MEDITERRANEAN WINTER 2019-2020 IN SOUTHWESTERN ROMANIA IN THE CONTEXT OF CLIMATE CHANGES

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Abstract. After the hot and very dry autumn of 2019, which ended, from a pluviometric point of view, with a secondary rainfall maximum in November, the 2019-2020 winter was overall very warm with a general annual average of 2.91°C and a 3.86°C deviation compared to normal values. December 2019 was hot and very dry. January was hot, and, from a pluviometric point of view, it was excessively dry. February was warm as a whole and excessively dry, but the water supply in the soil remained almost optimal due to the rainfall in November. The climate variability of this winter was particularly high, and the warming continued although the solar activity was at a minimum and the El Niño climatic process was absent. At the level of Romania, the 2019-2020 winter was the second warmest winter in the history of climate records and so far, the first being 2006-2007, and the third 2015-2016, which is also valid for Oltenia. The paper is part of an extensive series of studies on climate variability in southwestern Romania and climate change at the regional level and is useful to all those interested in climate issues and its evolution in this part of Romania.

Keywords: Mediterranean winter, monthly temperature averages, Hellmann criterion, warm winter phenomena, winter heat waves, vegetative processes.

Rezumat. Iarna mediteraneeană 2019-2020 în sud-vestul României în contextul schimbărilor climatice. După toamna călduroasă şi foarte secetoasă 2019 care s-a încheiat din punct de vedere pluviometric, cu maximul secundar de precipitaţii înregistrat în luna noiembrie, iarna 2019-2020 a fost în ansamblul său foarte caldă (FC) cu media anotimpuală generală de 2,91°C şi abaterea faţă de normală de 3,86°C. Luna decembrie 2019 a fost caldă şi foarte secetoasă (FS). Luna ianuarie a fost caldă, iar din punct de vedere pluviometric a fost excesiv de secetoasă (ES). Luna februarie a fost caldă (C) în ansamblul său şi excesiv de secetoasă (ES), dar rezerva de apă din sol s-a menţinut aproape de optim datorită precipitaţiilor din luna noiembrie. Variabilitatea climatică a acestei ierni a fost deosebit de mare, iar încălzirea climatică a continuat deşi activitatea solară a fost la minim şi procesul climatic El Ninõ a fost absent. La nivelul României iarna 2019-2020 a fost a doua cea mai calda iarnă din istoria înregistrărilor climatice şi până în prezent, prima fiind 2006-2007, iar a treia 2015-2016, aspect valabil şi pentru Oltenia. Lucrarea face parte dintr-o serie extinsă de studii privind variabilitatea climatică în sud-vestul României şi schimbările climatice la nivel regional şi este utilă tuturor celor interesaţi de problemele climatului şi evoluţia lui în această parte a României.

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

INTRODUCTION

For Romania, 2019 was the warmest year in the history of meteorological measurements in Romania (1900-2019), and its overall average exceeded the previous record recorded in 2015 (according to ANM, https://www.realitatea.net/news/weather/Director-ANM-confirm-year-2019-the-). ***The World Meteorological Organization*** has classified 2019 as the second hottest in history, after 2016 (from 1850 to the present). 2016 remains the hottest year ever recorded on the planet. It was marked by a very intense El Nino episode, a phenomenon that accentuated long term warming and caused abnormally high temperatures. Globally, the decade 2010-2019 was the warmest in the history of meteorological measurements, and after 1980, each decade was warmer than the previous one (according to WMO). The average surface temperature of the Globe increased by 1.1°C compared to the pre-industrial era (1850-1900). The average temperature of the surface of the Planetary Ocean shows that the last decade 2010-2019 was also the warmest for the oceans, which absorbed 93% of the surplus energy attributed to planetary warming. The hottest year was recorded on all continents with temperatures reaching and even exceeding 50°C in various places. For France, 2019 was the third hottest year, after 2018 and 2014. The temperature record was recorded on 28.VI.2019: 46°C in Vérargues (Hérault) (https://www.rfi.ro/special-paris-117421-2019-the-second-most-May-hot-in-history). The year 2019 was also marked by an increase in sea level and many other extreme weather events: for Australia 2019 was the driest year, and parts of Southeast Asia and Central America were affected by drought. Iran, Argentina and Uruguay were hit by heavy flooding. In the Northern Hemisphere, there were 66 cyclones compared to the average of 56. Due to the climatic events that caused damage, 10 million people emigrated from their own country, only in the first semester of 2019.

At the regional level, for ***Oltenia***, after the annual average temperature, the year 2019 was the warmest in the last 6 years with the general average for the entire region of 12.40°C (excluding the mountain area). The annual thermal maximum in 2019 was 38.2°C recorded at Bechet on 8.VIII.2019 (value which is also the thermal maximum for the whole of Romania. The biggest deviations of the monthly temperature averages were recorded in November 2019 (4.1°C), March 2019 (4.0°C), February 2019 (3.2°C) and December 2019 (2.9°C), which is consistent with country and global issues. warm than normal was extended during the winter 2019-2020, and in January 2020 the deviation of the average monthly temperature from normal was 3.26°C. Between 1-4.II.2020, a strong heat wave affected Western Europe, and especially the countries around the Western Mediterranean Sea, and the peak of this heat wave was recorded on 4.II when in Spain, maximum temperatures values of ≥ 25.0°C were registered in 30 localities, with the

maximum temperature of 30.0°C in Puerto de la Cruz, equal with the old record recorded in Alicante on 28.II.1910 (+30.0°C), the essential difference being that the one from 1910 was recorded on the last day of February (when the day length is longer) and the one from 2020 in the fourth day of the month. (https://www.severe-weather.eu/recent-events/all-time-february-record-valencia-spain-mk/). This heat wave has also manifested in Oltenia, and on 1.II.2020, at Calafat, the thermal maximum was 19.8°C. The paper is part of a series of extensive studies on climate variability in the southwest of the country and the effects of climate warming, being useful to all those interested in climate change in this part of Romania (BOGDAN et al., 2007, 2008; MARINICĂ & CHIMIŞLIU, 2008; BOGDAN & MARINICĂ, 2009; BOGDAN et al., 2010; MARINICĂ et al., 2010, 2011, 2012, 2013; BOGDAN et al., 2014). We will continue to analyse the multiple aspects of climate variability from Oltenia, characteristic of winter 2019-2020, regionally in Oltenia and the consequences on agricultural crops, biotopes, economy and the environment in general.

MATERIAL AND METHOD

For the accomplishment of the work we used the results of the daily processing, with special software from the weather forecasting process, the data archive of the ANM[1], the maps made currently in the operative activity, those on the Internet provided by the international analysis and forecasting centres and those from ANM Bucharest.

We used the facilities offered by Microsoft Office for drawing tables and graphs. The paper analyses the climate variability of the warm winter 2019-2020 in the southwest of Romania, based on the thermal and rainfall regime of December 2019, January and February 2020 and the overall thermal and rainfall regime of winter 2019-2020. The effects on the environment and biotopes were also analysed.

RESULTS

1a. The thermal regime of December 2019. ***The monthly averages of the air temperature*** ranged from -0.2°C at Voineasa (the only negative value) to 4.6°C at Drobeta Turnu Severin and Apa Neagră, and their deviations from the normal calculated for the period from 1901-1990, they were between 1.7°C in Voineasa and 4.0°C in Drăgăşani and Bâcleş (Table 1). According to Hellmann criterion, December 2019 was hot (C) throughout the Oltenia region. ***The monthly average air temperature*** calculated for the entire Oltenia region was 3.1°C, and its deviation from normal was 2.92°C, confirming that December 2019 was warm (C) for the entire Oltenia region. Only in 4 days, the general average of the air temperature for the whole region was negative (5, 6, 30 and 31.XII.2019). ***The monthly minimums of air temperature*** were recorded on the dates of 5, 6, 7, 30 and 31.XII.2019 and were between -10.4°C at Târgu Logreşti (31.XII.2019) and -3.4°C in Calafat (5.XII.2019), and their average for the whole region was -7.1°C. ***The monthly maximums of air temperature*** were recorded on the dates of 8, 15, 17, 18, 19, 22 and 23.XII.2019 and ranged between 9.8°C in Voineasa (23.XII.2019) and 17.0°C at Polovragi (18.XII.2019), and their average for the whole region was 14.6°C. All averages of daily maximums calculated for the entire region were positive and therefore no winter day was recorded for the whole region as a whole. Two warm periods were observed when the daily temperature maxima reached and exceeded 10.0°C: 7-10.XII and 15-25.XII, totalling 15 days. According to the average air temperature calculated for the entire Oltenia region, the hottest day was on 23.XII with the average for the whole region of 7.5°C, and the coldest on 6.XII.2019 with an average of -3.3°C**.** ***At the soil level, the monthly minimums of temperature*** were recorded in the data of 6, 7, 30 and 31.XII and were between -10.2°C at Târgu Logreşti (31.XII.2019) and 0.2°C in Caracal (31.XII.2019), and their average for the whole region was -5.9°C. We note that ***in the Romanați Plain at Caracal, the highest frequency of the highest daily minimum temperatures is recorded on the surface of the soil throughout Oltenia***, which shows that in general in this area the soils are "warmer" than in the rest of the region, aspect that is related to soil structure and composition and is bio-stimulant for all types of crops and not only, having a high degree of favourability. T***he monthly maxima of temperature at the level of the soil surface*** were recorded in the data of 8, 15, 16, 17, 18, 19, 22, 23 and 26.XII.2019 and were between 10.2°C in Slatina (22.XII.2019) and 17.4°C in Băileşti (8.XII.2019), and their average for the whole region was 14.6°C. The ***vernalization***[2] process was carried out during the cold periods of the month. ***The cold units***[3] were insignificant and ranged between 3.1 in Drăgăşani and 39.6 in Voineasa (Voineasa is the only value > 17), and their average for the whole region was 10.2. ***The heat units*** were

[1] ANM= Administrația Națională de Meteorologie (National Meteorological Administration)

[2] ***Vernalization*** represents the acquisition or acceleration of flowering capacity under the influence of exposure to low temperatures.

