WARM WINTER OF 2013-2014 IN OLTENIA

MARINICĂ Andreea Floriana, CHIMIŞLIU Cornelia, MARINICĂ Ion

Abstract. In Oltenia as well as in most part of Romania, the winter of 2013-2014 was warm, marked by long intervals of warm weather. After the warm and rainy autumn, in the end of November, a short episode of very early winter was registered, followed by an interval of 55 days of warm weather. In the interval January 25 - February 8, phenomena of severe winter were registered, with snowfalls, blizzards and snow layer, and then the warm weather returned and air temperature increased to 20°C in the middle of February. From a pluviometric point of view, winter was droughty overall, December was excessively droughty, January was very rainy and February was very droughty. At the ground surface, the maximum thermal values registered values specific to the spring months. The ground maintained unfrozen during long intervals of time. Consequently, significant effects affected the autumn crops and the ecosystems in general. The paper is a continuation of some extended studies on climatic variability in the South-West of Romania. It is useful to master graduates and specialists interested in climate evolution and climate changes.

Keywords: temperature monthly means, Hellmann criterion, phenomena of severe winter, vegetative processes.

Rezumat. Iarna caldă 2013-2014 în Oltenia. În Oltenia ca şi în cea mai mare parte a Românei, iarna 2013-2014 a fost caldă, marcată de intervale lungi de vreme caldă. După toamna caldă şi ploioasă, la sfârşitul lunii noiembrie s-a înregistrat un scurt episod de iarnă foarte timpurie, a urmat apoi un interval de 55 de zile de vreme caldă. În intervalul 25 ianuarie – 8 februarie s-au înregistrat fenomene de iarnă severă cu ninsori, viscole şi strat de zăpadă, apoi vremea caldă a revenit şi temperatura aerului a urcat la mijlocul lunii februarie la 20°C. Din punct de vedere pluviometric iarna a fost secetoasă în ansamblul ei, cu decembrie excesiv de secetoasă, ianuarie foarte ploioasă şi februarie foarte secetoasă. La suprafaţa solului maximele termice au înregistrat valori specifice lunilor de primăvară. Solul s-a menţinut dezgheţat pe intervale lungi de timp. Ca urmare a vremii calde, importante efecte s-au produs asupra culturilor de toamnă şi ecosistemelor în general. Lucrarea este o continuare a unor studii extinse privind variabilitatea climatului în sud-vestul României. Este utilă masteranzilor şi specialiştilor interesaţi de evoluţia climatului şi schimbările climatice.

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

INTRODUCTION

In the 21st century, so far there were registered the first 13 warmest years in the history. The warmest years were 2005 and 2010, characterized by global average temperature values, which exceeded with 0.55°C the normal mean, followed by 1998, marked by an extremely strong phenomenon called El Nino (OMM documents).

During the entire 2013, weather evolutions in Oltenia, Romania and in the whole European continent were atypical. In Oltenia, we note the following:

- *Weather intense cooling in the interval March 25-28, 2013*, which brought the winter again all over the continent, and in the south-west of Romania (Oltenia) after 84 days of warm weather, more than normal, the snow layer thickness was comprised between 4 and 10 cm on March 28, 2013 at 08 o'clock, being the largest snow layer in Romania on that date.

– *Intense drought in the interval April 10-May 21, 2013*, which lasted for 40 days and damaged spring and autumn crops, causing *gradual enforcements in the South-East of the region at barley crop* in the area of sands from Olt County, which ripened prematurely and damaged the production badly.

– This drought appeared immediately after the *period with pouring rains in the interval April 4-6, 2013*, which caused *floods in some areas in Oltenia* (on the Jiu, the Olt and their tributaries).

– During summer *three important heat waves* were registered, which led to maximum thermal values closed to 40°C (the maximum thermal value of the summer of 2013 was 39.8°C registered on July 29, 2013 at Bechet).

– *In the end of every summer month, intense weather cooling occurred,* which caused the fall of temperature below the normal average values reaching the autumn thermal regime.

– *In the end of September, two days with pouring rains were registered*, in which weather cooled significantly. These led to quantities of precipitation, which exceeded 100 l/m^2, and *September 2013 has been the rainiest month in the entire year,* although, usually, this is the second droughty month after February.

– *Weather cooling in the end of September continued and became more severe in the first days of October 2013 reaching the climax on October 5*, when the minimum air thermal values were comprised between -4.5°C at Voineasa and 0°C in Drobeta Turnu Severin, and at the ground surface between 0°C at Caracal and -4.7°C at Polovragi. This intense cooling destroyed unprotected vegetable crops significantly.

– Afterwards, there has been *a long interval of gradual weather warming* from October 6 to November 25, which made from November a warm month in general, thus prolonging the optimum period of setting up the autumn crops up to November 25 (one month more than its normal).

– *Weather massive cooling, which occurred in the rainy interval November 23-27 and especially in the night of 26/27 November, led to the appearance of the thermal regime specific to December beginning with November 27.*

The snow layers with thicknesses comprised between 3 cm in Târgu Jiu and 22 cm in Craiova and Caracal were the largest in the country on November 28 at 08 o'clock.

– *The atypical weather* continued in December 2013, January, February and March 2014.

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 of the effects on environment, society and bioclimate in general (BOGDAN et al., 2008, 2010; BOGDAN & MARINICĂ, 2009; MARINICĂ & CHIMIŞLIU, 2008; MARINICĂ et al., 2010, 2011, 2012, 2013; MARINICĂ & MARINICĂ, 2012).

MATERIAL AND METHODS

For this paper we analysed the results of the daily processing with special software from the weather forecast, the data from Oltenia MRC Archive, the current maps from the operative activity, and those on the internet provided by the analysis and forecast international centres 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 2013-2014, on the basis of the thermal and pluviometric regime of December 2013, January and February 2014 and the thermal and pluviometric regime on the whole of the winter of 2013-2014.

RESULTS

1a. The thermal regime of December 2013

In December 2013, *air temperature means* were comprised between -2.6°C at Voineasa in the mountainous area and 0.7°C, and their deviations from the multiannual means[1] were comprised between -1.6°C at Tg. Logreşti and 0.2°C at Plovragi and Bâcleş, and in the mountainous area there were 2.9°C in Parâng.

According to Hellmann criterion, the thermal time type at the meteorological stations in Oltenia was comprised between cool (CO) in Getic Piedmont at Slatina, Tg. Logreşti, Apa Neagră and Tg. Jiu and normal (N) in most part of the region (Table 1).

The air temperature mean for the entire region was -0.4°C, and its deviation from the normal was -0.3°C which according to Hellmann criterion classifies December 2013 as a normal pluviometric month, overall for the entire region.

The air temperature minimum values were comprised between -12.1°C registered at Târgu Logreşti on December 20, 2013 and -6.3°C in Dr. Tr. Severin on December 11, 2013, and the monthly mean for the entire region was -8.7°C. Most of the minimum thermal values were registered on December 11. Consequently, in December 2013, agrometeorological[2] frost was not registered.

The maximum air temperature values were comprised between 7.8°C at Voineasa registered on December 27 and 28 and 14.4°C in Râmnicu Vâlcea, registered on December 27, the monthly mean for the entire region was 11.5°C (Table 1). Most of the maximum thermal values were registered on 27 and 28 December, which constitutes a climatic anomaly.

Frost units[3] in December 2013 were comprised between 19.5°C in Drobeta Turnu Severin and 91.3°C at Voineasa, and their mean for the entire region was 41.7°C, which means a month of mild winter.

