

CONSIDERATIONS ON CLIMATE VARIABILITY IN SOUTH-WESTERN ROMANIA IN 2015

Ion Marinică¹, Dana Maria (Oprea) Constantin², Andreea Floriana Marinică³,
Victor Viorel Vătămanu⁴

^{1,4} Oltenia Regional Meteorological Centre, NMA, 3A Brestei Street, 200581, Craiova, Romania, Phone: +40 251 411 711, ionmarinica@yahoo.com, victor.vatamanu@gmail.com

² University of Bucharest, Faculty of Geography, Blvd. Nicolae Bălcescu no. 1, 010041, District 1, Bucharest, Romania, Phone: +4021 314 3508, danamartines@yahoo.com

³ Bachelor of Sciences, Klimacampus, Hamburg, Germany, marinica.andreea@gmail.com

ABSTRACT

The year 2015 was classified as the warmest year in the history (NASA and Petteri Taalas documents, General Secretary of WMO), the global average temperature exceeding by 1.0 °C the global average temperature recorded in the preindustrial times and by 0.9 °C higher than the global average temperature in the northern hemisphere. Regionally, in the south-western Romania, the climatic variability was exceptional, being marked by the rapid changes from a rainy weather to a dry one, from a cold weather (even frosty) and rainy weather to a very warm and dry one. Climatic alternations were recorded in every month of the year. After a rainy spring, a summer with heat and drought followed, and the autumn temperature regime was installed in south-western Romania, after the first half of September. The summer was extended on September 15th and the summer heat until September 5th. The autumn of 2015 was hot and excessively rainy. In November, the high daily average air temperatures have forced the crop stages and at the end of the month, the autumn crops were in advanced stage of development. On December 28th, the rapeseed flower buttons indicated the emergence and spread flowers on large areas in the south of Romania. The intensive weather cooling has occurred on December 31st, 2015. During the whole year, there have been 4 droughts and 16 rainy periods or with significant precipitations for agriculture. The wettest month of the year was September, with a monthly average, for the region, of 110.5 l/m², while the driest was December, with a monthly average of 3.2 l/m². As a result, the river flows and water levels had significant variations, affecting some areas with flooding, ponding water and erosion, while in the drought periods, there was a lack of drinking water. The climate risk analysis in the south-western Romania, in the year 2015 is a continuation of some extensive studies on the climatic variability (Marinică 2006; Sandu et al., 2012; Marinică et al., 2014).

Keywords: excessive drought, excedent precipitations, floods, intensive weather cooling

1 INTRODUCTION

During 2015, the climatic evolution in Oltenia and in Romania and even in the entire continent of Europe was atypical. The global warming has been further confirmed. The global average temperature, in the first six months of 2015, marked a record, according to the National Oceanic and Atmospheric Administration (NOAA) report. Thus, the average surface temperature of land combined with that of the ocean was 0.85 °C higher than the average of the 20th century and exceeded the previous record by 0.09 °C from 2010. According to the National Environmental information Center of NOAA, "the global average surface temperature of the land and oceans, in June 2015, was the highest for June, since the start of monitoring in 1880". "The average temperature for the *month of June 2015* at the land surface and oceans was 1.58 °F (0.88 °C) higher than the average of the 20th century". The previous record was set for June 2014 (according to NOAA, <http://www.wmo.int>, 2016).

For Oltenia, it can be noticed the followings: March 2015 was the last rainy month from a long rainy period that started after an exceptionally warm and dry summer (the summer of 2013), in September 2013, while for the crop year 2013 – 2014, it was the wettest crop year recorded in the south-west of the country, after 1960 (Mitrică et al., 2015). In March 2015, the precipitations ranged from 47.0 l/m² at Tg. Jiu to 100.3 l/m² at Craiova, with an average for the region of 65.8 l/m², the percentage deviation from the annual average being between 7.4 % at Tg. Jiu to 218.4 % at Craiova, designating a very rainy month, in average, for the whole region (Dumitrescu et al., 2014). Spring was a little early, with indices ranging between 154.5 °C at Voineasa to 385.1 °C at Dr. Tr. Severin and with an average of 255.8 °C for the region.

