

## CLIMATIC ANOMALIES IN OLTENIA IN THE WINTER AND SPRING OF 2018

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**Abstract. Climatic anomalies in Oltenia in the winter and spring of 2018.** In the winter of 2017-2018 and the spring of 2018 at the level of the entire Northern Hemisphere a series of climatic anomalies occurred. As a result, such phenomena have also been recorded in Romania, and at regional level, in the southwest of the country, they have been specific. All the winter months were warm, and of these, December 2017 was the warmest with the monthly mean temperature for the Oltenia region of 2.7°C and the *deviation* from the previous century of 2.5°C, followed by the February with an average of 0.9°C and *deviation* from the previous century of 1.4°C and January with 0.8°C and a *deviation* of 3.4°C. In the spring months, the alternating climatic processes continued. Thus, during *March*, between 18-23.III.2018 there was a snowy period that had deposited a consistent layer of snow accompanied by low temperatures. This climatic process of late cooling of the weather and the return of winter phenomena has affected all of Eurasia. In Oltenia, it produced lower mean temperatures than normal with *negative deviations* from the normal last century (average for the whole region was 3.6°C and -1.0°C deviation.) March was pluviometric excessively rainy with the average for the entire region of 95.3 mm and the *percentage deviation* from the normal last century of 126.2%. *The month of April* was the warmest in the history of meteorological observations, and *May* was particularly warm after the deviations of the monthly mean temperature from normal. highlighting climate change in Oltenia, climate change and their consequences (Bogdan Octavia, Marinică I., Mic Loredana-Elena 2008, Bogdan Octavia & Marinică I. 2009, Bogdan Octavia, Marinică I., Marinică Andreea Floriana 2010, 2017; Ion Marinică, Andreea Floriana Marinică, 2016).

**Keywords:** warm winter, late winter phenomena, early snowflakes, late spring hoar, atmospheric drought.

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## 1. INTRODUCTION

Year 2017 was the year of climatic extremes, and the evolution of the weather from one extreme to another continued in 2018. As a result, the winter of 2017-2018 was warm not only in Romania or Europe but across Eurasia, and in Northern America, very cold. In Romania the character of this winter was given by ***January, which for the whole country was the warmest month in the history of climatic observations*** (according to the ANM estimate, and in our opinion, for Oltenia did not exceed the average of January 2007 that was 4.7°C for the entire region, excluding the mountain range and exceeding by 2.0°C the average of January 2018). (<https://observator.tv/eveniment/luna-ianuarie-2018-cea-mai-caldadin-istoria-anm-240845.html>).

For the Northern Hemisphere of the Earth during winter, the polar vortex was divided into two lobes, one above the north of Eurasia (warmer) and another over the north of Northern America (colder). For the whole of the winter, northern Eurasia has been warmer than the North of Northern America, which has caused a warm winter on this immense stretch of land and a particularly cold winter in Northern America. The situation was due to the effect of the Golf-Stream, which is carrying a huge amount of heat towards north. However, ***the late winter phenomena*** occurred in Oltenia in the last days of February (25.II-1.III.2018).

***Alternate climatic processes***, from massive heats to massive cooling of the weather, occurred this winter across the entire Northern Hemisphere. Thus, for example, on 9.I.2018, in Romania, the warming of the weather led to the flowering of snowdrops and primroses, although they usually flourish in February and March; in Venice on 15.I.2018, the low temperatures led to the complete freezing of the Italian city's lagoon and canals, a frost phenomenon that lasted for a few days and has never happened so far (according to *Il Giornale italiano*). (<http://www.b1.ro/stiri/externe/imagini-fascinante-canalele-din-venetia-auninghetat-pentru-prima-data-in-istorie-foto-173847.html>). In Oltenia, ***the warmest month of the 2017-2018 winter was December***, with the average for the entire region of 2.7 °C and the deviation from the previous century, of 2.5°C, followed by February, with an average of 0.9°C and a deviation compared with the previous century of 1.4°C and then January with 0.8°C and the deviation of 3.4°C. In the spring months, the alternating climatic processes continued.

We will continue to analyze the most important climatic anomalies of winter 2017-2018 and spring 2018.

## 2. DATA AND METHODS

In order to realize this paper, we used the data from the ANM archive and the international databases, the synoptic maps available on the Internet from the international forecasting centres, the ANM site, the satellite information, the information published in the print media and the results of our processing.

## 3. RESULTS AND DISCUSSIONS

### 3.1. The thermal anomaly of December 2017

*Monthly air temperature averages* were between 0.1°C at Voineasa Intra-carpathian Depression and 4.3°C in the extreme west, at Dr. Tr. Severin. Their deviations from the normal values ranged between 1.4°C at Apa Neagră Subcarpathian Depression and 3.4°C at Caracal, which marks this month in the warm (W) type of warm time types in most of Oltenia (Table 1). Warmish time (WS) was recorded on a restricted area in the Gorj Subcarpathians. *The monthly mean air temperature*, calculated for the entire Oltenia region (with altitude below 600 m) was 2.7°C, and its deviation from normal was 2.5°C confirming that on average December 2017 was warm (W). Most *monthly air temperature minima* were recorded on 22.XII and were between -10.0°C recorded on 22.XII at Voineasa and -3.2°C at Dr. Tr. Severin on 31.XII.2107. The coldest morning was recorded on 22.XII.2017 with an average for the whole region of -7.0°C, and the thermal regime specific for December was installed only on 31.XII.2016. *The cold units* of December 2017 were insignificant and ranged from 0.0 at Dr. Tr. Severin and 28.0 at Voineasa, and their average for the entire Oltenia region was 7.9. The agro-meteorological frost was not recorded. The cooling of the weather in December fell into normal processes, and no cold waves occurred.