The sums of the daily active temperature means[4] were comprised between 9.3°C at Voineasa and 43.7°C at Calafat, their mean for the entire region was 27.8°C, and in the mountainous area was 38.3°C in Parâng. The value in Parâng, comparable to those in the west of the region is due to the high frequency of the phenomenon of thermal inversion in December 2013.

The chart of the air temperature variation in December 2013 presents a slight decreasing tendency for the daily average and minimum temperature values (Fig. 1).

The minimum temperatures at ground surface were comprised between -12.6°C registered at Polovragi on 20 December and -3.7°C at Calafat on December 25, and their monthly mean for the entire region was -8.7°C.

The maximum temperatures at ground surface were comprised between 14.1°C registered in Slatina on December 13 and 19.5°C registered in Drobeta Turnu Severin on the same date, as well as all the other maximum temperature values (excepting Drăgăşani meteorological station).

The monthly mean for the entire region of the maximum temperature values at ground surface was 17.1°C.

[1] The comparisons are made reported to the multiannual means calculated for the interval 1901-1990, which we consider normal values.

[2] ***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)

[3] Frost units for all the cold season is calculated as Σ of daily average temperatures <0°C, in November-March; A day of frost is the day in which the average temperature is ≤ 0°C;

[4] The active temperatures are those ≥0°C, and the temperature of the biological minimum is 0°C.

Table 1. The regime of air temperature in Oltenia and the minimum and maximum temperature values at ground surface in December 2013.

Meteorological station	Hm	NXII	M	ΔT=M-N	CH	air min T		air maxT		soil minT		soil maxT	
						(°C)	Data	(°C)	Data	(°C)	Data	(°C)	Data
Dr. Tr. Severin	77	1.4	**0.7**	-0.7	**N**	**-6.3**	11	11.4	21	-8.0	4; 6	19.4	13
Calafat	66	1.0	0.6	-0.4	**N**	-8.6	11	11.3	9	**-3.7**	25	15.9	13
Bechet	65	0.4	-0.3	-0.7	**N**	-7.0	21	12.5	21	-8.7	11	16.6	13
Băileşti	56	0.4	-0.3	-0.7	**N**	-7.4	11	11.2	21	-9.5	1	17.7	13
Caracal	112	-0.1	-0.5	-0.4	**N**	-8.1	11	8.3	9	-7.2	1	16.6	13
Craiova	190	0.1	-0.7	-0.8	**N**	-7.7	21	8.8	9	-9.2	1	16.8	13
Slatina	165	0.3	-0.7	-1.0	**CO**	-7.5	11	10.9	28	-4.6	11	***14.1***	13
Bâcleş	309	-0.4	-0.2	**0.2**	**N**	-7.0	11	13.0	21	-	-	-	-
Tg. Logreşti	262	0.1	-1.5	***-1.6***	**CO**	***-12.1***	20	13.9	28	-10.8	20	17.2	13
Drăgăşani	280	0.6	0.5	-0.1	**N**	-8.2	21	13.3	28	-9.7	5	16.4	28
Apa Neagră	250	0.1	-0.9	-1.0	**CO**	-11.8	20	13.4	28	-11.0	20	**19.5**	13
Tg. Jiu	210	0.1	-1.2	-1.3	**CO**	-8.0	4	11.2	27	-8.5	11	17.2	13
Polovragi	546	0.1	0.3	**0.2**	**N**	-9.4	11	12.3	27	***-12.6***	20	16.1	13
Rm.Vâlcea	243	0.5	0.5	0.0	**N**	-8.4	21	**14.4**	27	-9.5	21	19.1	13
Voineasa	587	-1.9	***-2.6***	-0.7	**N**	-9.9	11	***7.8***	27;28	-	-	-	-
Parâng	1585	-3.7	-0.8	**2.9**	**W**	-11.8	11	9.5	18;20	-	-	-	-
Mean Oltenia		-0.1	-0.4	-0.3	**N**	-8.7		11.5		-8.7	-	17.1	-

(Source: Data processed)

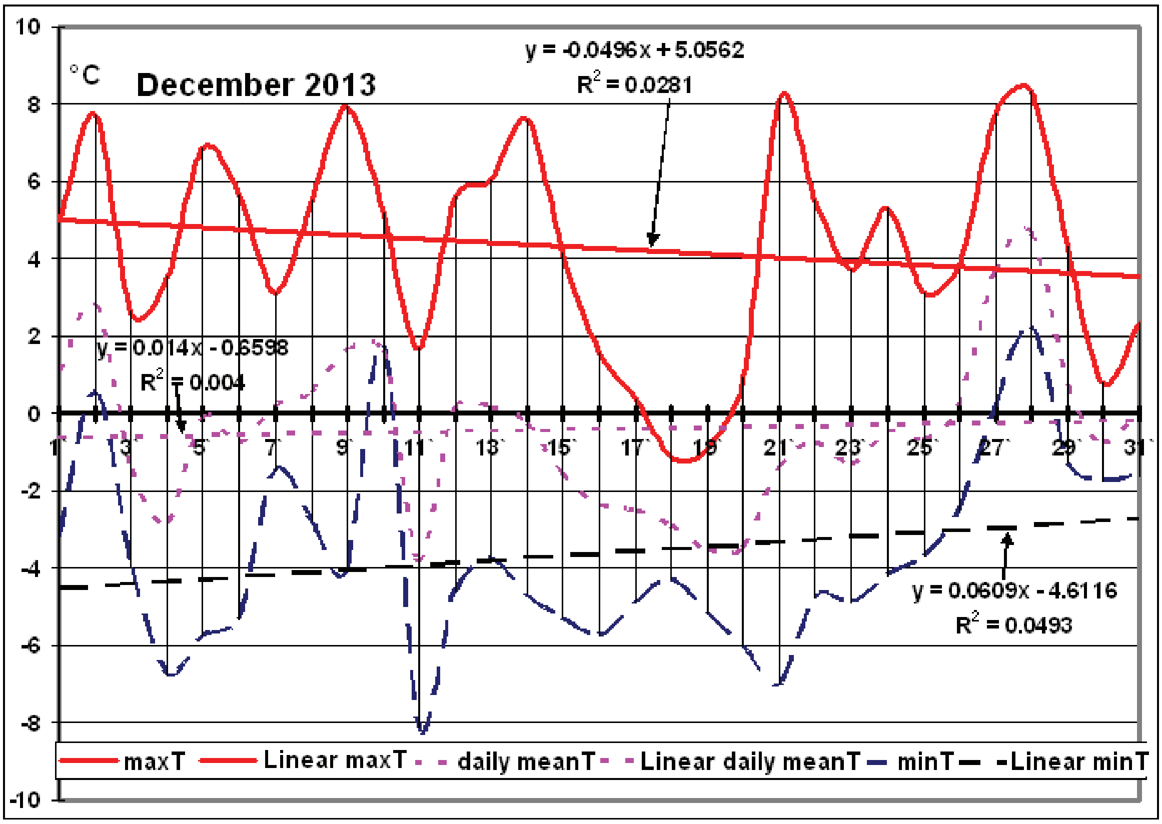

Figure 1. Air temperature variation (daily minimum temperature values, daily average temperature values and daily maximum temperature values) in December 2013. (Source: Data processed).

1.b. The pluviometric regime of December 2013

In December 2013, *the monthly quantities of precipitation* registered were comprised between 0.0 l/m^2 at Târgu Logreşti and Târgu Jiu and 2.9 l/m^2 at Polovragi, and their percentage deviations from the multiannual monthly means were comprised between -100.0% and -94.8%, which according to Hellmann criterion leads to classifications of the pluviometric time type of excessively droughty (ED) in the entire region. This situation is also confirmed by the *monthly mean* for the entire region of 2.8 l/m^2 and the percentage deviation from the normal of -94.5%.