As about *July 2015*, the international literature shows that: "July 2015 had the highest average temperature (16.5 °C) of all the 1,627 months of January 1880. The average surface temperature of land and oceans was in July 2015, by 0.8 °C above the average of the 20th century and exceeded the previous record by 0.08 °C from July 1998.

The drought in the first *15 days of August* in Romania was considered to be the worst in the last 50 years because of its association with a continuous string of hot days and extremely warm nights, many of

them being tropical. The hot days of this summer have lowered the water reserve in the soil and also river waters, which determined the higher prices of electricity produced in the hydro-plants, while the fruit and vegetable prices also increased (<http://www.gandul.info/stiri/romania-lovita-de-cea-mai-severa-seceta-din-ultimii-50-de-ani-efectele-temperaturilor-record-din-acest-an-14675978>, 2016).

The drought of 2015 was considered an attack on national security, because the crops were severely affected by drought. The Danube flow, at entry in the country, was 50 % lower than the normal annual average endangering the functioning of the Cernavodă nuclear plant. From July to August, the Danube flow, at the entry in the country, has been of only 2,900 m³/s in average, comparing to 5,350 m³/s, which is normal multiannual average.

After the extremely dry and warm summer, when the peak temperatures exceeded 40.0 °C, in Oltenia, the rains returned, and the autumn was warm and very rainy. December 2015 was the hottest month after the monthly average temperature of the whole set of climatic observations in Oltenia, thus, creating a climatic record. At global level, December 2015 was the warmest month for large areas from the Northern hemisphere. Thus, December 2015 was the warmest last month of this year, ever recorded in the United States since 1880, when the meteorological measurements started, while generally, 2015 was ranked the second year among the warmest years in this country, according to the data published by the US Agency for monitoring the oceans and atmosphere (NOAA), (quoted by AFP): "December 2015 broke the record of temperature for the continental part of the United States, the average temperature of 3.66 °C surpassing the previous record from 1939, by 3.16 °C" (<http://climate.nasa.gov/news/2391/> and Agerpres, 2016). In an "exceptional" way and "for the first time in 121 years, this month was not only the hottest, but also the most humid month of December ever recorded" (Jake Crouch, climatologist at the National Center for Environmental Information in the NOAA, <http://www.wmo.int>, 2016). In the United States, for all of 2015, the average temperature was 12.4 °C, near to *the absolute record in 2012, when the average temperature was 12.9 °C*. These climate swings have been reflected in the water drainage regime, in the lakes and groundwater levels, with serious economic consequences. Some exceptional circumstances that influenced the climatic evolution in 2015, in the south-western Romania, will be further analysed.

2 METHODS

There have been used data from the archive of WRC Oltenia, the synoptic maps and the operative ones from WRC Oltenia, the maps resulted from processing the mathematical models usually used in forecasting, the climatic and synoptic analysis, the Hellmann Criterion and the facilities offered by the Office software package.

3 RESULTS AND DISCUSSION

The temperature time types matrix, in Oltenia, in 2015, calculated using the Hellmann criterion (Table 1) shows that warm time was dominant (Tc)¹, summing 145 months/meteorological station, which means an expansion of space-time of 75.5 %, the cold time (Tr), summing only 6 months/meteorological station, all registered in October (cool times for 6 meteorological stations – Table 1) which represented 3.15 %, while the normal time (Tn) represented 21.35 %.

The graphics for the proportion of the temperature time types in Oltenia, in 2015, indicate a strong alternation of these, from month to month, the main alternation being that of warm time (Tc) with that of normal temperature time (Tn), while the cool time (Tr) appears only in October (Figure 1).

In July, *the monthly maximum air temperatures* were mostly recorded on July 20th and ranged from 33.3 °C at Voineasa to 39.4 °C at Calafat, with an average for the region of 36.2 °C. *The number of tropical days* was between 17 at Polovragi and Voineasa, and 28 at Tg. Jiu, with an average of 21.6 days for the entire region. *The number of tropical nights* ranged from 3 at Tg. Jiu and Polovragi to 15 at Dr. Tr. Severin, with the average for the region of 5.3. *The number of days with heat* was between 10 days at Voineasa and 22 days at Bechet, Calafat and Tg. Jiu, with the average of 17.3 for the entire region. *The number of days*