[3] ***The degree of winter harshness*** in agrometeorology (the type of winter) is classified by the sum of agrometeorological freeze units (∑ of the differences between the values of daily minimum temperatures <-15°C and the critical agroclimatic threshold of -15.0°C, in the interval XII-II). Therefore, one ***unit of agrometeorological freeze*** is ***the difference of 1°C which is obtained between the critical threshold of -15.0°C and a thermal minimum in air ≤ -15°C*** (for example for Tmin = -16.0°C then the difference -15.0°C - (-16.0°C) = 1, i.e. one unit of frost, (SANDU et al., 2010); ***The cold units for the whole cold season*** are calculated as ∑ of average daily temperatures ≤ 0°C, during November- March; ***A cold day*** is the day when the average temperature is ≤ 0°C; ***Active temperatures*** are ≥0°C, and the temperature of the biological minimum is 0°C. It is called ***winter day***, the day when the maximum air temperature is <0°C. ***Heat units*** (∑ of daily average temp. ≥ 0°C). For diagnoses and weather forecasts intended for the public ***by freezing, a temperature is understood*** to be ≤ -10.0°C. Defined ***freezing*** of the weather forecast terms (which are adapted for live organisms) differs from ***agrometeorological freeze*** (temperatures ≤ -15°C), as the plants are better adapted to the climatic conditions (due to their cellular structure and specific biotic processes).

between 32.7 in Voineasa and 145.4 in Drăgăşani with the general average for the whole region of 107.1, which means a warm winter month.

The agrometeorological freeze was not recorded in any day. These thermal characteristics had a special influence on the vegetal carpet and the biotopes that in December continued their vegetative activity and biotic processes in ***biocenoses***[4], the value of 0.0°C being the temperature of the biological minimum. The statistical analysis of the evolution of average air temperature in December over the last 59 years (1961-2019) leads to the conclusion ***that December 2019 was the third warm month in descending order of the monthly average temperature for the whole region***, after December 2015 with average 5.19°C and December 1979 average 3.21°C. ***The graphs of the variation*** of the parameters that characterize the temperature of the air (the average of the daily minimums, the daily average and the average of the daily maximums all calculated for the whole region) in December 2019, had significantly increasing linear trends (Fig. 1). The increase of the average monthly temperature, meant that in December, the frequency, duration and intensity of the cold waves decreased considerably. Climate warming is thus demonstrated at the regional level, and the continuation of this climate process in 2019 (with the average of December at 3.13°C), was achieved under the conditions of minimum solar activity and in the absence of the El Niño climate process.

1.b. The rainfall regime for December 2019. *The monthly precipitation amounts* were between 5.1 l/m^2 in Bâcleş in the Mehedinți Hills and 64.6 l/m^2 in Apa Neagră in the area of Sub-Carpathian depressions. *The percentage deviations* of these quantities from the normal calculated for the reference period 1901-1990 were between -90.7% in Bâcleş and 0.0% in Drăgăşani (Table 2). According to the Hellmann criterion, December 2019 was excessively dry (ES) and very dry (FS) in almost all of Oltenia except for some restricted areas where it was dry (S) or normal (N) (Table 2). *The average monthly precipitation amounts* calculated for the whole region was 26.8 l/m^2, and its percentage deviation of -47.5%, which according to the Hellmann criterion confirms that "on average" December 2019 was very dry for the entire Oltenia region. The snow layer was absent. At the end of December in the autumn wheat culture, the water content on the soil depth 0-100 cm is located at low and especially low limits (moderate, strong and extreme pedological drought), isolated in the south of Oltenia. ***The soil moisture reserve*** showed satisfactory values, close to the optimum and optimally isolated, in most of Oltenia. As a result of the warm weather and the ground water supply achieved in November 2019 when the maximum secondary rainfall was recorded, in December agricultural crops continued their vegetation phases and their condition was good and very good in many agricultural areas in Oltenia. From a phenological point of view, barley and autumn wheat sown in the optimum age were in the leafing and twinning phases (30-100%), and in the late crops the sunrise (80-100%) and the emergence of the third leaf (40-) 100%) (***. http://www.meteoromania.ro/).

2a. The thermal regime of January 2020. ***The monthly average temperatures*** of the air temperature were between -2.7°C in Voineasa and 2.6°C in Calafat. The monthly average temperatures were negative only at three weather stations: Voineasa, Târgu Logreşti and the Apa Neagră (Table 2). ***The deviations of the monthly average temperatures*** from normal were all positive and fell between 1.3°C at Târgu Logreşti and 4.5°C in Calafat. According to the Hellmann criterion, ***January 2020 was warm (C)*** in most of the region, except for some restricted areas where it was warm[5] (CL) (Târgu Logreşti and Apa Neagră and in the mountain area at Obârşia Lotrului) (Table 3). The daily averages of the daytime maximums, calculated for the entire region, were all positive except for the date of 17.I (with an average of -0.1°C), which shows that only one winter day was recorded for the whole region. After the average air temperature, calculated for the entire region, the hottest day was 29.I.2020 with an average of 5.3°C. The daily average of the maximum air temperatures calculated for the entire region was ≥5.0°C in 22 days and ≥10.0°C in 8 days. *The monthly minimums of air temperature* were recorded in the data of 7, 8, 9, 20, 21 and 25.I.2020 and were between -12.1°C at Târgu Logreşti and Apa Neagră (at both 25.I.2020) and -6.9°C at Drăgăşani (9.I.2020), and their average for the whole region was -9.0°C. *The monthly maximums of air temperature* were recorded on the dates of 10, 11, 25 and 26.I (most on 25.I.2020) and were between 11.3°C in Voineasa (25.I.2020) and 16.2°C in Calafat (25.I.2020), and their average for the whole region was 14.2°C. *The highest average daily maximum* calculated for the entire region was 14.2°C, recorded on 25.I.2020.

On the surface of the soil, monthly temperature minimums were recorded in the data of 7, 8, 9, 10 and 25.I.2020 and were between -12.5°C in Drăgăşani (25.I.2020) and -3.7°C at Caracal (25.I.2020).

The monthly maximums of soil surface temperature were recorded on the dates of 25, 26, 28 and 29.I.2020 and ranged between 9.2°C at Slatina (29.I.2020) and 22.4°C at Drobeta Turnu Severin (26.I.2020), and their average for the whole region was 17.5°C (Table 2).

The cold units were between 8 at Drobeta Turnu Severin and 95.6 at Voineasa with the average for the entire region of 30.1. *The heat units* were between 10.6 in Voineasa and 96.1 in Calafat, with the average for the entire region of 50.3, thus exceeding 1.7 times those of cold, which shows that January was a building as a whole. *The*

[4] The term **biocenosis** (from Greek *koinosis* - to share) represents a superindividual level of organization of living matter and describes all living organisms, plants (*phytocenosis*) and animals (*zoocenosis)*, which interact with each other and coexist in a certain environment or sector. biosphere (biotope), forming with it a unitary whole and which is in a dynamic equilibrium dependent on that environment. It is characterized by a certain structure and functioning given by the pattern of the circulation of matter, energy and information. The term biocenosis was proposed by Karl Möbius in 1877 (http://en.wikipedia.org/wiki/Biocenoz%C4%83).

[5] According to the size of the deviations, compared to normal, in the Hellmann criterion, the notion of "***warm***" has the meaning of "***warmish***", the deviations of this thermal time class (CL) (Δtm = 1.0 ... 1.9°C) being smaller than those of the thermal, hot weather class (C) (Δtm = 2.0 ... 4.9°C)

agrometeorological freeze was not registered. The graphs of the variation of the parameters that characterize the temperature of the air (the average of the daily minima, the daily average and the average of the daily maxima all calculated for the whole region) in January 2020, had linear trends significantly increasing (Fig. 2).

Table 1. The air temperature regime in Oltenia and the minimum and maximum temperature values on the soil surface In December 2019 (N XII = December normals calculated for the period 1901-1990, M XII = monthly averages for December 2019; Δ = MN = deviation temperature, CH = Hellmann criterion).

Weather station	Hm	N XII	M XII	Δ=M-N	CH	Tmin air		Tmax air		Tmin soil		Tmax soil	
						(°C)	Data	(°C)	Data	(°C)	Data	(°C)	Data
Drobeta Turnu Severin	77	1.4	**4.6**	3.2	**C**	**-5.8**	31	**14.1**	8;15	**-8.4**	**31**	**13.0**	**26**
Calafat	66	1.0	3.8	2.8	**C**	**-3.4**	5	**15.4**	8	**-2.2**	**30**	**13.8**	**8**
Bechet	65	0.4	3.0	2.6	**C**	**-6.2**	5	**14.2**	15	**-4.1**	**31**	**16.2**	**15**
Băileşti	56	0.4	3.1	2.7	**C**	**-5.3**	5	**13.6**	8	**-6.6**	**6**	**17.4**	**8**
Caracal	112	-0.1	3.5	3.6	**C**	**-4.5**	5;6	**14.7**	18	**0.2**	**31**	**12.5**	**15**
Craiova	190	0.1	3.6	3.5	**C**	**-6.1**	6	**13.8**	8	**-8.0**	**31**	**13.2**	**19**
Slatina	165	0.3	3.6	3.3	**C**	**-6.5**	6	**13.5**	18;22	**-3.1**	**31**	***10.2***	**22**
Bâcleş	309	-0.4	3.6	**4.0**	**C**	**-8.1**	6	**16.0**	18	-	-	-	-
Târgu Logreşti	262	0.1	2.0	1.9	**C**	***-10.4***	31	**16.2**	19	***-10.2***	**31**	**15.8**	**18**
Drăgăşani	280	0.6	**4.6**	**4.0**	**C**	**-5.8**	7	**15.7**	18	**-5.2**	**6;7**	**17.1**	**8**
Apa Neagră	250	0.1	1.9	1.8	**C**	**-9.4**	30	**15.9**	19	**-4.4**	**31**	**13.6**	**23**
Târgu Jiu	210	0.1	2.8	2.7	**C**	**-8.1**	6	**13.5**	8	**-7.7**	**31**	**12.5**	**16**
Polovragi	546	0.1	3.3	3.2	**C**	**-7.0**	6	**17.0**	18	**-8.7**	**31**	**16.6**	**17**
Râmnicu Vâlcea	243	0.5	3.8	3.3	**C**	**-6.7**	31	**16.2**	17	**-8.1**	**31**	**17.3**	**23**
Voineasa	587	-1.9	***-0.2***	***1.7***	**C**	**-8.7**	5	***9.8***	23	-	-	-	-
Parâng	1585	-3.7	-	-	**C**	**-11.5**	30	**14.5**	17	-	-	-	-
Oltenia average	-	0.18	3.1	2.92	**C**	**-7.1**	-	**14.6**	-	**-5.9**	-	**14.6**	-
Obârşia Lotrului	1404	-4.9	-3.0	1.9	**CL**	**-17.7**	30	**8.2**	20	-	-	-	-

(Data source processed from the ANM archive).