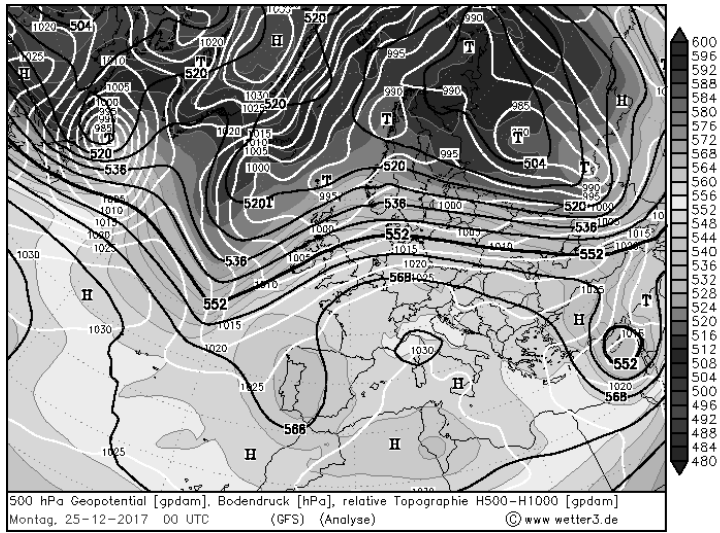
*Heat units* ranged between 31.8 at Voineasa and 133.9 at Dr. Tr. Severin, and their average for the whole region was 92.4, meaning a major difference between the heat and cold units, ie a warm month from the agrometeorological point of view. They have contributed to the vegetative processes of autumn crops and, in general, of vegetal carpet and biotic processes in biocenoses. *The accomodation of autumn crops to slow vegetative processes and the induction of vegetative rest (preparation for wintering) took place slowly throughout December and January. The monthly maximum temperature values* were recorded on 25.XII favoured by synoptic conditions (Figures 1 and 2) and were between 12.7°C at Voineasa and 18.9°C at Calafat and the average for the whole region was 15.3°C. For 14 days (7-9.XII, 12-16.XII and 24-29.XII), three moderate heat waves were recorded. Daily temperatures were kept positive all day, combined with sunny days, maintaining active vegetative processes. The variation of air

temperature in December 2017 shows slightly increasing trends for maximum and slightly decreasing values for the average and minimum values due to the slow cooling of the weather, especially after 26.XII. *The warmest day of December 2017* (after the mean temperature maxima for the entire region) was 25.XII when the average for the whole region was 15.0°C, and *the coldest day* was 22.XII with an average of -2.5°C. From the thermal point of view, *no winter day was recorded*. Only in the mountain area, were recorded 14 days in Parâng. In the intervals 7-9.XII.2017, 12-16.XII and 24-29.XII there were *three moderate heat waves*, and during their periods, the *maximum temperatures* exceeded frequently 10.0°C.

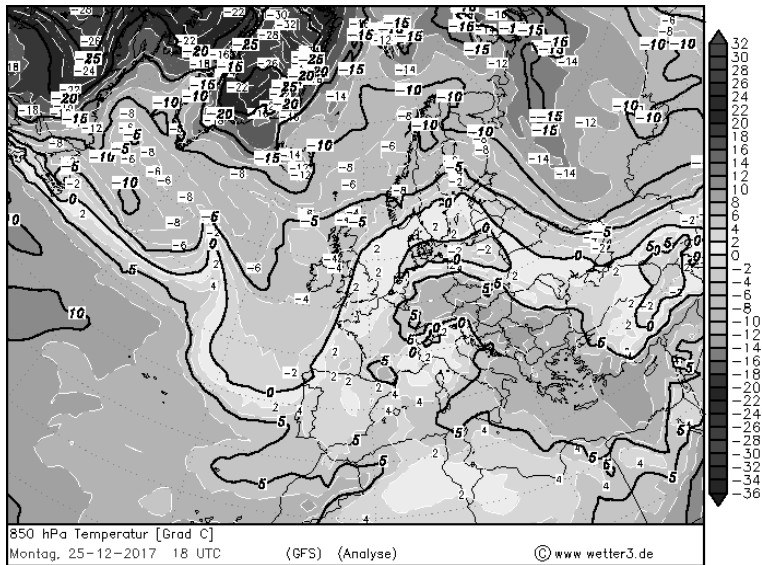
**Table 1.** Air temperature regime in Oltenia in December: N= normal for December calculated for the period 1901-1990; M = monthly mean values in December 2017;  $\Delta$ =M-N = temperature deviation from the normal; CH = Hellmann Criterion).

Meteorological Station	Hm	N	M	$\Delta$ (M-N)	CH	Tmax air		Tmin air	
						(°C)	Date	(°C)	Date
Dr.Tr. Severin	77	1.4	<b>4.3</b>	2.9	C	16.5	25	<b>-3.2</b>	31
Calafat	66	1.0	3.8	2.8	C	<b>18.9</b>	25	-4.1	11
Bechet	65	0.4	3.3	2.9	C	17.5	16	-5.4	22
Băilești	56	0.4	2.9	2.5	C	15.9	25	-5.6	22
Caracal	112	-0.1	3.3	<b>3.4</b>	C	14.9	25	-5.7	22
Craiova	190	0.1	3.2	3.1	C	15.7	25	-6.5	22
Slatina	165	0.3	2.9	2.6	C	14.8	25	-6.9	22
Băcleș	309	-0.4	2.9	3.3	C	14.3	25	-6.9	22
Tg. Logrești	262	0.1	2.1	2.0	C	16.3	25	-9.0	22
Drăgășani	280	0.6	3.6	3.0	C	16.3	25	-7.2	22
Apa Neagră	250	0.1	1.5	<b>1.4</b>	CL	14.2	25	-7.3	23
Tg. Jiu	210	0.1	1.7	1.6	CL	16.4	25	-7.0	22
Polovragi	546	0.1	2.4	2.3	C	17.1	25	-8.0	22
Rm. Vâlcea	243	0.5	2.9	2.4	C	15.6	25	-7.5	22
Voineasa	587	-1.9	<b>0.1</b>	2.0	C	<b>12.7</b>	25	<b>-10.0</b>	22
Parâng	1585	-3.7	-	-	-	8.3	12	-14.5	21
Average Oltenia	-	0.2	2.7	2.5	C	15.3		-7.2	
Ob. Lotrului	1404	-4.9	-3.3	1.6	CL	5.0	25	-16.0	20