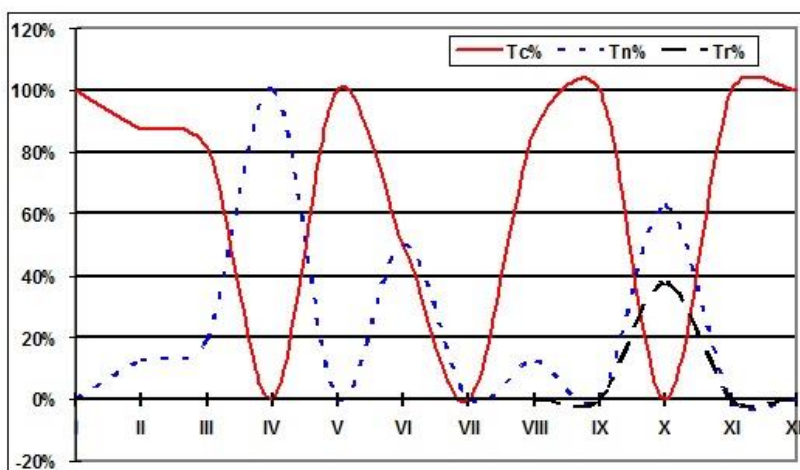
¹ *The number of months with hot time* (Tc) results from the sum of the types of hot weather months (CL), warm (C), very hot (FC) and excessively hot (EC) (the normal steps of the ladder Hellmann Criterion). *The number of months with cold time* (Tr) results from the sum of the types of cold weather months (RC), cold (R), cold (FR) and excessively cold (ER). *The number of months with normal time* (Tn) results from the sum of the months with normal time (N).

with heat ranged from 1 at Bâcleș in the Mehedinți Hills and 17 days at Calafat in the extreme south-western, with an average of 7.5 for the entire region. The heat wave occurred between July 16th – August 16th (with a short break in late July and early August, July 31st – August 1st), being the longest wave in the history of the meteorological measurements (29 days), which is a *climatic record*.

Table 1. The temperature time types matrix in 2015, in Oltenia (CL = warmly, C = warm, FC = very warm, RC = cool, N = normal temperature, calculated using the Hellmann Criterion and the deviations from the annual average temperatures, calculated for the period 1901 – 1990)

The meteorological station	Months of the year											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Dr. Tr. Severin	C	CL	CL	N	CL	CL	C	C	CL	N	C	FC
Calafat	C	N	CL	N	C	N	C	CL	CL	RC	C	FC
Bechet	C	CL	N	N	CL	N	C	N	CL	N	C	FC
Băilești	C	N	CL	N	CL	N	C	CL	C	N	C	FC
Caracal	C	C	CL	N	CL	N	C	CL	C	N	C	FC
Craiova	C	CL	N	N	CL	N	C	CL	CL	N	C	FC
Slatina	C	CL	CL	N	CL	N	C	CL	CL	N	C	C
Bâcleș	C	CL	N	N	CL	CL	C	C	CL	RC	C	FC
Tg. Logrești	C	CL	CL	N	CL	N	C	N	CL	RC	C	C
Drăgășani	C	C	CL	N	C	N	C	C	CL	RC	C	FC
Apa Neagră	C	CL	CL	N	CL	C	C	C	C	N	CL	C
Tg. Jiu	C	C	CL	N	C	CL	C	C	C	N	CL	C
Polovragi	C	CL	C	N	CL	CL	C	C	C	RC	C	FC
Rm. Vâlcea	C	C	CL	N	C	CL	C	C	C	N	C	C
Voineasa	C	CL	CL	N	CL	CL	C	C	C	N	C	C
Parâng	C	CL	CL	N	C	CL	C	C	C	N	C	C
Average for Oltenia	C	CL	CL	N	CL	CL	C	CL	C	N	C	FC
Ob. Lotrului	-	N	N	N	CL	N	C	-	C	N	C	C

Source: processed data from the records of the WRC Oltenia



Source: processed data from the records of the WRC Oltenia

Figure 1. Space-time extension of the temperature time types (%) and their alternation in Oltenia, in 2015

