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Agroclimatic Conditions in Oltenia During the Spring of 2011

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Abstract

The paper analyses the climatic and agroclimatic conditions during the spring of 2011. Although the climatic global warming process continues, in some years, the climatic evolutions are atypical in Oltenia as well as in the entire country, and, consequently, the spring of 2011 was cold and droughty. Compared to the last 12 springs, the thermal regime indicates that the spring of 2011 was unique, and the pluviometric regime that it was droughty, although the agricultural crops were not affected due to the lower thermal regime that maintained a satisfactory degree of the soil humidity. The late spring hoarfrosts on 7 and 8 May have also had damaging effects in Oltenia. In consequence, there were some stagnation periods for the agricultural crops, and some important delays for the vegetables crops, and there were significant damages in the places where the seedlings were removed in the field. As a consequence of the thermal variations, there have been some diseases and pests, especially Monilinia laxa in stone fruits. Although the periods of weather cooling are considered beneficial to the climate general evolution on the planet, if they appear in the late spring, they represent an important climatic risk factor. Thus, their forecast is welcome especially for the agriculture. This paper is useful for the Ph.D. and master graduates and to all the researchers in the climate and agroclimate field.

Keywords: *monthly temperature means, Hellman criterion, cold spring, spring phenomena, vegetative processes*

Rezumat. Condiţiile agroclimatice din Oltenia în primăvara anului 2011

În lucrare sunt analizate condiţiile climatice şi agroclimatice din primăvara 2011. Deşi procesul de încălzire climatică globală continuă, în unii ani evoluţiile climatice în Oltenia ca şi în întreaga ţară sunt atipice, astfel primăvara 2011 a fost rece şi secetoasă. Unică sub aspect termic, în şirul ultimelor 12 primăveri, iar sub aspect pluviometric a fost secetoasa în toată regiunea, deşi culturile agricole nu au avut de suferit datorită regimului termic, mai scăzut decât cel normal, care a dus la menţinerea gradului de umiditate în sol la un nivel satisfăcător. Brumele târzii de primăvară apărute în datele de 7 şi 8 mai au avut efecte distructive în Oltenia. Ca urmare culturile agricole au avut perioade de stagnare, iar la culturile de legume s-au produs întârzieri importante pentru perioadele de înfiinţare, iar acolo unde răsadurile au fost scoase în câmp s-au înregistrat pagube importante. Ca urmare a variaţiilor termice au apărut o serie de boli şi dăunători şi în special monilioza la speciile de sâmburoase. Perioadele de răcire a vremii, deşi considerate benefice pentru evoluţia generală a climatului pe planetă, dacă survin primăvara târziu sunt factor important de risc climatic. De aceea prognozarea lor este binevenită în special pentru agricultură. Lucrarea este utilă doctoranzilor masteranzilor şi tuturor cercetătorilor în domeniul climei şi agroclimei.

Cuvinte-cheie: *medii lunare de temperatură, criteriul Hellmann, primăvară rece, fenomene de primăvară, procese vegetative*

Introduction

The bioclimatic conditions are interconditioned by the climatic conditions during the spring, all of them influencing the ecosystems, including the economy and society. It is known that, in the last 30 years, the frequency of the early springs has increased, notably in the south-west of the country (Oltenia), but also in the entire country as well as at the level of the European continent. The cold and normal springs have been increasingly rare. It should be noted that the spring **of 2001 was cold**, and some climatic records were registered. The effect of the little early (LE) spring

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arrival on the vegetation- its small development, was cancelled out by April and May, which were cold months with low thermal regime. In the spring of 2011, the climatic conditions hardly returned to more normal levels in the second decade of May. We will further analyze the climatic conditions of the spring of 2011. This analysis is a continuation of a series of extensive studies related to the ever increasingly numerous climatic oscillations and risks as a follow up of the climatic variability in the South-Western part of Romania. (Bogdan, Octavia, and collaborators, 2008, 2009, 2010, 2011) (Marinică, 2006).

Methods

The index of spring arrival in 2011

The index of spring arrival is defined as **the sum of the daily temperature average values ≥ 0°C registered in the period 1 February - 10 April**. The analysis of the indexes of spring arrival registered in 2011 and of the percent deviations from the multiannual means calculated for the interval 1901-1990, revealed the following aspects:

According to the percent deviation value (24.7%) from the multiannual general mean for the entire region, the spring arrival of 2011 was a little early (LE) (table no. 1).

According to the percent deviations value from the multiannual means of the spring arrival index calculated for all the meteorological stations in Oltenia, a normal spring was registered in the extreme south of the region (the areas Dr. Tr. Severin, Calafat, Bechet and Băileşti) (table no. 1); a little early (LE) in Caracal, Craiova, Slatina Tg Jiu and Rm. Vâlcea, early (E) in Bâcleş, Apa Neagră and Polovragi and very early (VE) in Tg. Logreşti, and in the high mountainous area, in Parâng, excessively early (EE), confirming the climatic warming of the mountainous area (Fig. 1).

It should be noted that the **thermal inversion** phenomenon was frequent in this winter and in the first two months of spring, which explains the high frequency of the high temperature values from the hilly areas. At the level of the continent, the atmospheric blockage circulations were frequent, the different positions of the circulation blockage favouring the cold advections from north-west and north on the descending part of the blockage, and the warm advections from south and south-west on the ascending part, and, thus, series of alternations of cold and warm weather were produced.

Table 1 The indexes of spring arrival 2011 (I2001; in °C)

Meteorologic station	Hm[1]	I**Normal**	I2011	Δ%	Clas.
Dr. Tr. Severin	77	357.4	380.3	6.4	**N**
Calafat	66	343.9	350.9	2.0	**N**
Bechet	65	320.7	352.4	9.9	**N**
Băileşti	56	316.6	342.5	8.2	**N**
Caracal	112	294.8	332.1	12.7	LE
Craiova	190	282.5	335.2	18.7	LE
Slatina	165	257.8	327.9	27.2	LE
Bâcleş	309	236.3	311.7	31.9	**E**
Tg. Logreşti	262	237.3	401.0	69.0	**VE**
Drăgăşani	280	257.8	359.4	39.4	**E**
Apa Neagră	250	234.3	319.2	36.2	**E**
Tg. Jiu	210	279.5	333.8	19.4	LE
Polovragi	546	205.6	285.2	38.7	**E**
Rm. Vâlcea	243	291.1	345.9	18.8	LE
Voineasa	587	154.5	-	-	-
Ob. Lotrului	1404	-	-	-	-
Parâng	1585	23.0	86.5	276.1	**EE**
Mean for Oltenia		255.8	327.4	24.7	LE

Source: Data processed according to the Oltenia MRC Archive

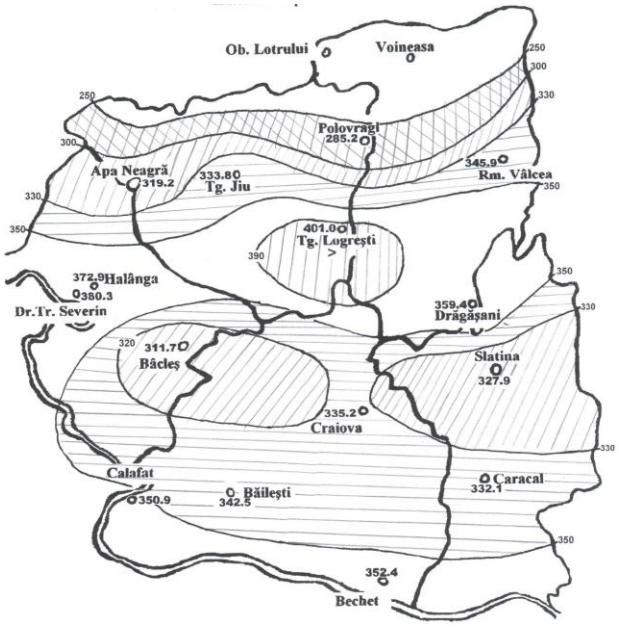

Fig. 1 The index of spring arrival in 2011 (°C)

There has been registered a frequency of the days in which the warm air advections from the Transylvanian Plateau on the wide Olt Couloir was felt in Rm. Vâlcea and Drăgăşani and which, combined with the effect of the thermal inversions led to maximum and minimum daily values for

[1] Hm= altitude of the meteorological station; INormal= Normal Index of spring arrival

these two stations higher than in the rest of the region. There were fewer warm advections on the Jiu Couloir, and they had a light effect due to the strong meandering of this gorge and its narrowness compared with the Olt Gorge.

