EXCEPTIONAL CLIMATIC VARIABILITY IN THE SOUTH-WEST OF ROMANIA DURING THE WINTER OF 2015-2016

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Abstract. The winter of 2015-2016 was very warm, with a general average of 3.08°C for the area with an altitude below 600 m, thus constituting ***the climatic record of the warmest winter of all meteorological forecasts***. The winter was marked by two very warm months - December and February, and a normal thermal month – January. Six heat waves accounting 37 very warm days have contributed to this climatic record. Only one intense frost wave was registered on January 19-24, 2016, which caused human victims and material damages. In February, the absolute record for Oltenia, which was registered 117 years ago (24.0°C in Drobeta Turnu Severin in 16 February 1899), was outclassed. Oltenia meteorological stations registered 5 absolute climatic records in February. Climate warming is well highlighted for December and February. The warm winter had significant effects on biotopes, agricultural crops and fruit trees, leading to an early spring arrival. The paper is included in a series of extended studies on climatic variability in the South-West of the country and the effects of global warming (MARINICĂ & CHIMIŞLIU, 2008; MARINICĂ et al., 2010, 2011). The paper is useful to all people interested in climate evolution in this part of Romania.

Keywords: monthly temperature means, Hellman criterion, warm winter phenomena, frost waves, vegetative processes.

Rezumat. Variabilitatea climatică excepţională din iarna 2015-2016 în sud-vestul României. Iarna 2015-2016 a fost foarte caldă, cu media generală de 3.08°C pentru arealul cu altitudinea sub 600 m, constituind astfel ***recordul climatic de cea mai caldă iarnă din toată perioada observaţiilor meteorologice***. Iarna a fost marcată de lunile decembrie şi februarie foarte calde şi luna ianuarie, în medie termic normală. Şase valuri de căldură care au însumat 37 de zile foarte calde au contribuit la realizarea acestui record climatic. Un singur val de frig intens în ianuarie, care a produs victime umane şi pagube materiale datorită îngheţului, s-a înregistrat în intervalul 19-24 ianuarie 2016. În luna februarie a fost surclasat recordul termic absolut pentru Oltenia înregistrat în urmă cu 117 ani, (24.0°C la Drobeta Turnu Severin în 16 februarie 1899). La staţiile meterologice din Oltenia au fost înregistrate cinci recorduri climatice absolute de temperatură în februarie. Încălzirea climatică este bine pusă în evidenţă pentru lunile decembrie şi februarie. Iarna caldă a avut efecte importante în cadrul biotopurilor, culturilor agricole şi pomilor fructiferi determinând premisele împrimăvărării timpurii. Lucrarea face parte dintr-o serie de studii extinse privind variabilitatea climatului în sud-vestul ţării şi efectele încălzirii climatice (MARINICĂ & CHIMIŞLIU 2008; MARINICĂ et al., 2010, 2011). Lucrarea este utilă tuturor celor interesaţi de evoluţia climatului în această parte a României.

Cuvinte cheie: medii lunare de temperatură, criteriul Hellmann, fenomene de iarnă caldă, valuri de frig, procese vegetative.

INTRODUCTION

Globally, December 2015 was the warmest month, on extended areas in the Northern Hemisphere. Therefore, December 2015 has been the warmest last month of the year ever registered in the United States meteorological measurement history since 1880. Overall, 2015 was the second year in the top of the warmest years in this country, according to data published by the National Oceanic and Atmospheric Administration (NOAA), (quoted by AFP): "December 2015 has exceeded the temperature record for the continental part of the USA, the average temperature of 3.66°C outclassing the previous record of 3.16°C from 1939", (NOAA http://climate.nasa.gov/news/2391/, /2386/, Goddard Institute for Space Studies (GISS) and Agerpres). 'Exceptionally', 'this month of December was the warmest and wettest in 121 years of record-keeping", (Jake Crouch, climatologist at the NOAA's National Centers for Environmental Information). In the United States, in 2015, the average temperature was 12.4°C, very close to the ***absolute record of 2012, when the average temperature was 12.94°C***. On the reverse side of the Northern Hemisphere, only few days before Christmas, there were registered 11.2°C in Kokemaki, in Finland, 12.6°C in Stockholm, 11.3°C in Tallin in Estonia, 16.9°C in London, 11.0°C in Sankt Petersburg and 5.0°C at 2500 kilometres Eastern Moscow. December 2015 has been the warmest end month ever registered on Earth, in 136 years of weather forecasts. In January 2016, the average temperature of the Planet on ground surface was 1.56°C above the temperature of the 20th century. (http://www.romanialibera.ro/actualitate/meteo/January-2016--cea-mai-calda-luna-January-din-istorie-407703).

In Romania, the warmest period of December was registered in the interval 22-28 December 2015, when the maximum temperature values reached 20.0°C in some areas in the country, and in Oltenia 19.3°C at Polovragi, Sub-Carpathian Depression on December 28, 2015. The types of atmospheric circulations predominating in December were specific to warm winter and if they had lasted till January they would have determined a very warm peak winter month. The changing of circulation types occurred in the last two days of December leading to atmospheric circulations specific to a very cold winter month. January 2016 was the warmest month on Terra in the beginning of the year of record-keeping, (National Oceanic and Atmospheric Administration - NOAA) (AFP). In general, the average temperature on ocean and ground surface was 1.04°C above the average of the 20th century, therefore January 2016 has been the first warmest month of the year since 1880, exceeding the previous record established in 2007 when it was registered 0.16°C above the average of the previous century (NOAA). Also, January 2016 marked the second consecutive month when the average temperature on Terra outclassed the monthly record, constituting a new record and a new proof of global warming. In Oltenia, January was a normal thermal month, being marked by a blizzard and a 6 days frost wave. These sudden weather changes caused

an exceptional climatic variability of the winter of 2015-2016 in Oltenia, in the entire country and even in the whole Northern Hemisphere. ***2015 registered the first climatic record of global average temperature ≥ 1.0°C than the global average of the previous century and of the entire period of weather forecasts during 1880-1899***. We will further analyze this exceptional climatic variability and its consequences on agricultural crops, biotopes, economy and environment.

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[1] Archive, the current maps from the operative activity, and those on the internet provided by the analysis and forecast international centers and NAM Bucharest (National Administration of Meteorology). We used the facilities provided by Office for drawing the tables and charts.

The paper analyses the exceptional climatic variability in the winter of 2015-2016 in the South-West of Romania according to thermal and pluviometric regime of December 2015, January and February 2016 and of the winter of 2015-2016. The effects on the environment and biotopes are also analysed.

RESULTS

1a. Thermal regime of December 2015

Monthly air temperature means were comprised between 1.5°C in Voineasa Intramountainous Depression and 7.1°C at Calafat in the extreme South-West, and their deviations from the multiannual means were comprised between 3.4°C Voineasa and 6.3°C in Mehedinţi Hills at Bâcleş, leading, according to Hellmann criterion, to classifications of the pluviometric time type from warm (W) in Getic Piedmont in Slatina, in the hilly area in Târgu Logreşti, Apa Neagră and Târgu Jiu Intra-Carpathian Depressions, in the Olt Couloir in Râmnicu Vâlcea and Voineasa to very warm (VW) in most part of Oltenia region (Table 1). In the interval 1-7 December, daily temperature mean for the entire region exceeded 10.0°C.

Monthly air temperature mean calculated for the entire region was 4.9°C, being the highest monthly mean of all ranges of climatic data for Oltenia since climatic forecasts have been recorded, and its deviation from the multiannual mean was 5.0°C, confirming that December 2015 was very warm overall for the entire region of Oltenia.

Table 1. Air temperature regime in Oltenia and the minimum and maximum temperature values on ground surface in December 2015.

Meteorological Station	Hm	N	M	Δ=M-N	CH	minT air		maxT air		minT soil		maxT soil	
						(°C)	Data	(°C)	Data	(°C)	Data	(°C)	Data
Dr. Tr. Severin	77	1.4	6.7	5.3	**VW**	-7.6	31	17.2	28	**-8.0**	31	24.2	19
Calafat	66	1.0	**7.1**	6.1	**VW**	-8.5	31	18.6	28	**-7.4**	31	24.3	28
Bechet	65	0.4	5.5	5.1	**VW**	-6.9	31	18.9	23	**-3.5**	31	19.0	23
Băileşti	56	0.4	5.5	5.1	**VW**	-6.3	31	16.5	28	**-7.3**	31	16.7	24
Caracal	112	-0.1	5.2	5.3	**VW**	**-4.9**	31	16.0	23	**-0.8**	31	13.0	23
Craiova	190	0.1	5.3	5.2	**VW**	-5.5	31	15.9	22	**-2.7**	31	15.7	23
Slatina	165	0.3	5.1	4.8	**W**	-5.6	31	15.6	22	**-0.2**	31	***9.9***	4
Bâcleş	309	-0.4	5.9	**6.3**	**VW**	-7.6	31	16.1	27	-	-	-	-
Tg. Logreşti	262	0.1	4.2	4.1	**W**	-11.5	31	18.6	28	**-13.8**	31	14.6	23
Drăgăşani	280	0.6	6.3	5.7	**VW**	-9.1	31	16.4	28	**-10.1**	31	**25.3**	27
Apa Neagră	250	0.1	4.2	4.1	**W**	-11.5	31	18.8	23	**-12.5**	31	15.8	2
Tg. Jiu	210	0.1	4.8	4.7	**W**	-8.4	31	17.8	23	**-7.6**	31	18.0	28
Polovragi	546	0.1	5.2	5.1	**VW**	-12.1	31	**19.3**	28	***-16.8***	31	16.7	23
Rm. Vâlcea	243	0.5	5.4	4.9	**W**	-10.9	31	18.1	27	**-14.2**	31	16.2	28
Voineasa	587	-1.9	***1.5***	***3.4***	**W**	***-14.7***	31	***14.3***	28	-	-	-	-
Parâng	1585	-3.7	-0.2	3.5	**W**	-16.7	31	12.9	21	-	-	-	-
Oltenia Mean	-	-0.1	4.9	5.0	VW	-9.2		16.9		-8.1		17.6	
Ob. Lotrului	1404	-4.9	-1.9	3.0	**W**	-21.5	31	6.7	22	-	-	-	-