The climax of this heat wave in July was recorded on July 30th, when in Muntenia, at Zimnicea meteorological station, it was recorded a maximum of 40.3 °C, while at Giurgiu meteorological station was of 40.7 °C. At the ground surface, the most minimum temperatures were recorded on July 11th and 12th and they were between 5.6 °C at Polovragi and 17.4 °C at Caracal, while the average for the region was 12.6 °C. The maximum temperatures recorded at the ground surface ranged from 40.0 °C at Caracal to 69.5 °C at Apa Neagră, with the average for the region of 54.3 °C, 46.2 % of the region's stations exceeded 60.0 °C. In August, the monthly maximum air temperatures were recorded on the dates of August 11th, 12th, 13th and 16th and they ranged from 33.0 °C at Voineasa to 40.9 °C at Calafat, with an average for the whole region of 36.5 °C, higher by 0.3 °C than that of July. The maximum value of 40.9 °C, recorded at Calafat on August 12th is

the second "peak" of the long heat wave in the summer of 2015. *The heat wave* was interrupted between August 17th and August 24th, when the cool weather associated with the intense precipitations decreased the daily maximum temperature from 15.1 °C at Polovragi to 18.5 °C at Halânga, this being specific to a March day (on August 22nd). Starting August 25th, the increasing of the air temperature determined maxima over 30.0 °C, and between August 28th and September 5th, 2015, it was recorded the last heat wave of warm season in 2015.

The number of summer days was between 21 at Slatina and 27 at Calafat, Bechet and Tg. Jiu, with the average for the region of 23.1 days. *The number of tropical days* was between 13 at Voineasa and 25 at Calafat while the average for the entire region was of 18.9 days. *The number of days with heat* was between 4 at Polovragi and 22 at Calafat, with an average of 13.9 days for the entire region. *The number of hot days* was between 2 at Tg. Logrești and 13 at Dr. Tr. Severin Calafat, with the average for the region of 6.1 days. In August 2015, at the ground surface, the monthly maximum temperatures ranged from 36.9 °C, recorded at Caracal on August 16th to 69.8 °C, recorded in the depressions of the Subcarpathian area, at Apa Neagră, on August 5th. The average maximum temperatures at the ground surface was 54.6 °C, 1.3 °C higher than that of July. The hot weather extended until September 5th, 2015, while the cool weather began on the night of 5th to 6th, 2015. *A heat wave in July and August* was initiated on July 6th, while between July 6th and July 9th, the first interval with hot temperatures (maximum temperatures ≥ 35.0 °C) was registered and a first peak of the heat wave was July 20th, when in Oltenia, it was recorded a monthly maximum of 39.4 °C at Calafat and of 66.6 °C at the ground surface, at Băilești (Table 2). The second heat wave was between July 16th and July 30th, 2015, when the second peak occurred on July 30th, while the maximum temperatures in Oltenia reached 38.3 °C at Caracal and 69.5 °C at the ground surface at Apa Neagră, while at the country level, on July 30th, 2015 were recorded temperatures of 40.3 °C at Zimnicea and 40.7 °C at Giurgiu. After a short decrease of the heat intensity between July 31st and August 2nd, 2015, the heat wave has grown and on August 12th, 2015, at Calafat was registered the maximum temperature of 2015 for Oltenia, while for the whole country was 40.9 °C. The heat wave continued without interruption until July 16th, and between August 16th and August 27th, it was interrupted by a cooling weather, with intense rains associated with significantly amounts of precipitations, which led to clasify the month of August 2015 as very rainy (Table 2). But the rains have not had any effect on saving the crops of maize, soya beans and sunflower. Between August 29th and September 5th, a new heat wave occurred, with the top on September 1st and a maximum intensity of 37.7 °C at Calafat – the maximum temperature of September 2015.