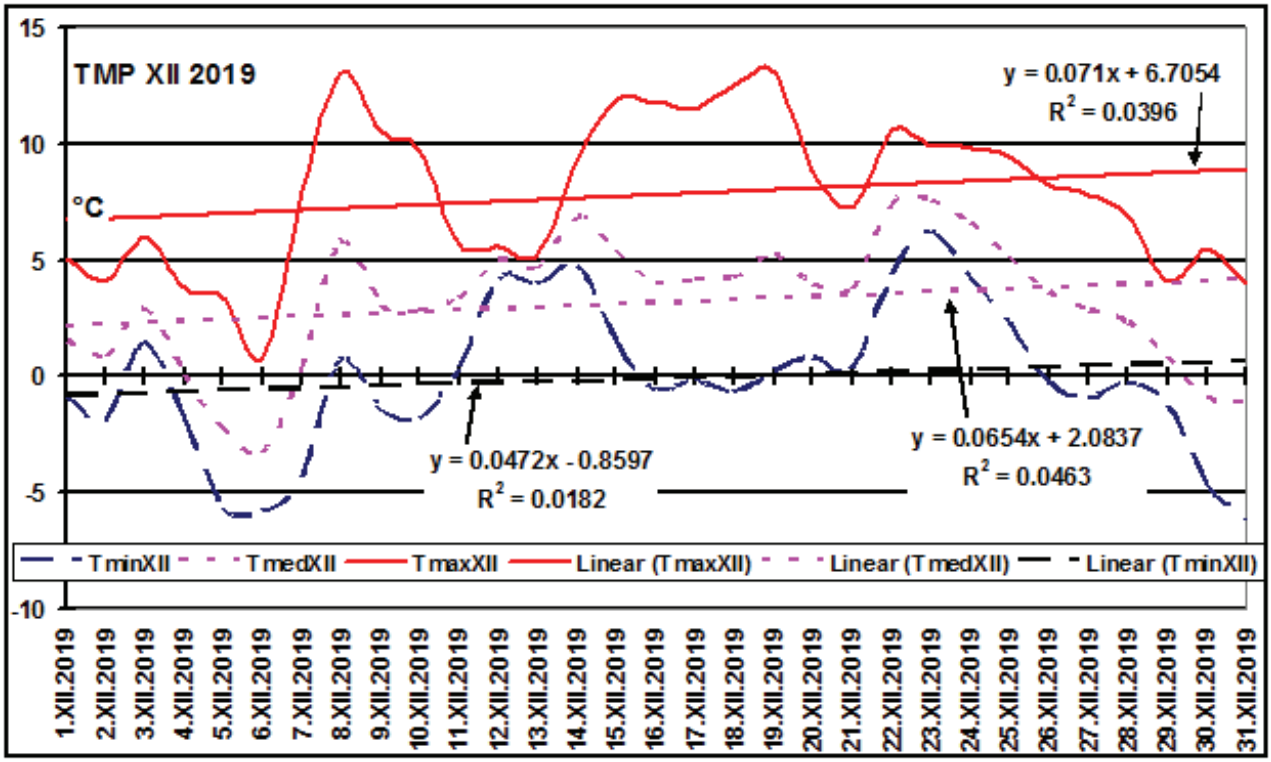

Figure 1. Variation of the parameters that characterize the air temperature (average daily minima, daily average and average daily maxima, calculated for the whole region) in December 2019. (Data source processed from the ANM archive).

2.b. The rainfall regime of January 2020. ***The monthly precipitation amounts*** were between 2.5 l/m^2 at Voineasa and 11.1 l/m^2 at Târgu Logreşti, and their percentage deviations from the norms calculated for the reference period 1901-1990 were between -94.1% in Voineasa and -69.1% Târgu Logreşti. According to the Hellmann criterion, January 2020 was excessively dry (ES) at all weather stations (Table 2).

Table 2. Rainfall quantities recorded in winter 2019-2020 (Σ), compared to normal values[6] (N); Δ% = percentage deviation from normal, CH = Hellmann's criterion.

No.	Weather station	Hm	December 2019				January 2020				February 2020			
			ΣXII	N	Δ%	CH	Σ I	N	Δ%	CH	ΣII	N	Δ%	CH
1	Drobeta Turnu Severin	77	23.5	61.2	-61.6	**ES**	5.3	51.4	-89.7	**ES**	31.1	47.9	-35.1	**FS**
2	Calafat	66	7.8	45.5	-82.9	**ES**	8.3	40.4	-79.5	**ES**	44.1	38.0	16.1	**PP**
3	Bechet	65	14.6	***36.3***	-59.8	**ES**	3.0	33.5	-91.0	**ES**	28.7	34.8	-17.5	**PS**
4	Băileşti	56	10.4	46.8	-77.8	**ES**	9.8	38.5	-74.5	**ES**	**45.7**	36.1	26.6	**P**
5	Caracal	112	18.4	39.5	-53.4	**ES**	7.1	34.7	-79.5	**ES**	34.6	34.5	0.3	**N**
6	Craiova	190	20.3	41.8	-51.4	**ES**	4.3	37.5	-88.5	**ES**	22.5	30.4	-26.0	**S**
7	Slatina	165	26.6	42.8	-37.9	**FS**	5.4	36.0	-85.0	**ES**	24.8	38.4	-35.4	**FS**
8	Bâcleş	309	***5.1***	54.7	***-90.7***	**ES**	5.9	50.5	-88.3	**ES**	27.3	44.1	-38.1	**FS**
9	Târgu Logreşti	262	33.0	44.8	-26.3	**S**	**11.1**	35.9	***-69.1***	**ES**	32.0	41.0	-22.0	**S**
10	Drăgăşani	280	44.6	44.6	**0.0**	**N**	6.0	34.1	-82.4	**ES**	37.4	35.4	5.6	**N**
11	Apa Neagră	250	**64.6**	**82.3**	-21.5	**S**	8.0	70.9	-88.7	**ES**	33.3	66.4	-49.8	**FS**
12	Târgu Jiu	210	44.7	64.0	-30.2	**FS**	7.1	53.9	-86.8	**ES**	19.8	52.0	-61.9	**ES**
13	Polovragi	546	36.7	56.1	-34.6	**FS**	7.5	48.9	-84.7	**ES**	33.9	48.4	-30.0	**S**
14	Râmnicu Vâlcea	243	24.8	46.2	-46.3	**FS**	2.8	35.5	-92.1	**ES**	21.2	38.4	-44.8	**FS**
15	Voineasa	587	15.1	55.1	-72.6	**ES**	***2.5***	42.7	***-94.1***	**ES**	***15.8***	44.0	-64.1	**ES**
16	Parâng	1585	38.0	54.6	-30.4	**FS**	19.1	57.7	-66.9	**ES**	72.0	47.7	50.9	**EP**
	Oltenia average	-	26.8	51.0	-47.5	**FS**	7.1	43.9	-83.9	**ES**	32.8	42.3	-22.6	**S**
17	Obârşia Lotrului	1404	58.4	-	-	**-**	17.3	-	-	**-**	79.2			

(Data source processed from the ANM archive).

The average monthly precipitation calculated for the entire region was 7.1 l/m^2, and its percentage deviation from the normal was 83.9%, which confirms that January 2020 was excessively dry (ES) for the entire region of Oltenia. As a result of the secondary rainfall maximum achieved in November 2019, the atmospheric drought and the high temperatures from the air and from the soil surface, on 31.I.2020, in the autumn wheat crop, the moisture content on the soil profile 0- 100 cm had low and particularly low values, with the pedological drought being moderate, isolated in the south of Oltenia. ***The groundwater reserve*** is within satisfactory limits to near optimum and optimal, on large agricultural areas in Oltenia. The tree - vine species continued their vegetative resting state. The high temperatures in the air, in the plains areas have resulted in slow and temporary resumes of the growth and development processes, especially in the cultures established in the optimum time (ANM).

Table 3. Air temperature regime in Oltenia, and minimum and maximum temperature values at the soil surface in January 2020 (NI = January norms calculated for the period 1901-1990, MI = monthly averages for January 2020; Δ = MN = temperature deviation, CH = Hellmann criterion).