(Source: data processed after ANM Archive)



**Fig. 1.** Synoptic situation over Europe at ground level on 25.XII.2017, 00 UTC (the geopotential field at 500hPa (about 5500m altitude) superimposed over the sea level pressure field, and the relative topography TR500 / 1000) (after www.wetter3.de)



**Fig. 2.** Temperature field over Europe at 850 hPa level (1500 m altitude) in 25.XII.2017, 18 UTC (after www.wetter3.de)

They accounted for 14 warm days (45.2% of the days of December), and on 25.XII, although the day's duration was only 8 hours and 52 minutes, the highest daily maximum air temperature values for December were recorded, between 12.7°C at Voineasa and 18.9°C at Calafat (Table 1). *The synoptic causes* of this warming of the weather were due to the warm air supply over Europe brought by the North African Anticyclone which presented an anticyclonic centre in the Venice Bay (rare synoptic situation) (Figure 1). The advection of hot air from Northern Africa covered most of Europe and the 0°C isotherm reached the south of the Scandinavian Peninsula and the West of the Black Sea (Figure 2). Air circulation has become tropical, and warm air advection from Northern Africa have intensified so that during the 25.XII and 25/26.XII, over the southern part of Romania at 850 hPa there was positioned an isotherm of 8.0°C (Figure 2).

### 3.2. The thermal anomaly of January 2018

*Monthly mean air temperatures* were between -1.7°C at Voineasa and 2.4°C at Dr. Tr. Severin and their *deviations* from normal values were between 2.0°C at Apa Neagră in the area of the Subcarpathian depressions and 4.0°C at Craiova and Băcleș, falling within the thermal time type of warm month (W) in Oltenia (Table 2). *The monthly mean air temperature for the whole region* was 0.8°C, and the *deviation* from the normal was 3.4°C, which confirms the classification as warm month (W) for the whole region (Table 2). This general monthly average (0.8°C) shows that January 2018 was the warmest month of the last 58 years (1961-2018), in the decreasing order of the overall temperature means calculated for the whole region. In January 2018, the *cold units* were recorded in the intervals 14-17.I and 23-28.I (totalling 10 days) ranging from 19.5 at Dr. Tr. Severin and 69.7 at Voineasa, and the general average for the whole region was 39.0, which means, agrometeorologically, a mild winter month. *Heat units* were significant between 16.9 at Voineasa and 93.6 at Dr. Tr. Severin, with the average for the whole region of 64.8 surpassing the cold ones. *Monthly minimum air temperature values* were recorded, most in the period 16-25.I and were between -15.1°C at Apa Neagră and -6.3°C at Dr. Tr. Severin, and *their average* for the whole region was -10.1°C. There were *two cooling periods of weather* between 14-17.I and 23-28.I, the duration of which amounted to 10 days. *The coldest mornings* were recorded on 16.I and 25.I, with the average for the whole region of -8.8°C, the days when the winter cold reached its peak. At 20 am, the temperature averages for the entire region were  $\geq 0^\circ\text{C}$ . There was *no agrometeorological frost* rather than totally isolated, in a single morning, in the Subcarpathian area.

**Table 2.** Air temperature regime in Oltenia in January 2018(N – normal values calculated for the period 1901-1990, M – monthly mean values for January 2018,  $\Delta$  (M-N) – temperature deviation from the normal, CH – Hellmann Criterion).

Meterological Station	Hm	N	M	$\Delta$ (M-N)	CH	Tmax air		Tmin air	
						(°C)	Date	(°C)	Date
Dr. Tr. Severin	77	-1.1	<b>2.4</b>	3.5	W	15.1	30	<b>-6.3</b>	17
Calafat	66	-1.8	1.7	3.5	W	<b>16.7</b>	30	-8.0	17
Bechet	65	-2.2	1.1	3.3	W	16.4	30	-9.8	17
Băilești	56	-2.3	0.9	3.2	W	14.7	30	-8.1	17
Caracal	112	-2.9	1.0	3.9	W	13.7	30	-8.9	25
Craiova	190	-2.6	1.4	<b>4.0</b>	W	15.0	30	-8.4	25
Slatina	165	-2.4	0.7	3.1	W	14.9	30	-11.5	25
Bălceș	309	-3.0	1.0	<b>4.0</b>	W	13.4	30	-8.9	17
Tg. Logrești	262	-2.7	0.8	3.5	W	15.2	30	-10.0	17
Drăgășani	280	-2.2	1.6	3.8	W	16.2	30	-8.6	16
Apa Neagră	250	-2.6	-0.6	<b>2.0</b>	W	14.7	30	<b>-15.1</b>	16
Tg. Jiu	210	-2.6	0.7	3.3	W	16.1	30	-9.2	16
Polovragi	546	-3.2	0.4	3.6	W	13.6	30	-11.7	16
Rm. Vâlcea	243	-2.2	1.4	3.6	W	16.3	30	-10.0	16
Voineasa	587	-4.7	<b>-1.7</b>	3.0	W	<b>10.3</b>	30	-13.3	24
Parâng	1585	-	-	-	-	10.5	6	-14.5	15
Average Oltenia	-	-2.6	0.8	3.4	W	14.6		-10.1	-
Ob. Lotrului	1404	-6.2	-4.1	2.1	W	8.9	26	-21.3	24

(Source: data processed after ANM Archive)

*The amplitude of the air temperature variation in January was between 21.4°C at Dr. Tr. Severin and 29.8°C at Apa Neagră, and for the whole region the maximum amplitude was 31.8°C. The maximum monthly temperature values were recorded on 30.I, when the average of the daily maxima for the entire region was 14.6°C, being the highest average in January. Monthly thermal peaks were between 10.3°C at Voineasa and 16.7°C at Calafat, and their average for the whole region was 14.6°C. **The variation of air temperature in January 2018** shows slightly decreasing trends for all three parameters analysed (daily minimum, daily mean and daily maximum). A weak heat wave with a duration of 6 days was recorded in the period 29.I - 3.II.*

There were **2 moderate heat waves** during 1-8.I.2018 and 29.I-3.II.2018, with a total of 14 warm days, of which 11 were in January (35.5% of January). After the deviations of mean air temperatures from normal, January was the warmest month in the history of climate observations.