(Source: processed data from Oltenia RMC archive)

The monthly minimum air temperature values were registered in the last day of the month and were comprised between -14.7°C at Voineasa and -4.7°C in Romanaţi Plain at Caracal, and their mean for the entire region was -9.2°C. In the mountainous area, the minimum thermal value was -21.5°C registered at Obârşia Lotrului. *The coldest morning* was registered on December 31 with the minimum temperature mean for the entire region of -9.2°C. *Frost units*[2] in December

[1] RMC= Oltenia Regional Meteorological Centre

[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); *Frost units for the entire 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; *The active temperature are*

2015 were insignificant, were registered in the interval 30-31 December and sporadically in some days and were comprised between 5.7 at Băileşti and 32.0 la Voineasa. Their mean for the entire region was 13.3. In the mountainous area in Parâng the number of frost units was 52.7, and at Obârşia Lotrului 73.7. In most part of the region the number of frost units was ≤10. A*grometeorological frost* was not registered in Oltenia, excepting the mountainous area, where it was insignificant (1.7 units in Parâng and 6.5 at Obărşia Lotrului). ***1 frosty[3] day*** was registered sparsely in the hilly area in the interval 30-31 December (in the low altitude area only on 31), and only two days in the mountainous area in Parâng. There were 17 days when the minimum temperature mean for the entire region dropped below 0.0°C. During 3 days (December 29-31), air temperature dropped from the highest values, registering *the maximum amplitude of* 34.0°C.

Heat units highly exceeded the frost units and were comprised between 78.1 at Voineasa and 228.1 at Calafat, and their mean for the entire region was 163.9, comparable values to a spring month, confirming that December 2015 was very warm. These helped vegetative processes at autumn crops slow down and, in general, the vegetal cover and biotic processes in biocoenoses[4] to take place.

Monthly maximum temperature values were registered in the interval 22-28 December, most of them on December 28, an atypical situation for December, because, normally, in this month the monthly maximum temperature values are registered in the first decade of the month. Monthly maximum thermal values were comprised between 14.3°C at Voineasa and 19.3°C at Polovragi, and their mean for the entire region was 16.9°C. There were registered 19 days in which the maximum thermal values exceeded 10.0°C. Air temperature amplitude was 34.0°C. The highest maximum temperature values for the entire region according to their mean were registered on December 23, when their mean was 15.7°C.

As a consequence of warm weather, on Christmas Eve, in Bărăgan, the fields were looking as in May, hectares of golden rape were shinning in the spring sun". (http://www.detinutinromania.ro/index.php/2015/12/23/vreme-anormal-de-calda-in-inainte-de-craciun-a-inflorit-rapita/). Bees came up harvesting many days, some species of fruit trees blossomed and even yielded fruit (apple trees), roses, snowdrops and other plants of the spontaneous flora blossomed, autumn crops had a great development as a consequence of warm weather and optimum water reserve in the ground layer of 0-50 cm, after the warm and rainy autumn of 2015. Warm weather offered an interval of 29 days in which autumn agricultural works were made in good conditions in the first winter month and *people were in good mood*, due to sunny days and reduced cost of home central heating.

The chart of air temperature variation in December 2015 presents a slightly decreasing tendency due to weather cooling in the last two days (Fig. 1).

For ***the interval 1-28 December*** the tendency increased for all these parameters and weather cooling started on December 29. In the intervals 1-7 December and 22-28 December *two winter heat waves* were registered***: 1-4 December and 19-28 December***, amounting a total of 14 days, in which the thermal maximum values often exceeded 15.0°C. *The coldest interval in December* was 30-31, the cooling peak for this month being on December 31, when the monthly minimum thermal values were registered. In the interval 1-7 December, the air temperature mean for the entire region exceeded 10.0°C. *The warmest day of December 2015,* according to temperature means for the entire region, was on 3 when the mean for the entire region was 12.7°C, and the coldest day was on December 31 with a mean of -6.6°C.

Only *2 winter days* were registered in the hilly area, 4 in the mountains at Obârşia Lotrului and 9 in Parâng.

On ground surface, *the minimum temperature and air values* were registered on December 31 and were comprised between -16.8°C at Voineasa and -0.2°C in Slatina, with a mean for the entire region of -8.1°C. The ground was not frosty in the interval 1-29 December. Most of *the maximum temperature values on ground surface* were registered on December 23 and 24 and were comprised between 9.9°C in Slatina and 25.3°C at Drăgăşani, and their mean for the entire region was 17.6°C. The thermal regime specific to winter began on December 30.

1.b. Pluviometric regime of December 2015

In December 2015, *the monthly quantities of precipitation* were comprised between 0.3 l/m^2 at Calafat and Băileşti in the South of the region and 8.1 l/m^2 at Polovragi, and in the mountainous area in Parâng[5] 8.3 l/m^2 (Table 2), and their deviations from the multiannual means were comprised between -99.4% at Băileşti and -85.6% at Polovragi, and in the mountainous area in Parâng -84.8%, designating an exceedingly droughty month in the entire Oltenia region. *Monthly mean of precipitation* for the entire region was 3.2 l/m^2 and its deviation from the multiannual mean of -93.7%, confirming that December 2015 was an excessively droughty month. Precipitation was mainly registered on December 29 and 30.

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those ≥0 ℃, and the temperature of the biological minimum is 0°C. A winter day is a day in which air temperature is < 0°C. Heat units (∑ daily average temp ≥ 0°C), Active temperatures = are temperatures ≥0°C

[3] From the point of view of *weather forecast for people*, the notion of *"frost" (*or *frosty weather)* means temperature values of ≤ -10°C. Therefore we observe that *frost* defined by the terms of weather forecast (which are adapted to living organisms) is different from *agrometeorological frost* (temperatures of ≤-15°C), plants being better adapted to climatic conditions (due to their cellular structure and specific biotic processes).

[4] The term of biocoenoses (Greek *koinosis* – to share) is the supra individual level of organizing living matter and describes the totality of living, vegetal (phytocoenosis) and animal (zoocoenosis) organisms, which interact with each other and live together in a habitat or a sector of biosphere (*biotope*), forming a single whole and is in a dynamic balance dependent on that environment. It is characterized by a certain structure and functioning given by the mode of matter, energy and information flow. The term of biocoenoses was proposed by Karl Möbius in 1877 (http://ro.wikipedia.org/wiki/Biocenoz%C4%83).

[5] Parâng meteorological station, being located on the southern slopes of Parâng Mountain, closed to the northern limit of Gorj County, having a wide range of data and being a station with personnel, has the most significant data for the mountainous area in the north of Oltenia, although it is situated in Hunedoara County.

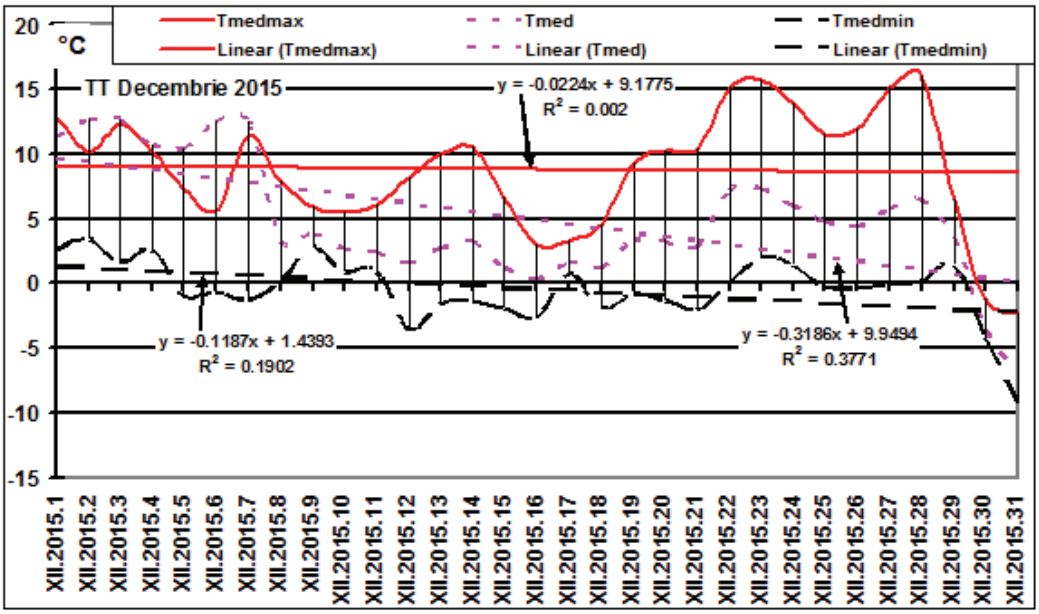


Figure 1. Air temperature variation (the daily means, daily minimum and maximum temperatures mean) in December 2015. (Source: processed data from Oltenia RMC archive).

Table 2. Quantities of precipitation registered in the winter of 2015-2016 (Σ), compared to normal[6] values.