Nevertheless, the spring arrival was a little early (LE) in Rm. Vâlcea and early (E) in Drăgăşani which is emphasized by the value of the percent deviations from the multiannual means.

April and May were cool, and in some periods even cold, which determined the extremely slow vegetation development and even its stagnation. Late hoarfrosts were registered, and between 6 and 7 May 2011 the weather cooling led to late hoarfrosts. (In the north and north-east of the country, in the aforementioned period, the weather was excessively cold. Thus, on 7 May 2011, it snowed in the mountainous region of Suceava, Maramureş and Bistriţa-Năsăud counties, in the morning it snowed abundantly in Moldoviţa and Ulma communes, close to the border with Ukraine. The road traffic took place under winter conditions on DN17, in Mestecăniş pass area. Between Vatra Dornei and Câmpulung Moldovenesc the snow layer measured 5 cm. The heavy cars climbed the slopes with difficulty because they were not equipped with winter tyres. It snowed on DN 17; in Palma Pass, the snow layer on the roadway measured 3 cm. In Straja and Parâng ski resorts it was snowing during this period, a strong wind blew, and the temperatures highly decreased on 7 May 2011).

Discussion

This interval of cool weather and associated phenomena practically cancelled the effect of the little early spring arrival (LE).

Climatic characteristics of March 2011

The thermal regime of March 2011

Usually, in March the air thermal regime has spectacular variations passing from the wintry negative values to the specific warm season positive values. The thermal balance passes from negative values to positive values. In most of the years this change happens before the spring equinox.

The monthly air temperature means were comprised between -1.5°C in Tg. Logreşti and 2.2°C in Dr. Tr. Severin, and their deviations from the multiannual means (calculated for the interval 1901-1990) were comprised between -5.4°C in Apa Neagră (Gorj county) and -2.2°C in Polovragi (Gorj county), and according to Hellmann classification criterion, March was cold (CL) in most of the region, excepting the areas of Tg. Logreşti and Apa Neagră, where it was very cold (VC). The deviation of the monthly mean calculated for the entire region was -3.6°C, which classifies March as a cold (CL) month for the entire region (table no. 2). Until 10 March, the daily means were negative, then they became positive, and the highest means were registered between 24 and 27 March. The smallest thermal means were registered on 1 and 2 March.

The daily maximum thermal values became positive starting with 4 March.

The monthly minimum air temperature values were registered in the first decade and were comprised between -14.4°C registered in Apa Neagră on 9 March and -7.2°C registered in Drăgăşani on 1 March, and in Calafat in the south- west of Oltenia, which is usually the warmest area, the minimum thermal value was -13.2°C registered on 10 March.

The monthly maximum difference of the daily minimum air temperatures was 25.1°C registered in Calafat.

The monthly maximum air temperature values were registered, starting with 15 March, and most of them in the last decade, and were comprised between 18.7°C, registered in Polovragi on 16 March and 23°C registered in Calafat on 25 March. *The monthly maximum difference of the daily maximum air temperatures* was 25.8°C registered in Calafat, which means an average increase of the maximum thermal values with 0.8°C/day.

The maximum difference of air temperature (maximum difference is the difference between the monthly maximum temperature in March 2011 - monthly maximum value for the entire region - and the minimum temperature in the region - monthly minimum thermal value for the entire region) for the entire region was 37.4°C, reflecting the intensity of air warming and the important energetic transformations which happened in this month. In March 2011, 4 intervals of weather warming (3-6 March; 10-16 March; 22-27 March, 29-31 March) and cooling (1-3 March; 6-16 March; 17-22 March; 27-29 March) were registered, thus marking 5 significant thermal alternations (Fig. 2), and the linear tendency of air temperature was increasing.

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Table 2 The air temperature in March 2011 and the minimum temperatures at the soil surface (°C). The monthly means during 2011 (M), normal (N), the deviation from the normal value (ΔT), the monthly minimum temperature (Tmin), the monthly maximum temperature (Tmax) and the day they were registered

Meteorologic station	Hm	N.III	M	Δ=M-N	CH	MinT (air)		MaxT (air)		Min T surface soil			
						(°C)	Date TMin	(°C)	Date TMax	Cm	Date Cm	CM	Date CM
Dr. Tr. Severin	77	5.9	**2.2**	-3.7	CL	-8.0	8	22.1	25	-14.4	8	6.6	30
Calafat	66	5.6	1.5	-4.1	CL	-13.2	10	**23.0**	25	-16.2	1	**7.6**	27
Bechet	65	5.4	1.4	-4.0	CL	-7.9	5	22.5	15	-7.5	9	6.0	30
Băileşti	56	5.4	0.5	-4.9	CL	-11.5	8	22.4	26	-14.6	9	6.8	30
Caracal	112	4.9	1.4	-3.5	CL	-9.5	5	20.7	25	-11.0	1	6.2	17;30
Craiova	190	5.1	1.0	-4.1	CL	-10.1	1	21.0	25	-14.0	1	6.2	30
Slatina	165	5.0	1.1	-3.9	CL	-10.3	1	20.7	25	-10.4	8	5.7	30
Bâcleş	309	4.5	1.0	-3.5	CL	-9.5	9	19.5	25	**-18.9**	1	6.7	30
Tg. Logreşti	262	3.6	**-1.5**	-5.1	VC	-13.4	8	21.4	25	-12.7	9	6.2	30
Drăgăşani	280	4.7	2.0	-2.7	CL	**-7.2**	1	21.6	15	-10.2	2	5.0	17
Apa Neagră	250	4.2	-1.2	**-5.4**	VC	**-14.4**	9	21.8	25	-16.0	6	6.4	30
Tg. Jiu	210	4.8	0.6	-4.2	CL	-9.7	9	22.0	25	**-6.5**	8	6.8	30
Polovragi	546	3.0	0.8	**-2.2**	CL	-12.0	9	**18.7**	16	**-18.9**	9	**4.0**	19;30
Rm. Vâlcea	243	5.0	1.5	-3.5	CL	-8.0	8	21.7	15	-9.9	9	6.0	30;31
Voineasa	587	2.4	0.0	-2.4	CL	-10.3	10	19.3	15;25				
Parâng	1585	-3.1	-3.3	-0.2	N	-14.1	8	10.7	16				
Mean for Oltenia		4.2	0.6	-3.6	CL	-10.6		20.6		-12.9		6.2	
Ob. Lotrului		-2.4	-2.6	-0.2	N	-10.3	10	19.3	15;25				

(Source: Data processed according to the Oltenia MRC Archive)
Cm= The lowest minimum recorded daily on the surface (minimum monthly) CM= The highest recorded daily minimum soil surface

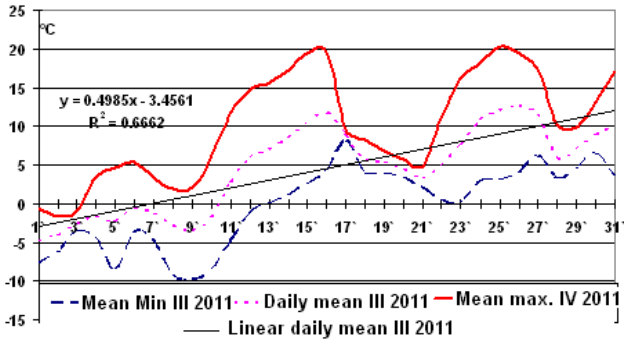

Fig. 2 The chart of the daily average temperature variation, daily minimum temperatures mean and daily maximum temperatures mean calculated for the entire region of Oltenia during March 2011

(Source processed data)

The thermal regime at soil surface registered important variations, passing from frozen soil in the first decade to unfrozen soil starting with 11 March.