During December, there was not any snow layer excepting the area of Polovragi Subcarpathian Depression, where in the first decade, the snow layer was insignificant or patched in some days.

On December 31, 2013, the water reserve in the ground layer of 0-100 cm in the autumn wheat crop had satisfactory and closed to optimum values, as a consequence of the abundant rains in the autumn of 2013.

Table 2. Quantities of precipitations registered during the winter of 2013-2014 (Σ), in comparison with the normal values.

Meteorological station	**Hm**	**December 2013**				**January 2014**				**February 2014**				**Winter 2013 – 2014**			
		ΣXII	**N**	**Δ%**	**CH**	**ΣI**	**N**	**Δ%**	**CH**	**ΣII**	**N**	**Δ%**	**CH**	**ΣW**	**N**	**Δ%**	**CH**
Dr. Tr. Severin	77	1.2	61.2	-98.0	**ED**	70.4	51.4	37.0	**VR**	26.8	47.9	-44.1	**VD**	98.4	160.5	-38.7	**VD**
Calafat	66	0.4	45.5	-99.1	**ED**	***52.2***	40.4	***29.2***	**R**	***4.4***	38.0	**-88.4**	**ED**	***57.0***	123.9	***-54.0***	**ED**
Bechet	65	0.2	36.3	-99.4	**ED**	54.8	33.5	63.6	**ER**	9.2	34.8	-73.6	**ED**	64.2	104.6	-38.6	**VD**
Băileşti	56	0.3	46.8	-99.4	**ED**	63.4	38.5	64.7	**ER**	12.7	36.1	-64.8	**ED**	76.4	121.4	-37.1	**VD**
Caracal	112	0.3	39.5	-99.2	**ED**	63.5	34.7	83.0	**ER**	5.5	34.5	-84.1	**ED**	69.3	108.7	-36.2	**VD**
Craiova	190	0.6	41.8	-98.6	**ED**	81.7	37.5	117.9	**ER**	8.2	30.4	-73.0	**ED**	90.5	109.7	-17.5	**LD**
Slatina	165	0.3	42.8	-99.3	**ED**	80.8	36.0	124.4	**ER**	8.1	38.4	-78.9	**ED**	89.2	117.2	-23.9	**D**
Bâcleş	309	1.1	54.7	-98.0	**ED**	74.1	50.5	46.7	**VR**	30.5	44.1	***-30.8***	**VD**	105.7	149.3	-29.2	**VD**
Tg. Logreşti	262	***0.0***	44.8	***-100***	**ED**	73.0	35.9	103.3	**ER**	17.7	41.0	-56.8	**ED**	90.7	121.7	-25.5	**D**
Drăgăşani	280	0.2	44.6	-99.6	**ED**	64.0	34.1	87.7	**ER**	9.9	35.4	-72.0	**ED**	74.1	114.1	-35.1	**VD**
Apa Neagră	250	1.6	82.3	-98.1	**ED**	**101.5**	70.9	43.2	**VR**	**32.6**	66.4	-50.9	**ED**	**135.7**	219.6	-38.2	**VD**
Tg. Jiu	210	***0.0***	64.0	***-100***	**ED**	86.6	53.9	60.7	**ER**	29.8	52.0	-42.7	**VD**	116.4	169.9	-31.5	**VD**
Polovragi	546	**2.9**	56.1	**-94.8**	**ED**	74.8	48.9	53.0	**ER**	32.0	48.4	-33.9	**VD**	109.7	153.4	-28.5	**VD**
Rm. Vâlcea	243	0.2	46.2	-99.6	**ED**	81.8	35.5	**130.4**	**ER**	18.5	38.4	-51.8	**ED**	100.5	120.1	**-16.3**	**LD**
Parâng	1585	32.3	54.6	-40.8	**ED**	22.4	57.7	-61.2	**ER**	17.1	47.7	-64.2	**ED**	71.8	160.0	-55.1	**ED**
Mean Oltenia		2.8	50.7	-94.5	**ED**	69.7	44	58.5	**ER**	17.5	42.2	-58.5	**ED**	90.0	136.9	-34.3	**VD**

(Source: Data processed).

2a. The thermal regime of January 2014

The monthly thermal means were comprised between -0.1°C at Voineasa and 1.7°C in Drobeta Turnu Severin, and their deviations from the multiannual means were comprised between 2.4°C in Slatina and 4.6°C at Voineasa, leading to the classification of warm month (W) for the entire region, according to Hellmann criterion, excepting the mountainous area where the deviation was of 5.6°C in Parâng, which designates a very warm month (VW) (Table 3). In the intervals January 1-14 and January 16-23, there were registered 22 days in which the daily average temperature for the entire region was positive.

The monthly average temperature calculated for the entire region was 0.4°C, and its deviation from the normal was of 3.2°C, which confirms the classification of warm month (W).

The monthly minimum temperatures were registered in the last day of the month and were comprised between -9.9°C at Voineasa and -15.3°C at Drăgăşani, which shows that the agrometeorological frost was registered only in the last day of the month on restricted and insignificant areas. The air temperature monthly mean was of -12.8°C.

The monthly maximum temperatures were comprised between 11.7°C at Voineasa on January 10, 2014 and 17.1°C in Râmnicu Vâlcea on January 9, 2014, and the monthly maximum temperature mean was of 14.6°C. The monthly maximum air temperature values were registered in the interval January 9-13. Beginning with January 24, weather cooled gradually, and in the last day of the month a moderate cold wave was registered, which continued in the first days of February.

At the ground surface, *the minimum temperature values* were registered in the last day of the month and fell within -6.2°C at Bechet on the Danube Floodplain and -15.0°C at Calafat, and the monthly mean for the entire region was -11.8°C.

The maximum temperature values at ground surface were comprised between 10.3°C in Slatina and 21.4°C at Drăgăşani, and their deviation for the entire region was 16.4°C. *Frost units in January* were comprised between 33.2°C in Drobeta Turnu Severin and 55.6°C at Bâcleş, and their mean for the entire region was 47.5°C, which means a mild winter from an agrometeorological point of view.

Active temperatures [5] were comprised between 35.5°C at Voineasa and 87.1°C in Drobeta Turnu Severin, and their deviation for the entire region was 60.3°C, being higher than that of the frost units, which confirms the positive thermal balance of January.

The chart of the air temperature variation in January indicates linear decreasing tendencies for the three parameters of temperature analysed (daily minimum temperature values, daily average temperature values and daily maximum temperature values), of which the most decreasing one was the maximum temperature with a variation difference of 28.7°C (the lowest maximum thermal values was of -11.6°C registered at Bechet on January 31, and the highest was of 17.1°C registered in Râmnicu Vâlcea on January 9) (Fig. 2).

[5] The temperature values 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 ground surface temperature below 0°C induces the vegetative sleep.

Table 3. The thermal air regime in Oltenia and the minimum and maximum temperature values at ground surface in January 2014.