### 3.3. The thermal anomaly of February 2018

**In February 2018, the monthly mean air temperatures** were  $-0.5^{\circ}\text{C}$  at Voineasa and  $2.1^{\circ}\text{C}$  at Dr. Tr. Severin, and their deviations from the normal values ranged between  $1.0^{\circ}\text{C}$  on the Danube Meadow at Calafat and Oltenia Hills in Drăgășani and Băcleș and  $2.0^{\circ}\text{C}$  in the Voineasa Intramontanic Depression, ranging from the warmish (WS) classes in most parts of the region to warm (W) at Voineasa (Table 3). **The monthly mean air temperature calculated for the whole region** was  $0.9^{\circ}\text{C}$ , and its deviation from normal was  $1.4^{\circ}\text{C}$ , which is included in the class of the warmish months (WS), “on average”, for the entire Oltenia region. **The daily average values** calculated for the entire region was  $-9.0^{\circ}\text{C}$  on 28.II and  $7.2^{\circ}\text{C}$  on 3.II. **The warmest part of February** was between 1-19.II, when the thermal extremes, totally isolated, slightly exceeded  $20.0^{\circ}\text{C}$ . **Minimum monthly air temperature values** were recorded for the most part on 28.II, ranging from  $-11.9^{\circ}\text{C}$  in the area of the Subcarpathian depressions at Polovragi and  $-9.1^{\circ}\text{C}$  at Dr. Tr. Severin, and their **average** was  $-10.9^{\circ}\text{C}$ , higher by  $0.2^{\circ}\text{C}$  than in January. **The coldest morning** was on the 28.II when the average for the whole region was  $-9.0^{\circ}\text{C}$ . **The cold units** were modest, ranging between 22.1 at Dr. Tr. Severin and 40.0 at Polovragi, and their average for the whole region was 31.0. These were recorded mostly in the period 25-28.II, ie within 4 days. **The agrometeorological frost** was not registered in February and only in the 1st of the year was of local character. **Heat units** were recorded in 1-24.II for 24 days and were between 15.4 at Voineasa and 81.5 at Dr. Tr. Severin and their **average** for the whole region was 54.8, far exceeding units of cold, which confirms the warm winter moon feature as well as the translation of the spring season to the winter. **The warmest day** was 3.II when the temperature average of this day for the whole region was  $7.2^{\circ}\text{C}$ . **The maximum monthly temperature values** were recorded differently on 1, 2, 3, 8 and 9.II. They ranged between  $7.9^{\circ}\text{C}$  in the Voineasa Intramontanic Depression and  $21.4^{\circ}\text{C}$  at Bechet (this was the maximum winter thermal), and their average for the whole region was  $13.0^{\circ}\text{C}$ .



**Table 3.** Air temperature regime in February 2018 in Oltenia. (N, normal for February calculated for the period 1901-1990; M, monthly means for February 2018;  $\Delta(M-N)$  temperature deviation, CH = Hellmann Criterion)

Meteorological Station	Hm	N	M	$\Delta(M-N)$	CH	Tmax air		Tmin air	
						(°C)	Date	(°C)	Date
Dr.Tr. Severin	77	0.9	<b>2.1</b>	1.2	<b>WS</b>	12.4	3	<b>-9.1</b>	28
Calafat	66	0.4	1.4	<b>1.0</b>	<b>WS</b>	14.5	3	-10.4	28
Bechet	65	-0.1	1.5	1.6	<b>WS</b>	<b>21.4</b>	3	-10.2	28
Băilești	56	-0.1	1.1	1.2	<b>WS</b>	18.7	3	-10.6	28
Caracal	112	-0.7	1.0	1.7	<b>WS</b>	17.2	3	-10.9	28
Craiova	190	-0.4	0.7	1.1	<b>WS</b>	15.5	3	-10.6	28
Slatina	165	-0.2	0.9	1.1	<b>WS</b>	16.4	3	-10.7	28
Băcleș	309	-0.9	0.1	<b>1.0</b>	<b>WS</b>	11.4	3	-11.0	28
Tg. Logrești	262	-0.7	0.6	1.3	<b>WS</b>	11.3	1	-10.8	28
Drăgășani	280	-0.2	0.8	<b>1.0</b>	<b>WS</b>	11.8	3	-11.4	28
Apa Neagră	250	-0.6	0.5	1.1	<b>WS</b>	11.2	9	-11.5	28
Tg. Jiu	210	-0.4	1.3	1.7	<b>WS</b>	11.8	9	-9.9	28
Polovragi	546	-1.4	-0.1	1.3	<b>WS</b>	11.0	2	<b>-11.9</b>	28
Rm. Vâlcea	243	0.0	1.7	1.7	<b>WS</b>	12.1	2	-9.8	28
Voineasa	587	-2.5	<b>-0.5</b>	<b>2.0</b>	<b>W</b>	<b>7.9</b>	8	-8.7	27
Parâng	1585	-	-	-	-	3.6	3	-17.4	28
Average Oltenia	-	-0.5	0.9	1.4	<b>WS</b>	13.0	-	-10.9	-
Ob. Lotrului	1404	-5.5	-4.7	0.8	<b>N</b>	5.2	2	-15.1	6

(Source: data processed after ANM Archive)

The highest daily average of the temperature peaks was 12.3°C, recorded on 3.II. A moderate heat wave was recorded between the 29.I-9.II, which was extended until 18.II.2018, triggering the vegetative cycle of the agricultural crops, the opening of the buds to willow, the beginning of leaving and swelling of the almond and apricot tree buds etc. which signifies an early coming of the spring, although the late winter episode interrupted the development of vegetative processes between the 25.II-2.III.