The monthly minimum thermal values at the soil surface were comprised between -18.9°C registered in Polovragi and Bâcleş on 1 and 9 March and -6.5°C registered in Tg. Jiu on 8 March becoming positive in the entire region starting with 16 March .

As a consequence of the weather warming, the highest minimum daily temperatures at the soil surface were comprised between 4.0°C in Polovragi registered on 19 and 30 March and 7.6°C registered in Calafat on 27 March.

The maximum thermal difference of the minimum values at the soil surface was 25.6°C, registered in Bâcleş, and 26.5°C for the entire region.

There were various **climatic phenomena during March 2011** which comprised snowfalls and blizzards, wintry phenomena, in the first decade (6-7 March meteorological forecast of abundant snowfalls and wind intensifications) and warm season specific phenomena, rainfalls and sometimes heavy rainfalls and thunder.

Snow layer. In the first 8 days of the month, the snow layer was compact in the entire region, and until 14 March it had completely disappeared. The maximum thickness of the snow layer registered in Oltenia reached 37 cm in Apa Neagră on 4 March, being higher than the maximum thickness registered in all the three winter months. The slow continuation of the vegetative processes started

beginning with 10 March, once with the changing of the thermal balance.

The pluviometric regime of March 2011

The monthly quantities of precipitations were comprised between 5.2 l/m2 registered in Voineasa and 48.6 l/m2 registered in Apa Neagră, and the *percent deviations of the quantities of precipitations* from the monthly multiannual means were comprised between -86.3% in Voineasa and 10.2% in Calafat. The classification of the pluviometric time type for the meteorological stations in Oltenia showed that it was Excessively Droughty (ED) in the areas of submountainous and mountainous high hills and little rainy (LR) in Calafat in the south-west of the region (table no. 3).

Table 3 The quantities of precipitations registered during the spring of 2011 (Σ), compared to the normal values (N for the period 1901-1990), the deviation (%) and the pluviometric time type according to the Hellmann criterion (CH)

Meterologic station	Hm	March 2011				April 2011			
		ΣIII	N	Δ%	CH	ΣIV	N	Δ%	CH
Dr. Tr. Severin	77	31.9	49.3	-35.3	VD	14.6	56.5	-74.2	ED
Calafat	66	42.0	38.1	10.2	LR	20.2	47.3	-57.3	ED
Bechet	65	22.3	36.3	-38.6	VD	32.0	48.5	-34.0	VD
Băileşti	56	33.4	38.3	-12.8	LD	24.9	49.4	-49.6	VD
Caracal	112	28.1	35.7	-21.3	D	19.2	45.1	-57.4	ED
Craiova	190	27.6	31.5	-12.4	LD	38.8	43.1	-10.0	N
Slatina	165	38.1	37.5	1.6	N	38.0	47.4	-19.8	LD
Bâcleş	309	29.8	43.1	-30.9	VD	20.2	54.5	-62.9	ED
Tg. Logreşti	262	22.1	37.9	-41.7	VD	14.8	49.9	-70.3	ED
Drăgăşani	280	10.0	37.4	-73.3	ED	43.2	40.1	7.7	N
Apa Neagră	250	48.6	63.6	-23.6	D	14.3	76.4	-81.3	ED
Tg. Jiu	210	32.2	43.8	-26.5	D	5.8	64.0	-90.9	ED
Polovragi	546	33.6	50.9	-34.0	VD	15.4	70.4	-78.1	ED
Rm. Vâlcea	243	26.5	36.8	-28.0	D	26.4	58.5	-54.9	ED
Voineasa	587	5.2	37.9	-86.3	ED	21.8	67.2	-67.6	ED
Parâng	1585	13.5	53.0	-74.5	ED	37.8	86.3	-56.2	ED
Mean f. Oltenia		27.8	41.9	-33.7	VD	24.2	56.5	-57.2	ED
Ob. Lotrului		10.6				27.2			
Meterologic station	Hm	May 2011				Spring 2011			
		ΣV	N	Δ%	CH	ΣS	N	Δ%	CH
Dr. Tr. Severin	77	20.8	80.7	-74.2	ED	67.3	186.5	-63.9	ED
Calafat	66	19.8	60.8	-67.4	ED	82.0	146.2	-43.9	VD
Bechet	65	50.4	58.6	-14.0	LD	104.7	143.4	-27.0	D
Băileşti	56	34.1	70.1	-51.4	ED	92.4	157.8	-41.4	VD
Caracal	112	40.4	61.4	-34.2	VD	87.7	142.2	-38.3	VD
Craiova	190	72.0	60.6	18.8	LR	138.4	135.2	2.4	N
Slatina	165	91.8	64.8	41.7	VR	167.9	149.7	12.2	LR
Bâcleş	309	16.3	74.9	-78.2	ED	66.3	172.5	-61.6	ED
Tg. Logreşti	262	74.2	73.4	1.1	N	111.1	161.2	-31.1	VD
Drăgăşani	280	54.0	69.7	-22.5	D	107.2	147.2	-27.2	D
Apa Neagră	250	52.1	108.8	-52.1	ED	115.0	248.8	-53.8	ED
Tg. Jiu	210	69.4	85.3	-18.6	LD	107.4	193.1	-44.4	VD
Polovragi	546	76.8	103.9	-26.1	D	125.8	225.2	-44.1	VD
Rm. Vâlcea	243	45.6	97.3	-53.1	ED	98.5	192.6	-48.9	ED
Voineasa	587	60.8	95.5	-36.3	VD	87.8	200.6	-56.2	ED
Parâng	1585	111.8	124.1	-9.9	N	163.1	263.4	-38.1	VD
Mean f. Oltenia		55.6	80.6	-31.0	VD	107.7	179.1	-39.9	VD
Ob. Lotrului		91.6				129.4			

(Source: Data processed according to the Oltenia MRC Archive)

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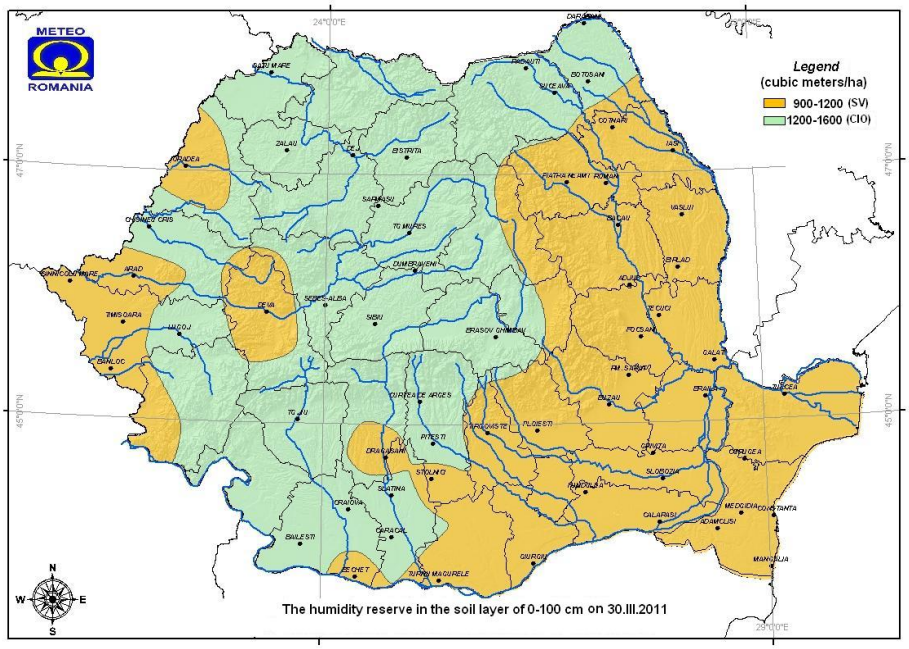

Fig. 3 The humidity reserve in the soil layer of 0-100 cm in the autumn wheat crop on 30 March 2011 (According to NMA Bucharest)

The monthly quantities of precipitations mean calculated for the entire region was 27.8 l/m2, and the its percent deviation from the multiannual average value was -33.7%, which means a very droughty month.

