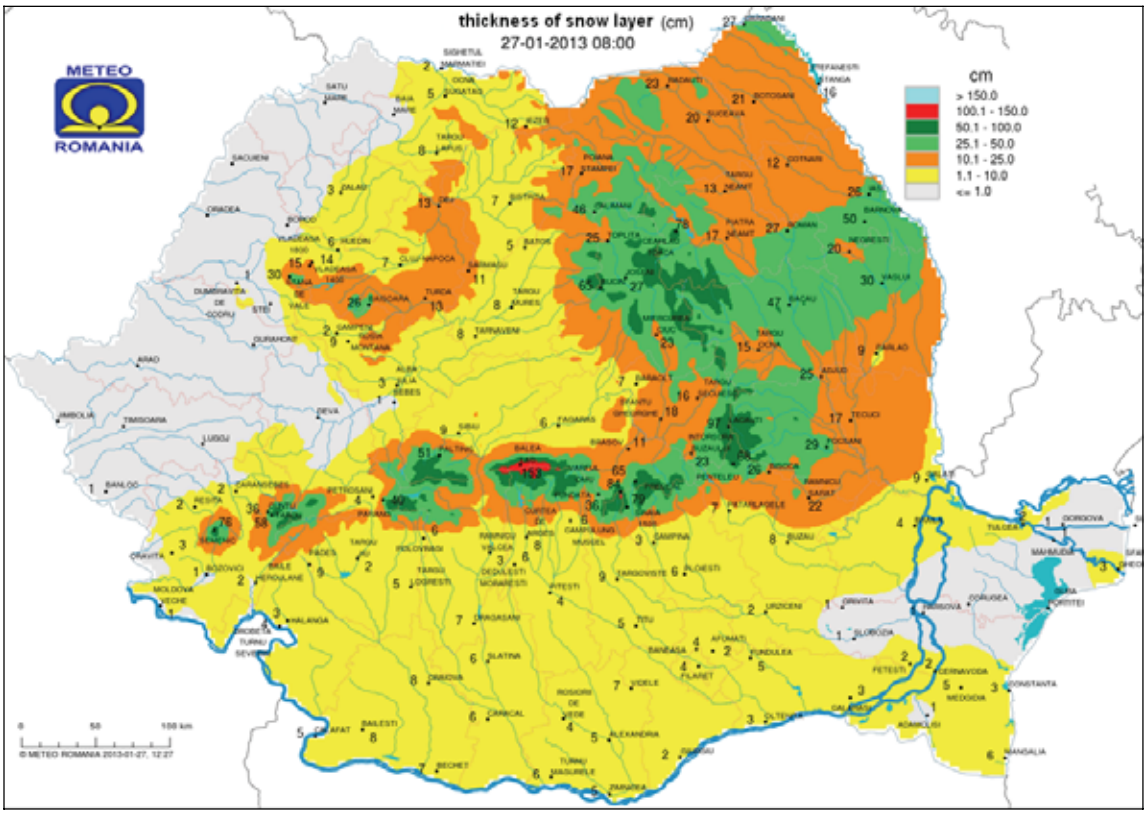

Figure 4. The maximum snow layer thickness in January 2013 registered on January 27, 2013 (according to NAM Bucharest).

On extended areas there was glazed frost. In all these regions there were unceasing wind gusts, with speeds exceeding 50 - 60 km/h. In the counties from the southern half of Moldavia, in the Curvature Carpathians area and Bucegi Mountains it snowed, the wind gust exceeding 70 km/h and there was a snowstorm, too.

The snow layer was absent in the interval January 1-25, in most of the region (excepting the mountainous and submountainous area) and its reduced thickness was formed beginning with January 28 and was comprised between 2 cm in Târgu Jiu 9 cm in Apa Neagră, and in the mountainous area 41 cm in Parâng (Fig. 4).

On January 31, *the water reserve* in the soil layer of 0-100 cm, was satisfactory, close to optimum and optimum, in all crop regions.