*The air temperature variation chart* in February 2018 shows **decreasing trends** for all three analysed parameters (daily minima, daily mean and daily

maxima), and the fastest decrease was for the maximum temperature. ***This downward trend is a climatic anomaly***, as air temperature is normally increasing in February. As a result of the weather's evolution, ***caused by the advection of hot air on a large part of the European continent from the end of January and maintained almost the entire February, an early coming of spring occurred***; the migratory birds arrived, and the starlings arrived from 2.III.2017. The bees came out to pick up pollen on many days of February. ***Biocenoses*** maintained their activity in almost all winter. After 19th the air temperature gradually decreased, and during the period of 25.II-2.III.2017 there was ***a short late winter episode***. ***The late winter*** episode was marked by abundant snowfall, blizzard and a wave of Siberian cold that covered most of Europe and Asia, and in Romania peaked on 1.III in the morning, when after a serene night, the lowest temperatures of 2017-2018 the cold season occurred (***-24.8°C at Apa Neagră and Tg. Logrești became the absolute minimum thermal of March for this last meteorological station***) (Table 4). The vernalization took place between 25.II-2.III.2018..

### 3.4. Winter's general thermal characteristics

**The average annual temperatures** were between -0.7°C at Voineasa and 2.9°C at Dr. Tr. Severin and their deviations from the normal values ranged between 1.5°C in the area of the Subcarpathian depressions at Apa Neagră and 3.0°C in the Romanați Plain at Caracal, being included in the ***very warm winter*** (VW) type class throughout Oltenia. ***The winter average for the entire region was 1.5°C***, and its ***deviation*** from normal was 2.7°C, confirming that the winter of 2017-2018 was very warm (VW). ***Cold units*** for the whole winter ranged from 41.6 at Dr. Tr. Severin and 132.1 at Voineasa. ***Heat units*** for the whole winter were between 64.1 at Voineasa and 309.0 at Dr. Tr. Severin, and the average for the whole region was 212.0, indicating a gentle agrometeorological winter.

### 3.5. Thermal anomalies of February 2018

**Monthly mean temperatures** ranged between 2.7°C in the Subcarpathian depression at Polovragi and 4.9°C at Dr. Tr. Severin in the extreme west, and the deviations from the normal values ranged between -1.8°C in the Oltenia Plain at Băilești and 0.4°C in the Voineasa Intracarpethian Depression, according to the Hellmann Criterion belonging to the cool months class (CO) in Oltenia Plain, Mehedinți Hills and the Apa Neagră Depression, and normal (N) in the hill area (Table 4). ***The mean monthly temperature*** calculated for the entire region was 3.6°C, and its deviation from the normal value of -1.0°C confirms the coldish month classification (Table 4). The negative deviations of monthly temperature averages are due to the cold weather with a snow layer in the period 1-4.III.2018 and 19-27.III (14 days). In the period 19-27.III, the late winter phenomena came back: snowfall occurred and the

snow layer reached a maximum thickness of 19 cm at Rm. Vâlcea and 44 cm at Craiova on 1.III and between 20 cm at Caracal and 36 cm at Polovragi on 23 and 24.III. On 23.III.2018, *the snow was mixed with Saharian dust*, and in Oltenia, the snow layer was yellowish (in Tulcea County, orange).

*Monthly temperature maxima* were recorded on 31.III and were between 18.6°C at Bâcleș and 26.1°C at Bechet and their average for the whole region was 20.7°C. Minimum monthly air temperatures were recorded on 1.III.2018, after a serene night with snow and in the presence of cold air advections (cPk + A) (of arctic origin, initially circulating over Europe from Siberia, over which additional cold air advection from the Scandinavian Peninsula occurred); the recorded minimum temperatures were -9.4°C at Calafat and -24.8°C at Apa Neagră and Tg. Logrești. *The value of -24.8°C from Tg. Logrești is the absolute minimum of March for this station*, thus constituting *an absolute local climate record. The monthly mean minimum temperature calculated for the entire region* was -17.6°C. *High temperature fluctuations were recorded in March* from the minimum temperature values from 1.III (-24.8) to the maximum of 26.1°C on 31.III at Bechet (Table 4).

**Table 4.** Air temperature regime in Oltenia in March 2018, for the altitude interval  $\leq 600$  m (N, monthly mean values for March, for the period 1901-1990; M, temperature means in March 2018;  $\Delta(M-N)$ , temperature deviation; CH, Hellmann Criterion)

Meteorological Station	Hm	NIII	MIII 18	$\Delta=M-N$	CH	Tmax air		Tmin air	
						(°C)	Date	(°C)	Date
Dr. Tr. Severin	77	5.9	4.9	-1.0	CO	21.3	31	-14.4	1
Calafat	66	5.6	4.1	-1.5	CO	19.9	31	-9.4	1
Bechet	65	5.4	4.1	-1.3	CO	26.1	31	-18.4	1
Băilești	56	5.4	3.6	-1.8	CO	22.5	31	-13.9	1
Caracal	112	4.9	3.7	-1.2	CO	24.5	31	-16.4	1
Craiova	190	5.1	3.8	-1.3	CO	21.3	31	-14.4	1
Slatina	165	5.0	3.6	-1.4	CO	22.3	31	-21.9	1
Bâcleș	309	4.5	3.0	-1.5	CO	18.6	31	-15.0	1
Tg. Logrești	262	3.6	3.3	-0.3	N	21.7	31	-24.8	1
Drăgășani	280	4.7	3.8	-0.9	N	20.8	31	-16.9	1
Apa Neagră	250	4.2	2.8	-1.4	CO	20.1	31	-24.8	1
Tg. Jiu	210	4.8	4.1	-0.7	N	21.9	31	-19.0	1
Polovragi	546	3.0	2.7	-0.3	N	19.4	31	-17.8	1
Rm. Vâlcea	243	5.0	4.2	-0.8	N	21.9	31	-17.8	1
Voineasa	587	2.4	2.8	0.4	N	19.7	31	-17.4	1
Parâng	1585					9.6	31	-19.5	1
Average Oltenia	-	4.6	3.6	-1.0	CO	20.7		-17.6	
Ob. Lotrului	1404	-2.4	-1.2	1.2	WS	11.9	31	-22.9	1

(Source: data processed after ANM Archive)