Meteorological station	Hm	NI	M	ΔT=M-N	CH	air minT		air maxT		soil minT		soil maxT	
						(°C)	Data	(°C)	Data	(°C)	Data	(°C)	Data
Dr.Tr. Severin	77	-1.1	**1.7**	2.8	W	-11.5	31	14.3	11	-10.2	31	19.6	13
Calafat	66	-1.8	0.7	2.5	W	-14.0	31	14.9	11	-7.9	31	13.5	13
Bechet	65	-2.2	0.4	2.6	W	-13.6	31	15.7	13	**-6.2**	31	18.1	11
Băileşti	56	-2.3	0.6	2.9	W	-13.8	31	14.6	11	-13.2	31	15.5	23
Caracal	112	-2.9	0.1	3.0	W	-14.4	31	13.9	12	***-15.0***	31	17.8	13
Craiova	190	-2.6	0.2	2.8	W	-14.5	31	14.9	12	-13.2	31	17.3	13
Slatina	165	-2.4	0.0	***2.4***	W	-14.8	31	14.2	12	-14.4	31	***10.3***	25
Bâcleş	309	-3.0	0.5	3.5	W	-11.3	31	14.9	12				
Tg. Logreşti	262	-2.7	0.1	2.8	W	-12.8	31	15.9	9	-13.2	31	16.5	9
Drăgăşani	280	-2.2	0.4	2.6	W	**-15.3**	31	14.2	12	-14.4	31	**21.4**	13
Apa Neagră	250	-2.6	0.6	3.2	W	-11.4	31	15.4	10	-11.0	31	13.8	6
Tg. Jiu	210	-2.6	0.3	2.9	W	-10.9	31	14.8	12	-10.4	31	15.2	12
Polovragi	546	-3.2	0.6	3.8	W	-13.3	31	15.1	9	-11.9	31	14.4	9
Rm.Vâlcea	243	-2.2	0.9	3.1	W	-12.3	31	**17.1**	9	-12.6	31	19.7	12
Voineasa	587	-4.7	***-0.1***	**4.6**	W	***-9.9***	31	***11.7***	10				
Parâng	1585	-5.9	-0.3	5.6	VW	-10.8	27	12.4	9				
Media Oltenia		-2.8	0.4	3.2	W	-12.8		14.6		-11.8		16.4	

(Source: Data processed)

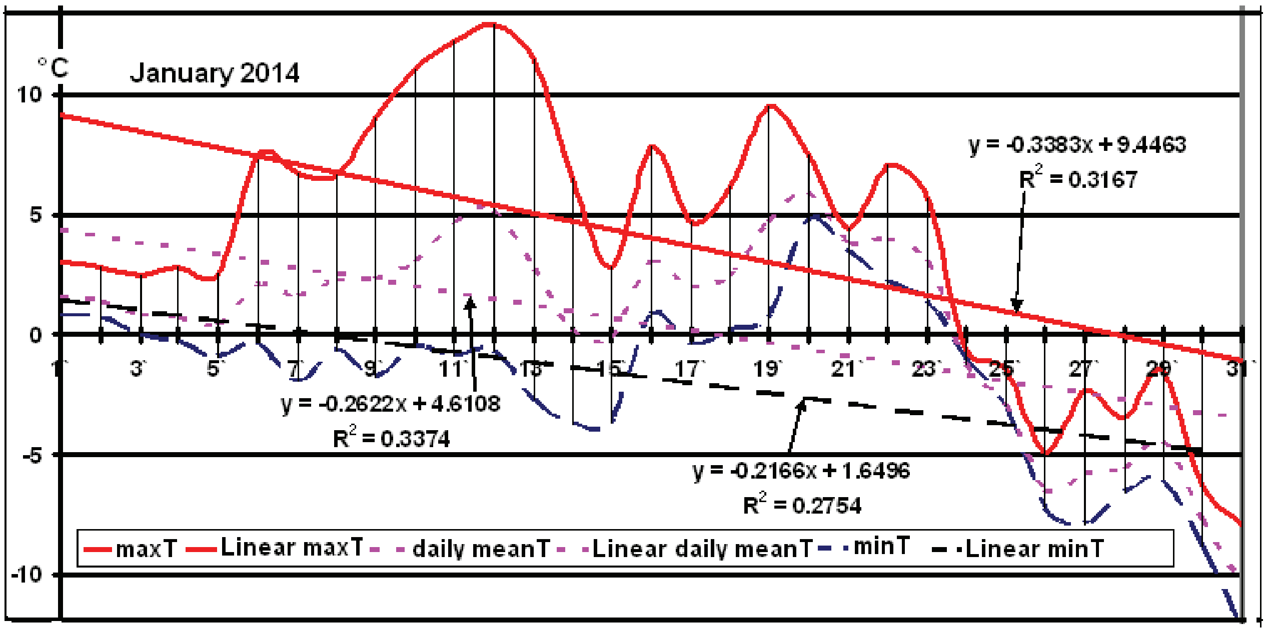

Figure 2. Air temperature variation (daily minimum temperature values, daily average temperature values and daily maximum temperature values) in January 2014. (Source: Data processed).

2b. The pluviometric regime of January 2014

The monthly quantities of precipitations were comprised between 52.5 l/m² at Calafat in the South-West of the region and 101.5 l/m² at Apa Neagră in Gorj Subcarpathians, and their percentage deviations from the multiannual means were comprised between 29.2% at Calafat and 130.4% in Râmnicu Vâlcea, which according to Hellmann criterion, leads to classifications of pluviometric time type comprised between rainy (R) at Calafat and exceedingly rainy (ER) in most part of the region.

The quantities of precipitation mean calculated for the entire region was 69.7 l/m², and the percentage deviation from the normal mean was 58.5% confirming the general characterization of excessively rainy month (ER) (Table. 2). In the interval November 28, 2013 - January 18, 2014 there was registered a number of *52 days of excessive atmospheric drought.*

The precipitation of January occurred after January 19, and in the night of January 24/25, 2014 precipitation turned into snowfall, and thus a snow layer formed.

As *climatic risk phenomena two blizzards were registered* in the intervals January 24, 2014, at 18 o'clock – January 26, 2014, at 22 o'clock and January 29, 2014, at 06 o'clock- January 30, 2014, at 10 o'clock for which a *yellow and orange code warnings* were remitted, and for Muntenia a red code was remitted. In the interval January 29 at 23 o'clock–January 30, at 10 o'clock, for some areas in Muntenia, *a red code warning* was remitted, *for the first time from the entering into force of code warnings.*

The interval with the most significant precipitation was January 24, 2014, at 18 o'clock- January 26, 2014, at 22 o'clock, in which the quantities of precipitation amounted values comprised between 28.9 l/m^2 at Băileşti and 50.7 l/m^2 in Slatina, which compared to the multiannual monthly means represents percentage values comprised between 64.6% at Apa Neagră and 140.8% in Slatina.

The most significant quantities of precipitation were registered on January 25, 2014, and their mean for the entire region was 19.3 l/m^2. *The snow layer* was formed beginning with January 25, and the maximum thickness was registered on January 29, at 20 o'clock when at the meteorological station from Oltenia it was comprised between 29 cm at Băileşti, Bechet and Râmnicu Vâlcea and 66 cm at Olăneşti-Băi (Vâlcea County), and in the mountainous area 85 cm at Obârşia Lotrului (Fig. 3).