3.a. The thermal regime of February 2013

The monthly average air temperature values were comprised between 0.1°C in the intra-Carpathian Depression Voineasa and -3.5°C in Drobeta Turnu Severin in the western region, and their deviations from the multiannual means were comprised between 2.6°C in Voineasa and Râmnicu Vâlcea in the Olt Couloir. According to Hellmann criterion the thermal time types in Oltenia were comprised between warm (W) in most of the region excepting the mountainous area Obârşia Lotrului (Table 4), where the multiannual mean is a little significant, being calculated for a short series of data.

The monthly air temperature mean calculated for the entire region was 2.1°C, and its deviation from the multiannual monthly mean[7] was 2.9°C, thus confirming the classification of warm month (W) for the entire region.

The minimum air temperature values were comprised between -12.6°C in Voineasa registered on February 11 and -2.5°C registered in Calafat on February 5, and the monthly minimum temperature mean was -6.0°C, higher than that of January.

The monthly maximum temperature values were mostly registered on 1 (excepting the mountainous and submountainous area), an atypical situation for February and were comprised between 8.3°C in Voineasa registered on February 25 and 14.1°C registered on February 1.

The maximum temperature values mean for the entire region was 11.5°C.

The daily maximum temperature values were positive in the entire region and in all days, excepting the mountainous area, which shows and confirms a warm weather in February.

Table 4. The air thermal regime in Oltenia and the minimum thermal values at the soil surface in February 2013.

Meteorological Station	Hm	NI	M	ΔT=M-N	CH	MinT		MaxT		MinsoilT	
						(°C)	Date	(°C)	Date	(°C)	Date
Drobeta Turnu Severin	77	0.9	**3.5**	**2.6**	**W**	-4.8	5	13.4	1	-6.4	12
Calafat	66	0.4	3.4	3.0	**W**	**-2.5**	5	**14.1**	1	**-4.2**	5
Bechet	65	-0.1	3.4	3.5	**W**	-4.1	5	13.7	1	-5.0	5;6
Băileşti	56	-0.1	3.0	3.1	**W**	-4.6	11	12.6	1	-5.4	11
Caracal	112	-0.7	2.9	**3.6**	**W**	-3.7	5;12	11.9	1	-5.8	5
Craiova	190	-0.4	2.6	3.0	**W**	-4.2	11	12.9	1	-4.4	5
Slatina	165	-0.2	2.7	2.9	**W**	-4.4	12	12.1	1	-5.2	5;12
Bâcleş	309	-0.9	1.9	2.8	**W**	-6.8	11	11.4	1	-	-
Târgu Logreşti	262	-0.7	2.0	2.7	**W**	-6.8	5	10.8	1	-5.4	5
Drăgăşani	280	-0.2	2.5	2.7	**W**	-3.5	5	11.8	1	-6.2	12
Apa Neagră	250	-0.6	2.2	2.8	**W**	-6.5	5	9.6	1	-7.0	1
Tîrgu Jiu	210	-0.4	2.7	3.1	**W**	-4.9	5	13.1	1	-5.6	5;12
Polovragi	546	-1.4	1.8	3.2	**W**	-9.4	11	9.1	1	**-17.6**	11
Rm.Vâlcea	243	0.0	2.9	2.9	**W**	-5.0	5	12.2	1	-5.9	2;5
Voineasa	573	-2.5	**0.1**	**2.6**	**W**	**-12.6**	11	**8.3**	25	-	-
Parâng	1585	-5.6	-3.5	2.1	**W**	-11.6	11	7.6	25	-	-
Media Oltenia	-	-0.8	2.1	2.9	**W**	-6.0	-	11.5	-	-6.5	-
Obîrşia Lotrului	1348	-5.5	-3.6	1.9	**WS**	-20.2	12	5.9	5	-	-

(Source: processed data)

The chart of the maximum temperature values presented a linear decreasing tendency after the warming in the first part of the month, and the daily means and the daily minimum temperature values had a linear increasing tendency, which confirms the warm weather during the entire month (Fig. 5). 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 10.

[7] The multiannual means used as a comparison terms were calculated for the interval 1901-1990, which gives to the conclusions obtained a very good meaning.

There were registered 13 days when the air temperature reached the *critical threshold of 0°C*[8] (days with frost and thaw) and 15 days in which the daily minimum temperature values were positive in most of the region.