The water soil reserve. On March 30, 2011, the humidity content which is accessible to the autumn wheat plants, in the soil layer of 0-100 cm, reached satisfactory values (SV) on the restricted areas in the south of Vâlcea county, the extreme south of Dolj county, and close to optimum limits (ClO) in the most part of the region (Fig. 3).

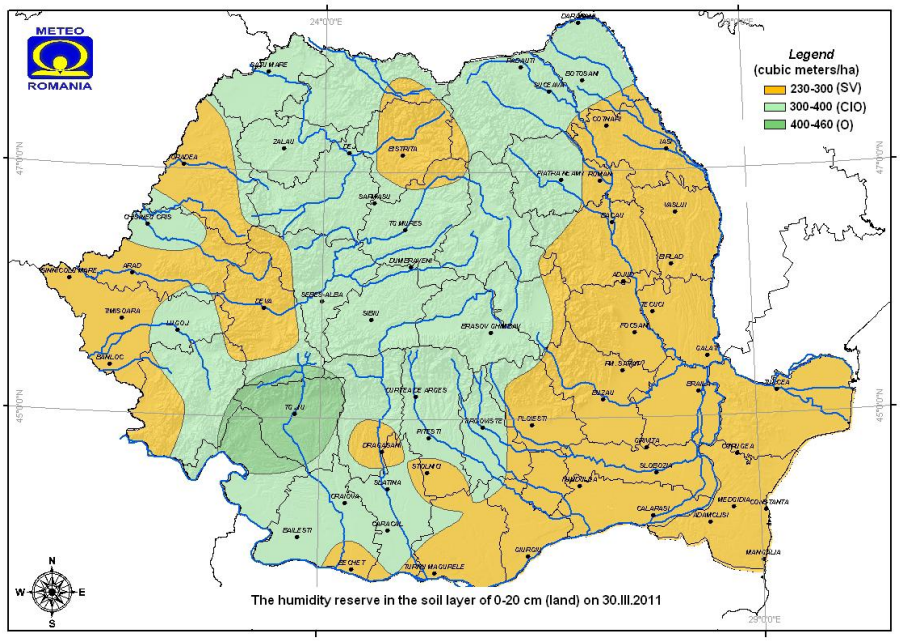

Fig. 4 The humidity reserve in the soil layer of 0-20 cm (land) on 30 March 2011 (According to NMA Bucharest)

For the spring crops, the humidity reserve on the soil profile of 0-20 cm (land), maintained satisfactory values (SV) in the aforementioned areas and in restricted areas of the east Olt county, close to optimum (ClO) and optimum (O) values in the most agricultural territory of the region (Fig. 4). The relative good condition of the water reserve is due to the water accumulation in soil from the precipitation fallen during winter and autumn, as well as the low temperatures which did not produced an intense evaporation in this month.

Climatic characteristics of April 2011

The air temperature. The monthly air temperatures means were comprised between 4.6°C in Voineasa in the north of the region and 10.0°C in Dr. Tr. Severin in the South-West.

Their deviations from the multiannual means calculated for the interval 1901-1990 were comprised between -3.7°C in Tg. Logreşti (in Amaradia Hills) and in the Subcarpathian Depression Apa Neagră -1.9°C in Dr. Tr. Severin. According to the Hellman criterion it is a cold month (CL) in the entire region excepting a restricted area in the south-west (Dr. Tr. Severin) and the mountainous area (Parâng) where, taking into account the thermal aspect, the warmer advections were less frequent (Dr. Tr. Severin). In the mountainous area this aspect is due to thermal inversion phenomenon, which occurred in many days and in April.

The average temperature in April calculated for the entire region was 7.7°C, and its deviation from the

multiannual mean was -2.7°C, thus confirming the classification of cold month (CL) for the entire region (table no. 4).

Table 4 The air temperature in April 2011 and the minimum temperatures at the soil surface (°C). The monthly means in April 2011 (M), normal (N), the deviation from the normal temperature (ΔT), the monthly minimum temperature (minT), the monthly maximum temperature (maxT) and the day in which they were registered

Meteorologic station	Hm	NIV	M	Δ=M-N	CH	MinT (air)		MaxT (air)		Min T surface soil			
						(°C)	Date	(°C)	Date	Cm	Date	CM	Date
Dr. Tr. Severin	77	11.9	**10**	**-1.9**	CO	**4.1**	1;7	**24.1**	1	**2.0**	11	10.8	9
Calafat	66	11.8	9.6	-2.2	CL	2.5	24	23.5	7	-1.6	18	11.9	8
Bechet	65	12.0	8.6	-3.4	CL	-0.4	16	22.3	7;30	0.0	16	**12.0**	9
Băileşti	56	11.9	8.8	-3.1	CL	1.6	16	23.6	7	-0.8	16	10.6	28
Caracal	112	11.6	8.3	-3.3	CL	2.0	11	22.3	30	-0.4	12	10.5	30
Craiova	190	11.5	8.3	-3.2	CL	1.7	11	21.8	7	2.0	11	10.8	9
Slatina	165	11.4	8.6	-2.8	CL	1.5	18	22.2	30	0.4	11	8.2	20
Bâcleş	309	10.2	8.0	-2.2	CL	1.0	11	21.5	7	-1.9	18	8.6	29
Tg. Logreşti	262	10.3	6.6	**-3.7**	CL	-2.1	11	21.8	20	-3.1	11	8.2	6;28
Drăgăşani	280	10.9	8.7	-2.2	CL	1.3	11	22.0	30	0.4	11	10.2	29
Apa Neagră	250	10.1	6.4	**-3.7**	CL	**-3.0**	11	21.8	7	-2.5	11	**12.0**	8
Tg. Jiu	210	10.9	8.9	-2.0	CL	0.2	15	22.6	30	**-0.2**	15	10.2	28
Polovragi	546	10.4	8.0	-2.4	CL	-2.3	15	**20.0**	29	**-5.3**	11	**7.8**	28
Rm. Vâlcea	243	10.8	8.4	-2.4	CL	0.6	15	21.9	29	-1.0	15	10.0	28
Voineasa	587	7.7	**4.6**	-3.1	CL	-0.8	4	20.7	20				
Parâng	1585	2.3	0.9	-1.4	CO	-6.6	11	13.0	20				
Mean for Oltenia		10.4	7.7	-2.7	CL	0.1		21.6					
Ob. Lotrului		2.0	0.9	-1.1	CO	-4.1	11	14.3	20				

The monthly minimum air temperatures were comprised between -3°C in Apa Neagră and 4.1°C in Dr. Tr. Severin, all of them being registered in the interval 11-18 April, and in Calafat on 24, which means the emergence of some intense late and long term cooling. Dr. Tr. Severin is an exception, since the thermal minimum temperature was registered on 1 and 7. The monthly minimum temperature mean for this month was of just 0.1°C, an exceptional low value for the month of April.

At 7 meteorological stations, situated on all the relief forms, minimum temperatures ≤0°C (two of the mountainous areas: Ob. Lotrului and Parâng) (Bechet, Tg. Logreşti, Apa Neagră, Polovragi şi Voineasa) were registered, thus the phenomenon of frost in the air took place, and the number of days with such temperatures, excepting the mountainous areas, varied from 2 to 6 (6 days in the Subcarpathian Depression Apa Neagră).