Meteorological Station	Hm	December 2015				January 2016				February 2016			
		ΣXII	N	Δ%	CH	ΣI	N	Δ%	CH	ΣII	N	Δ%	CH
Dr. Tr. Severin	77	0.5	61.2	-99.2	**ED**	70.5	51.4	37.2	**VR**	40.5	47.9	-15.4	**LD**
Calafat	66	***0.3***	45.5	-99.3	**ED**	68.6	40.4	69.8	**ER**	34.1	38.0	-10.3	**LD**
Bechet	65	0.6	36.3	-98.3	**ED**	81.9	33.5	**144.5**	**ER**	25.1	34.8	-27.9	**D**
Băileşti	56	***0.3***	46.8	**-99.4**	**ED**	79.6	38.5	106.8	**ER**	35.1	36.1	-2.8	**N**
Caracal	112	0.7	39.5	-98.2	**ED**	**83.3**	34.7	140.1	**ER**	***20.1***	34.5	***-41.7***	**VD**
Craiova	190	1.0	41.8	-97.6	**ED**	82.3	37.5	119.5	**ER**	33.1	30.4	8.9	**N**
Slatina	165	3.3	42.8	-92.3	**ED**	68.7	36.0	90.8	**ER**	27.0	38.4	-29.7	**D**
Tg. Logreşti	262	5.4	44.8	-87.9	**ED**	43.9	35.9	22.3	**R**	33.6	41.0	-18	**LD**
Drăgăşani	280	3.8	44.6	-91.5	**ED**	76.9	34.1	125.5	**ER**	31.1	35.4	-12.1	**LD**
Apa Neagră	250	3.9	82.3	-95.3	**ED**	52.3	70.9	-26.2	**D**	**71.1**	66.4	7.1	**N**
Tg. Jiu	210	7.5	64.0	-88.3	**ED**	34.2	53.9	***-36.5***	**VD**	51.3	52.0	-1.3	**N**
Polovragi	546	8.1	56.1	**-85.6**	**ED**	***33.8***	48.9	-30.9	**VD**	52.9	48.4	**9.3**	**N**
Rm. Vâlcea	243	6.5	46.2	-85.9	**ED**	28.8	35.5	-18.9	**LD**	27.9	38.4	-27.3	**D**
Parâng	1585	**8.3**	54.6	**-84.8**	**ED**	38.0	57.7	-34.1	**VD**	59.2	47.7	24.1	**R**
Media Oltenia	-	3.2	51.0	-93.7	**ED**	60.2	43.9	37.2	**VR**	38.7	42.1	-8.0	**N**
Ob. Lotrului	1404	25.3	-	-	-	62.0	-	-	-	90.8	-	-	-

(Source: processed data from Oltenia RMC archive).

Nationally, ***December 2015 has been the third warmest December in the last 90 years*** **and** ***the second most droughty month of all history of meteorological forecasts*** (NAM documents), the percentage deviations of the quantities of precipitation from the multiannual means calculated for the interval 1961-2010 being ≤ -75.0% in most part of the country.

2a. Thermal regime of January 2016

Monthly air temperature means were comprised between -3.8°C at Caracal and Bechet and -0.6°C in Drobeta Turnu Severin, and *their deviations from the multiannual means* were comprised between -1.6°C at Bechet and 1.4°C at Voineasa leading to classifications of thermal time type from normal in most part of the region to cool at Băileşti / Bechet area and warm in some areas with a higher relief (Bâcleş, Polovragi and Voineasa) (Table 3).

Monthly air temperature mean for the entire region was -2.8°C equal with the multiannual mean, confirming that January 2016 was thermally normal overall, although air temperature had extremely high variations. *The coldest interval of January* and of the winter of 2015-2016 was 19-25 January, during which the lowest daily temperature means of all winter were registered and were comprised between -9.5°C in Râmnicu Vâlcea and -16.8°C at Bechet. The *amplitude of air temperature variation* in January was comprised between 26.4°C at Drăgăşani and 37.9°C at Calafat, and *for the entire region the maximum amplitude* was 40.8°C.

[6] Voineasa and Bâcleş meteorological stations, since they have incomplete data, cannot be taken into consideration.

The monthly minimum air temperature values were mostly registered in the interval 20-24 January and were comprised between -23.3°C at Caracal on 24 January and -13.1°C registered at Drăgăşani on 20 January, and their mean for the entire region was -17.9°C. *The coldest morning* was registered on 24 January with the minimum temperature mean for the entire region of -17.1°C. *Frost units* in January 2016 were comprised between 90.0 in Drobeta Turnu Severin and 150.9 at Bechet, and their mean for the entire region was 127.7. These were registered in the intervals 1-6 January and 17-26 January, amounting 16 frosty days. In the mountainous Parâng area, the number of frost units was 194.2, and at Obârşia Lotrului, it was 222.0. *Agrometeorological frost* was registered in the interval 19-25 January and sparsely in the interval 1-2 January, and the frost units were comprised between 0 in Drobeta Turnu Severin, Bâcleş, Drăgăşani and Râmnicu Vâlcea and 30.2 at Bechet, and in the mountainous area between 9.9 in Parâng situated on the Southern slope of the mountain and 55.3 at Obârşia Lotrului situated on the North-Western side. Because of the extremely cold weather in the aforementioned intervals, in January, the vernalization[7] process occurred.

Table 3. Air temperature regime in Oltenia and the minimum and maximum temperature values on ground surface in January 2016.

Meteorological Station	Hm	N	M	Δ=M-N	CH	minT air		maxT air		minT soil		maxT soil	
						(°C)	Data	(°C)	Data	(°C)	Data	(°C)	Data
Dr. Tr. Severin	77	-1.1	**-0.6**	0.5	**N**	**-11.9**	20	**17.1**	29	**-18.9**	23	**20.2**	30
Calafat	66	-1.8	-2.0	-0.2	**N**	**-20.4**	23	**17.5**	29	**-22.5**	20	**20.1**	29
Bechet	65	-2.2	**-3.8**	***-1.6***	**CO**	**-21.6**	24	**13.6**	29	**-21.0**	20;23;24;25	**12.0**	29
Băileşti	56	-2.3	-3.4	-1.1	**CO**	**-21.8**	24	**14.6**	29	**-24.6**	20;23	**6.3**	31
Caracal	112	-2.9	**-3.8**	-0.9	**N**	***-23.3***	24	***10.1***	13	**-23.5**	24	**12.0**	14
Craiova	190	-2.6	-2.8	-0.2	**N**	**-18.1**	21	**12.5**	29	**-22.4**	24	**15.5**	29
Slatina	165	-2.4	-3.0	-0.6	**N**	**-19.1**	24	**12.0**	28	**-21.9**	24	***6.6***	8
Bacleş	309	-3.0	-1.8	1.2	**WS**	**-13.6**	21	**14.7**	29	-	-	-	-
Tg. Logreşti	262	-2.7	-3.4	-0.7	**N**	**-20.7**	24	**14.3**	29	**-24.2**	20	**14.4**	30
Drăgăşani	280	-2.2	-1.3	0.9	**N**	**-13.1**	20	**13.3**	29	**-21.0**	20	**17.9**	29
Apa Neagră	250	-2.6	-3.0	-0.4	**N**	**-20.4**	24	**16.4**	28	***-26.2***	24	**13.0**	30
Tg. Jiu	210	-2.6	-2.7	-0.1	**N**	**-17.1**	24	**15.8**	29	**-16.5**	20	**14.2**	30
Polovragi	546	-3.2	-2.2	1.0	**WS**	**-15.6**	1	**12.9**	28	**-23.4**	20	**15.2**	11
Rm. Vâlcea	243	-2.2	-1.6	0.6	**N**	**-14.1**	24	**15.9**	29	**-16.2**	21	**18.5**	29
Voineasa	587	-4.7	-3.3	**1.4**	**WS**	**-17.1**	2	**13.9**	29	-	-	-	-
Parâng	1585	-5.9	-5.8	0.1	**N**	**-18.6**	3	**7.9**	30	-	-	-	-
Media Oltenia	-	-2.8	-2.8	0.0	**N**	**-17.9**	-	**13.9**	-	**-21.7**	-	**11.9**	-
Ob. Lotrului	1404	-	-6.8	-6.8	-	**-25.6**	23	**8.7**	30	-	-	-	-

(Source: processed data from Oltenia RMC archive).

Heat units were registered in ***the intervals 7-16 January and 27-31 January amounting 15 days*** and were comprised between 18.7 at Voineasa and 72.5 in Drobeta Turnu Severin with an average of 41.7 for the entire region. These have maintained the slow biotic processes and contributed to the viability of plants and animals. Consequently, January had two "warm windows" in these intervals. Most of the *monthly maximum temperature values* were registered in the last pentad of the month on January 28 and 29 and were comprised between 10.1°C at Caracal and 17.5°C at Calafat, and their mean for the entire region was de 13.9°C.

The chart of air temperature variation in January 2016 shows increasing tendencies for average, minimum and maximum daily temperature values (Fig. 2). Maximum daily temperatures had the fastest increase and the minimum daily temperatures had the slowest increase. A 4 days heat wave was registered in the interval 27-30 January.

On ground surface, the monthly minimum temperature values were registered in the interval 20-24 January and were comprised between -26.2°C at Voineasa and -16.2°C in Râmnicu Vâlcea, and their mean for the entire region was -21.7°C. Consequently, the ground was frosted in the interval 1-6 January and 18-27 January, and in the other days there was thaw and superficial frost at night. In the interval 19-25 January, ***an intense cold wave*** occurred. The value of -26.2°C, registered at Voineasa is ***the minimum thermal value of the winter of 2015-2016 on ground surface.*** *Monthly maximum temperature values on ground surface* were atypically registered, most of them in the first two days of winter and were comprised between 6.3°C at Băileşti on January 31 and 20.2°C in Drobeta Turnu Severin on January 30, and their mean for the entire region was 11.9°C.