The synoptic analysis of the heat wave between July 16th and July 30th, 2015 when the maximum intensity was registered. On July 30th, 2015 at 12 o'clock UTC, in the lower troposphere, at the ground surface, the northern half of Europe was dominated by a vast cyclonic field of Icelandic origin with 2 cyclonic cores, one positioned to the southwest of Iceland, with values below 1005 hPa at the center and another one over Scandinavia, the Baltic Sea and the Gulf of Bothnia, with values below 995 hPa in the center (Figure 2a). The southern half of the continental Europe was dominated by a vast anticyclone field of subtropical origin - The Azores Anticyclone, whose dorsal was extended over Hungary and the south-eastern Europe, while the Mediterranean Sea was under the influence of a vast weak cyclonic field with values around 1010 hPa, of barometric "tide" type (barometric "swamp"). At the 500 hPa altitude level, the geopotential field presented a vast complex of low geopotential, extended from over the Greenland coasts to Scandinavia and Germany. The most part over Europe was covered by a vast high geopotential field. Thus, at this level, the air circulation over Europe, at the lower troposphere was from the west, causing the air advection towards Romania.

The analysis of the thermic field at 850 hPa level (Figure 2b) shows that more than half of the southern part of Europe was dominated by the hot tropical air advection from the previous days from the North Africa and the Arabian Peninsula.

The isotherm of 25.0 °C was, at that time, above the coasts of Sicily, while the entire Minor Asia Peninsula was under the isotherms of 25 °C, 30 °C and 35.0 °C, a very hot air advection from the Arabian Peninsula continuing to get warm here. Over the southern Romania and especially over Wallachia, at this level, the isotherm of 22.0 °C was present, which justifies the records of 40.3 °C at Zimnicea and 40.7 °C at Giurgiu.

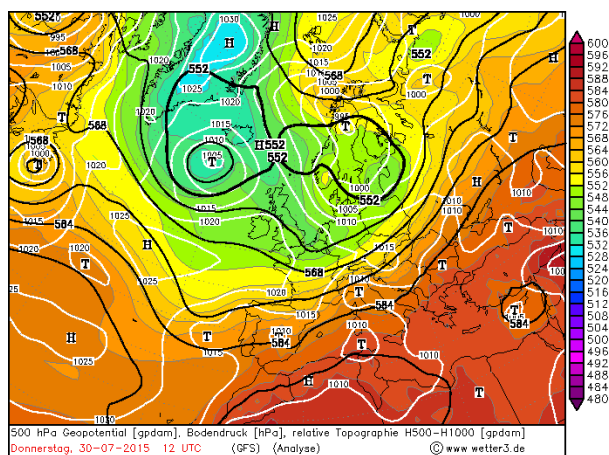
The precipitation time types matrix in Oltenia, in 2015, calculated using the Hellmann criterion (Table 3) shows that the rainy time (Tp) has prevailed, with an extension of space-time of 49.4 % , the drought (T) had a space-time expansion of 41.1 % , while the normal precipitation time (Tn) was of 9.5 % . Although the rainy time has exceeded by 8.3 % the dry one, *the main climatic risk in 2015 was the drought.* The driest month of the year 2015 was December, with a monthly average precipitations of 3.2 l/m² for the entire region, but without a noticeable effect on the winter crops, as it occurred after the warm and very rainy

autumn, which made the soil moisture reserves to maintain from satisfactory to close optimum (www.meteoromania.ro).

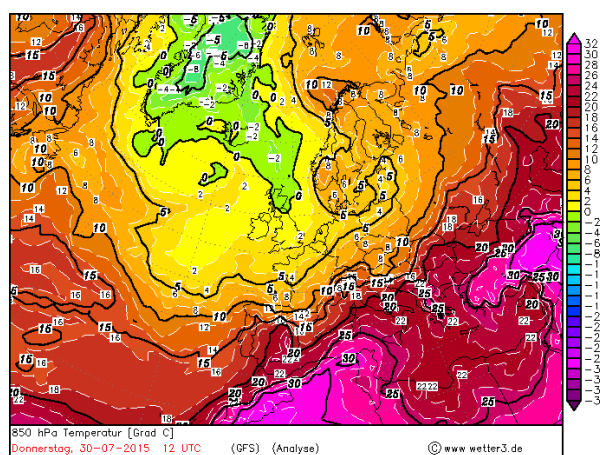
Table 2. The extreme air and ground surface temperatures (°C), registered in the hottest months of July, August and September 2015, in Oltenia