In the mountainous areas, in Parâng, there were registered 13 days of minimum temperatures ≤0°C, and 23 days in Ob. Lotrului. In the same areas, there were registered 5 days with sleet and snowfalls, and the snow layer appeared again (maximum thickness 19 cm in Parâng on 15 April).

As a consequence, there was registered an equal number of days with hoarfrost, and regarding this dangerous meteorological phenomenon in April, it is useful to mention that due to the extension of automatic meteorological stations, they do not signal neither this phenomenon nor the type of precipitations (rainfall, sleet, snowfall, heavy rainfall, etc.). It can be deduced, but only to a certain extend. Some days with hoarfrost were **very late**, for example: in Bechet on 16 April, in Tg. Logreşti on 24 April , in Apa Neagră on 26 April, etc. affecting the vegetation, the orchards and vineyards which were in a stage of full development on the respective dates.

The highest daily minimum temperatures were mostly registered in the last two days of the month (excepting the south-west stations which registered the maximum values on 7 April) and were comprised between 20.0°C in Polovragi registered on 29 April and 24.1°C in Dr. Tr. Severin on 1 April (the only meteorological station in which the maximum value was registered on 1 April) and they were a little higher than those registered in March (1-2°C).

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In April we mention 6 intervals of air cooling of which the most severe and dangerous for the agroclimatic conditions were those between 10-12 April, 14-18 April and 22-26 April (Fig. 5) when low temperatures in some meteorological stations were ≤ 0°C.

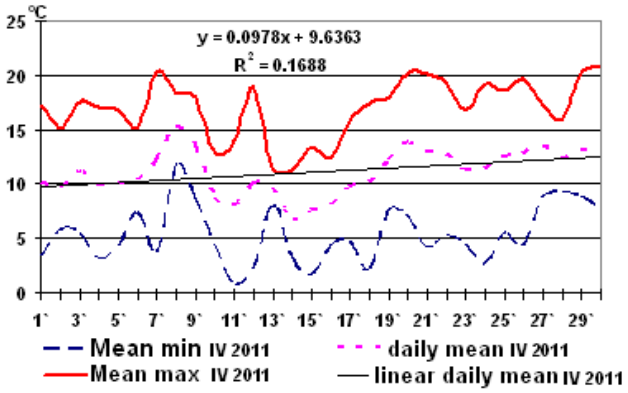

Fig. 5 The chart of the daily average temperature variation, the daily minimum temperature mean and the maximum temperature mean calculated for the entire region of Oltenia in April 2011

The monthly minimum temperatures at the soil surface were ≤ 0°C for 64.3% of the region's stations (to 9 of 14 stations) and were comprised between -5.3°C in Polovragi and 2.0°C in Dr. Tr. Severin, thus causing the phenomenon of frost on the ground. We also can note that two stations (Slatina and Drăgăşani) registered a minimum temperature at the soil surface of only 0.4°C, value which determines the phenomenon of hoarfrost. It should also be noticed that all these values were registered in the interval 11-18 April, causing the phenomenon of late frost at the soil surface.

The highest daily minimum values at the soil surface were comprised between 7.8°C in Rm Vâlcea, recorded on 28 April and 12.0°C registered on 8 April in Apa Neagră and 9 April in Bechet, most of them were registered in the last 3 days of the month.

The number of days with minimum temperatures at the soil surface of ≤0°C was comprised between 1 (in Bechet, Caracal and Tg. Jiu) and 6 in Bâcleş, and the latest day with frost on the ground being 26 April in Apa Neagra, in the areas of the Subcarpathian depressions, on the high relief form (250 m altitude) and 16 April in Bechet (65 m altitude) on the lowest relief form.

All these lead us to consider **April 2011 as very cold**, in fact colder than the classification according to the Hellmann criterion, which does not take into account the minimum temperatures at the soil surface neither the late date on which it occurred nor the period of time with a thermal regime lower than the normal.

As a consequence of this period of cold weather the stagnation of vegetation development occurred, and then, the degradation of some crops, damages of orchards, vineyards and vegetable gardens, especially where seedlings were removed in the field.

The pluviometric regime in April 2011

The monthly quantities of precipitations were deficient in the almost entire region and they were within 5.8 l/m2 in Tg. Jiu and 43.2 l/m2 in Drăgăşani; their percent deviations were comprised between -90.9% in Tg. Jiu and 7.7% in Drăgăşani. According to the Hellmann criterion, pluviometrically, April was excessively droughty (ED) for the most part of Oltenia and only on restricted areas in Craiova and Drăgăşani it was pluviometrically normal (N). (table no. 3).

The monthly precipitations mean calculated for the entire region of Oltenia was 24.2 1/m2, and its percent deviation from the multiannual mean was –57.2%, which confirms the classification according to the Hellmann criterion as an excessively droughty month.

The humidity reserve in the soil. On April 29, 2011, in autumn wheat crop, the humidity reserve accessible for plants in the soil depth of 0-100 cm, was satisfactory (SV) in most of Oltenia and close to optimum (ClO) in the north-east of Vâlcea County (Fig. 6).

In the soil layer of 0-20 cm (land), the water reserve was in satisfactory limits (SV) in most of the region. Locally, in Central and South-Eastern Oltenia there were registered moderate humidity deficits in the soil (moderate pedological drought – MD) (Fig. 7).

The situation of water reserve can be considered relatively good and it is due to the low air temperature which did not produced an intense and massive evaporation of soil water and maintained the water reserve in the aforementioned limits. The stress of the lack of water in the superficial soil layer, together with the low air and soil temperatures, manifested in some periods, especially by delaying the rising of spring crops in optimum time, although the sowing calendar date was optimum.

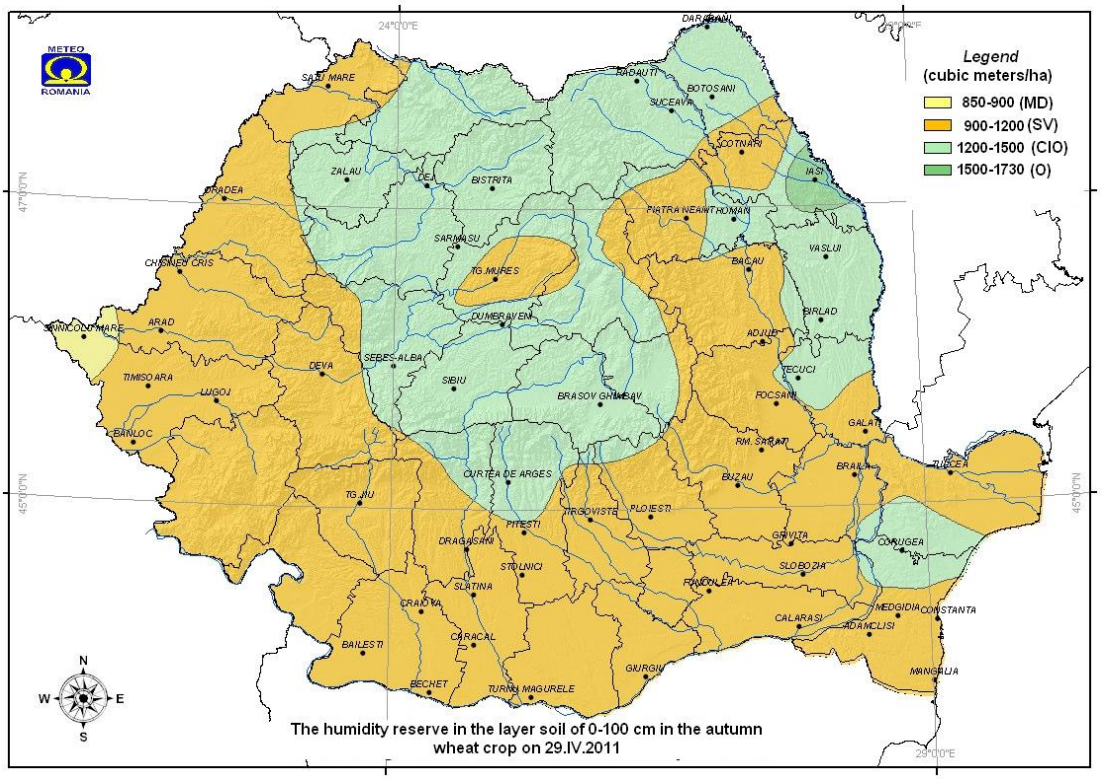

Fig. 6 The humidity reserve in the layer soil of 0-100 cm in the autumn wheat crop on 29.IV.2011 (According to NMA Bucharest)