The minimum temperatures at the soil surface were extremely low and were comprised between -17.6°C in Polovragi on February 11 and -4.2°C in Calafat, registered on February 5, and at some meteorological stations on February 6, 11 and 12, which shows the cooling 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 in the interval February 5-12. The soil has been thawed during long periods of time, and in the periods when it occurred it was superficial in general.

The number of frost units in February was comprised between 0 in most of the Romanian Plain and in the Olt Couloir in Râmnicu Vâlcea and 18.4 in Voineasa, which confirms the fact that from an agrometeorological point of view, February 2013 was a warm month, in which the vegetative processes occurred again in some intervals of time.

The agrometeorological[9] *frost* was not registered in February.

The sums of the active daily average temperatures were comprised between 19.5°C in Voineasa and 99.0°C in Drobeta Turnu Severin, and in the mountainous area 4.9°C in Parâng, which confirms the predominance of warm weather on extended periods of time.

3.b. The pluviometric regime of February 2013

The monthly quantities of precipitations in February were comprised between 38.8 l/m^2 in Bechet and 200 l/m^2 in Apa Neagră, the Subcarpathian depression, and their deviations from the multiannual means were comprised between -11.5% in Bechet (the only negative deviation being in the mountainous area -15.7% in Parâng) and 201.4% in Apa Neagră, and according to Hellmann criterion, the pluviometric time types at the meteorological stations in Oltenia were comprised between little rainy (LR) in Bechet and exceedingly rainy (ER) in most part of the region (Drobeta Turnu Severin, Calafat, Băileşti, Craiova, Târgu Logreşti, Drăgăşani, Apa Neagră, Tg Jiu), and in the mountainous area a little droughty (LD) in Parâng (Table 2).

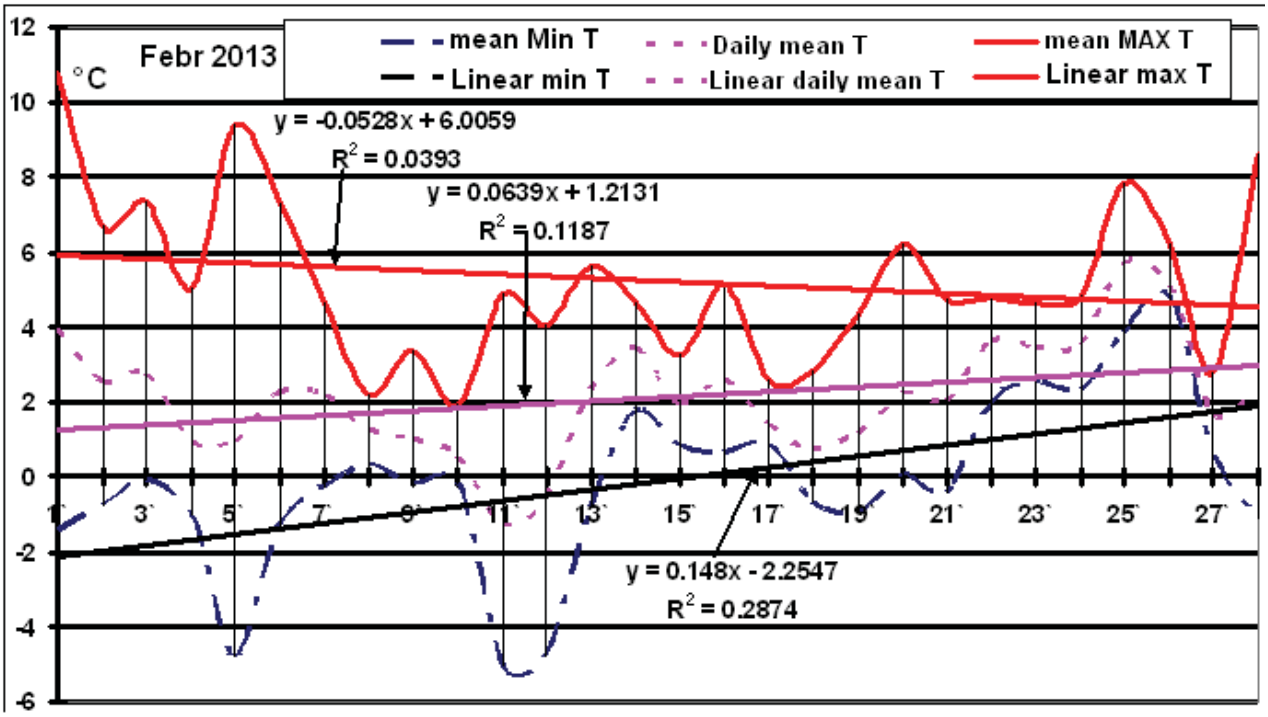

Figure 5. The air temperature variation, the daily means (Daily mean T), daily minimum (mean min T) and maximum temperatures mean (mean MAX T), calculated for the entire region in February 2013.