The meteorological station	Tmax air VII		Tmax ground surface VII		Tmax air VIII		Tmax ground surface VIII		Tmax air IX		Tmax ground surface IX	
	(°C)	Data	(°C)	Data	(°C)	Data	(°C)	Data	(°C)	Data	(°C)	Data
Dr. Tr. Severin	38.5	20	65.0	7	38.9	12	64.4	5	37.1	3	59.6	1
Calafat	39.4	20	48.3	20	40.9	12	46.0	12	37.7	1	44.2	3
Bechet	38.5	20	57.6	29	38.3	16	54.8	4	37.5	3	50.6	18
Băilești	37.3	30	66.6	20	38.1	12	68.0	12	37.4	5	59.8	1
Caracal	38.3	30	40.0	7	37.0	16	36.9	16	36.6	5	42.4	18
Craiova	37.3	20	46.2	22	36.8	12	48.0	16	35.2	2	47.8	2
Slatina	37.3	30	40.7	30	36.8	16	39.2	16	35.9	2	35.8	1
Băcleș	35.9	20	-	-	36.7	11	-	-	34.4	23	-	-
Tg. Logrești	35.7	30	62.2	29	35.7	16	59.2	13	34.1	2	52.2	18
Drăgășani	36.6	30	43.7	30	35.5	12; 16	43.7	31	35.1	2	44.0	2
Apa Neagră	36.5	20	69.5	30	38.8	12	69.8	5	35.0	2	61.0	2
Tg. Jiu	38.0	7	63.6	30	38.9	12	61.6	12	35.8	3	56.2	2
Polovragi	33.7	20	59.1	19	34.9	12	55.7	16	32.3	18	54.3	2
Rm. Vâlcea	38.1	18	65.5	18	39.0	12	62.4	13	36.0	2	57.3	3
Voineasa	33.3	7;8	-	-	33.0	12; 13	-	-	31.4	1	-	-
Parâng	25.3	20	-	-	25.2	12	-	-	26.2	18	-	-
Average for Oltenia	36.2	-	54.3	29	36.5	-	54.6	13	34.9		49.3	2
Ob. Lotrului	26.9	20	-	-	26.9	12	-	-	28.7	18	-	-
PETROSANI	33.0	20	51.4	24	33.2	12	53.4	5	33.0	2	40.0	1;2;3
Halânga	38.6	20	68.0	7	38.7	12	63.2	12	37.0	3	-	-

Source: processed data from the records of the WRC Oltenia



a)



b)

<http://www1.wetter3.de/Archiv/>

Figure 2. a) The synoptic situation at the ground level, superimposed on the 500 hPa altitude level and relative baric TR 500/1000 topography, at 12 o'clock UTC, on August 30th, 2015; b) The field of temperature at 850 hPa altitude level at 12 o'clock UTC, on August 30th, 2015

The graphics of the proportion of the precipitation time types in Oltenia, in 2015, indicate a strong alternation from month to month, the main alternation being that of the drought (Ts) with the rainy time (Tp), while the normal precipitation time appears only in a small proportion from January to June (Figure 3).

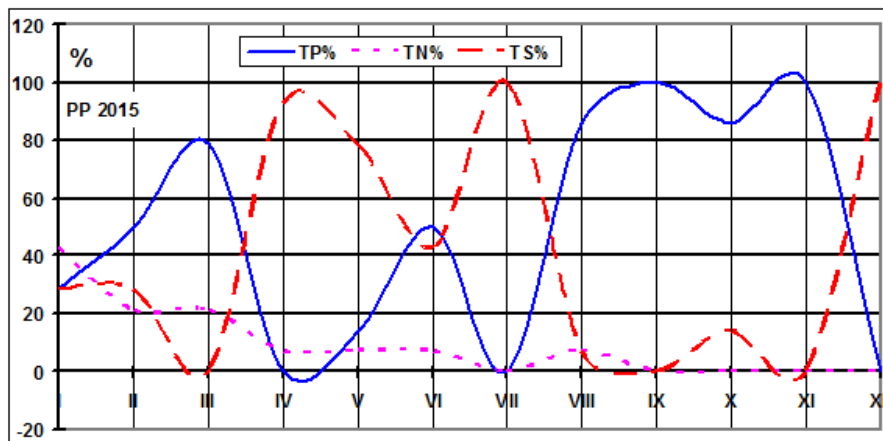
The rainiest season of 2015 was autumn, and the seasonal precipitations were between 188.1 l/m² at Voineasa and 464.8 l/m² at Apa Neagră, values that characterize the secondary pluviometric maximum, the percentage deviations from the multiannual averages ranged between 52.6 % at Bechet and 160.0 % at Craiova, determining the classification of the autumn precipitation time types as exceptionally rainy, in most parts of the region. The seasonal average for the whole region was 299.6 l/m² and its percentage deviation

from the annual average was 89.1 %, confirming the classification as an exceptionally rainy autumn, in average, for the whole region. The autumn was characterized by four waves of torrential rains, in the intervals: September 9th – September 11th, September 25th – September 28th, September 10th – October 11th and November 21st – November 28th.