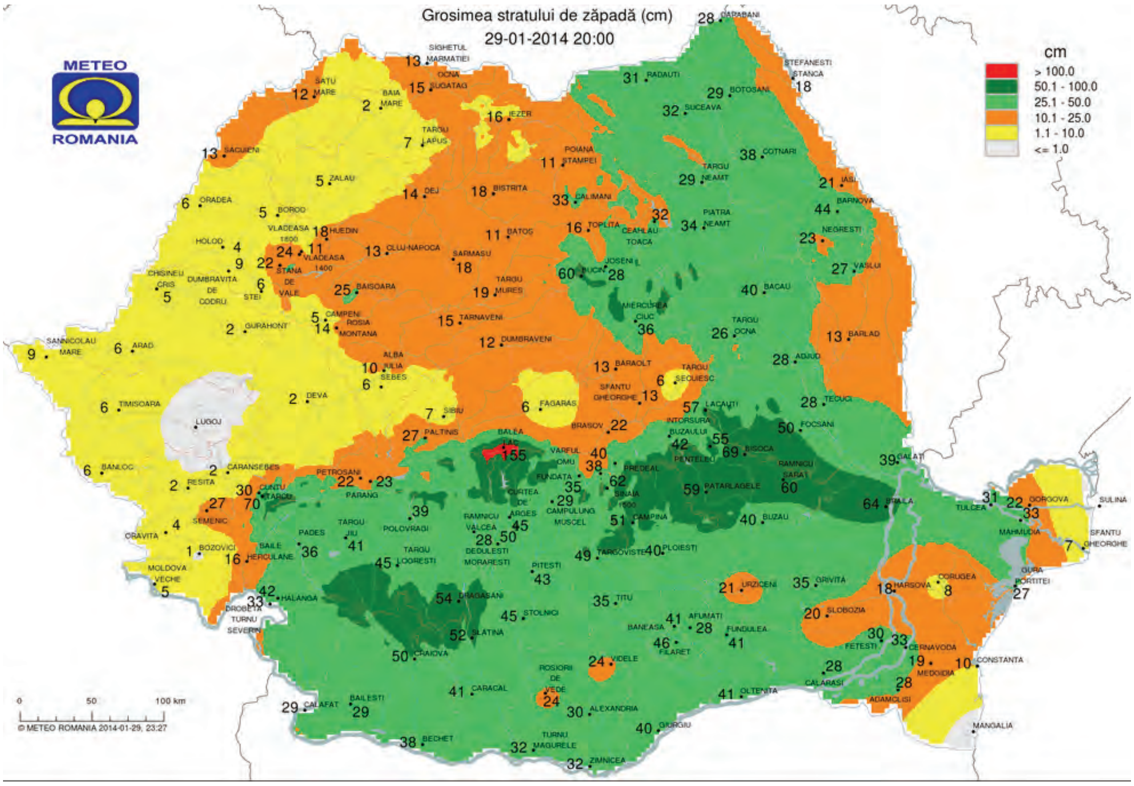

Figure 3. The maximum snow layer in January 2014 (according to NAM Bucharest).

We also note that *Oltenia was the second area in the country (at the southern limit of hills), after the area from Carpathians Curvature, in which the snow layer exceeded the thickness of 50 cm* (excepting the mountainous area). On January 25, 2014, *the maximum quantity of precipitation registered was of 46.8 l/mp in Băbeni and Berislăveşti* (Vâlcea County), which constitutes the maximum quantity of precipitation registered in 24 hours for the whole winter of 2013-2014.

As a consequence of this abundant precipitation in the end of January, in the autumn wheat crop, the water supply in the ground depth of 0-100 cm was optimum. In the interval January 31- February 1, 2014, a moderate frost wave was registered, then the air temperature has increased gradually and in the interval February 1-13, the snow layer melted.

There were no floods due to the snow layer melting, and the water reserve in the ground maintained at an optimum level in the entire region until the end of February.

3a. The thermal regime of February 2014

The monthly average air temperature values were comprised between 0.9°C at Voineasa and 3.2°C in Drobeta Turnu Severin, and the deviations from the multiannual means were comprised between 1.2°C at Calafat and 3.7°C at Polovragi, which according to Hellmann criterion leads to the classifications of the thermal time type comprised between warmish (WS) in most part of Oltenia Plain and warm in the hilly area and Subcarpathians, and in the mountain, in Parâng, very warm (VW) (Table 4).

The phenomenon of thermal inversion, which is frequent in Oltenia, contributed to the registration of low deviations in Oltenia Plain.

Air temperature mean calculated for the entire region was 1.9°C, higher with 2.3°C than the mean of January, and its deviation from the normal was 2.7°C confirming that February was a warm month (W).

The monthly minimum air temperatures were comprised between -18.1°C at Târgu Logreşti registered on February 5 2014 and -10.4°C at Bâcleş registered on February 1, and their monthly mean for the entire region was -12.8°C, equal with the mean in January and with 4.1°C lower than that of December.

The monthly maximum air temperatures were registered on February 17 and were comprised between 16.4°C at Polovragi and 20.3°C at Calafat, and their mean for the entire region was 17.6°C, being the highest value during the whole winter.

The chart of the air temperature variation presents highly linear increasing tendencies (Fig. 4).

Table 4. Air temperature regime in Oltenia and the minimum and maximum temperature values at ground surface in February 2014.

Meteorological station	Hm	NII	M	ΔT=M-N	CH	air Tmin		air Tmax		Tmin soil		Tmax soil	
						(°C)	Data	(°C)	Data	(°C)	Data	(°C)	Data
Dr. Tr. Severin	77	0.9	**3.2**	2.3	**W**	-10.5	1	17.5	17	-11.0	1	23.8	19
Calafat	66	0.4	1.6	***1.2***	**WS**	-12.1	1	**20.3**	17	-8.1	1	16.6	17
Bechet	65	-0.1	1.2	1.3	**WS**	-12.5	1	17.0	17	**-6.1**	1	24.7	17
Băileşti	56	-0.1	1.5	1.6	**WS**	-12.9	1	18.0	17	-13.2	8	**25.0**	17
Caracal	112	-0.7	1.1	1.8	**WS**	-12.1	1;8	18.5	17	-14.7	1	18.6	19
Craiova	190	-0.4	2.0	2.4	**W**	-11.8	1	19.1	17	-13.0	1	19.0	19
Slatina	165	-0.2	1.5	1.7	**WS**	-12.2	7	17.9	17	-15.5	7	***12.9***	19
Bâcleş	309	-0.9	2.4	3.3	**W**	**-10.4**	1	17.0	17	-	-	-	-
Tg. Logreşti	262	-0.7	1.9	2.6	**W**	***-18.1***	5	18.3	17	***-19.8***	5	23.0	19
Drăgăşani	280	-0.2	2.7	2.9	**W**	-11.8	1	18.5	17	-13.6	7	21.0	19
Apa Neagră	250	-0.6	2.7	3.3	**W**	-15.0	5	20.2	17	-15.6	5	21.0	19
Tg. Jiu	210	-0.4	2.6	3.0	**W**	-15.1	5	18.1	17	-16.5	5	23.0	17
Polovragi	546	-1.4	2.3	**3.7**	**W**	-13.2	5	***16.4***	17	-18.0	6	21.8	18
Rm. Vâlcea	243	0	2.9	2.9	**W**	-13.3	5	18.2	17	-16.8	6	**25.0**	17
Voineasa	587	-2.5	***0.9***	3.4	**W**	-13.9	4	17.4	17	-	-	-	-
Parâng	1585	-5.6	0.6	6.2	**VW**	-10.3	2	9.8	17	-	-	-	-
Media Oltenia	-	-0.8	1.9	2.7	**W**	-12.8		17.6	-	-14.0	-	21.2	-

(Source: Data processed)