The return of the late winter episode (10 days) in 19-27.III period led to the decrease of the minimum temperatures on 20.III (spring equinox day) to  $-6.0^{\circ}\text{C}$  at Bâcleș and  $-2.6^{\circ}\text{C}$  at Voineasa with *the minimum (this day) average calculated for the entire region of  $-4.9^{\circ}\text{C}$* . This long interval of temperature decrease, with falling of snow and snow layer (reaching 20 cm at Caracal on 23.III and 36 cm at Polovragi on 24.III) caused the fruit trees to be heavily affected, especially the early stone trees (almond, apricot, peach, cherry plum, plum) that already had floral buttons from the previous warm-weather period, which are now completely destroyed. *During 28-31.III, the weather warmed strongly and fast*, so that on 31.III the monthly thermal maxima were recorded and the mean temperature for the whole region increased to  $7.3^{\circ}\text{C}$ . The warming continued throughout April until the 5.V when the thermal maxima of May were recorded. The rapid and strong warming of the weather led to the melting of snow *and to floods in 11 counties in southern and south-western Romania*. From the pluviometric point of view, March was extremely rainy, *with the mean monthly rainfall for the entire region of 95.3 mm*, and at 5 meteorological stations, the quantities exceeded 100 mm (Dr. Tr. Severin, Calafat, Băilești, Apa Neagră, Polovragi). These significant rainfalls have kept the water reserve in the soil at the optimal and even excessive level on the entire Oltenia throughout March, and have been a beneficial reserve for the excessively drought of April that followed.

### 3.5. Thermal anomalies of April 2018

*Monthly mean temperatures* were between  $12.2^{\circ}\text{C}$  at Voineasa and  $17.2^{\circ}\text{C}$  at Dr. Tr. Severin (this was the highest monthly mean temperature in the country) *and their deviations* from the normal values were between  $4.3^{\circ}\text{C}$  at Bechet and Caracal in the Oltenia Plain and  $5.7^{\circ}\text{C}$  at Drăgășani, which belong to the warm class (W) in the most part of Oltenia to very warm (VW) in the extreme west of the region (at Dr Severin), Mehedinti Hills (Bâcleș), Olt Valley (Drăgășani and Rm. Vâlcea) and the Subcarpathian Depression (Tîrgu Jiu) (Table 5). It is the first year in the meteorological observation hystory, when in April, some stations (5 stations and certainly at Parâng in the mountain area) recorded the very warm time (VW).

*The monthly mean air temperature* calculated for the whole region was  $15.8^{\circ}\text{C}$ , and its deviation from normal was  $4.9^{\circ}\text{C}$ , which confirms that April was a warm month (W) for the whole region. For the whole country, April's thermal deviation from the average of the last 60 years was  $4.3^{\circ}\text{C}$ , which marks April 2018 as the warmest month of the last 60 years (ANM Documents). The highest monthly mean temperature values, above  $16.0^{\circ}\text{C}$ , were registered in southern Muntenia and some areas in Oltenia, Banat and Crișana. The highest positive deviation,  $6.0^{\circ}\text{C}$ , was recorded at the Sinaia meteorological station (1500 m) (ANM).

For the Craiova Meteorological Station, the monthly mean of  $16.4^{\circ}\text{C}$  (Table 5) is an *absolute climatic record* of the monthly mean temperature for the

entire observation period (1894-2018) *and such climatic records for the monthly mean temperature* were recorded at many weather stations in Romania, and *in Oltenia at all weather stations*. For the average calculated over the period 1894-2017, the deviation of the monthly mean temperature in Craiova is 7.0°C, which, according to the Hellmann Criterion, leads to *the very warm month classification (VW) for the entire period of climatic observations*. *Monthly temperature maxima* were recorded between 22-26.IV and ranged between 26.3°C at Polovragi on 22.IV.2018 and 32.4°C on 24.IV.2018 at Calafat, their average for the entire region was 28.6°C. Of these values, *the one of 28.8°C at Apa Neagră (Padeș) registered on 22.IV.2018 is equal to the absolute maximum temperature of April for this station (28.8°C recorded on the last day of 30.IV .2003)*, which means a warming of the earlier one-week weather at this weather station.

**Table 5.** Air temperature regime in Oltenia in April 2018, for the altitude interval  $\leq 600$  m; N, monthly mean values for the period 1901-1990, M, temperature means for April 2018,  $\Delta(M-N)$ , temperature deviation; CH, Hellmann Criterion)

Meteorological Station	Hm	N	M	$\Delta(M-N)$	CH	Tmin air		Tmax air	
						(°C)	Date	(°C)	Date
Dr. Tr. Severin	77	11.9	<b>17.2</b>	5.3	<b>VW</b>	<b>1.9</b>	<b>3</b>	<b>30.2</b>	<b>23;24</b>
Calafat	66	11.8	16.7	4.9	<b>W</b>	<b>0.5</b>	<b>3</b>	<b>32.4</b>	<b>24</b>
Bechet	65	12.0	16.3	<b>4.3</b>	<b>W</b>	<b>-0.5</b>	<b>3</b>	<b>31.6</b>	<b>24</b>
Băilești	56	11.9	16.3	4.4	<b>W</b>	<b>1.2</b>	<b>3</b>	<b>30.2</b>	<b>24</b>
Caracal	112	11.6	15.9	<b>4.3</b>	<b>W</b>	<b>0.4</b>	<b>3</b>	<b>30.2</b>	<b>26</b>
Craiova	190	11.5	16.4	4.9	<b>W</b>	<b>1.5</b>	<b>3</b>	<b>30.0</b>	<b>24</b>
Slatina	165	11.4	15.9	4.5	<b>W</b>	<b>-0.4</b>	<b>3</b>	<b>29.5</b>	<b>24</b>
Băcleș	309	10.2	15.7	5.5	<b>VW</b>	<b>2.9</b>	<b>2</b>	<b>27.7</b>	<b>24</b>
Tg. Logrești	262	10.3	14.9	4.6	<b>W</b>	<b>-2.7</b>	<b>3</b>	<b>27.9</b>	<b>24</b>
Drăgășani	280	10.9	16.6	<b>5.7</b>	<b>VW</b>	<b>2.0</b>	<b>3</b>	<b>29.7</b>	<b>24</b>
Apa Neagră	250	10.1	15.0	4.9	<b>W</b>	<b>-1.0</b>	<b>3</b>	<b>28.8</b>	<b>22</b>
Tg. Jiu	210	10.9	16.4	5.5	<b>VW</b>	<b>-0.3</b>	<b>3</b>	<b>29.0</b>	<b>23</b>
Polovragi	546	10.4	15.0	4.6	<b>W</b>	<b>-0.4</b>	<b>3</b>	<b>26.3</b>	<b>22</b>
Rm. Vâlcea	243	10.8	16.3	5.5	<b>VW</b>	<b>1.1</b>	<b>3</b>	<b>28.3</b>	<b>24</b>
Voineasa	587	7.7	<b>12.2</b>	4.5	<b>W</b>	<b>-2.6</b>	<b>3</b>	<b>27.4</b>	<b>22</b>
Parâng	1585	-	-	-	-	<b>-3.9</b>	<b>3</b>	<b>18.5</b>	<b>26</b>
Average Oltenia	-	10.9	15.8	4.9	<b>W</b>	-0.0	-	28.6	-
Ob. Lotrului	1404	2.0	6.6	4.6	<b>W</b>	<b>-8.4</b>	<b>3</b>	<b>20.2</b>	<b>26</b>