Weather station	Hm	N I	M I	Δ=M-N	CH	Tmin air		Tmax air		Tmin soil		Tmax soil	
						(°C)	Data	(°C)	Data	(°C)	Data	(°C)	Data
Drobeta Turnu Severin	77	-1.1	2.3	3.4	**C**	-7.2	7	**16.1**	25	-10.7	25	**22.4**	26
Calafat	66	-1.8	**2.6**	4.4	**C**	-8.9	8	**16.2**	25	-3.9	9	18.7	26
Bechet	65	-2.2	1.0	3.2	**C**	-9.8	8	**16.0**	25	-6.6	8	21.5	26
Băileşti	56	-2.3	0.9	3.2	**C**	-8.5	8	**15.5**	25	-9.3	8	21.6	26
Caracal	112	-2.9	1.6	**4.5**	**C**	-7.7	8	**14.3**	25	**-3.7**	25	12.4	28
Craiova	190	-2.6	1.0	3.6	**C**	-8.0	7	**13.9**	25	-10.7	7;8	21.8	26
Slatina	165	-2.4	1.3	3.7	**C**	-8.9	7	**14.0**	25	-6.9	8;9	***9.2***	29
Bâcleş	309	-3.0	1.3	4.3	**C**	-7.2	8	**14.2**	26	-	-	-	-
Târgu Logreşti	262	-2.7	-1.4	***1.3***	**CL**	***-12.1***	25	**14.7**	25	***-12.5***	25	18.2	26
Drăgăşani	280	-2.2	2.1	4.3	**C**	**-6.9**	9	**14.7**	25	-6.2	9;10	17.6	25
Apa Neagră	250	-2.6	-1.1	1.5	**CL**	***-12.1***	25	**13.8**	11	-7.7	25	14.0	26
Târgu Jiu	210	-2.6	0.0	2.6	**C**	-8.7	8	**14.4**	25	-10.8	25	14.3	26
Polovragi	546	-3.2	0.6	3.8	**C**	-7.8	9	**12.7**	25	-11.5	8	18.2	25
Rm. Vâlcea	243	-2.2	1.0	3.2	**C**	-8.1	8	**12.9**	26	-10.2	8	17.3	26
Voineasa	587	-4.7	***-2.7***	2.0	**C**	-11	21	***11.3***	25	-	-	-	-
Parâng	1585	-		-	**-**	-11.1	20	**12.0**	10	-	-	-	-
Oltenia average	-	-2.6	0.7	3.3	**C**	-9.0		14.2		-8.5		17.5	26
Obârşia Lotrului	1404	-6.2	-4.8	1.4	**CL**	-17	7	**9.3**	16	-	-	-	-
Petroşani	607	-3.2	-	-	-	-14.5	7	**12.7**	26	-13.8	8	5.4	25

(Data source processed from the ANM archive).

[6] Voineasa and Bâcleş weather stations because in the cold season, they have incomplete rainfall data, they cannot be taken into account.

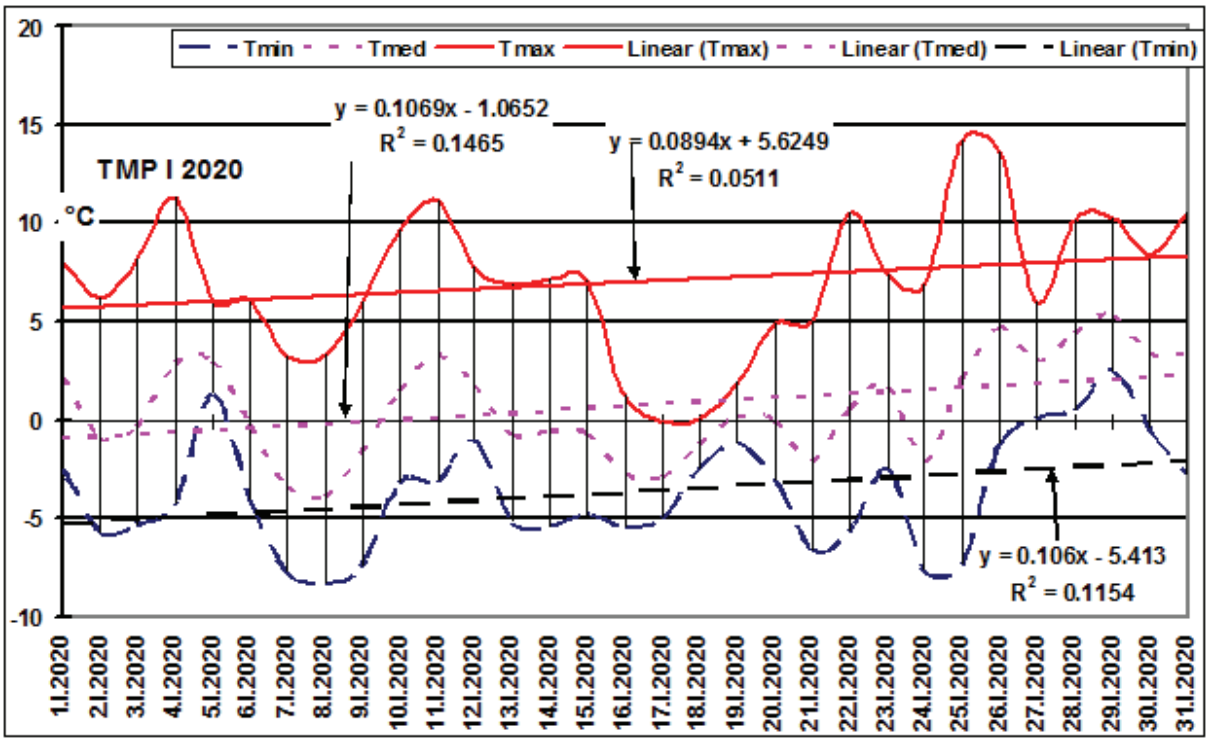

Figure 2. Variation of the parameters that characterize the air temperature (average daily minimums, daily average and average daily maximums, calculated for the whole region) in January 2020 (Data source processed from the ANM archive).

3.a. The thermal regime of February 2020. ***The monthly averages of the air temperature*** ranged from 2.6°C in Voineasa to 6.6°C in Calafat, and their deviations from the normal values were between 3.5°C at Tg. Logresti and 6.2°C in Calafat. According to the Hellmann criterion, February was very hot (FC) throughout Oltenia (Table 4). ***The general average for February*** calculated for all Oltenia was 4.91°C, and its deviation from normal was 5.37°C, which confirms that February 2020 was very hot (FC) throughout Oltenia. ***The general monthly average of 4.91°C for February 2020 is the third average in descending order in the entire history of meteorological observations*** after February 2016 with the average of 6.04°C and February 2002 with the average of 5.93°C. In the data of 1-3.II the highest daily averages calculated for the whole region were registered: 11.1°C on 1.II, 9.0°C on 2.II and 10.1°C on 3.II, and the average daily maximum for the whole region was ≥17.0°C, which justifies the choice of the heat wave from 1-3.II as a case study. ***The monthly minimums of air temperature*** were recorded on the dates of 8 and 9.II (most on 9.II.2020) and were between -9.0°C in Voineasa (8.II.2020) and - 4.8°C at Drobeta Turnu Severin and Băileşti (9.II.2020), and their average for the whole region of -6.7°C. The highest daily average value for the minimum temperatures calculated for the entire region was 6.1°C, on 1.II. In 16 days the average daily minimum for the entire region was ≥0°C, which means 16 days of spring[7] for the entire region.

The graphs of the variation of the parameters that characterize the air temperature (the average of the daily minima, the daily average and the average of the daily maxima all calculated for the whole region) in February 2020, had significantly increasing linear trends, except for the minima that had a slightly decreasing trend (Fig. 3). ***The monthly maxima of air temperature*** were recorded on the dates of 1, 2, 3, 17, 18, and 25 and 26.II.2020 (most on 26.II) and were between 16.8°C at Voineasa (18.II) and 22.7°C in Bechet (26.II) with the average for the whole region of 19.3°C. In 7 days the average daily maxima for the whole region was ≥15.0°C and in 15 days it was ≥10.0°C. ***The cold units*** were insignificant and ranged from 0 to Drobeta Turnu Severin and Calafat and 5.7 to Voineasa with the average for the entire region of 2.2. ***The heat units*** were between 79.3 in Voineasa and 190.1 in Calafat, with the average for the entire region of 144.8, which is a very hot month for agrometeorological views. The frost did not register in February. ***On the surface of the soil the monthly minimum temperatures*** were recorded in the data of 9. 10, 13, 25 and 28.II and were between -8.4°C at Râmnicu Vâlcea (9.II) and -0.7°C at Calafat (28.II), and their average for the whole region was -5.5°C. ***The monthly maximums of soil surface*** temperature were recorded in data of 1, 3, 18 and 26.II and ranged between 17.8°C in the Apa Neagră (18.II) and 31.1°C in Băileşti (26.II) with the average for the entire region of 25.2°C. All these high values of temperature in air and soil have caused the slow recovery of the vegetation phases in all types of agricultural crops but also for the whole vegetable carpet. Thus, in January, even from the first days the almond blossomed, in the interval 1-5.III there was swelling of buds on the early fruit trees: almond,

[7] It is called spring day, the day when the minimum air temperature is ≥0°C.

apricot, cherry, sour cherry, wax cherry, and on 7.III the first reported flowers of wax cherry and magnolia bloomed. On 6.II, the willow and woodcock and lilac began to freeze. ***These phenological observations*** on the evolution of the "heat indicator" plants show an extremely early discharge for spring 2020.

Table 4. The air temperature regime in Oltenia, and the minimum and maximum temperature values at the soil surface in February 2020 (N II = February normal calculated for the period 1901-1990, M II = monthly averages for February 2020; Δ = MN = temperature deviation, CH = Hellmann criterion).