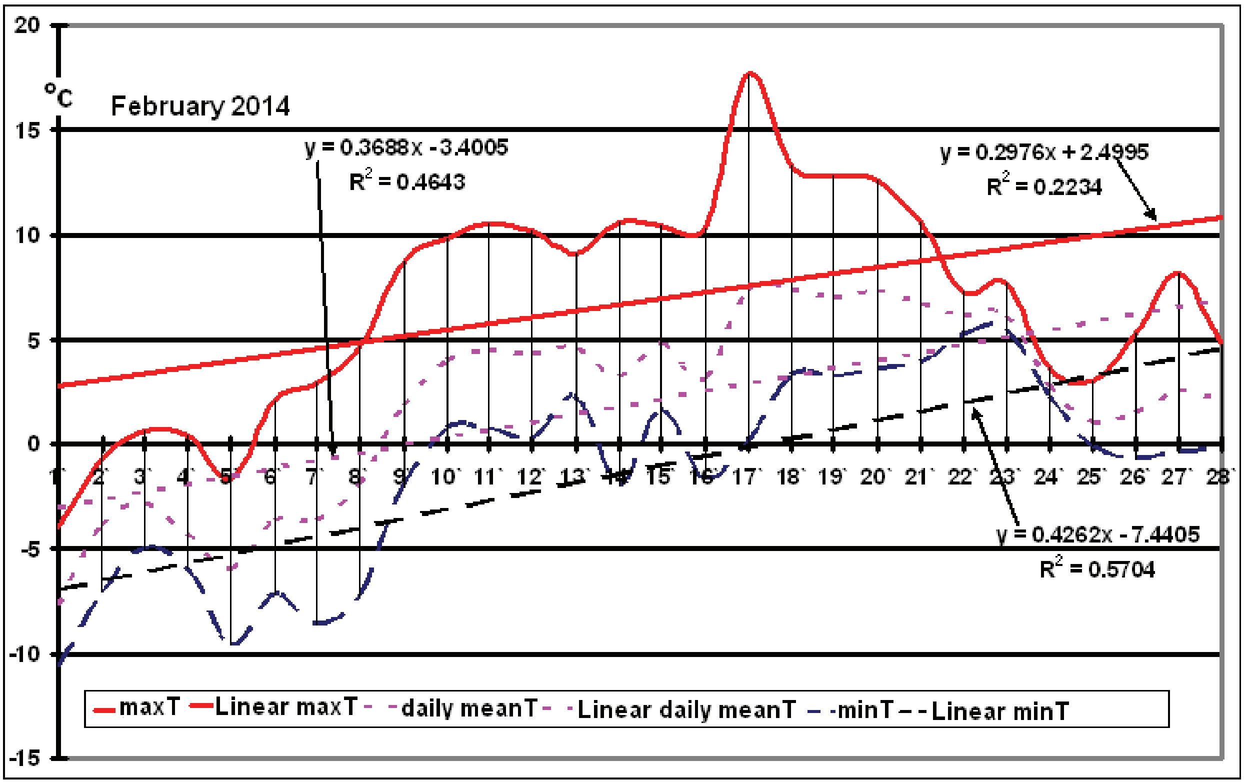

Figure 4. Air temperature variation (daily minimum temperature values, daily average temperature values and daily maximum temperature values) in February 2014. (Source: Data processed).

The most significant interval of warm weather was registered in the interval February 9-21 when the maximum thermal values often exceeded 10.0°C.

The agrometeorological frost was insignificant.

The frost units in February were registered in the interval February 1-9 and were comprised between 25.3°C at Apa Neagră and 46.7°C at Caracal, and their monthly mean was 48.7°C.

Active temperatures were comprised between 67.0°C at Voineasa and 117.7°C in Drobeta Turnu Severin, and their deviation for the entire region was 90.0°C, meaning a warm winter month.

The monthly means of the daily minimum temperatures at ground surface were comprised between -4.8°C at Târgu Logreşti and -0.7°C at Calafat, and the mean calculated for the entire region was -2.9°C.

The monthly minimum temperatures at ground surface were comprised between -19.8°C registered at Tg. Logreşti on February 5 and -6.1°C registered at Bechet on February 5, and their mean was -14.0°C.

The monthly means of the daily maximum temperatures at ground surface were comprised between 5.5°C at Slatina and 10.5°C in Drobeta Turnu Severin, and their mean calculated for the entire region was 8.2°C.

The monthly maximum temperatures at ground surface were comprised between 12.9°C registered on February 19 and 25.0°C registered at Băileşti and Râmnicu Vâlcea on February 17, and their monthly mean calculated for the entire region was 21.2°C.

3.b. The pluviometric regime of February 2014

The monthly quantities of precipitation were comprised between 4.4 l/m^2 at Calafat in the extreme South-East and 42.6 l/m^2 at Apa Neagră in the Subcarpathian area, and their percentage deviation from the multiannual means were comprised between -30.8% in Bâcleş in Mehedinţi Hills and -88.4% in Calafat, which according to Hellmann criterion leads to the classifications of the pluviometric time type in Oltenia meteorological stations comprised between very droughty (VD) and exceedingly droughty (ED) (Table 2).

The general precipitation mean for the entire region was 17.5 l/m^2, and its percentage deviation from the multiannual mean was -58.5%, which confirms that February was exceedingly droughty for the entire region.

There was a *snow layer* in the first decade of the month and has gradually melted, thus February 1 had thicknesses comprised between 25 cm at Bechet and 54 cm at Drăgăşani, on February 11 it became patched, and on 14 February it disappeared completely. The snow layer from Oltenia, as well as in most part of Europe and South-Eastern Europe, contributed to the persistence of low temperatures especially at night in the first 8 days of the month, moderated the spring arrival and contributed essentially to the registration of some spring arrival indexes with moderate values.

The ground water reserve in the end of February (that is in the end of winter) in the autumn wheat crop, the water supply available for plants on the ground depth of 0-100 cm, had satisfactory, closed to optimum and locally optimum values, in all the agricultural areas, due to the slow melting of the snow layer, the low consumption of the vegetal carpet and the low thermal regime compared to the warm season.

The overall thermal regime of the winter of 2013-2014

The seasonal temperature means for the winter of 2013-2014 were comprised between -0.6°C at Voineasa Intracarpathian Depression (the only area with negative values) and 1.9°C in Drobeta Turnu Severin in the extreme West of the region, and their deviations from the multiannual seasonal means were comprised between 1.0°C at Bechet and 2.6°C at Polovragi, which according to Hellmann criterion leads to the classification of warm winter (W) in most of Oltenia meteorological stations, and within Polovragi Subcarpathian Depression and in Parâng the winter was very warm (VW) (Table 5).

Table 5. Overall average thermal characteristics of the winter of 2013-2014.

Meteorological station	Hm	N-meanTwinter	MeanTwinter2013-2014	Δ=meanT-N	CH
Drobeta Turnu Severin	77	0.4	**1.9**	1.5	**W**
Calafat	66	-0.1	1.0	1.1	**W**
Bechet	65	-0.6	0.4	***1.0***	**W**
Băileşti	56	-0.7	0.6	1.3	**W**
Caracal	112	-1.2	0.2	1.4	**W**
Craiova	190	-1	0.5	1.5	**W**
Slatina	165	-0.8	0.3	1.1	**W**
Bâcleş	309	-1.4	0.9	2.3	**W**
Târgu Logreşti	262	-1.1	0.2	1.3	**W**
Drăgăşani	280	-0.6	1.2	1.8	**W**
Apa Neagră	250	-1	0.8	1.8	**W**
Târgu Jiu	210	-1	0.6	1.6	**W**
Polovragi	546	-1.5	1.1	**2.6**	**VW**
Râmnicu Vâlcea	243	-0.6	1.4	2.0	**W**
Voineasa	587	-3	***-0.6***	2.4	**W**
Parâng	1585	-5.1	-0.2	4.9	**VW**
Mean Oltenia		-1.2	0.6	1.8	**W**

(Source: Data processed)

Winter general mean for the entire region was 0.6°C, and its deviation from the normal was 1.8°C, which confirms the fact that the winter of 2013-2014 was warm (W) for the entire region. This general aspect is due to the increase of the general mean because of the high values in January and very high in February.