2.b. Pluviometric regime of January 2016

The monthly quantities of precipitation were comprised between 33.8 l/m^2 at Polovragi and 83.3 l/m^2 at Caracal, and their percentage deviations from the multiannual means were comprised between -36.5% in Târgu Jiu and 144.5% at Bechet leading to classifications of pluviometric time type from excessively rainy to very rainy in plain area and the South of Getic Piedmont to very droughty in Târgu Jiu and Polovragi Sub-Carpathian Depressions (Table 2). *The mean of the monthly quantities of precipitation* for the entire region was 60.2 l/m^2, and their deviation from the multiannual mean was 37.2%, which leads to the general classification of very rainy month overall for the entire region. In January, there are two intervals with significant precipitation, 2-7 January and 15-17 January, amounting a total of 9 days. The richest day in precipitation was

[7] ***Vernalization*** is a biochemical process by which prolonged exposure to cold temperatures promotes the flowering of some plant species.

on January 16 with a mean for the entire region of 13.9 l/m^2. There were registered all types of atmospheric precipitation: drizzle, rain, sleet and snowfall. *The average number of days with drizzle* was 1, *with rain* 62, *with sleet* 1.6, *with snowfall* 7.9. *The average number of days with liquid precipitation (11).* The number of days with sleet is taken into consideration for the number of days with liquid and solid precipitation; sleet being a mixed precipitation was 7.2, closed of the number of days with snowfall. *The total number of days with precipitation* was comprised between 11 in Craiova and 22 in Drobeta Turnu Severin and Parâng in the mountainous area, with the *mean for the entire region* of 16.1. *The mean of the number of days with glazed frost* for the entire region was 2, being registered with a local extension on January 5 and 6 and sparsely on January 7. *The number of days with snow layer* was comprised between 17 in Râmnicu Vâlcea and Drobeta Turnu Severin, and the mean for the entire region was 21.1. *The snow layer maximum thickness* was registered on January 18 and was comprised between 13 cm at Polovragi and 42 cm at Drăgăşani (Fig. 3) in Oltenia; in Eastern Muntenia, it was registered the biggest snow layer in this winter (44 cm in Stolnici – Argeş County).

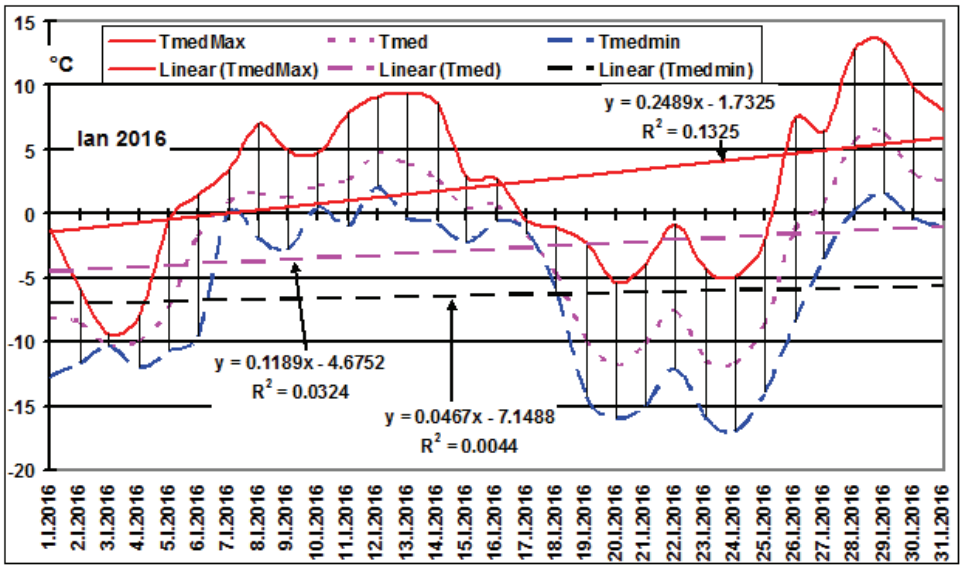
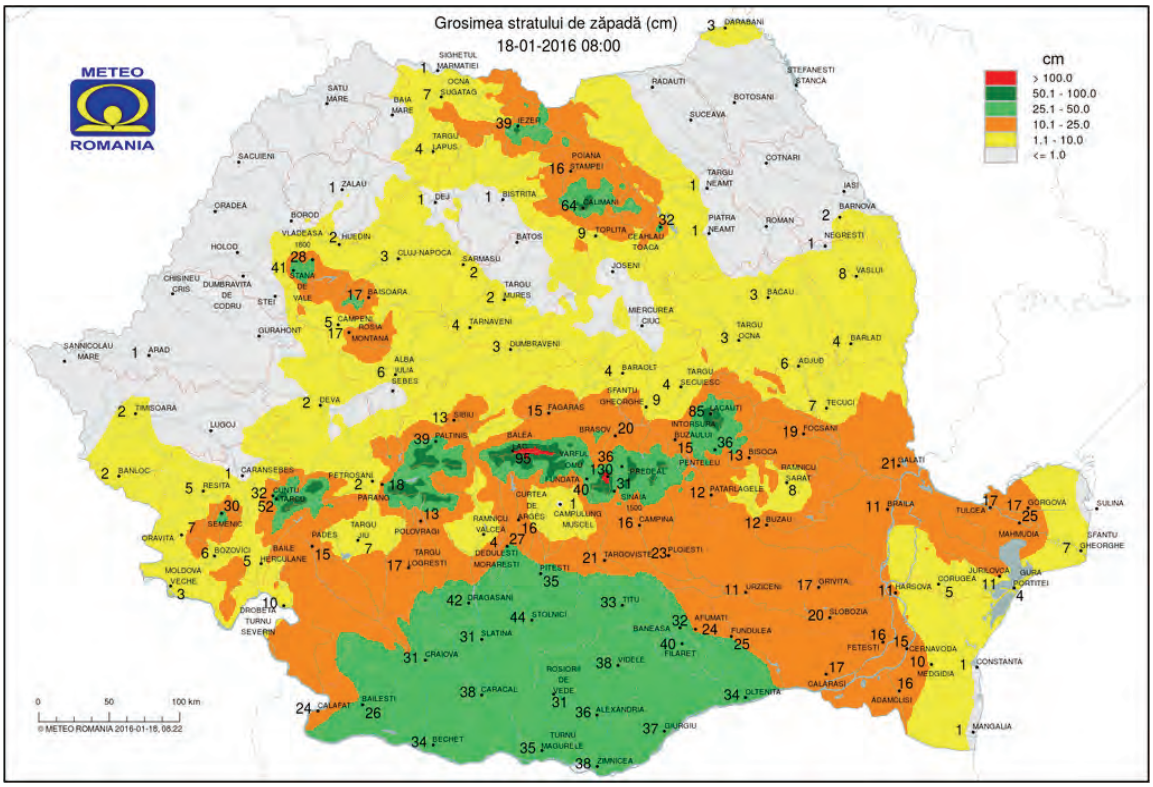


Figure 2. Air temperature variation (the daily means, daily minimum and maximum temperatures mean) in January 2016.



(Source: processed data from Oltenia RMC archive).

Figure 3. Spatial extension of snow layer, with the maximum thickness registered in the winter of 2015-2016, on January 18, 2016 at 08 (according to NAM Bucharest).

3a. Thermal regime of February 2016

Monthly air temperature means were comprised between 3.0°C at Voineasa and 7.3°C in Drobeta Turnu Severin, and their deviations from the multiannual means were comprised between 5.5°C at Apa Neagră and Voineasa and 7.2°C at Caracal leading to the classification of very warm month (VW) to all meteorological stations in Oltenia. *Air temperature mean* calculated for the entire region was 5.7°C and its deviation from the multiannual mean was 6.5°C confirming that February was a warm month. *Daily means calculated for the entire region* were comprised between 0.6°C registered on February 7 and 12 and 5°C registered on February 23. *The warmest interval of February* and of the winter of 2015-2016 was 20-24 February, when many of the absolute temperature means were exceeded, and in the country the warmest interval was 14-17 February, when the absolute maximum thermal value of Romania was equalled (26.0°C at Pătârlagele, Buzău County on February 16, 2016).

The monthly minimum air temperature values were registered in the interval 6-8 February and were comprised between -6.9°C at Târgu Logreşti and -2.4°C in Drobeta Turnu Severin, and their mean for the entire region was -4.5°C. There were registered 21 days (72.4% of the days of the month) in which the daily minimum temperature mean for the entire region was positive. *The coldest morning* was registered on February 7 with the minimum temperature mean of -4.1°C. *Frost units* were significant and were registered only in the Sub-Carpathian area being comprised between 1.3 at Apa Neagră and 4.8 at Voineasa, and in the mountainous area 43.0 in Parâng. There was no frost. *Heat units* were registered every day of the month and were comprised between 91.2 at Voineasa and 212.7 in Drobeta Turnu Severin with the mean for the entire region of 167.7, leading to a ***February with a spring thermal regime*** and confirming ***the translation of spring towards autumn***. *The warmest morning* was on February 24 with the mean for the entire region of 7.0°C.

Monthly maximum temperature values were registered differently in Sub-Carpathian area on February 16 and in Oltenia Plain, South of Getic Piedmont and Mehedinţi Hills on February 22. The maximum thermal values were comprised between 20.4°C at Voineasa and Bâcleş and 24.2°C at Bechet. The value of 24.2°C registered at Bechet becomes the maximum absolute thermal value of February in Oltenia, exceeding after 117 years the maximum thermal value of 24.0°C registered in Oltenia on February 16, 1899 in Drobeta Turnu Severin. The value of 24.0°C on February 16, 1899 was the maximum absolute thermal value for the entire country until February 27, 1995, when there were registered 26.0°C at Medgidia. In February 2016, nationally, the maximum absolute thermal value from 1995 was equalled, due to the thermal maximum value on February 16, 2016, registered at Pătârlagele, in Buzău County. The analysis of the archive data shows that climate warming of February was well highlighted after 1990. Taking into account that February 16 is 11 days earlier than February 27 and February 2016 was thermally a true spring month, that February 2002 and 2007 were warm month, global warming was much more intense beginning with 2000.