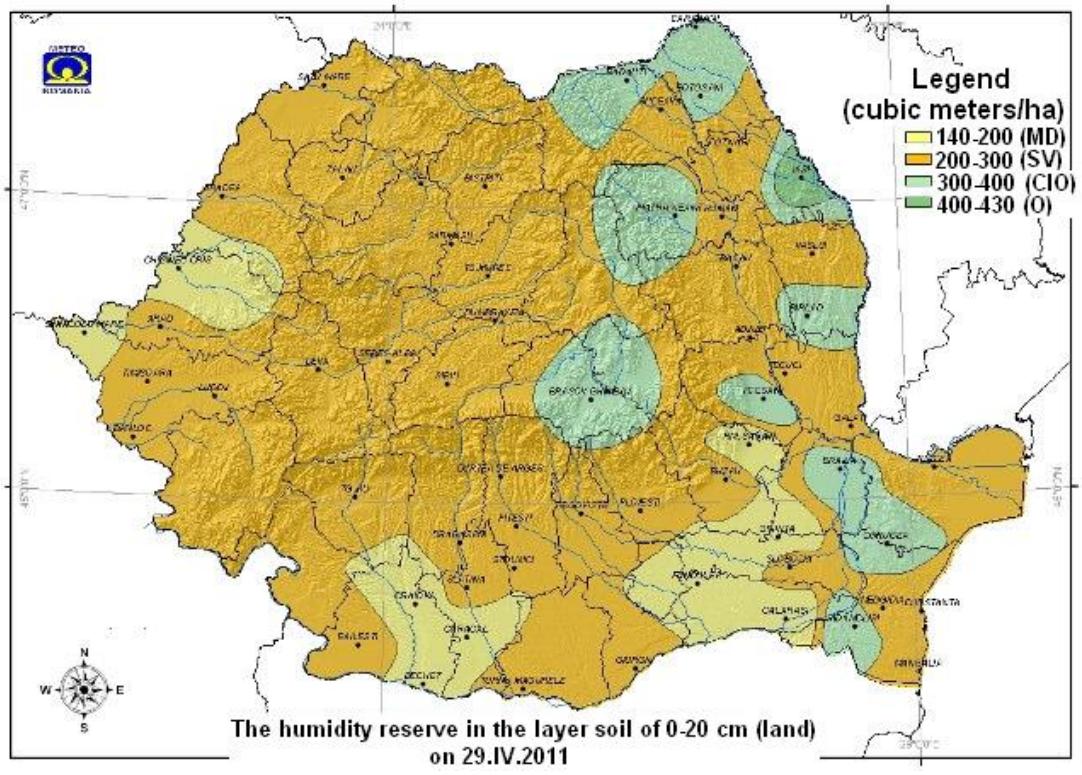

Fig. 7 The humidity reserve in the layer soil of 0-20 cm (land) on 29.IV.2011 (According to NMA Bucharest)

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Climatic characteristics of May 2011

The thermal regime of May 2011. *Air temperature. The monthly air temperatures means* were comprised between 9.0°C in Voineasa and 15.2°C in Dr. Tr. Severin, and their deviations from the multiannual means were all negative and were comprised between -3.3°C in Tg. Logreşti and -0.6°C in Polovragi. According to the Hellmann criterion, May was cold (CL) in most of the region and cool (CO) on restricted areas in Dr. Tr. Severin, Drăgăşani, Tg. Jiu and Ob. Lotrului. (At Ob. Lotrului Station, the multiannual means are calculated on a shorter period, that is 35 years, the station started to function in 1976 and had some periods of activity interruption, that is why we did not take it into account when we calculated the mean for Oltenia region. The Parâng meteorological station is significant for the mountainous areas of Oltenia, although it pertains to Hunedoara county it has a large range of data). In the mountainous and submountainous areas, May was normal (N) (table no. 5).

The monthly minimum temperatures were comprised between -3.2°C in Apa Neagră, registered on 6 May and 4.6°C in Caracal on 8 May. In the areas with an altitude of over 250 m, there were registered days with minimum temperatures ≤°C (frost in air), thus counting: in Tg. Logreşti one day, in Apa Neagră 2 days, in Voineasa 2 days, in Parâng 5 days, and in Ob. Lotrului 11 days.

Table 5 The air temperature and the minimum temperatures at the soil surface of May 2011 (°C). The monthly means in May 2011 (M), normal (N), the deviation from the normal temperature (ΔT), the monthly minimum temperature (Tmin), the monthly maximum temperature (Tmax) and the day in which they were registered

Meteorologic station	Hm	N.V	M	Δ=M-N	CH	TMin (aer) (°C)	TMin (aer) Data TMin	TMax (aer) (°C)	TMax (aer) Data TMax	T min la suprafața solului Cm	T min la suprafața solului Data Cm	T min la suprafața solului CM	T min la suprafața solului Data CM
Dr. Tr. Severin	77	17.1	**15.2**	-1.9	CO	2.4	6	30.1	30	0.1	6	15.4	29
Calafat	66	17.3	14.9	-2.4	CL	4.2	9	**30.2**	30	2.9	9	16.1	26
Bechet	65	17.5	14.4	-3.1	CL	3.2	9	29.7	24	3.0	7	16.0	26
Băileşti	56	17.4	14.2	-3.2	CL	2.4	6	29.3	25	0.5	6	16.9	26
Caracal	112	17.1	14.3	-2.8	CL	**4.6**	8	28.0	25	2.6	7	14.1	26
Craiova	190	17.0	13.8	-3.2	CL	3.6	6	29.2	25	**3.5**	9	**18.0**	27
Slatina	165	16.9	14.3	-2.6	CL	2.8	8	28.0	23	2.8	7	14.4	26,30,31
Bâcleş	309	15.5	13.5	-2.0	CL	3.2	6	28.2	30	-1.4	7	**12.0**	31
Tg. Logreşti	262	15.3	12.0	**-3.3**	CL	-0.2	7	27.8	22	0.8	6	13.0	29
Drăgăşani	280	15.8	14.1	-1.7	CO	4.4	8	28.6	25	1.9	8	14.6	30
Apa Neagră	250	15.1	12.2	-2.9	CL	**-3.2**	6	28.6	29	**-2.6**	6	15.4	27
Tg. Jiu	210	15.9	14.1	-1.8	CO	1.5	7	29.4	24	1.6	6	16.0	29
Polovragi	546	14.3	13.7	**-0.6**	N	0.2	6	**26.3**	24;30	-2.2	8	12.6	26
Rm. Vâlcea	243	15.4	14.7	-0.7	N	2.8	6	29.5	23	-0.5	6	14.8	26
Voineasa	587	12.1	**9.0**	-3.1	CL	-1.4	6	26.6	30				
Parâng	1585	7.1	6.4	-0.7	N	-4.2	8	17.5	30				
Mean for Oltenia		15.4	13.2	-2.3	CL	1.6		27.9					
Ob. Lotrului		7.2	5.5	-1.7	CO	-5.1	6	20.7	28				

Source: Data processed according to the Oltenia MRC Archive

The coolest interval was 6-9 May 2011, in the mountainous area it snowed and an insignificant layer of snow was formed. In the same interval, on 6 and 7 May, there were signaled 1-2 days with hoarfrost of local character in the areas with an altitude of ≥ 250 m. (In the north and north-east of the country in the aforementioned interval, the weather was excessively cold. Thus, on 7.V.2011, it snowed in the mountainous region of Suceava, Maramureş and Bistriţa-Năsăud counties, in the morning it snowed abundantly in Moldoviţa and Ulma communes, close to the border with Ukraine. The road traffic took place under winter conditions on DN17, in Mestecăniş pass area. Between Vatra Dornei and Câmpulung Moldovenesc the snow measured 5 cm. The heavy cars climbed the slopes with difficulty because they were not equipped with winter tyres. It snowed on DN 17; in Palma Pass, the

snow on the roadway measured 3 cm. In Straja and Parâng ski resorts have been snowing during this period, a strong wind blew, and the temperatures highly decreased on 7.V.2011).