[8] The temperatures value exceeding 0°C, in agrometeorology are active temperatures, and their persistence during some consecutive days establishes the start over of the vegetative processes. The decrease of the air and soil surface temperature below 0°C induces the vegetative sleep.

[9] For weather forecast and in general in mass-media, for people and animals, the notion of *frost* means temperature values of ≤ -10°C, but in agrometeorology and for plants the term of frost means air temperatures of < -15.0°C. *The threshold of -15.0°C* is *the critical threshold of* crops resistance to frost, below this threshold there are registered frostbites of crops and irremediable damages. These different thresholds of resistance to low temperatures show that plant are better adapted to low temperatures than animals, a normal aspect if we take into account that during the geological eras plants were the first to appear and afterwards the animals, an aspect which is also justified by the different cellular structures of the two kingdoms.

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.

The monthly quantities of precipitations mean for the entire region was 77.5 l/m^2, and its percentage deviation from the multiannual mean was 84.0%, which classifies February as an excessively rainy (VR) month for the entire region, meaning the interruption of the droughty period which has extended from the beginning of the summer of 2012 to the end of January 2013.

The snow layer was absent, excepting the mountainous area some days when it was insignificant and temporary on restricted areas. *The water soil reserve* in the end of February (in the end of winter) in the depth of 0-100 cm, in the autumn wheat crop was satisfactory (S), close to optimum (ClO) and optimum (O), in the entire Oltenia.

4.a. The overall thermal regime of the winter of 2012-2013

The seasonal temperature means for the winter of 2012-2013 were comprised between -1.8°C in the intra-Carpathian depression Voineasa and 1.6°C in Dobeta Turnu Severin, and their deviations from the multiannual means were comprised between 0.6°C in Apa Neagră and 1.7°C in Bâcleş, Polovragi and Râmnicu Vâlcea.

According to Hellmann criterion (CH) applied to seasonal means the thermal time types for the winter of 2012-2013 were comprised between warmish (WS) in Bechet, Apa Neagră and Obîrşia Lotrului (spatial-temporal extension of 17.7%) and warm (W) in most of the region (at 15 of 18 meteorological stations) having a spatial-temporal extension of 83.3% (Table 5).

The seasonal thermal mean was 0.1°C, and its deviation from the normal was 1.3°C, which according to Hellmann criterion classifies it as a warm winter (W) on the whole. This general aspect is due to the increase of the overall mean because of the high values in January and February.

The interval comprised between December 5 and December 27 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 22 days.

However, this climatic risk phenomena manifested also in this winter especially through the great number of days with frost and thaw (62 days with the isotherm of 0°C, namely 68.9% of the total number of days of the season), which made vulnerable some crops and particular species of fruit trees such as the apricot tree, which is extremely reactive to weather warming.

The number of frost units for the entire winter was comprised between 100.3 in Drobeta Turnu Severin and 296.4 in Voineasa close to the lower limit of the mountainous area, and in the mountainous area 437.0 in Parâng, which designates a mild winter from an agrometeorological point of view.

The sum of the active average temperatures for the entire winter was comprised between 51.5°C in Voineasa and 198.9°C in Drobeta Turnu Severin, prefiguring an early spring, and in the mountainous area 50.5 in Parâng. For the interval December 1, 2012 March 31, 2013 the sum of the active average temperatures was comprised between 128.8°C in Voineasa and 366.4°C in Drobeta Turnu Severin, which designates the values of a mild winter.

Table 5. Overall average thermal values of the winter of 2012-2013.