The chart of air temperature variation in February 2016 shows increasing tendencies for daily average, minimum and maximum temperature values (Fig. 4). Minimum daily temperatures had the fastest increase and the maximum daily temperatures had the slowest increase. According to the average, minimum and maximum temperatures and the deviations from the multiannual means (calculated for the interval 1901-1990), ***February 2016 is the warmest month of all history of meteorological forecasts, being an absolute climate record, not only for Oltenia but for the entire country***. The maximum values registered at Bechet, Târgu Logreşti, Drăgăşani, Polovragi and Râmnicu Vâlcea meteorological stations became absolute thermal maximum values for these stations in February (Table 4).

Table 4. Air temperature regime in Oltenia and the minimum and maximum temperature values on ground surface in February 2016 (values marked with "*****" are the new **records of absolute maximum temperatures** to those meteorological stations.

Meteorological Station	Hm	N	M	Δ=M-N	CH	minT air		maxT air		minT soil		maxT soil	
						(°C)	Data	(°C)	Data	(°C)	Data	(°C)	Data
Dr.Tr.Severin	77	0.9	**7.3**	6.4	**VW**	**-2.4**	6	**23.3**	22	**-4.5**	8	**25.4**	22
Calafat	66	0.4	7.2	6.8	**VW**	**-3.2**	7	**23.3**	22	**-4.1**	7	**24.5**	23
Bechet	65	-0.1	6.6	6.7	**VW**	**-5.0**	7	**24.2***	22	**-5.0**	7	**30.0**	22
Băileşti	56	-0.1	6.9	7.0	**VW**	**-3.4**	8	**22.0**	22	**-5.2**	8	**28.2**	23
Caracal	112	-0.7	6.5	7.2	**VW**	**-3.1**	7	**22.0**	22	**-0.9**	7;8	**19.0**	23
Craiova	190	-0.4	6.6	7.0	**VW**	**-3.6**	6	**21.5**	22	**-1.6**	7	**22.4**	22
Slatina	165	-0.2	6.4	6.6	**VW**	**-3.8**	6	**21.9**	22	**-0.4**	8	***16.4***	16
Bâcleş	309	-0.9	6.2	7.1	**VW**	**-2.8**	7	***20.4***	22	-	-	-	-
Tg. Logreşti	262	-0.7	5.2	5.9	**VW**	**-6.9**	6	**22.9***	16	**-5.4**	6	**24.2**	16
Drăgăşani	280	-0.2	6.7	6.9	**VW**	**-2.6**	6	**21.1***	22	**-5.5**	6	**26.9**	16
Apa Neagră	250	-0.6	4.9	5.5	**VW**	**-7.0**	7	**22.0**	16	**-7.0**	7	**23.5**	16
Tg. Jiu	210	-0.4	5.7	6.1	**VW**	**-5.4**	7	**22.9**	16	**-6.2**	6	**26.4**	23
Polovragi	546	-1.4	5.2	6.6	**VW**	**-4.6**	7	**20.9***	16	**-6.5**	8	**24.9**	16
Rm.Valcea	243	0.0	6.2	6.2	**VW**	**-3.9**	7	**23.1***	16	**-5.1**	6	**24.7**	23
Voineasa	587	-2.5	***3.0***	5.5	**VW**	**-6.6**	7	***20.4****	22	-	-	-	-
Parâng	1585	-5.6	0.3	5.9	**VW**	**-8.4**	5	**12.6**	22	-	-	-	-
Media Oltenia	-	-0.8	5.7	6.5	**VW**	**-4.5**	-	**21.5**	-	**-4.2**	-	**24.3**	-
Ob.Lotrului	1404	-5.5	-0.2	5.3	**VW**	**-14.1**	12	**13.2**	16	-	-	-	-

(Source: processed data from Oltenia RMC archive).

In February, ***four heat waves*** were registered in the intervals: ***1-4 February, 8-12 February, 14-17 February, 20-24 February,*** and on February 29, a heat wave occurred, which developed in the interval 29 February - 3 March 2016. Thus, in February there were 19 very warm days. For Oltenia, *the warmest day of February, according to daily maximum temperature values*, was on February 22 with the maximum temperature mean calculated for the entire region of 20.7°C.

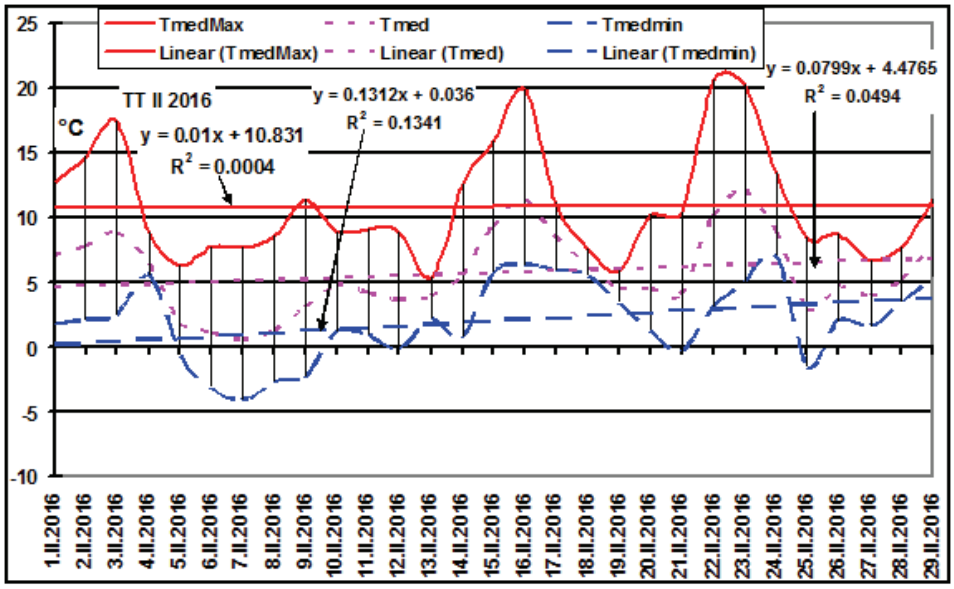


Figure 4. Air temperature variation (the daily means, daily minimum and maximum temperatures mean) in February 2016. (Source: processed data from Oltenia RMC archive).

On ground surface *monthly minimum temperature values* were registered on February 6, 7 and 8 and were comprised between -7.0°C at Apa Neagră and -0.4°C in Slatina, and their mean for the entire region was de -4.2°C. *Monthly maximum temperature values on ground surface* were registered on February 16, 22 and 23 and were comprised between 16.4°C on February 16 in Slatina in Olt County and 30.0°C on February 22 at Bechet in Dolj County, and their mean for the entire region was 24.3°C. The ground was not frosty during most part of the month excepting some mornings when there was a superficial frost. *As a consequence of the thermal regime of warm spring month,* autumn crops slowly began the vegetation phases, trees buds developed and on February 17 the buds of the weeping willow opened, on February 27 the white magnolia blossomed, on March 2 the first almond tree blossomed and on March 4 the wax cherry tree began to blossom. Migrating birds came earlier and pigeons and doves made baby doves in the end of February. Bees came out harvesting pollen and propolis in many days. Biotopes maintained the activity during February.

3.b. Pluviometric regime of February 2016

The monthly quantities of precipitation were comprised between 20.1 l/m^2 in Caracal at Romanaţi Plain and 71.1 l/m^2 at Apa Neagră in the area of Sub-Carpathian Depressions, and their percentage deviations from the multiannual means were comprised between -41.7% at Caracal and 9.3% at Polovragi, and in the mountainous area 24.1% in Parâng, leading to classifications of pluviometric time type from very droughty (VD) at Caracal to normal at Băileşti, Craiova, Apa Neagră, Târgu Jiu and Polovragi and rainy (R) in the mountainous area. The quantities of precipitation mean for the entire region was 38.7 l/m^2 and its percentage deviation from the multiannual mean was -8.0%, which designates a normal pluviometric month overall. In February, one single rainy period was registered with significant rainfalls for agriculture in the interval 10-13 February of which only two days, February 10 and 13, stand out. The maximum quantity of precipitation registered in 24 hours was 30.3 l/m^2 at Runcu, Gorj County on February 13. Excepting the mountainous area and February 4, in February, all the precipitation was liquid. On February 4, the rainfalls turned into sleet and snow sparsely, but no snow layer was formed. There was not any snow layer in the whole month. Water reserve in Oltenia was optimum and closed to optimum during the month.

4.a. General thermal characteristics of winter

The seasonal average temperatures were comprised between 0.4°C at Voineasa and 4.5°C in Drobeta Turnu Severin and their deviations from the multiannual means were comprised between 3.0°C at Apa Neagră, in the Sub-Carpathian depressions area and 4.8°C at Bâcleş in Mehedinţi Hills leading to classifications of thermal time type of warm winter for all the meteorological stations (Table 5). ***The seasonal winter mean for the entire region was 2.6°C***, and its deviation from the multiannual mean was 3.8°C, confirming the overall classification of warm month. The warmest winter month was February with the general average for the entire region of 5.7°C and the second warm

month was December with a general average for the entire region of 4.9°C; the only winter month was January with a general average of -2.8°C. Consequently, ***the winter of 2015-2016, having a general average of 3.06°*** for the area of 600 m altitude, ***in Oltenia was the warmest,*** outclassing the winter of 2006-2007, whose general average was 2.78°C, becoming ***the warmest winter of the history of climate recordings.*** Therefore, ***the winter of 2015-2016 holds the absolute climatic record of the warmest winter***.

4.b. General pluviometric characteristics of winter

The seasonal quantities of precipitation were comprised between 63.2 l/m^2 in Râmnicu Vâlcea and 127.3 l/m^2 at Apa Neagră, and their percentage deviations from the multiannual means were comprised between -47.4% in Rm. Vâlcea and 6.1% in Craiova, leading to classifications of pluviometric time type from exceedingly droughty (ED) on a restricted area in the Sub-Carpathian Depressions in Târgu Jiu and Râmnicu Vâlcea to normal (N) in most part of Oltenia Plain (Table 5).