(Source: data processed after ANM Archive)

The value of 26.3°C recorded on 22.IV.2018 at Polovragi is the second in decreasing order after the absolute thermal maximum of 26.6°C ofrom30.IV.2012 with the same meaning as above. The values from Drăgășani, Rm. Valcea, Voineasa and Parâng are ranked third in decreasing order. Since 10.IV, the temperature maxima have exceeded 25.0°C with numerous summer days of  $\geq 25.0^\circ\text{C}$ , and tropical days with temperature  $\geq 30.0^\circ\text{C}$  were recorded in the 23-26.IV period, at 6 meteorological stations. **The monthly temperature minima** were recorded on June 3, 2018, ranging from -2.7°C at Tg Logrești and 2.9°C at Băcleș, and their average for the whole region was 0.0°C. The date of 3.IV.2018 was the only day with negative minima in April, and the local hoar, registered that morning had destructive effects on many areas of Oltenia. The charts of parameters that characterize the air temperature had **strong increasing linear trends**: daily maxima having a significant increase coefficient of 0.3174, daily averages of 0.255, and daily minima of 0.1793. From the pluviometric point of view, April 2018 was excessively dry, with rainfall values between 7.0 mm at Caracal (Romanați Plain) and 43.2 mm at Dr. Tr. Severin, and their percentage deviations from normal were between -23.5% at Dr. Tr. Severin (the only station that falls within the dry class (D), while at all the other stations are classified as excessively dry (ED)) and -84.6% at Băilești. As a result of this situation with warm days and deficient rainfall, many agricultural crops have been affected, for example, the strawy crops had under-sized and the short straws; there have been delays in the emergence of spring crops as a result of dryness in the surface layer of the soil; some agricultural work has been carried out with difficulty, and a series of diseases and pests have occurred in the hot and dry weather. The synoptic causes of this situation are the persistence of the North African anticyclone for several days in a row, and of the South-West movements that have brought hot air from Northern Africa.

### 3.7. Thermal anomalies of May 2018

**Monthly mean air temperatures** were between 14.4°C at Voineasa and 20.3°C at Dr. Tr. Severin and their deviations from the normal values ranged between 2.0°C at Bechet (in the extreme south), Oltenia and 3.2°C at Dr. Tr. Severin in the extreme west, values that according to the Hellmann Criterion show that May was warm (W) in Oltenia (Table 6). **The monthly mean temperature calculated for the whole region** was 18.5°C, and its **deviation from normal** was 2.5°C, which confirms that May was, on average, a warm month for Oltenia (Table 6). **The monthly mean** of 19.4°C recorded in Craiova in May 2018 is the same as in 1969 and the second in decreasing order after the maximum of 20.4°C in 2003.

**Table 6.** Air temperature regime in Oltenia in May 2018, for the altitude interval  $\leq 600$  m (N, monthly mean values for the period 1901-1990, M, temperature means for May 2018,  $\Delta(M-N)$ , temperature deviation; CH, Hellmann Criterion)

Meteorological Station	Hm	NV	MV`18	$\Delta=M-N$	CH	Tmin air		Tmax air	
						(°C)	Date	(°C)	Date
Dr. Tr. Severin	77	17.1	<b>20.3</b>	<b>3.2</b>	<b>W</b>	<b>9.9</b>	18	<b>32.5</b>	5
Calafat	66	17.3	19.8	2.5	<b>W</b>	<b>10.2</b>	9	<b>32.5</b>	5
Bechet	65	17.5	19.5	<b>2.0</b>	<b>W</b>	<b>7.2</b>	2	<b>32.6</b>	5
Băilești	56	17.4	19.6	2.2	<b>W</b>	<b>8.2</b>	9	<b>30.8</b>	5
Caracal	112	17.1	19.4	2.3	<b>W</b>	<b>10.7</b>	14	<b>31.0</b>	31
Craiova	190	17.0	19.4	2.4	<b>W</b>	<b>10.0</b>	20	<b>30.7</b>	5
Slatina	165	16.9	19.0	2.1	<b>W</b>	<b>9.3</b>	18	<b>30.2</b>	5
Băcleș	309	15.5	18.2	2.7	<b>W</b>	<b>10.5</b>	20	<b>28.6</b>	5
Tg. Logrești	262	15.3	17.5	2.2	<b>W</b>	<b>6.1</b>	18	<b>29.6</b>	5
Drăgășani	280	15.8	18.9	3.1	<b>W</b>	<b>9.3</b>	20	<b>29.9</b>	5
Apa Neagră	250	15.1	17.4	2.3	<b>W</b>	<b>6.9</b>	20	<b>29.6</b>	5
Tg. Jiu	210	15.9	18.5	2.6	<b>W</b>	<b>7.4</b>	18	<b>31.5</b>	5
Polovragi	546	14.3	16.6	2.3	<b>W</b>	<b>6.2</b>	17	<b>28.8</b>	5
Rm.Vâlcea	243	15.4	18.6	3.2	<b>W</b>	<b>8.8</b>	17	<b>31.5</b>	5
Voineasa	587	12.1	<b>14.4</b>	2.3	<b>W</b>	<b>4.6</b>	18	<b>28.7</b>	5
Parâng	1585	-	-	-	-	<b>4.0</b>	17	<b>19.4</b>	31
Average Oltenia	-	16.0	18.5	2.5	<b>W</b>	<b>8.1</b>	-	<b>29.9</b>	-
Ob. Lotrului	1404	7.2	9.6	2.4	<b>W</b>	<b>-0.5</b>	17	<b>21.7</b>	1;2