Meteorological Station	Hm	meanT N Winter	Mean Winter 2012-2013	Δ=meanT-N	CH
Drobeta Turnu Severin	77	0.4	1.6	1.2	**W**
Calafat	66	-0.1	1.1	1.2	**W**
Bechet	65	-0.6	0.1	0.7	**WS**
Băileşti	56	-0.7	0.5	1.2	**W**
Caracal	112	-1.2	0.4	1.6	**W**
Craiova	190	-1.0	0.4	1.4	**W**
Slatina	165	-0.8	0.5	1.3	**W**
Bâcleş	309	-1.4	0.3	1.7	**W**
Târgu Logreşti	262	-1.1	0.0	1.1	**W**
Drăgăşani	280	-0.6	0.8	1.4	**W**
Apa Neagră	250	-1.0	-0.4	0.6	**WS**
Târgu Jiu	210	-1.0	0.5	1.5	**W**
Polovragi	546	-1.5	0.2	1.7	**W**
Râmnicu Vâlcea	243	-0.6	1.1	1.7	**W**
Voineasa	573	-3.0	-1.8	1.2	**W**
Parâng	1585	-5.1	-4.0	1.1	**W**
Media Oltenia		-1.2	0.1	1.3	**W**
Obârşia Lotrului	1348	-5.5	-4.8	0.7	**WS**

(Source: processed data)

4.b. The overall pluviometric regime of the winter of 2012-2013

The seasonal quantities of precipitations were comprised between 90.2 l/m^2 in Bechet in the extreme south and 384.0 l/m^2 in Apa Neagră, and their percentage deviations from the normal values were comprised between -13.8% in Bechet and 74.9% in Apa Neagră. According to Hellmann criterion applied to the seasonal quantities of precipitations, the pluviometric time types at the meteorological stations in Oltenia were comprised between little droughty (LD) in Bechet and in the mountainous area and exceedingly rainy (ER) in Drobeta Turnu Severin, Târgu Logreşti and Apa Neagră.

The spatial-temporal extension of the rainy (R) + very rainy (VR) and exceedingly rainy (ER) pluviometric time types was of 60.0%, which shows that on the whole, pluviometrically, the winter of 2012-2013 was very rainy (VR). This aspect is also sustained by the overall precipitations mean for the entire region of 176.4 l/m^2 whose percentage deviation from the normal values is of 29.6%, and according to Hellmann criterion on the whole the winter was very rainy (VR) (Table 2).

DISCUSSIONS

It is widely known that the interval January 15 February 15 is winter`s peak period in Romania, when, usually there occur the most intense cooling 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. In the winter of 2012-2013, the thermal regime was contradictory compared to the normal, registering (with few exceptions) the monthly maximum thermal values for January and February in the end and respectively the beginning of the month. The high frequency of the Mediterranean Cyclones caused an excessive pluviometric regime and interrupted the drought, which had persisted until the end of autumn.

The causes of this warm winter were determined by the appearance and development of some Mediterranean cyclones which evolved in the intervals: December 1-4, December 5-6, December 8-10, December 11-13, December 17-20, December 26-27, December 26-27, December 28-29, January 5-6, January 10-12, January 13-27, January 28-29, February 2-4, February 7-11, 11-17 February and February 19-26 and led to warm and wet air advections from the south of the continent, and in the intervals in which they did not act, the Azores High was there bringing oceanic warm air masses above Oltenia and sunny days, and the East European Anticyclone acted during short intervals of time. The North-Atlantic Oscillation maintained in a positive phase during some intervals of time.

Economic and bioclimatic effects on the environment of the winter of 2012-2013

The cold and early winter episode appeared even from the first decade caught unprepared some autumn crops for winter because of the cooling intensity. The significant destructive effects were observed in general on all biotopes[10]. Significant surfaces of rape crops were damaged and destroyed because the plants were caught unprepared for winter, due to the severe autumn drought, which delayed their spring.