The average seasonal quantity of precipitation calculated for the entire region was 102.5 l/m^2 and its percentage deviation from the multiannual mean was -24.7% leading to the classification of droughty winter overall for the entire region.

Table 5. Overall pluviometric and thermal regime of the winter of 2015-2016.

Meteorological Station	Hm	Pluviometric regime (l/m^2)					Thermal regime (°C)			
		SW	NW	Δ=S-N	Δ%	CrH	W`15-`16	NW	Δ=W-N	CrH
Dr. Tr. Severin	77	111.5	160.5	-49.0	-30.5	**VD**	**4.5**	0.4	4.1	**VW**
Calafat	66	103.0	123.9	-20.9	-16.9	**LD**	4.1	-0.1	4.2	**VW**
Bechet	65	107.6	104.6	3.0	2.9	**N**	2.8	-0.6	3.4	**VW**
Băileşti	56	115.0	121.4	-6.4	-5.3	**N**	3.0	-0.7	3.7	**VW**
Caracal	112	104.1	108.7	-4.6	-4.2	**N**	2.6	-1.2	3.8	**VW**
Craiova	190	116.4	109.7	**6.7**	**6.1**	**N**	3.0	-1.0	4.0	**VW**
Slatina	165	99.0	117.2	-18.2	-15.5	**LD**	2.8	-0.8	3.6	**VW**
Bâcleş	309	-	-		-	-	3.4	-1.4	**4.8**	**VW**
Tg. Logreşti	262	82.9	121.7	-38.8	-31.9	**VD**	2.0	-1.1	3.1	**VW**
Drăgăşani	280	111.8	114.1	-2.3	-2.0	**N**	3.9	-0.6	4.5	**VW**
Apa Neagră	250	**127.3**	219.6	***-92.3***	-42.0	**VD**	2.0	-1.0	***3.0***	**VW**
Tg. Jiu	210	93.0	169.9	-76.9	-45.3	**ED**	2.6	-1.0	3.6	**VW**
Polovragi	546	94.8	153.4	-58.6	-38.2	**VD**	2.7	-1.5	4.2	**VW**
Rm. Vâlcea	243	***63.2***	120.1	-56.9	***-47.4***	**ED**	3.3	-0.6	3.9	**VW**
Voineasa	573	-	-		-	-	***0.4***	-3.0	3.4	**VW**
Parâng	1585	105.5	160.0	-54.5	-34.1	**VD**	-1.9	-5.7	3.8	**VW**
Media Oltenia	-	102.5	136.1	-33.6	-24.7	**D**	2.6	-1.2	3.8	**VW**
Ob. Lotrului	1348	178.1	-		-	-	-3.0	-5.2	2.2	**W**

Legend: Hm= altitude of meteorological station, SW=sum of precipitations in the winter of 2015-2016 (l/m^2), N W=normal values of precipitations in winter (l/m^2), CrH=Hellmann criterion (l/m^2), Δ = S-N= deviations from the normal (l/m^2), Δ% = percentage deviations from the normal, W `15-`16 = mean of temperature values in the winter of 2015-2016 (°C), NW=normal values of seasonal temperature values in winter (°C), Δ = W-N = deviations of average temperatures from the normal. (Source: processed data from Oltenia RMC archive).

DISCUSSIONS

Synoptic causes of the most extended and intense heat wave of December 2015*, registered in the interval 19-28 December*. This heat wave had two peaks of warm air advection in the intervals 22-23 December and 27-28 December, when there were registered monthly maximum thermal values in December 2015.

We shall further analyze the synoptic situation on December 28, 2015, when the highest maximum temperature values were registered. On December 28, 2015, the field of atmospheric pressure above Europe showed a large Iceland Cyclone centred towards South-West of Iceland with core values below 945 hPa, and above Northern and Central Europe and Central Basin of Mediterranean Sea a large anticyclone field formed of the union of the North-African and Scandinavian Anticyclones, with core values exceeding 1035 hPa and the East European Anticyclone, which was located to the North of the Black Sea having many nuclei. In the North of the Russian Plain, there was an ex-Icelander Cyclone with core values below 995 hPa. In the lower troposphere, at that time, the cold air advection had already been initiated, causing weather cooling beginning with the night of December 28/29, 2015, which became colder on December 30, bringing a winter regime in the last two days of December (Fig. 5).

It is known from dynamic meteorology that in these situations, before the advection of cold air, the advection of warm air is intensified, an aspect which largely explains the cause of registering the highest temperature values on December 28.

The analysis of the situation of the thermal field at the level of 850 hPa will complete the causes of the intensification of warm air advection. *In altitude, at the level of 500 hPa*, the structure of the geopotential field highlights a blockage atmospheric circulation (isohypse of 576 damgp - figure 5). The Northern half of Europe was dominated by a field of low geopotential (to North the isohypse of 552 damgp). For Western Europe, South-Western circulation led by the posterior thalweg of blocking structure, caused the strong advection of warm subtropical air, supported also by the Golf Stream up above the Western coasts of the South of the Scandinavian Peninsula (Fig. 6), as

well as above most part of Europe. As a consequence, for Romania, even though air circulation at this level was North-Western led by the anterior thalweg of the blockage, the advection was still with warm air.

The analysis of thermal field at the level of 850 hPa, on December 28 at 12 UTC shows the great spatial extension of warm air above Europe to North of Iceland.

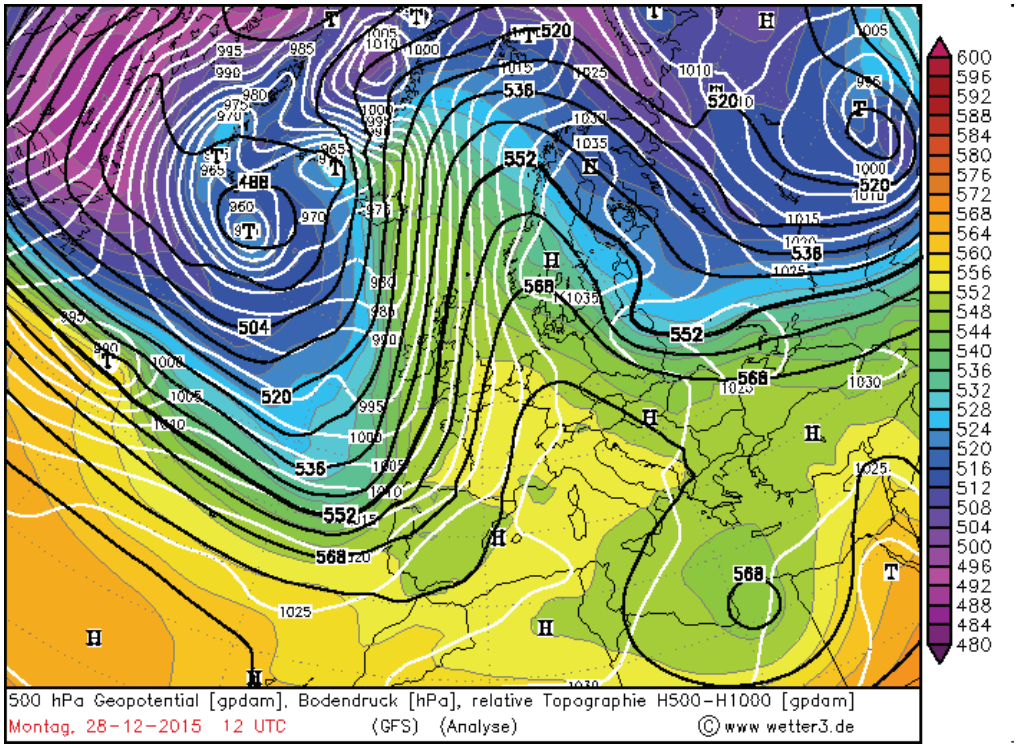


Figure 5. The synoptic situation on ground (field of pressure) superposed on the altitude one at the level of 500 hPa (geopotential field at average height of 5000 m) and isohypes of the maps of relative baric topography TR 500/1000 on December 28, 2016 at 12 UTC (according to http://www1.wetter3.de/Archiv/).

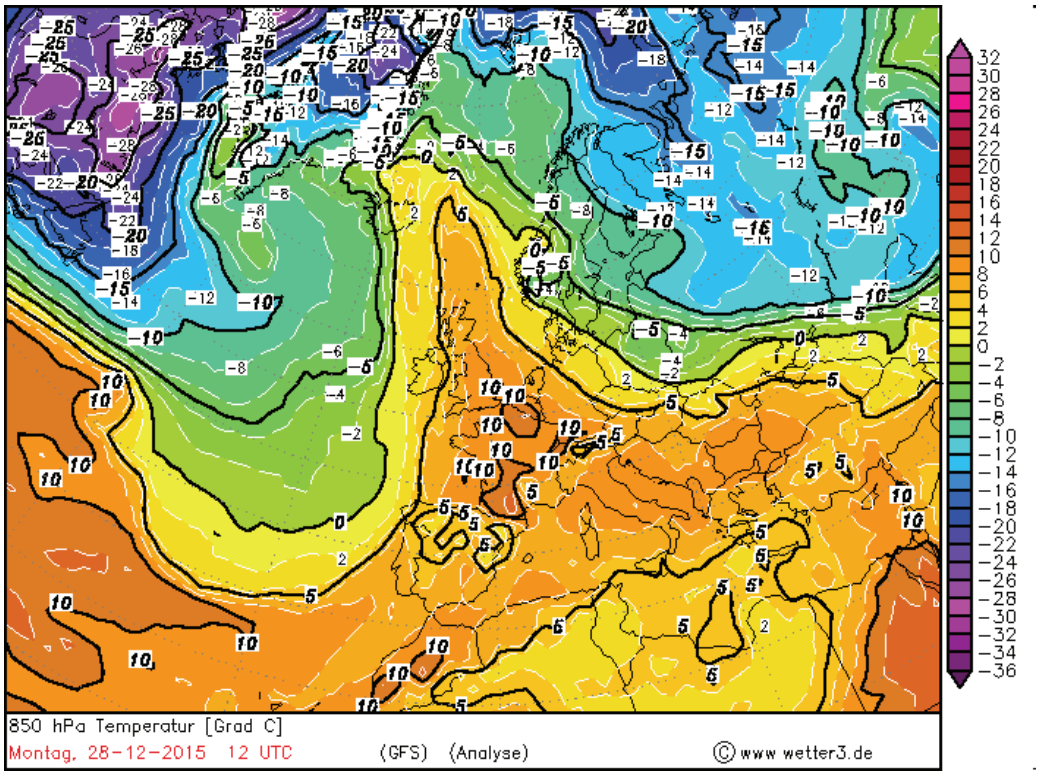


Figure 6. Thermal field in altitude at the level of 850 hPa (at the average height of 1500 m) on December 28, 2015 at 12 UTC (according to http://www1.wetter3.de/Archiv/).