The monthly minimum temperatures mean for the entire region was 1.6°C, an extremely low temperature for the month of May.

The monthly maximum temperatures were comprised between 26.3°C in Polovragi registered on 24 and 30 May and 30.2°C in Bechet on 30 May. Most of the monthly maximum temperatures were registered in the last five days of the month.

There were registered 5 intervals of weather cooling: 3-5 May, 8-9 May, 17 May, 26-27 May, and 31 May (Fig. 8).

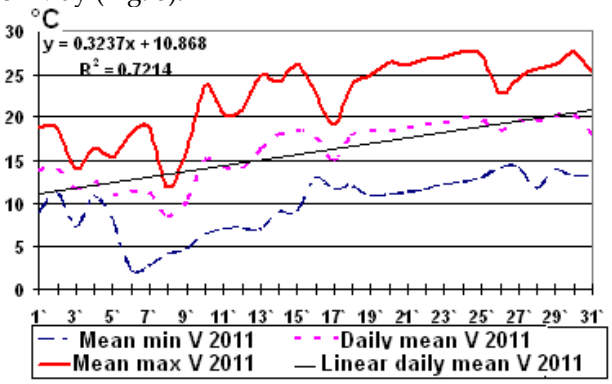

Fig. 8 The chart of the daily average temperature variation, daily minimum temperatures mean and daily maximum temperatures mean calculated for the entire region of Oltenia in May 2011

Source processed data

The highest daily minimum temperatures at the soil surface were registered in the last 5 days of the month, once with the onset of the normal thermal regime, and were comprised between 12°C in Bâcleş and 18.0°C in Craiova.

As a consequence of the thermal regime which was cold for the month of May, the early vegetables and fruits of May (the early cherries of May) had a delay of about 14 days compared to their normal date of sprouting. The agricultural crops, especially the vegetables crops, stagnated in the first two weeks of the month, and they hardly stared to grow again in the third week.

The pluviometric regime of May 2011

The monthly quantities of precipitations registered in May were comprised between 16.3 l/m2, in the west hills in Bâcleş and 91.8 l/m2 in Slatina in the east part of the region, and their percent deviations from the annual means were comprised between -78.2% in Bâcleş and 41.7% in Slatina. According to the Hellmann criterion, the types of pluviometric time at the meteorological stations of Oltenia were comprised between excessively droughty (ED) and very droughty (VD) in the most part of the region and very rainy (VR) in Slatina (table no. 3). It should be noted that this type (VR) was registered only in a small restricted area in Slatina, and among the exceedingly pluviometric time types, one single station, Craiova station, registered the little rainy (LR) type, but also in a small area. These two exceptions are mainly due to their geographical positions, Slatina at the south limit of Getic Piedmont and Craiova at the south limit of Oltenia Hills. The high frequency of the atmospheric circulations from south and south-west, and the penetration directions of the atmospheric fronts associated to the Mediterranean Cyclones determined the cloudy systems forming as well as the increasing of the precipitation potential once with the ascension of the moist air masses over the high relief forms of Oltenia. We also mention that the activity of the Mediterranean Cyclones was weak in May as well as during the entire spring, and, as a consequence, although, in some days, the precipitations were in relative extended areas, they were quantitatively low most of the time, and more significant quantities of precipitation were registered only "punctiform". We give as an example the following two meteorological stations:

- *at Craiova*, there were registered 19 rainy days among which only in two days there were registered significant quantities of precipitations 14.8 l/m2 on 16 and 17.4 l/m2 on 30, totalizing 32.2 l/m2 that is 44.7% of the registered quantity, and the last value was registered in the penultimate day of the month. There were registered 9 days with precipitations comprised between 0.0 l/m2 and 0.4 l/m2 (among which 7 days with 0.0, that is only several drops!). The air and soil low temperature compared to the normal climatological value contributed essentially to maintain the water reserves in the layer of arable soil.

- *at Slatina*, there were registered 17 rainy days among which only in four days there were registered significant quantities of precipitations 10.41 l/m2 on 3 and 19.61 l/m2 on 4, 10.2 l/m2 on 17 and 18.2 l/m2 on 30, totalizing 58.4 l/m2 that is 63.6% of the registered quantity. The precipitations were insignificant during 10 days (under 5 l/m2), and among these the quantities were < 2 l/m2 during 9

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days, in 5 of these 9 days the quantities were < 1 l/m2. As a consequence of this distribution, qualifying this month very rainy (VR) at this station is not so significant compared to the usefulness of these precipitations.

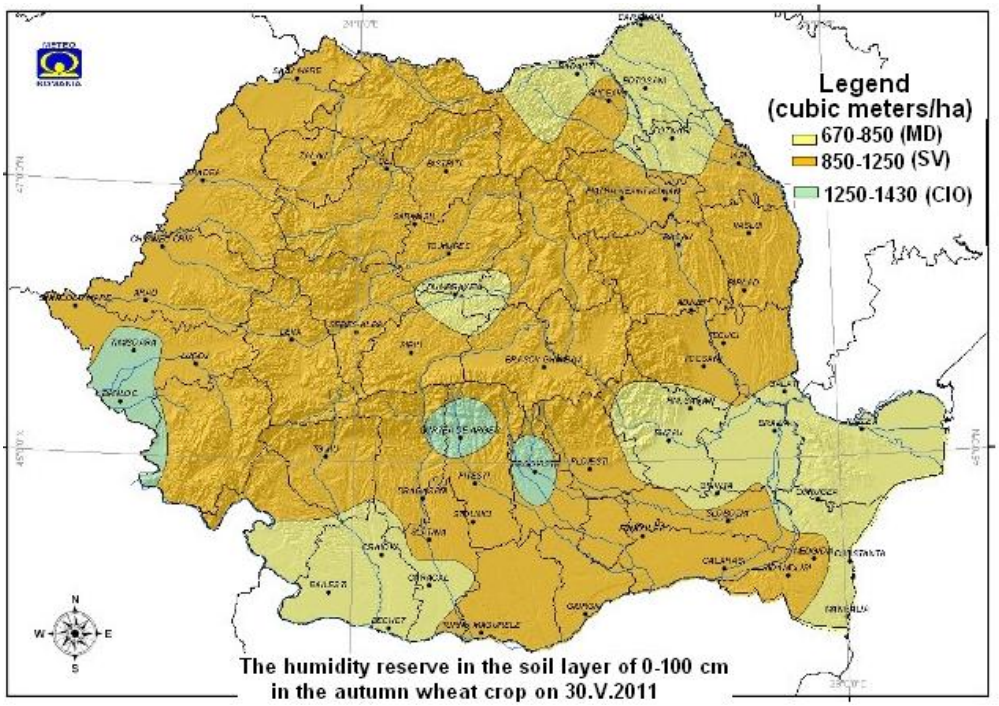

Fig. 9 The humidity reserve in the soil layer of 0-100 cm in the autumn wheat crop on 30 May 2011 (According to NMA Bucharest)