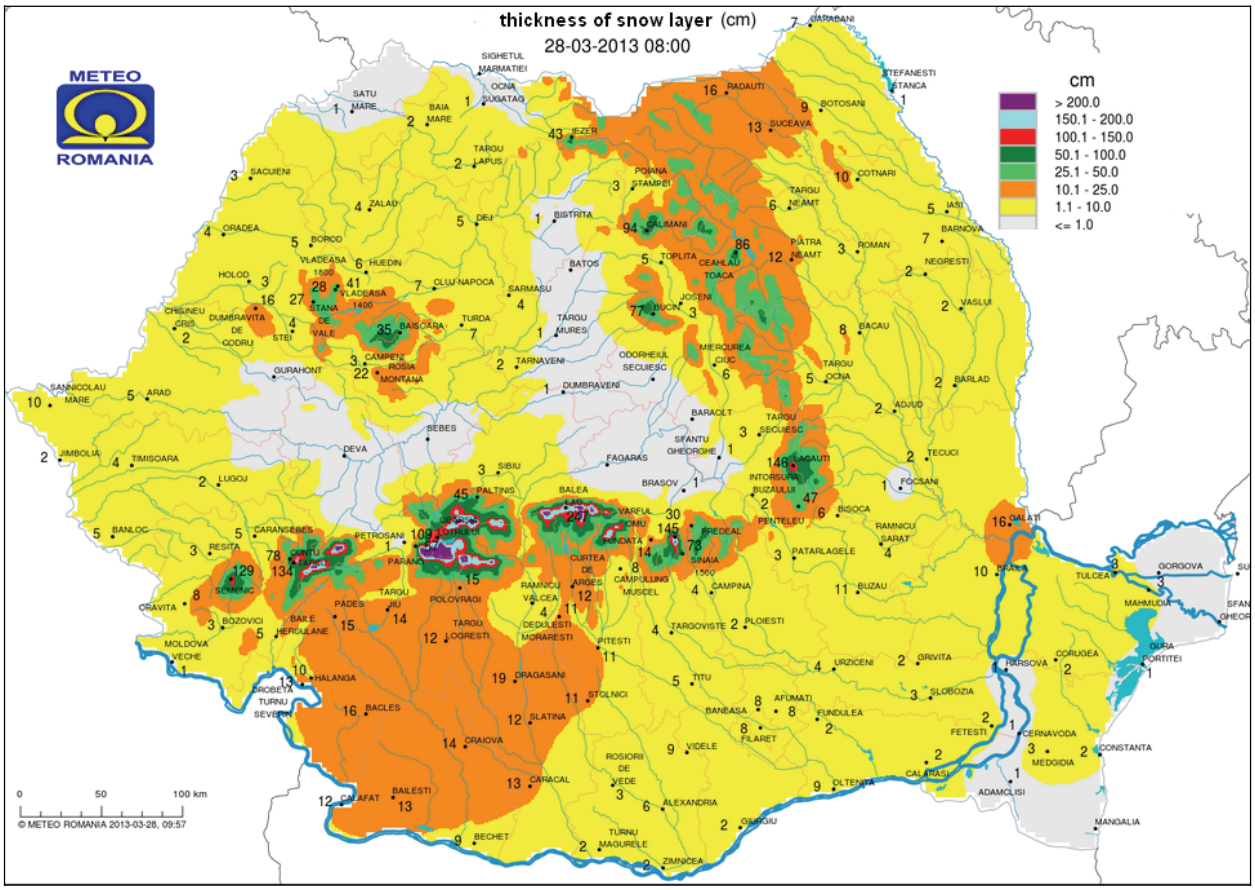

Figure 6. The maximum snow layer thickness in March 2013 registered on March 28, 2013 (according to NAM Bucharest).

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

The warm weather on long periods of time in January and February led to the slow start over of the vegetation phases in particular intervals of time, and often the frost-thaw episodes made some cultures vulnerable (for example rape and apricot trees crops).

The climatic risk of warm winters is related to the effects of active temperatures on the vegetal carpet and biotopes. These phenomena occur on extended surfaces of the continent not only in the south-west of Romania, but also on the entire biosphere. Therefore, even from the first day of March the early arrival of migratory birds in Romania, the late cooling and the cold wave from the last five days of March caused the death of a significant number of migratory birds, which were surprised by weather cooling and did not have the possibility to feed themselves, their resistance to cold being low.