The interval comprised between January 25 and February 8 is *a severe winter* in which air temperature dropped to extremely low values and there were risk climatic phenomena: snowfalls, blizzards, snow layer, which show that winter lasted only 13 days. However, the risk climatic phenomena have occurred early, since the end of November, when in the interval November 27-30 a snow layer with a thickness of 24 cm was registered at Pieleşti (Dolj county) on 28 November, which rendered some crops vulnerable, unprepared for wintering (especially rape crops) after the warm November in most part of it. This early snow layer melted until December 1, 2013. *The number of frost unit for the entire winter* was comprised between 80.2°C in Drobeta Turnu Severin and 172.0°C at Voineasa with a general seasonal mean of 124.7°C, which from an agrometeorological point of view means a mild winter.

Active temperatures for the entire winter were comprised between 111.8°C in Voineasa Intramountainous Depression and 247.2°C in Drobeta Turnu Severin in the extreme west of the region, and the mean for the entire region was 178.1°C, which confirms the positive thermal balance of the whole winter of 2013-2014, announcing an early spring arrival, and in the mountainous area 131.7°C in Parâng.

4b. Overall pluviometric regime of the winter of 2013-2014

The seasonal quantities of precipitation were comprised between 57.0 l/m^2 at Calafat in the South-West of Oltenia and 135.7 l/m^2 in Apa Neagră Subcarpathian Depression, and their percentage deviations from the multiannual seasonal means were comprised between -54.0% at Calafat and -16.3% in Rm. Vâlcea, which according to Hellmann criterion leads to classification of the pluviometric time type in this winter comprised between little droughty (LD) on restricted areas in Râmnicu Vâlcea and Craiova and exceedingly droughty (ED) at Calafat. The very droughty weather (VD) predominated with a spatial-temporal extension of 60.0%. The mean of the seasonal quantities of precipitation calculated for the entire region was 90.0 l/m^2, and its percentage deviation from the multiannual mean was -34.3% which means a very droughty winter overall for the whole region (Table 2).

DISCUSSIONS

Although *winter phenomena* started early with snowfalls in the night of November 26-27 2013, and the snow layer was dense in November, after a passing weather cooling in the interval November 28-30 2013, weather has gradually warmed. The snow layer disappeared beginning with December 2.

The installation of the positive phase of the North-Atlantic Oscillation led during all December and most part of January (until January 24) a pluviometric regime poor in precipitation (atmospheric drought), and thermally warmer than normal.

Ground water reserve maintained closed to optimum and optimum during almost the entire winter as a consequence of autumn abundant rains, which led in some periods to periods of humidity excess in the ground.

Vernalization[6] occurred especially in the cold season in the interval January 25- February 8, 2014 and in the intervals in which the minimum thermal values dropped below 0°C. With this regard, the temperature increase during winter, the long warm periods and the climate warming, in general, represents a major bioclimatic risk for the vegetal species from our country's latitude.

Consequently, the high temperatures and long warm intervals in the winter of 2013-2014 represented a bioclimatic risk for autumn crops, especially for fruit trees. In the west of the country, especially in Banat temperatures were much higher than in all the winter months and there wasn't any snow layer.

During winter the fruit trees and roses blossomed, and in the end of autumn the strawberries ripened for the second time. In Oltenia, in the end of autumn wheat, barley and rape crops were very developed, and in case of rape the floral stems and bottoms were formed at some plants. Snowdrops blossomed in December.

During winter, in warm periods the phases of plants' development started over, which led to the increase of the vulnerability degree to frost. Most of the parts have been surprised by the snowfalls in the end of November, since they were unprepared for wintering, and weather warming in December improved the climatic conditions by removing the danger of degradations until January 25 when the intense cooling, blizzard and snowfalls represented a new danger.

[6] In most species of plants, positive low temperatures have a significant influence on the initiation and development of reproduction organs. For this purpose, the annual plants need low temperatures in the first growing phases, and the biennial plants remain vegetative in the first year and blossom in the second year, if they are exposed to a treatment with low temperatures. *Vernalization is the acquisition or acceleration of plant's ability to flower by exposure to low temperatures.* According to the requirements for low temperatures plants fall within 3 groups: 1. Autumn annual plants-which begin their vegetation in the end of autumn, resist during winter under the form of seedling and the germinated seeds are vernalized. 2. Biennial plants- which enter in the winter under the form of quite big plants, blossom in the next year and are vernalized in a more advanced growing phase. 3. Perennial plants- which produce sprouts or new ramifications every season and need low temperatures in order to form flowers. This Vernalization process can be explained due to the presence of a hypothetical (vernalin) hormone, which is still unidentified and is formed during Vernalization. This hormone can be transmitted to plants through graft. The Vernalization effect is transmitted through cellular division from one cell to another, and the light has an influence only on sprout meristems with cellular division and Vernalization. This Vernalization process, which has an autoreproduction character of *plants.* (https://sites.google.com/site/biokorinna/botanica/transformarea-circulația-și-depunerea-substantelor-la-plante, accessed February, 2014).

The thick snow layer protected crops well, and after the snow melting weather fast warming in the interval February 11-28 led to the start over of the vegetation phases. Thus, on February 17, 2014 the buds of stone fruit trees bulbed. The intervals with periods in which there is a passing through the isotherm of 0°C constitute *periods in which plants are prepared for wintering.*

Taking into account the increase of the global average temperature, the winter is expected to become warmer and warmer, plants preparation for wintering may lack in some winters, and the appearance of short periods of intense cooling (as for example, the interval in this winter January 25-February 8, 2014) can cause significant damages for crops, and can seriously affect ecosystems.

The synoptic causes of blizzards in the interval January 25-29, 2014.

The blizzard and abundant snowfalls in the interval 24-26 January were caused by the coupling of a Mediterranean Anticyclone with the Scandinavian Anticyclone. The Mediterranean Anticyclone was formed very quickly, in the thalweg of the Icelandic Cyclone, during 6 hours in the interval January 24, 2014 at 00 o'clock UTC-January 24, 2014 at 06 o'clock UTC, in Genoa Gulf. Its movement above Romania and Balkan Peninsula was performed on Vc classic trajectory. On January 25, 2014 at 00 o'clock UTC the blizzard in the Southern half of Romania was on-going.

The position of baric centres above the European continent, *at ground level*, was the following: the Mediterranean Cyclone was cantered at the ground surface above the south of Italy where the cyclonic nucleus has pressure values below 1000 hPa (Fig. 5). An anticyclone girdle joined the Azores High, Scandinavian Anticyclone and East-European Anticyclone. In the inferior troposphere the circulation of air masses for Oltenia was North-Eastern, causing the advection of a mass of polar continental cold air (cP).

In altitude at the level of 500 hPa there was the geopotential ridge with the value of 548 damgp of the high geopotential field located above the Atlantic Ocean, which extended over the Scandinavian Peninsula sustaining the anticyclone girdle from the ground. In these conditions, for the North-West of Europe, there was a circulation of atmospheric blockage. Downwards this blockage, above Eastern and Central Europe, there was the geopotential thalweg in which a low geopotential nucleus with the isohypse of 536 damgp was visible over the South of Italy that was exactly above the cyclonic nucleus on the ground.