Weather station	Hm	N II	M II	Δ=M-N	CH	Tmin air		Tmax air		Tmin soil		Tmax soil	
						(°C)	Data	(°C)	Data	(°C)	Data	(°C)	Data
Dr. Tr. Severin	77	0.9	6.3	5.4	**FC**	***-4.8***	9	**18.8**	26	**-8.3**	10	**27.9**	26
Calafat	66	0.4	**6.6**	**6.2**	**FC**	**-5.0**	9	**21.2**	26	**-0.7**	28	**25.2**	1
Bechet	65	-0.1	6.0	6.1	**FC**	**-5.5**	9	**22.7**	26	**-2.8**	10	**25.1**	26
Băileşti	56	-0.1	5.6	5.7	**FC**	***-4.8***	9	**21.4**	26	**-6.6**	9	**31.1**	26
Caracal	112	-0.7	5.5	**6.2**	**FC**	**-5.2**	9	**21.1**	26	**-6.4**	9	**24.6**	26
Craiova	190	-0.4	5.6	6.0	**FC**	**-4.9**	9	**20.3**	26	**-7.9**	9	**31.6**	26
Slatina	165	-0.2	5.3	5.5	**FC**	**-6.1**	9	**20.1**	26	**-2.6**	9	**18.7**	26
Bâcleş	309	-0.9	4.9	5.8	**FC**	**-5.5**	9	**18.8**	26				
Tg. Logreşti	262	-0.7	2.8	**3.5**	**C**	**-8.6**	9	**18.1**	1	**-8.0**	9	**23.2**	26
Drăgăşani	280	-0.2	5.7	5.9	**FC**	**-5.1**	8	**19.3**	26	**-4.3**	9	**22.2**	1
Apa Neagră	250	-0.6	4.0	4.6	**C**	**-8.7**	9	**19.1**	1	**-2.8**	10	***17.8***	18
Tg. Jiu	210	-0.4	4.5	4.9	**C**	**-6.4**	9	**18.7**	2	**-6.4**	25	**27.4**	26
Polovragi	546	-1.4	3.6	5.0	**FC**	**-6.6**	9	**17.6**	1	**-6.0**	13	**22.5**	18
Rm. Vâlcea	243	0.0	4.7	4.7	**C**	**-6.9**	9	**18.8**	3	***-8.4***	9	**29.8**	3
Voineasa	587	-2.5	**2.6**	5.1	**FC**	***-9.0***	8	***16.8***	18				
Parâng	1585					**-13.5**	8	**15.5**	17				
Oltenia average	-	-0.46	4.91	5.37	**FC**	-6.7		19.3		-5.5		**25.2**	
Ob. Lotrului	1404	-5.5	-2.6	2.9	**C**	**-17.9**	8	**12.2**	25				
Petroşani	607	-1.3				**-12.3**	8	**15.3**	26	**-8**	8	**12.5**	26

(Data source processed from the ANM archive)

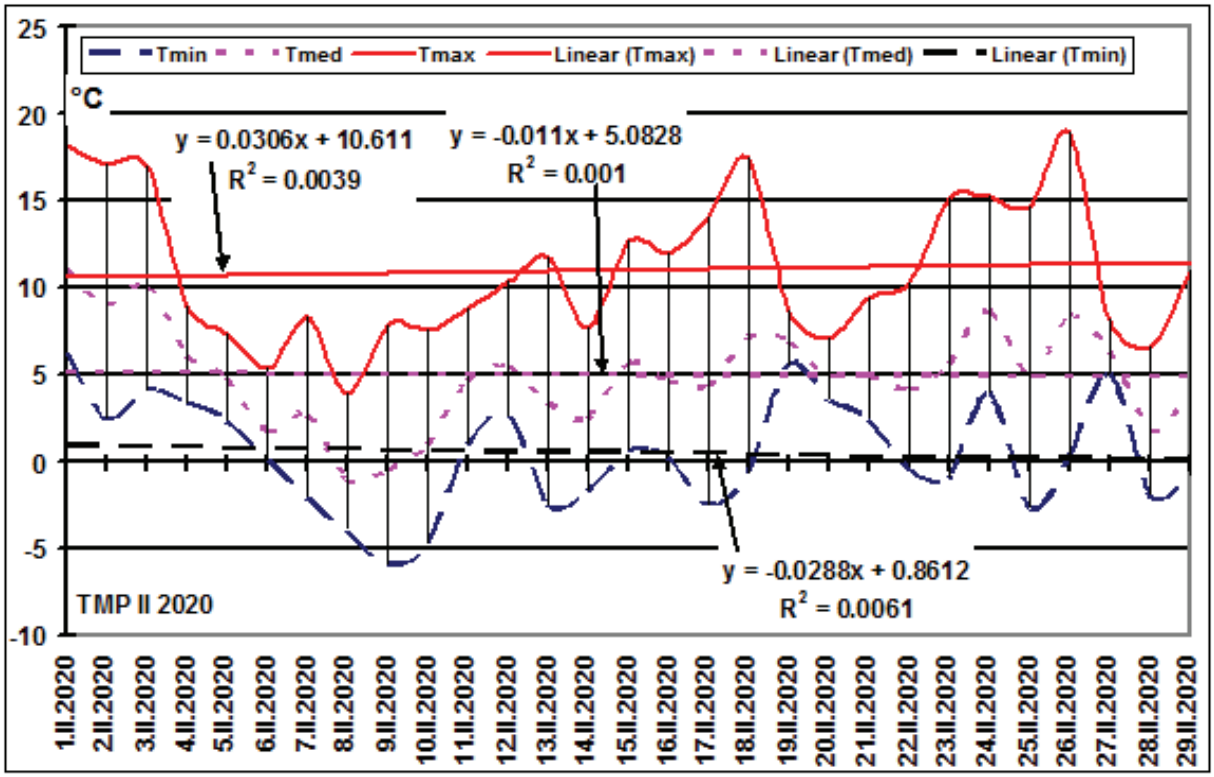

Figure 3. Variation of the parameters that characterize the air temperature (average daily minima, daily average and average daily maxima, calculated for the whole region) in February 2020 (Data source processed from the ANM archive)

3.b. The rainfall regime for February 2020

The monthly precipitation amounts ranged from 15.8 l/m^2 in Voineasa to 45.7 l/m^2 in Băileşti, and their deviations from the normal ranged from -64.1% in Voineasa to 26.6% in Băileşti. According to the Hellmann criterion, February was excessively dry (ES) at Voineasa and Târgu Jiu, very dry at Drobeta Turnu Severin, Slatina, Bâcleş, Apa Neagră and Râmnicu Vâlcea, dry (S) at Craiova, Târgu Logreşti and Polovragi, slightly rainy (PP) in Calafat, rainy (P)

in Băileşti and excessively rainy (EP) in the mountain area (Parâng). The average monthly volume calculated for the whole region was 32.8 l/m^2, and its percentage deviation from the normal one was -22.6%, which shows that according to the Hellmann criterion February, it was on average dry (S) for the entire region. As a result of the hot weather, the water consumption of the soil and the deficient precipitation, in the autumn agricultural crops on 29.II.2020. The water content on the soil depth 0-100 cm, in the autumn wheat culture, was within low and particularly low limits (moderate, strong and extremely isolated pedological drought), isolated south and center of Oltenia. The soil moisture reserve showed satisfactory values to near optimum and optimum, in Maramureş, on large agricultural areas in Oltenia.

4. Seasonal climate characteristics of the winter 2019-2020.

The seasonal averages of air temperature ranged from -0.1°C at Voineasa (the only negative average) to 4.4°C at Drobeta Turnu Severin, and their deviations from the normal ones ranged from 2.2°C at Târgu Logreşti to 4.7°C in Drăgăşani and Bâcleş. According to the Hellmann criterion, the 2019-2020 winter was very hot (FC) throughout Oltenia. The average season calculated for the whole region was 2.91°C, and its deviation from the normal of 3.86. confirming that the average winter 2019-2020 was very hot (FC) for the entire region (Table 5). The annual precipitation amounts were between 33.4 l/m^2 in Voineasa and 105.9 l/m^2 in Apa Neagră, and their percentage deviations from the normal ones were between -76.4% in Voineasa and -22.9% in Drăgăşani (Table 5). According to the Hellmann criterion, the winter 2019-2020 was excessively dry (ES) throughout Oltenia except for a restricted area in Drăgăşani (very dry - FS) and of the mountain area where it was dry (S). The average annual precipitation amounts calculated for the entire Oltenia region was 66.7 l/m^2, and its percentage deviation from normal was -51.4%, which, according to the Hellmann criterion, confirms that the winter 2019-2020 was excessively dry (ES) on average for the whole region.

DISCUSSIONS

The hottest period of winter 2019-2020 was 1-4.II.2020, with ***the peak of the heat wave***, for Oltenia and Romania on 1.II, and for Western Europe and the countries near the Western Mediterranean Sea on the date of 4.II. On 4.II.2020, after three consecutive days of particularly high temperatures when new temperature records were established that exceeded the values recorded so far in some regions, ***the peak of the heat wave*** was recorded this day. In the east of Spain the highest temperatures were registered, at the Valencia airport reached 29.6°C and a new record was set for February, in Javea/Xabia it reached 28.9°C, and the city of Alicante reached 28.6°C. The highest temperature in Spain on February 4, 2020 was 30.1°C recorded in the city of Puerto de la Cruz. In the city of Alicante it reached 28.6°C, which is the 5th highest winter temperature ever recorded in this location since 1859. In 1910, a warm day with a maximum thermal temperature of 30.0°C was recorded in Alicante. History of the records of thermal records in this city shows that the values were measured: 30.0°C on 28.II.1910, 29.0°C on 27.II.1990, 29.2°C on 7.I.1982, 28.8°C on 25 .II.1995 and 28.6°C in 4.II. 2020. We will analyse ***the synoptic situation from 1.II,*** when the ***strongest heat wave of winter 2019-2020*** affected the south-west of Romania (Oltenia), registering in Calafat the thermal maximum of 19.8°C, which means a very high temperature for this calendar date. In Oltenia on 1.II, at 12 weather stations out of 16 (75.0%) there were thermal maxima ≥18.0°C, and the area occupied by the very hot air covered the whole Balkan Peninsula and Italy. ***At ground level***, the distribution of the main barrel centers located above Europe at this time was as follows: The anticyclonic belt, present in winter in extended areas in the Northern Hemisphere, had an anticyclonic centre over the Iberian Peninsula and Northern Africa, with values at the centre slightly greater than 1025 hPa (Fig. 4), above the Asia Minor Peninsula was located an anticyclonic center with values slightly greater than 1020 hPa, and on the Russian Great Plain another anticyclonic center with values greater than 1025 hPa. North of the 45° parallel, the vast field of the Icelandic Cyclones was operating, where several centres are noted: one very strong west of the Scandinavian Peninsula with values below 965 hPa and another on the Oc. Atlantic with values below 980 hPa. At an altitude of 500 hPa (about 5000 m), in the geopotential field, a low geopotential nucleus is observed north of the 45° parallel to the northwest of the Scandinavian Peninsula with values below 488 damgp[8], and in the south, southwest of the Iberian Peninsula and above Northern Africa, a high geopotential core with values slightly above 584 damgp. Under these conditions the atmospheric circulation was southwest, Continental Tropical (cT), which brought over much of Europe, a Tropical Continental (cT) hot and dry air mass, advected from northern Africa. This phase is confirmed by the distribution of the temperature values of the thermal field at the level of 850 hPa (Fig. 5). In Fig. 5, it is observed that the clad air at this date (1.II.2020), in which the maximum advection was reached, the warm air was extended north to south from the Scandinavian Peninsula (0°C isotherm) to the south of England and to southern Scandinavia. Above the Iberian Peninsula are observed the isotherms of 10 and 12°C, and above the isotherm of 8.0°C. On the date of 4.II when temperature values that frequently exceeded ≥ 25.0°C and reached the value of 30.1°C (Puerto de la Cruz) were recorded in the countries around the Western Mediterranean Sea, the 15.0°C isotherm was positioned above the Iberian Peninsula and In North Africa, but the expansion of hot air over Europe did not exceed the southern half of Romania.