Weather cooling in the last 5 days of March was extremely intense (for that calendar date), and the minimum temperature values registered in the morning of March 27 were comprised between -5.2°C in Polovragi and -0.8°C in Drobeta Turnu Severin and in Parâng (-9.9°C), and constitute climatic records for that date being associated with very low values of the cooling index (CI), due to the wind cooling effect, which contributed essentially to destructive effects. The snow layer in Oltenia registered in the morning of March 28 the maximum thickness in the country being comprised between 12 and 21 cm in Târmigani in Mehedinţi County (Fig. 6), which shows the risk intensity if we take into account the advanced vegetation phases in some crops. On March 24, 2013 at some stone fruits (for example apricot tree) the floral sprouts were developed, and the blossoming was imminent. Weather cooling in the interval March 25-27, 2013, snowfalls and the snow layer caused damages in orchards, so that in the morning of March 28 it was observed the fall of the floral sprouts of apricot trees. In the night of March 25/26, the cooling index (CI) reached the value of -17°C (in Slatina), being a bioclimatic record for this calendar date, and the effects caused shows that even the vegetal carpet is sensitive to low values of the CI index, thus confirming its usefulness in the bioclimate study. As a consequence of these effects the early spring vegetables appeared later and had a poor quality.

In the Danube Meadow, there were flood as a consequence of the increase of the river level caused by the fast snow layer melting from the continent.

CONCLUSIONS

After an early and cold winter beginning in the interval December 10-23, 2012, in the south-west of Romania weather radically changed, following a weather warming which maintained with slight fluctuations in January and February.

Our study shows that the climatic and agroclimatic indexes are thus bioclimatic indexes, with a good significance for the biosphere.

Earth has more than a climate as the other planets of our solar system[11], it has a climate that has created life and has preserved its perpetuity during the geological eras, and therefore in our opinion Earth has a bioclimate, something different from the other planets. The entire biosphere is fragile and extremely sensitive to climate variations, and this is why these studies are necessary in order to highlight the effects of these variations which became very frequent as a consequence of the climatic variability increase, and their thorough study can help find some solutions in the situations in which these variations become dangerous.

This severe winter interval was caused by the appearance and development of some Mediterranean cyclones, which evolved in some intervals of time mentioned in the paper, which in interaction with the anticyclone field that had covered most of the continent led to abundant snowfalls associated with wind gusts (snowstorm).

The snowfalls were followed by weather intense cooling because of the advection of the northern, northeastern 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 2012-2013 marked an important climatic oscillation not only in the south-west of Romania, but also in the entire European continent, where on extended areas, mild winter phenomena occurred and only in the northern part predominated the cold winter and the prolonged frost.

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

The abundant snowfalls as well as the rains of December, January and February 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.

REFERENCES

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

[11] Earth bioclimate and climate is mainly due to the position of our planet in the solar system ("geometry Earth-Sun as well as the significant quantity of water forming the hydrosphere which has the role of heat storage, and the thermodynamic processes and the general atmosphere circulation essentially contribute to its redistribution in the atmosphere and planetary Ocean, leading to a relative stability of the bioclimate.

BOGDAN OCTAVIA & MARINICĂ I. 2009. *Caracteristici climatice ale iernii 2007-2008 în Oltenia*. Revista Geografică Serie Nouă. Edit. 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: Gavril Pandi şi Florin Moldovan (Eds.). Aerul şi Apa, componente ale Mediului. Edit. Presa Universitară Clujană. Cluj-Napoca: 45-54.

SANDU I., MATEESCU ELENA, VĂTĂMANU V. V. 2010. *Schimbări climatice în România şi efectele asupra agriculturii.* Edit. Sitech. Craiova. 406 pp.

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. Conferinţa "Air and water components of the environment", 23-24 martie 2012, Cluj Napoca. Edit. Presa Universitară Clujană. http: aerapa.conference.ubbcluj.ro/ (Accessed: March, 2013): 351-358.

MARINICĂ I., CHIMIŞLIU CORNELIA, MARINICĂ ANDREEA FLORIANA. 2012. *Consideration on climatic conditions in Oltenia during the winter of 2011-2012*. Oltenia. Studii şi comunicări. Ştiinţele Naturii. Muzeul Olteniei Craiova. **28**(1): 149-160.

***.http://www.meteoromania.ro/. (Accessed: March, 2013).

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Received: March 19, 2013
Accepted: June 15, 2013