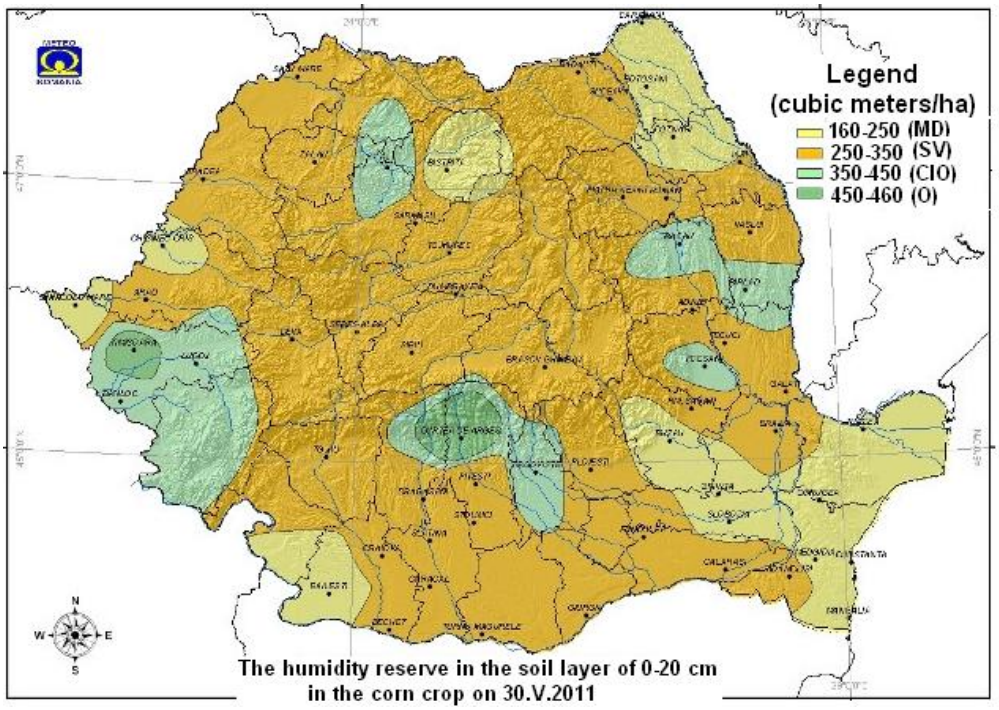

Fig. 10 The humidity reserve in the soil layer of 0-20 cm in the corn crop on 30 May 2011 (According to NMA Bucharest)

The monthly mean of the quantity of precipitations, calculated for the entire region was 55.6 l/m2, and its percent deviation from the multiannual mean was -31.0%, which means a very droughty month (VD) for the entire region.

The humidity reserve in the soil. On May 30, 2011, *the humidity reserve accessible to autumn wheat plants* on the soil profile of 0-100 cm, fell into satisfying limits (SL). In the north and the extreme south-east of the region and on extended areas from the centre and the south of Oltenia, there were registered moderate water deficits in the soil (moderate pedological drought - MD), (Fig. 9).
In the corn crop, the water supply accessible to plants in the soil layer of 0-20 cm, on 30 May, presented satisfactory values (SV) in the most part of the region. Moderated humidity deficits in the soil (moderate pedological drought - MD) were signalled in the south-west of the region (Fig. 10

The general thermal regime of the spring of 2011

The seasonal temperature means were comprised between 7.4°C in Voineasa in the high mountainous areas and 11.6°C in the low areas of Dr. Tr. Severin, Calafat, Bechet and Băileşti.

The thermal deviations of the seasonal means from the multiannual means were comprised between – 4.0°C in Tg. Logreşti and Apa Neagră and -1.7°C in Polovragi. The classification of the thermal time types at the meteorological stations of Oltenia were comprised between very cold (VC) in most of the meteorological stations (table no. 6) and cold on restricted areas in the south-west and in the high hills areas (Dr. Tr. Severin, Drăgăşani – station with southern spatial distribution situated on a hill), in some subcarpathian depressions (Polovragi) and in the Olt Couloir (Rm. Vâlcea where the warm advections from south and north were more frequent and intense).

Table 6 The average seasonal air temperature (M), the deviations from the normal temperature (ΔT) and the classification of the thermal regime according to the Hellmann criterion (H)

Meteo. station	N(°C)	M(°C)	Δ=Tmed-N	Hellmann
Dr. Tr. Severin	**11.6**	9.1	-2.5	CL
Calafat	**11.6**	8.7	-2.9	VC
Bechet	**11.6**	8.1	-3.5	VC
Băileşti	**11.6**	7.8	-3.8	VC
Caracal	11.2	8.0	-3.2	VC
Craiova	11.2	7.7	-3.5	VC
Slatina	11.1	8.0	-3.1	VC
Bâcleş	10.1	7.5	-2.6	VC
Tg. Logreşti	9.7	5.7	**-4.0**	VC
Drăgăşani	10.5	8.3	-2.2	CL
Apa Neagră	9.8	5.8	**-4.0**	VC
Tg. Jiu	10.5	7.7	-2.8	VC
Polovragi	9.2	7.5	**-1.7**	CL
Rm. Vâlcea	10.4	8.2	-2.2	CL
Voineasa	**7.4**	4.5	-2.9	VC
Parâng	2.1	1.3	-0.8	CO
Mean for Oltenia	10.0	7.1	-2.9	VC
Ob. Lotrului	2.3	1.3	-1.0	CO

Source: Data processed according to the Oltenia MRC Archive

As a consequence of registering negative thermal deviations in every month of spring compared to the multiannual means, there has been an "accumulation" of negative deviations in what the deviations of the seasonal means from the multiannual average values are concerned, which lead to a very cold (VC) spring in most of the region.

This fact is also confirmed by the deviation of -2.9°C of the seasonal mean calculated for the entire region which leads to the classification of a very cold (VC) spring for the entire region.

In the mountainous areas in Parâng and Ob. Lotrului the deviations were smaller, and the general classification for the spring season was very cool (VC).

The general pluviometric regime of the spring of 2011

The seasonal quantities of precipitations were comprised between 66.3 l/m2 and 167.9 l/m2 in Slatina, and the percent deviations were comprised between -63.9% and 12.2% in Slatina (only two deviations were positive, Slatina and Craiova). According to the Hellmann criterion, the pluviometric time types for the entire spring were comprised between exceptionally droughty (ED) in the extreme west, the high hills and Subcarpathian depressions areas (table no. 3), little rainy (LR) on restricted areas in the east of Slatina and normal also on restricted areas in Craiova. In the mountainous areas the spring was very droughty.

The medium quantity of precipitations calculated for the entire region was 107.7 l/m2, and its percent deviation from the multiannual mean was -39.9% according to the Hellmann criterion the spring is very droughty (VD).

Conclusion

Although, at a global level and for the entire European continent, the climatic global warming continues, in Oltenia, the spring of 2011 was very cold (VC) with seasonal thermal deviations comprised between -4.0°C and -1.7°C.

In the mountainous areas, the spring was cool (CO), thus, confirming that the climatic warming is more intense here.

Although the spring arrival was a little early (LE), the small advance of the vegetation development was cancelled, and then, there was a delay due to the thermal regime which was permanently deficient.

The period May 6-9 was the latest cold period, and the hoarfrosts registered produced important

damages, the vegetation being in advanced development stages.

Pluviometrically, the spring of 2011 was very droughty (VD), and the month in the middle (April) was exceptionally droughty (ED).

The water reserve in the soil maintained within satisfying limits in most part of the region, being registered a moderate drought (MD) due to the low thermal regime which did not determined evaporation and transpiration phenomena.

There was registered a great number of days with low precipitations and high nebulosity which created favorable conditions for the development of disease attacks and pests in the crops, especially fruit trees, vineyards and vegetable crops.

Although, regionally, continentally or for the entire northern hemisphere, the cold periods are considered beneficial to the general climate evolution, the cold weather in spring is a climatic risk due to the delays of vegetation development and the resultant economic consequences.

The spring of 2011 was thermally and pluviometrically unique compared to the last 12 springs of Oltenia.

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