[8] Damgp= geopotential decameter

The blizzard episode. After the most significant heat wave of February, the most significant cooling of the weather followed in February. The cold wave started with the rapid cooling of the weather on the night of 5/6.II.2020, accompanied by precipitation, initially in the form of rain and then turned into snow and snow. Snow was accompanied by intensification of the wind, as the frost affected an extended area from south-eastern Oltenia to Dobrogea. At the level of the whole country, the area affected by the intensifications of wind and blizzard was in S, SE, E and NE of Romania. The wind gusts were: 80 km/h in Brăila, 54 m/s in Ţarcu, 35 m/s in Griviţa, 216 km/h in Sinaia. In Cheia from Prahova county, hundreds of trees were broken and thrown down, some of them on the road.

Table 5. The overall rainfall and thermal regime of winter 2019-2020. (Hm = altitude of the weather station, W`19 -`20 = average of temperature values in winter 2019-2020 (°C), NW = normal values of seasonal averages of winter temperature (°C), Δ = WN = deviations of average temperatures compared to normal (°C) CrH = Hellmann criterion; SW = sum of rainfall in winter 2019-2020 (l/m^2), NW = normal values of winter precipitation (l/m^2), Δ = SN = deviations from normal (l/m^2), Δ% = percentage deviations from normal).

No.	Weather station	Hm	Thermal regime (°C)				Pluviometric regime (l/m^2)				
			W`19-`20	NW	Δ=W-N	CrH	SW	NW	Δ=S-N	Δ%	CrH
1	Drobeta Turnu Severin	77	**4.4**	0.4	4.0	**FC**	59.9	160.5	-100.6	-62.7	**ES**
2	Calafat	66	4.3	-0.1	4.4	**FC**	60.2	123.9	-63.7	-51.4	**ES**
3	Bechet	65	3.3	-0.6	3.9	**FC**	46.3	104.6	-58.3	-55.7	**ES**
4	Băileşti	56	3.2	-0.7	3.9	**FC**	65.9	121.4	-55.5	-45.7	**ES**
5	Caracal	112	3.5	-1.2	4.7	**FC**	60.1	108.7	-48.6	-44.7	**ES**
6	Craiova	190	3.4	-1.0	4.4	**FC**	47.1	109.7	-62.6	-57.1	**ES**
7	Slatina	165	3.4	-0.8	4.2	**FC**	56.8	117.2	-60.4	-51.5	**ES**
8	Bâcleş	309	3.3	-1.4	**4.7**	**FC**	38.3	149.3	-111.0	-74.3	**ES**
9	Târgu Logreşti	262	1.1	-1.1	***2.2***	**FC**	76.1	121.7	-45.6	-37.5	**ES**
10	Drăgăşani	280	4.1	-0.6	**4.7**	**FC**	88.0	114.1	***-26.1***	**-22.9**	**FS**
11	Apa Neagră	250	1.6	-1.0	2.6	**FC**	**105.9**	219.6	***-113.7***	-51.8	**ES**
12	Târgu Jiu	210	2.4	-1.0	3.4	**FC**	71.6	169.9	-98.3	-57.9	**ES**
13	Polovragi	546	2.5	-1.5	4.0	**FC**	78.1	153.4	-75.3	-49.1	**ES**
14	Râmnicu Vâlcea	243	3.2	-0.6	3.8	**FC**	48.8	120.1	-71.3	-59.4	**ES**
15	Voineasa	573	***-0.1***	-3.0	2.9	**FC**	***33.4***	141.8	-108.4	***-76.4***	**ES**
16	Parâng	1585					129.1	160.0	-30.9	**-19.3**	**S**
	Oltenia average	-	2.91	-0.95	3.86	**FC**	66.7	137.2	-70.5	-51.4	**ES**
17	Obârşia Lotrului	1348	-3.5	-5.5	2.0	**C**	154.9				
18	Petroşani	607		-1.7			111.3	139.5	-28.2	-20.2	**S**

(Data source processed from the ANM archive).

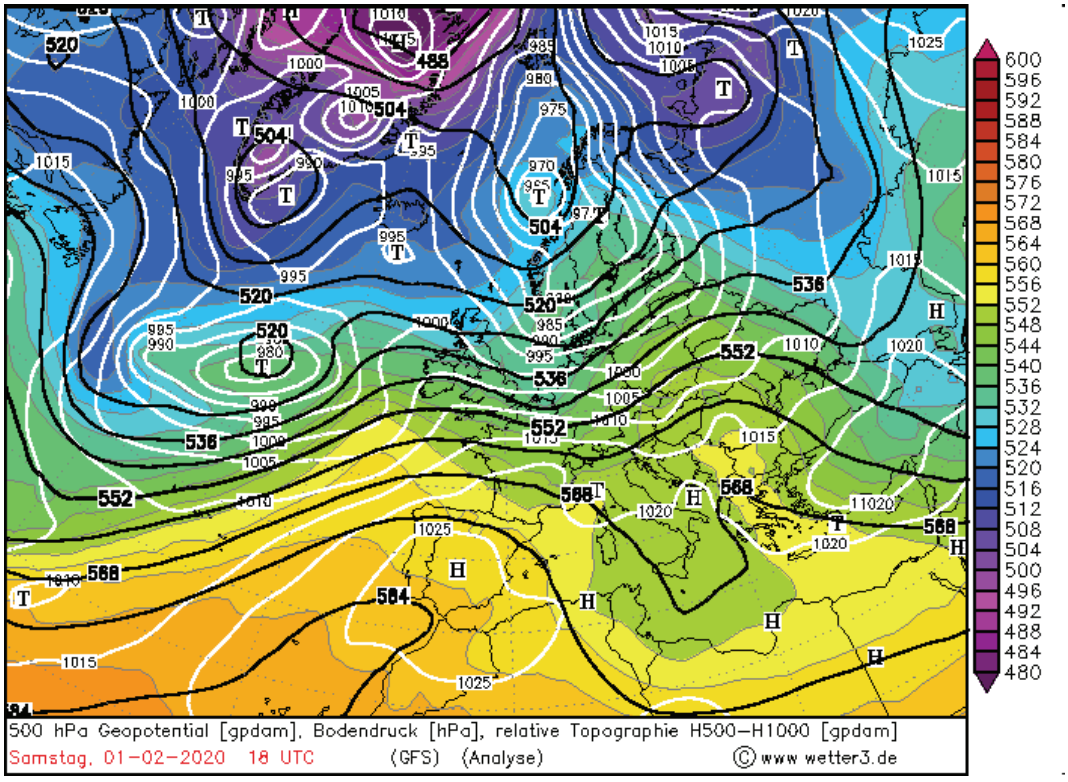

Figure 4. The synoptic situation at the ground surface level (the atmospheric pressure field) superimposed with the synoptic situation at altitude (the geopotential field at the level of 500 hPa - about 5000 m altitude) and the field of relative barographic topography (TR 500/1000) from 1.II. 2020 now 18 UTC. (***. www.wetterr3.de).

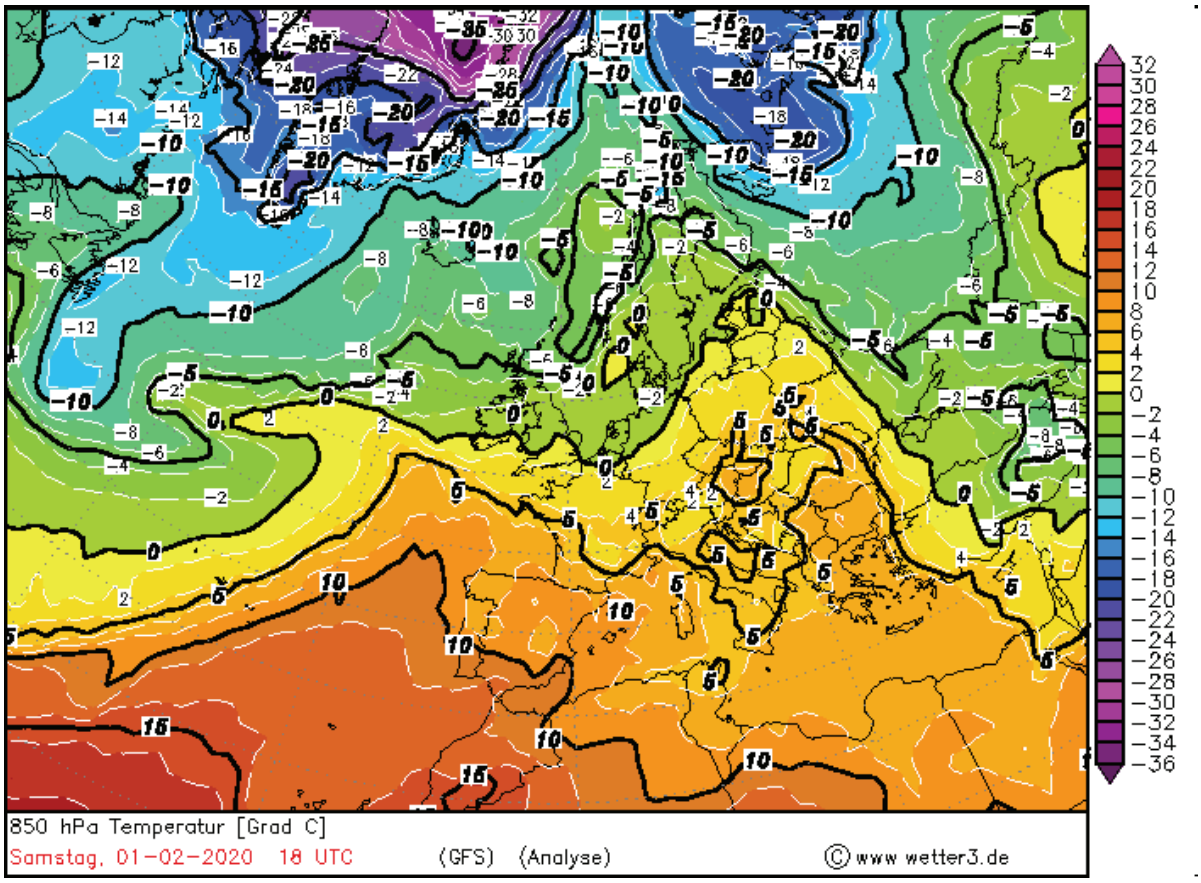

Figure 5. The temperature field at the level of the geopotential surface at the level 850 hPa - about 1500 m altitude) from 1.II.2020 at 18 UTC. (***. www.wetterr3.de).