Thus, the vertical axle of the Mediterranean Cyclone in that moment was perpendicular on earth, which indicates the fact that the cyclone was on-going, in its maximum phase. Now, in altitude, the circulation of air masses was Southern, advecting a mass of warm and moist air above the Mediterranean Sea, a maritime tropical mass (mT). On the posterior side of the altitude geopotential thalweg, a mass of cold and moist air was advected, which was recirculated from the Northern seas and was maritime polar (mP).

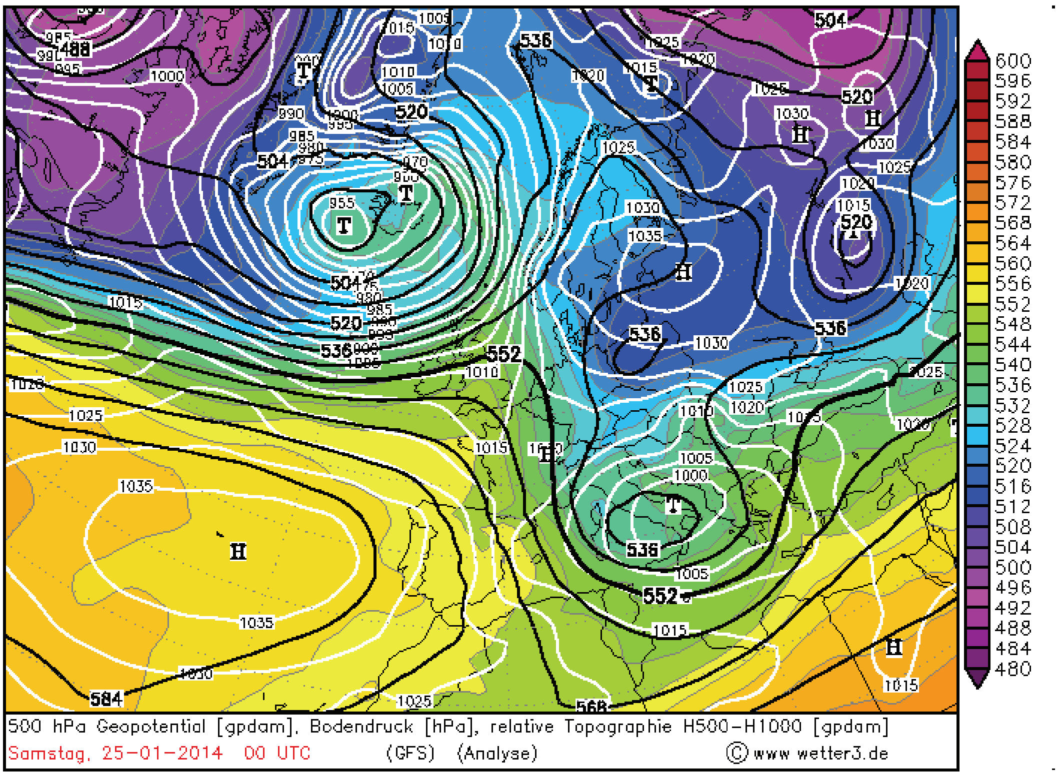

Figure 5. The synoptic situation at the ground level superposed with the altitude situation at the level of 500 hPa and the relative baric topography TR500/1000 on January 25, 2014 at 00 UTC (according to wetter3.de/).

Consequently, the strong Mediterranean Cyclone had a triple supply with air rich in moisture and strong and vast cloudy systems associated to this cyclone caused abundant snowfalls and the blizzard drifted the snow on extended areas in the south of the country. In the counties from the Carpathian Curvature, entire localities were buried in snow, and the drifts of snow reached thicknesses of over 3m in some places, thus the situation in the interval January 26-28, 2012 was repeated, but with a low intensity.

This kind of synoptic situation occurs quite often in the interval January 24-27 and is followed by intense frost waves. According to the old calendar the Epiphany was celebrated around 25 January, and the frost which followed was called in the popular tradition “bitter cold/Epiphany frost”. In time, in the last century, for example, these frosts were much more intense.

We mention as example the frost in the interval February 24-29 1942[7] when in the morning of January 25, 1942 the lowest minimum temperatures of the European continent and even on the Northern hemisphere were registered, many of which have remained records up to the present.

These kind of excessively cold intervals occurred after long warm periods, in which plants start the vegetation phase, can cause massive destructions in autumn crops.

CONCLUSIONS

After a very early and cold winter beginning in the interval November 26-December 1, 2014, warm weather in the interval December 2- January 24, 2014 led to the start over of vegetation phases of autumn crops, which even from the end of November were in advanced stages of vegetation, exposing them to the danger of freezing.

The winter of 2013-2014 was warm overall, and in the interval January 25- February 8, winter phenomena were registered, consequently this winter lasted only 13 days.

February has been the warmest month of this winter with thermal maximum values comprised between 16.4°C at Polovragi and 20.3°C at Calafat, and their mean for the entire region was 17.6°C, being the highest in all winter.

Active temperatures in February were comprised between 67.0°C at Voineasa and 117.7°C in Drobeta Turnu Severin, and their mean for the entire region was 90.0°C, meaning a warm winter month.

During the entire winter *active temperatures* were comprised between 111.8°C in Voineasa intramountainous depression and 247.2°C in Drobeta Turnu Severin in the extreme west of the region, and the mean for the entire region was 178.1°C, which confirms the positive thermal balance of the winter of 2013-2014, announcing an early spring arrival, and in the mountainous area it was 131.7°C in Parâng.

From a pluviometric point of view, the winter of 2013-2014 was very droughty, and the *seasonal quantities of precipitation* were comprised between 57.0 l/m^2 at Calafat in the South-West of Oltenia and 135.7 l/m^2 at Apa Neagră Subcarpathian Depression, their percentage deviations from the multiannual seasonal means were comprised between -54.0% at Calafat and -16.3% in Râmnicu Vâlcea, which according to Hellmann criterion leads to classifications of the pluviometric time type in this winter comprised between little droughty (LD) on restricted areas in Râmnicu Vâlcea and Craiova and excessively droughty (ED) at Calafat.

The very droughty weather (VD) predominated with a spatial-temporal extension of 60.0%.

The agrometeorological frost was insignificant, registering only in the Subcarpathian area for short periods of time and with low values of the frost units.

In the last 20 years, the frequency of warm winters has increased and high values of active temperatures and exceptional maximum values were marked, confirming climate warming at a regional level and the extension of Mediterranean climate towards North.

These changes are reflected in ecosystems through their effects and the gradual extension of some species of plants and animals specific to the Mediterranean climate northwards (intense development of fig trees, some Mediterranean plants from meadow vegetation, the extension of the habitat area of golden jackal, etc.). Oltenia climate is in perfect harmony with the European climate.

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[7] The winter of 1941-1942 has been the coldest winter in the Northern emisphere in the last century. The exceptional bitterness of this winter, snowfalls, blizzards and intense and long frosts contributed crucially to the return to the situation of the second world war.

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Marinică Andreea Floriana
Earth and Space Science, Jacobs University,
Bremen, gGmbH.
E-mail: seryblack@yahoo.com

Chimişliu Cornelia
The Oltenia Museum Craiova,
Str. Popa Şapcă, No. 8, Craiova, Romania.
E-mail: chimisliuc@gmail.com

Marinică Ion
Regional Meteorological Centre Oltenia,
Str. Brestei, No. 3A, Craiova, Romania.
E-mail: ionmarinica@yahoo.com

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