The analysis of the map archive shows that on December 27, 2015 at 12 UTC, warm air was all over Europe, excepting the Scandinavian Peninsula and the North of the Russian Plain, and subsequently warm advection continued its extension towards North in the Southern half of the continent registering the maximum area on December 28 at 12 UTC. Consequently, the maximum air warming above Europe, not only Romania, occurred on December 28. The heat wave in December, due to its long duration of 10 days and the two peaks in the intervals 22-23 December and 27-28 December, was the most important heat wave of the winter of 2015-2016 and essentially contributed to the characteristic of very warm month for December 2015. (12: An advection of warm air is considered ***a heat wave*** if it has a duration of minimum three days and average temperatures ≥ 5°C than the multiannual means or maximum values ≥ 10°C than the multiannual means of maximum thermal values, (according to NAM instructions). Similarly, the frost wave is defined, but with reversed inequalities (≤). Weather warming with a duration smaller than three days is called ***thermal singularity.*** The definition of heat wave is different from country to country depending on the climatic specificity.)

Synoptic causes of the most intense and extended frost wave in the winter of 2015-2016, in the interval 19-26 January 2016

The most important frost wave of this winter had two peaks in the intervals 20-21 January and 23-24 January, of which the most important was in the morning of January 24, 2016, when many minimum thermal values of this winter were registered.

We will further analyze the situation on January 24, 2016 at 00 UTC.

The synoptic analysis on ground surface on January 24, 2016 at 00 UTC, an anticyclonic girdle formed by the union of the Azores High with the East-European Anticyclone dominated most part of the continent (Fig. 7). A nucleus of this anticyclonic field with values exceeding 1035 hPa was located above Central Europe and Romania, and the second extremely strong field was in the North-East of the continent on the Great Russian Plain with values exceeding 1050 hPa. A vast cyclonic nucleus with values below 1025 hPa was located in the West of the Russian Plain, which had a significant role in the advection of extremely cold air (Siberian) in the lower layers of the atmosphere towards Romania. The North-West of the continent was influenced by a broad Iceland Depression with core values below 960 hPa, and, in the extreme South-East, there was the Arabian Cyclone with core values below 1015 hPa. As a consequence for Oltenia, in the lower troposphere the air circulation was Northern advecting towards our country a mass of Scandinavian cold air (cPk+A).

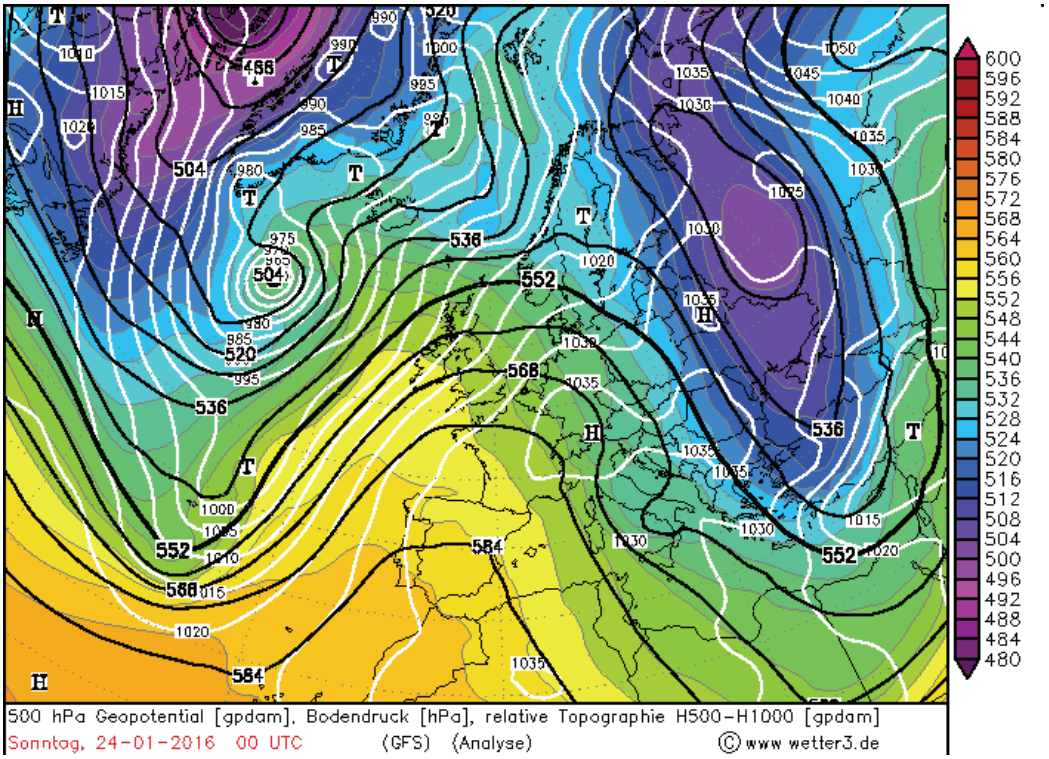


Figure 7.The synoptic situation on ground (field of pressure) superposed on the altitude one at the level of 500 hPa (geopotential field at average height of 5000 m) and isohypes of the maps of relative baric topography TR 500/1000 on January 24, 2016 at 00 UTC (according to http://www1.wetter3.de/Archiv/).

In altitude at the level of 500 hP, there is a blocking circulation (the isohypse of 552 damgp has the form of "ω" letter), and the geopotential ridge extended towards the Southern half of the Scandinavian Peninsula and the West of Romania. A nucleus of low geopotential below 528 damgp located above the East and North-East of the continent caused an advection of extremely cold air (cPk+A), above the Scandinavian Peninsula towards Romania.

In altitude at the level of 850 hPa, the beginning of cold air penetration above our country began on January 17, 2016 at 00 UTC. The advection was initially slow, but on January 17, 2016 at 12 UTC, the cold air penetrated above Romania in two directions: one from North next to the Carpathian chain and the other through Serbia and Bulgaria and then towards North-East, above Dobrogea and Eastern Muntenia. Thus, above Oltenia, an area with a warmer air was isolated, with temperature slightly higher than -10°C. This area was taken over by an extremely cold air with temperatures ≤ -10°C, on January 18, 2016 at 06 UTC. In the interval 19 January 2016 at 12 UTC-21 January 2016 at 18 UTC the extremely cold air at this level withdrew towards North, then in the night of January 21/22, 2016 a new advection of extremely cold air occurred (with temperatures ≤ -10°C).

The extremely cold air took over the entire Romania on January 22 at 18, when the isotherm of -12.0°C was located above the South of Bulgaria, and the isotherms -14.0°C and -15.0°C were located above Moldavia. Subsequently, the cold air, at this level, was slowly moved by the atmospheric circulation towards East, and on January 24, 2016 at 00 UTC, at this level the isotherms -10.0°C and -12.0°C were above the Eastern half of Romania (Fig. 8). In the Carpathian-Balkan Depression, above the North of Bulgaria, Oltenia and Muntenia, close to the ground, an extremely cold air maintained on the low relief forms. Night cooling due to radiation phenomenon, in the clear long night of 14 hours in January and the snow layer with thicknesses of 2 - 23 cm caused the sudden drop of air temperature to -23.3°C in Romanaţi Plain at Caracal.

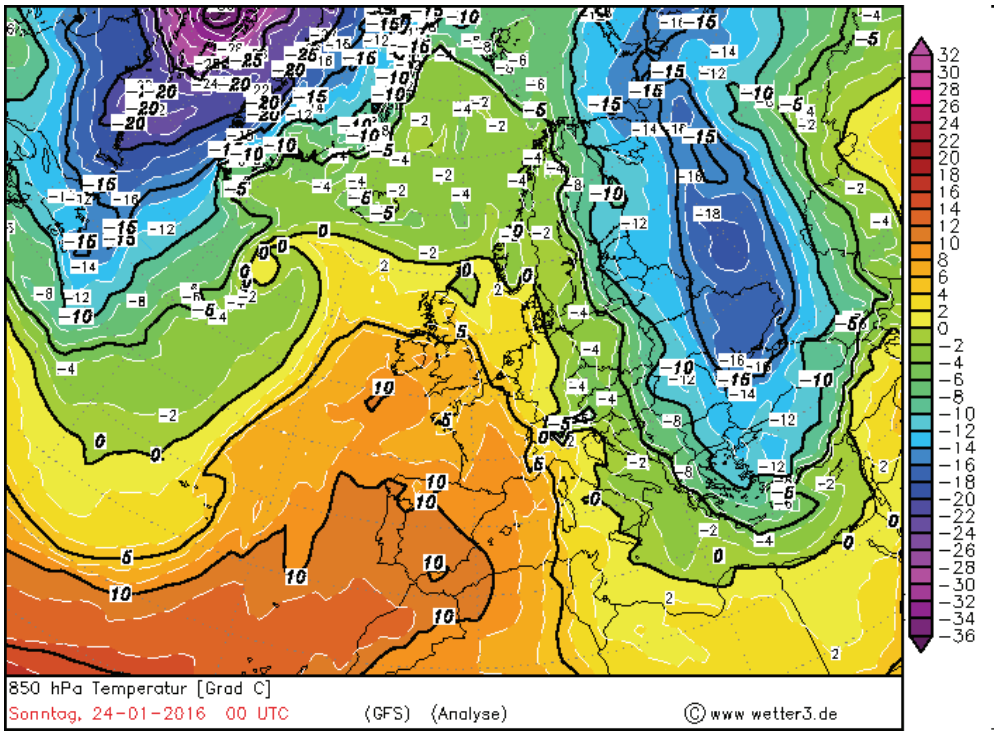


Figure 8. Thermal field in altitude at the level of 850 hPa (at an average height of 1500 m) on January 24, 2016 at 00 UTC (according to http://www1.wetter3.de/Archiv/.