(Source: data processed after ANM Archive)

*The graph of the mean monthly air temperature variation* at the meteorological station in Craiova for the period 1961-2018 (58 years) shows an increasing trend, which confirms climate warming in May. Increasing trends and similar conclusions also result from the analysis of temperature data from each meteorological station, reinforcing the aforementioned. Monthly temperatures were recorded atypically in the first pentadal of the month on 5.V.2018 (only 2 values at 31 May) being between 28.6°C at Băcleș and 32.6°C at Bechet, and their average for the whole region was 29.9°C (Table 6).

All this shows that May 2018 was particularly warm in terms of monthly temperature means, although no exceptional thermal maxima were recorded, and the process of climate warming continued. From the pluviometric point of view, May was dry in Oltenia Plain, (Mehedinti Hills, the extreme west to Dr. Tr. Severin

and the Apa Neagră Subcarpathian Depression) and rainy in the hills and mountains, and "on average" a slightly rainy for the whole region after the average for Oltenia (94.7 mm) and its deviation from normal (18.3%).

### 3.8. Thermal and pluviometric regime of spring 2018

*The monthly mean air temperatures* in the spring of 2018 were between 9.8°C at Voineasa and 14.1°C at Dr. Tr. Severin and their *deviations* from the normal values (calculated for the last century) were between 1.6°C at Băilești (in the Oltenia Plain) and 2.6°C in the Olt Corridor at Drăgășani and Rm. Vâlcea, which is in the warm class (W) for all weather stations except Rm. Vâlcea where it was very warm (VW). In the mountain area at Ob. Lotrului the spring was very warm, according to the same criterion. *The mean annual average calculated for Oltenia* was 12.6°C and its deviation from normal was 2.1°C, which confirms the *warm classification for the whole region*. *The annual precipitation ranges* were 115.8mm in Caracal (in the Romanati Plain) and 362.8mm (in the Polovragi Subcarpathian Depression), and their percentage deviations from the *normal seasonal values* (calculated for the last century) were between -18.6% at Caracal and + 61.1% at Polovragi. As a result, the classifications of rainfall types in the spring of 2018 ranged from dry (D) in the Romanati Plain, little dry (LD) in the mountainous area of Voineasa and Parâng to excessively rainy (ER) at Polovragi.

## 4. CONCLUSIONS

*The winter of 2017-2018 and the spring of 2018* were marked by important climatic anomalies, not only in Oltenia but even throughout the Northern Hemisphere, and among them the most significant ones were the thermal ones. This winter was very warm (VW) throughout Oltenia. *The mean winter value for the whole region was 1.5°C*, and its deviation from normal was 2.7°C, confirming that the winter of 2017-2018 was very warm. *Cold units* for the whole winter ranged from 41.6 at Dr. Tr. Severin and 132.1 at Voineasa. *Heat units* for the whole winter were between 64.1 at Voineasa and 309.0 at Dr. Tr. Severin, and the average for the whole region was 212.0, indicating a mild agrometeorological winter. *The winter* was marked by a warm December with the highest average of the winter months, then, although the temperature slowly decreased, the weather stayed warm. *Between the 25.II-2.III*, the weather cooled sharply; snow has fallen and snow layer formed. The maximum of the cooling was recorded on 1.III in the morning, when at Apa Neagră and Tg. Longrești, the thermal minima reached -24.8°C, this value being the absolute thermal minimum at the Tg. Logrești meteorological station for March.



*The spring was warm for the whole region*, although March started with the severe cooling episode of dates 1 and 2.III, after which a severe cooling of the weather in the period 19-26.III, with snow and snow layer, which caused the destruction of the floral buttons of the stone trees that had appeared in the period 7-18.III. Significant damage also occurred to the growing rapeseed crop. The migratory birds that had returned to the country were surprised by the winter temperatures recorded on 19, 21 and 22.III. **March** was excessively rainy with more than 100 mm monthly rainfall at Dr. Tr. Severin, Calafat, Bailești, Apa Neagră, Polovragi; the average for the whole region was 95.3 mm, which kept the ground water reserve at the optimum level. The month of April was the warmest, the averages of deviations from the normal values throughout the history of meteorological observations, although there were no exceptional thermal maxima, and *from the pluviometric point of view* it was excessively dry. The two late-winter episodes (25.II-2.III and 19-27.III) determined the slowing of the coming of the spring with indexes between 211.9°C at Voineasa and 388.2°C at Dr. Tr. Severin and the average for the whole region was 321.6°C. As a result, the coming of spring was normal (N) in the south-west of the region (Dr. Tr. Severin, Calafat, Bechet, Bailesti) and little early (LE) in most of Oltenia, confirmed by the general mean deviation from the normal. In **May**, although extreme temperature extremes were not recorded, mean deviations from the average over 2.0°C ranked it as a warm month, in line with *the global average deviation for the Northern Hemisphere*. In May, in the Olt Corridor and Romanati Plain (Slatina and Caracal), dry regime was maintained. *The spring in its entirety* was warm and rainy (R), and the warm and excessively dry regime of April determined the static forcing of the vegetation that affected all the crops and especially the straw. All this shows that climate warming in the first six months of 2018 continued.

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