The journalists spoke of a tornado in the mountain area (of course there was no tornado, but it was safe to say). It was estimated that the wind speed was 217 km/h in the area with tree tops. It formed a snow layer with thicknesses of 34 cm at Videle (at 08), 33 cm at Zimnicea, 25 cm at Alexandria, 23 cm at Turnu Măgurele, 22 cm at Videle, ***35 cm at Giurgiu*** (at 14), 10 cm at Caracal, 4 cm at Slatina, 3 cm at Drăgăşani, 2 cm at Craiova and 1 cm at Băileşti (Fig. 6). In the mentioned area, at Zimnicea, it was the largest layer of snow in winter 2019-2020. Three people died in the blizzard, two elderly women, each from the localities of Ghimpaţi and Ion Roată, and a 37-year-old from Griviţa (Romania TV, 6.II.2020). The quantities of precipitation recorded in the area affected by the blizzard: Craiova 5.6 l/m^2, Slatina 10.0 l/m^2, Calafat 14.8 l/m^2, Bechet 16.2 l/m^2, Băileşti 19.8 l/m^2, Caracal 27.2 l/m^2, Zimnicea 58.0 l/m^2, Turnu Măgurele 41.5 l/m^2, Roşiori de Vede 36.1 l/m^2, Giurgiu 42.3 l/m^2, Videle 32.0 l/m^2, Bucharest Filaret 32.3 l/m^2, Oltenița 25.4 l/m^2, Călăraşi 20.6 l/m^2, Griviţa 10.4 l/m^2, Stolnici 11.7 l/m^2, Adamclisi 27.8 l/m^2, Mangalia 23.9 l/m^2, Jurilovca 34.4 l/m^2, Gura Portiţei 29.9 l/m^2, Hârşova 16.6 l/m^2, Gorgova 28.5 l/m^2, Tulcea 24.7 l/m^2, Constanța 15.2 l/m^2. During the night 5/6.II.2020, the wind speed at the gust reached 216 km/h in the counties of Bacău, Covasna, Harghita, Maramureş, Neamţ and Suceava, and 100,000 hectares of forest were laid down, a wood mass estimated at over 700,000 m^3 (Romania TV). The greatest damages were registered in the counties of Bacău, Covasna, Harghita, Maramureş and as a result the massive reforestation of the destroyed areas was decided. In Oltenia, for the most part, the rainfall was liquid, and the snow layer was recorded and significant only in the south-eastern half of Olt county. In most of Oltenia there was no snow start (Fig. 6). Until 8.II.2020 at 14 o'clock the snow layer disappeared from Oltenia, and from the area with maximum thickness (Giurgiu) it disappeared until 12.II.2020 at 14. After this snow episode, the weather cooling continued, and the peak of cooling was registered on 9.II.2020, when 13 monthly minimum values were recorded for February from 16 weather stations (81.3%).

The synoptic causes of this short winter episode. On 6.II.2020 at 00 UTC, the above-mentioned meteorological phenomena (snow, wind intensities and mist) were in full swing. At this time, on the synoptic map from the ground surface the position of the main barricades of action of the atmosphere was as follows: in the back of the North African Anticyclone extending over the west and the north of Europe, we observe an anticyclonic nucleus positioned above France and Germany, with values at centre ≥ 1035 hPa. To the northwest of this vast anticyclonic field, to the west of Iceland there was a strong Icelandic Cyclone with values at the centre ≤965 hPa. To the southeast of this ridge, above the eastern Mediterranean Sea and above the Black Sea, was located a vast Mediterranean Cyclone with values in the center ≤ 1000 hPa. These Cyclone-Anticyclone coupling made over Romania between the Mediterranean Cyclone and the anticyclonic field in Central and Western Europe is specific to the situation of blizzard in the east and south-east of Romania. In the lower troposphere air circulation over Romania was northeast, advancing

cold continental polar air (cPk) from the Eastern European Plain, and from the Mediterranean Sea a mass of moist, tropical maritime (mT) (above the Mediterranean) air in the mix with the one above the Black Sea colder but still wet, which was transported to the northeast and then recirculated from the northeast direction over Romania (Fig. 7). At the level of 500 hPa, we have a blockage in atmospheric circulation (the 552 damgp isohypse has the form of the Greek letter "Ω"). The ridge of the high geopotential field is extended north to south by Iceland, and to the west and east of it two low geopotential talwegs in which the low geopotential nuclei are identified: one south-west of Greenland with values at centre ≤496 damgp and another above the Balkan Peninsula with values at the centre of ≤ 536 damgp. Under these conditions in the middle troposphere above Romania, a cold continental polar air mass (cPk) was predicted. At 850 hPa (about 1500 m altitude), cold air advection is observed over Eastern Europe, 0°C isotherm positioned on the coast of Africa, as well as hot air advection over western Europe to northern Iceland (Fig. 8). Above Romania there is a cold air mass with values slightly below -10°C. This alternation of hot air advection on the back of the jam and cold air on the front of the jam is specific to the blockage circulation. After the advection of the cold air mass over Eastern and South-Eastern Europe and after the cessation of snow, the cooling of the air continued so that the peak of cooling was registered on 9.II (for the North of Oltenia 8.II2020, when the monthly minimum temperatures were recorded).

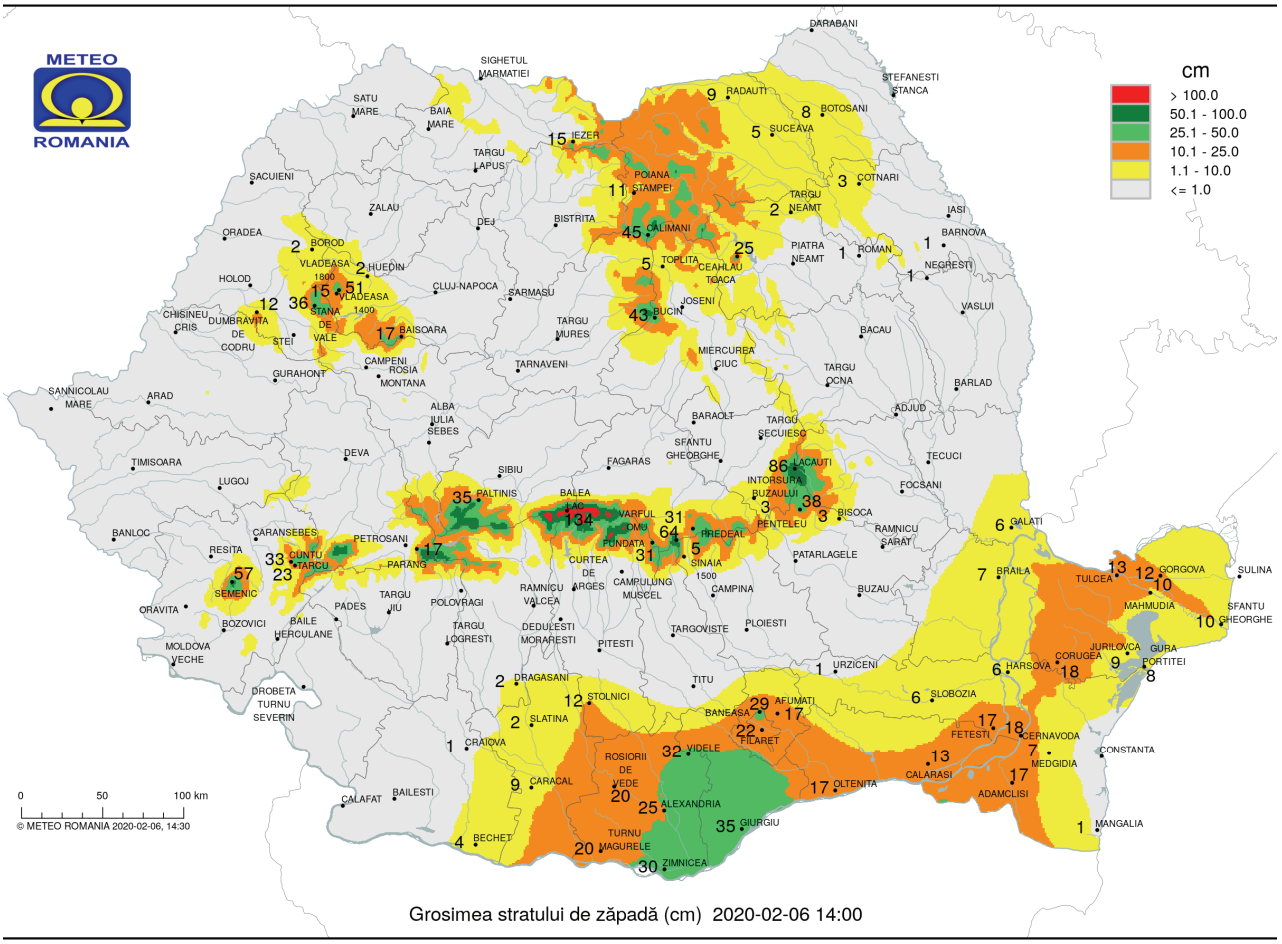

Figure 6. The snow layer from 6.II.2020 at 14:00 (NAM archive).