The synoptic causes of the most extended and intense heat wave of the winter of 2015-2016

In Romania, the most intense heat wave was registered in the interval 14-17 February, when the absolute thermal maximum value for the entire country was equalled, and many meteorological stations registered maximum thermal values, which became absolute records, but during this heat wave the warmest area in Romania took over Muntenia and Dobrogea. ***For Oltenia, the most intense heat wave registered in the interval 20-24 February 2016***, with a warming peak on February 22, when the absolute thermal maximum value of February was exceeded in Oltenia and monthly absolute records of temperatures were registered at five meteorological stations: Bechet, Târgu Logreşti, Drăgăşani, Polovragi and Râmnicu Vâlcea. The maximum values of temperatures were registered on February 22, 2016 in the interval 14-17 RWH[8]. Therefore, we will analyse the synoptic situations from 18 UTC, since they are the closest to this time interval.

On ground level, the South of Europe was dominated by a broad anticyclonic girdle formed of the union of the North-African and Azores High (Fig. 9), and the North of the continent was under the influence of a large Iceland cyclonic field, centred above the Finnish Gulf, with values below 985 hPa. *In altitude at the level of isobaric surface of 500 hPa*, the Northern half of the continent was under the influence of a low geopotential field with a low geopotential nucleus largely located in the North of the continent with core values below 512 damgp. The South of the continent was under the influence of high geopotential (isohypse of 568 damgp above the Southern Carpathians). In Romania, the air

[8] RWH = Romania winter hour

circulation during the heat wave was South-Western, tropical continental cT, advecting an extremely warm air from the North of Africa above the Mediterranean Sea, Italy, Balkan Peninsula and Romania.

In altitude at the level of isobaric surface of 850 hPa, the field of temperature shows that the warm air was located above a great part of the continent, in the South and West, and was extended towards North up to the half of Germany (Fig. 10). The isotherm of 10.0°C was above Romania and the isotherm of 12.0°C was above Oltenia. The persistence of warm air advection for an extended period of time caused the strong ground warming as it were a spring day (30.0°C), high minimum thermal values in the air, which led to air warming and the headway of warm air to North. The intensity of this heat wave is also due to the large area of warm air above Europe.

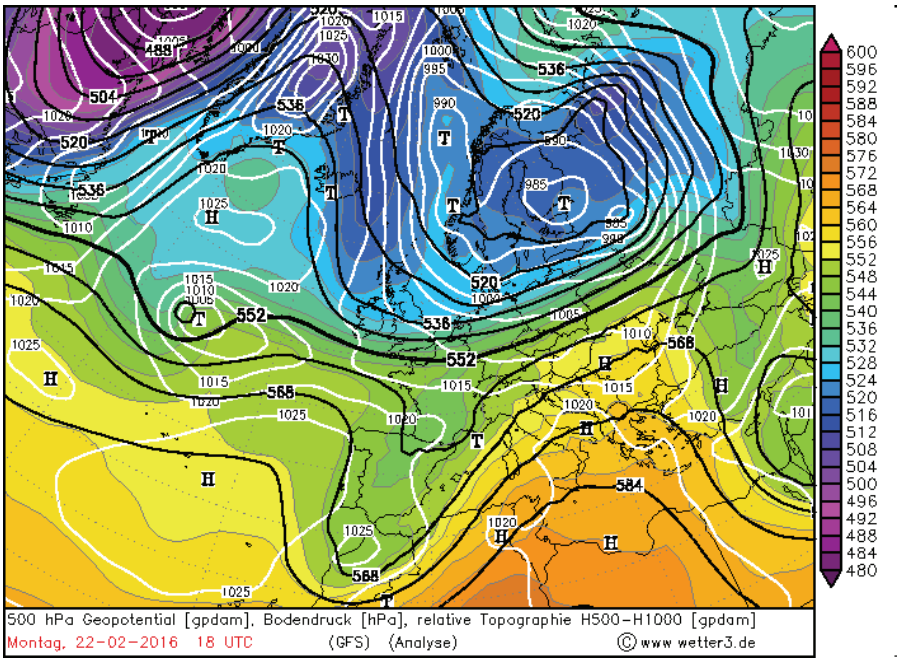


Figure 9. The synoptic situation on ground (field of pressure) superposed on the altitude at the level of 500 hPa (geopotential field at average height of 5000 m) and isohypes of the maps of relative baric topography TR 500/1000 on February 22, 2016 at 18 UTC (according to http://www1.wetter3.de/Archiv/).

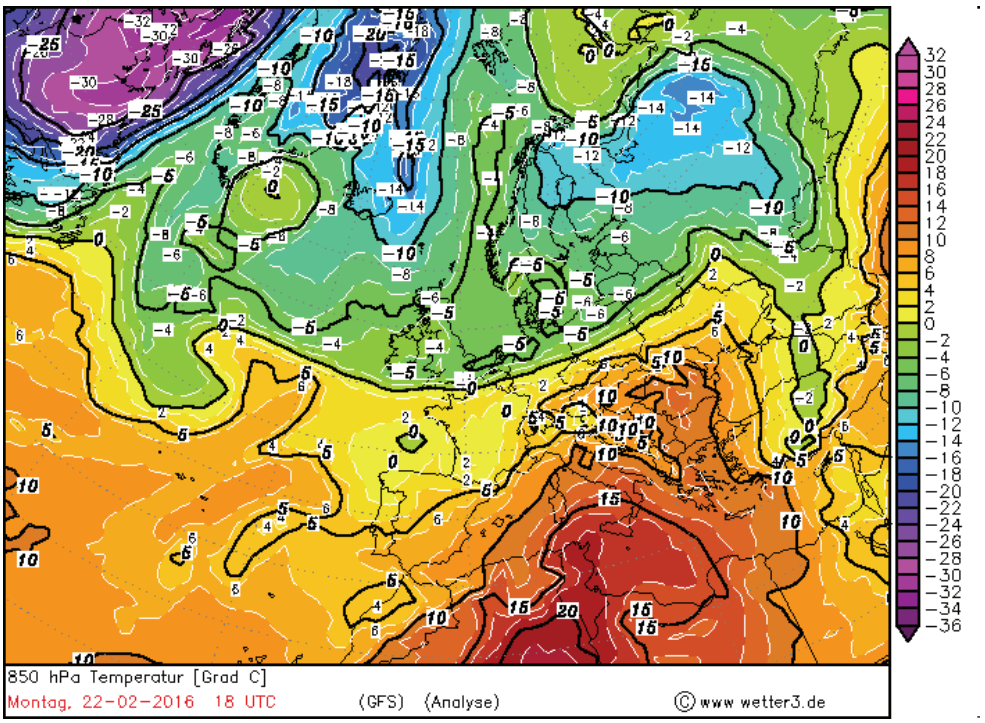


Figure 10. Thermal field in altitude at the level of 850 hPa (at the average height of 1500 m) on February 22, 2016 at 18 UTC (according to http://www1.wetter3.de/Archiv/).

CONCLUSIONS

The winter of 2015-2016 was a warm winter, ***the warmest winter ever registered in Oltenia of all history of meteorological forecasts,*** constituting ***an absolute climatic record***. In Oltenia, the absolute maximum thermal value of February was registered at 5 meteorological stations: 24.2°C at Bechet, 23.1°C in Râmnicu Vâlcea, 22.9°C at Târgu Logreşti, 21.1°C at Drăgăşani and 20.9°C at Polovragi. The old absolute maximum thermal value of 24.0°C for Oltenia registered on February 16, 1899 was outclassed after 117 years in Drobeta Turnu Severin. The warmest month was February, followed by December; January was a normal thermal winter month according to the deviations of monthly means from the multiannual means. Winter phenomena and snow layer occurred only in January. Vernalization occurred in January. The high temperatures led to the continuation of vegetation phases in December and February and created the premises of an extremely early spring arrival. The early blossoming of fruit trees in the first part of March has created a significant climatic and agroclimatic risk, because, usually, in the second part of March there are sudden weather cooling and in some years there were even snowfalls.

From a pluviometric point of view, the winter was droughty, especially because of the excessively droughty December and droughty February in the Southern half of the region. However, water reserve in the ground was maintained almost optimum and even optimum in some intervals of time due to the fact that the autumn was very rainy.

The winter was marked by 5 heat waves: two in December, one in January and three in February amounting 37 days of very warm weather. One single frost wave was registered in January lasting 8 days.

Climate warming is well highlighted for December and February and for winter overall, confirming the increasing tendency of warm winters (BOGDAN et al., 2008, 2010; BOGDAN & MARINICĂ, 2009) and the translation of autumn to winter and of spring to winter, causing the shortening of winter. Therefore, ***climatic variability in the winter of 2015-2016 was extremely great***.

The winter of 2015-2016 showed that no matter how warm weather report would forecast for winter, intense cooling might happen and people should be prepared to pass winter in good conditions.

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