CONCLUSIONS

The winter of 2019-2020 was a very warm winter (FC) with an average of 2.89°C and a deviation from the normal of 3.84°C, which means the second warmest winter in the entire history of meteorological observations, after the winter 2006-2007, with an exceptional average of 3.44°C and a deviation of 4.39°C, which constituted the absolute climatic record of warm winters. The term Mediterranean winter was first introduced in 2007 (BOGDAN et al., 2007), regarding winter 2006-2007, meaning a warm winter, almost devoid of snow layer or with insignificant layer and short duration. The third warm winter in descending order of the seasonal average of temperature was winter 2015-2016 with the seasonal average of 2.88°C and the deviation from the normal of 3.83°C, but which was marked by January 2016 with the monthly average for the whole region of -2.58°C and the deviation from the normal of -0.025°C, ie normal thermal month (N) of winter and with significant snow cover. In winter 2019-2020 the snow layer was present only 2 days, in the extreme southeast of Olt County, between 6-7.II, and the maximum thickness was 10 cm at Caracal (Fig. 8).

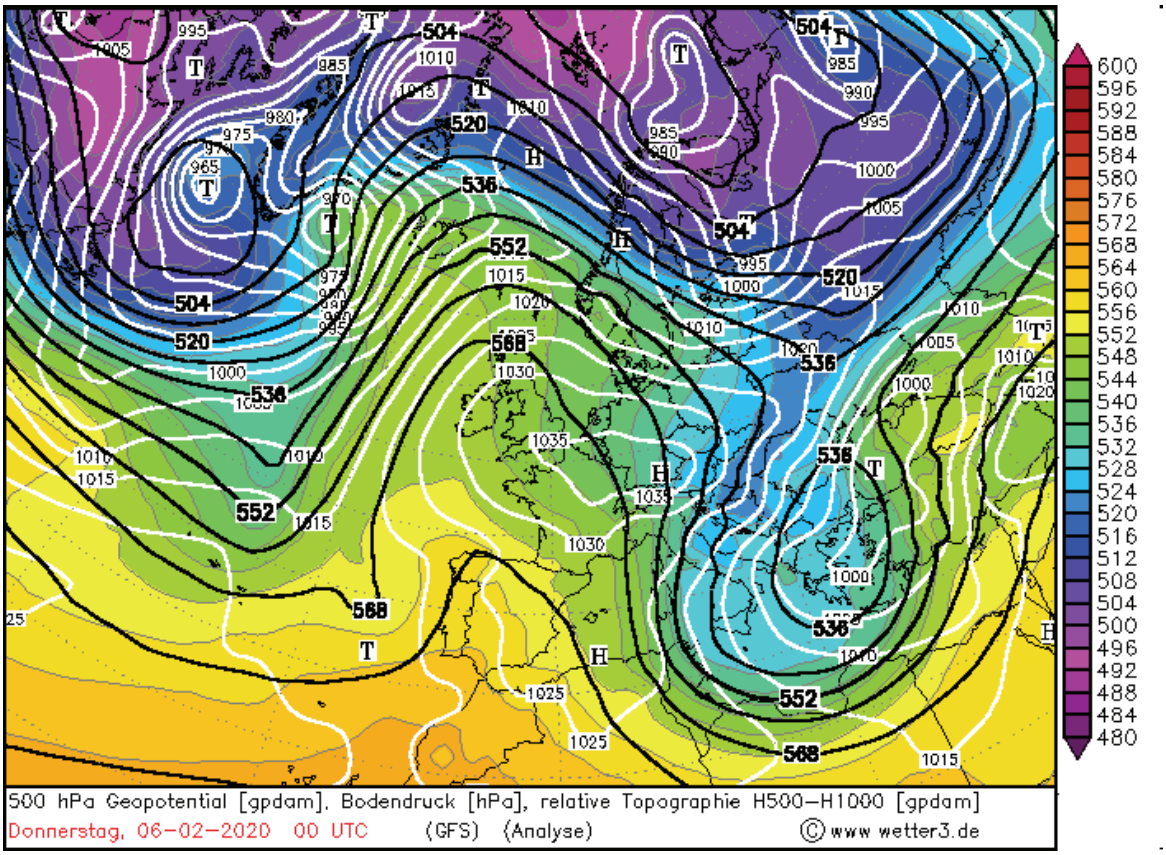

Figure 7. The synoptic situation at the ground surface level (the atmospheric pressure field) superimposed with the synoptic situation at altitude (the geopotential field at the level of 500 hPa - about 5000 m altitude) and the field of relative barographic topography (TR 500/1000) from 6.II. 2020 now 06 UTC. (***. www.wetterr3.de)

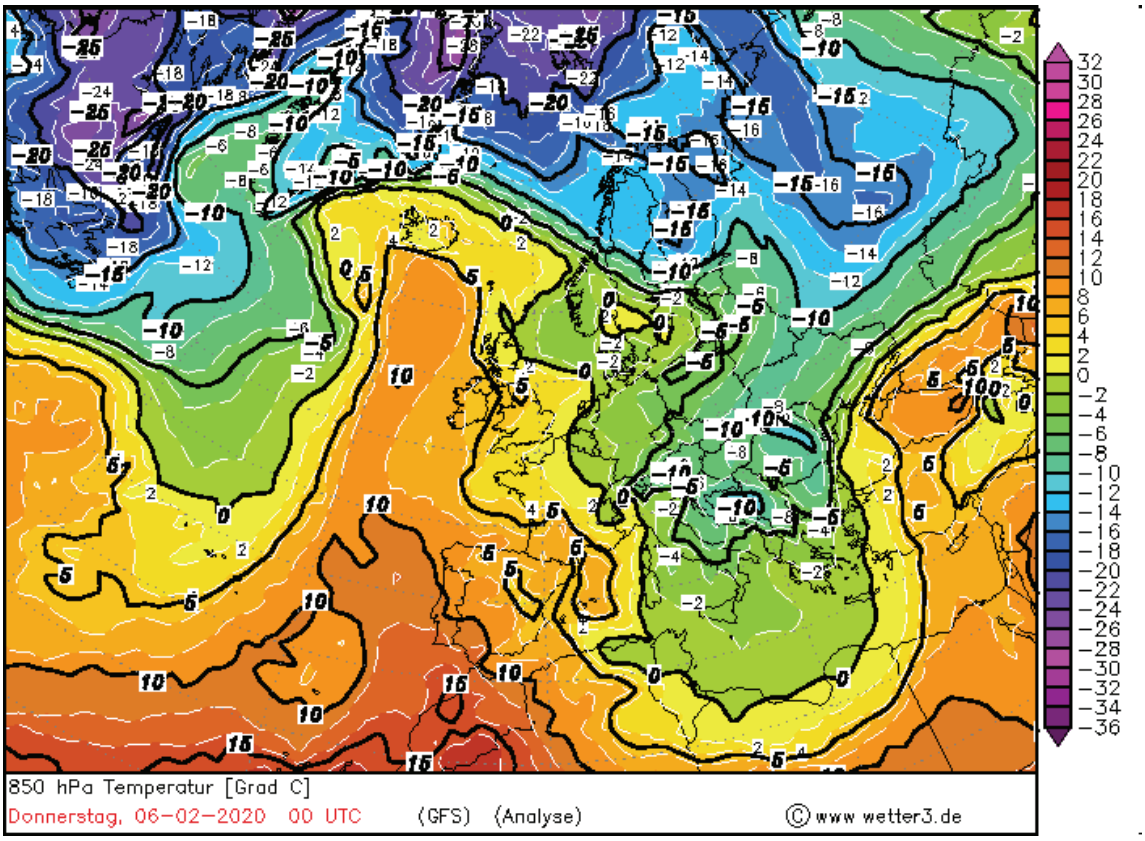

Figure 8. The temperature field at the geopotential surface level at 850 hPa - about 1500 m altitude) from 6.II.2020 at 00 UTC. (***. www.wetterr3.de).

The winter of 2019-2020 was very hot in all its ensemble with the warm December (C) with the average of 3.13°C and the deviation of 2.92°C, the month of January 2020 was. December 2019 was the third warm month, in the entire history of meteorological observations, in the decreasing order of the average monthly values of temperature calculated for the entire region after December 2015, with the average of 5.19°C (absent climate record) and December 1979 with an average of 3.21°C. January was the 9th warm month in the decreasing order of monthly average temperature values for the entire region, the absolute climatic record is held since January 1983 with the average of 2.62°C. For the whole winter, the cold units were between 10.5 at Drobeta Turnu Severin and 140.9 at Voineasa, and the heat units between 122.6 at Voineasa and 407.5 at Dr. Severin, confirming that the 2019-2020 winter was very hot and from the agrometeorological point of view, the agrometeorological freeze totally missing. The rainfall regime was poor, the whole season being excessively dry with the average for the entire region of 66.7 l/m^2 and the percentage deviation from the normal of -51.4%. The driest month was January 2020 with an average for the entire region of 7.1 l/m^2 and the percentage deviation from the normal of -83.9%. Thus, we record the second winter of the Mediterranean type in Oltenia, with a difference of the seasonal average temperature of 0.55°C compared to the first, which confirms the continuation of the climatic heating at regional level, although the El Niño climatic process was absent, and the solar activity at minimum. At the same time, these results show a further extension of the influence of the Mediterranean climate towards the north (MARINICĂ & MARINICĂ, 2012; 2016). The winter of 2019-2020 was warm and with a thin layer of snow and covered large areas of Eurasia and even the Northern Hemisphere, as a result of the beginning of the December 12, 2019 coronavirus (2019-nCoV) epidemic in downtown Wuhan China, which subsequently spread across the globe (1-8.III.2020) becoming a pandemic (11.III.2020 - WHO Declaration) and affecting not only the people, but also having serious consequences on the economy of many countries. In a warm winter, this is a special climate risk that can have multiple serious consequences, on large areas of the Earth.

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