Table 3. The precipitation time types matrix, in Oltenia, in 2015 (ES = exceptionally dry, FS = very dry, S = dry, PS = less dry, N = normal precipitation, PP = less rainy, P = rainy, fp = very rainy, EP = exceptionally rainy, calculated using the Hellmann Criterion and the deviations from the multiannual average precipitations, calculated for the period 1901 – 1990)

The meteorological station	The months of the year											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Dr. Tr. Severin	N	P	N	FS	S	ES	ES	P	EP	EP	PP	ES
Calafat	S	FP	EP	FS	ES	P	ES	PP	FP	EP	EP	ES
Bechet	FS	PS	EP	ES	P	EP	ES	P	FP	EP	P	ES
Băilești	FS	EP	EP	ES	ES	PP	ES	PP	EP	FP	EP	ES
Caracal	PS	N	EP	S	ES	FP	ES	N	EP	EP	EP	ES
Craiova	N	FP	EP	S	FP	PP	ES	EP	EP	EP	EP	ES
Slatina	N	N	EP	PS	ES	EP	ES	EP	EP	FP	EP	ES
Băcleș ²	ES	ES	ES	ES	PS	EP	ES	EP	EP	FP	FS	ES
Tg. Logrești	N	S	EP	ES	N	FS	FS	EP	EP	EP	EP	ES
Drăgășani	N	PP	EP	N	FS	FS	FS	EP	EP	FP	EP	ES
Apa Neagră	P	FP	PP	ES	S	PS	ES	P	EP	EP	P	ES
Tg. Jiu	PP	P	N	ES	FS	ES	FS	FS	EP	EP	FP	ES
Polovragi	N	S	P	ES	FS	PS	FS	EP	EP	P	EP	ES
Rm. Vâlcea	PP	N	EP	S	ES	ES	ES	PP	EP	EP	EP	ES
Voineasa ²	FS	ES	ES	FS	ES	FS	S	FP	EP	FS	N	ES
Parâng	EP	FS	N	FS	PS	N	S	PP	EP	S	FP	ES
Average for Oltenia	N	N	FP	FS	FS	N	ES	FP	EP	EP	EP	ES

Source: processed data from the records of the WRM Oltenia



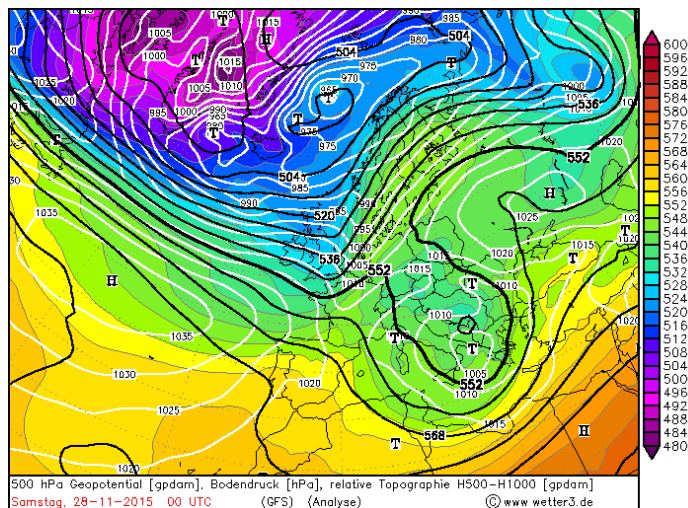
Source: processed data from the records of the WRM Oltenia

Figure 3. The space – time extension of the types of precipitation times (%) and their alternation in Oltenia, in 2015

The highest daily precipitation average for 24 hours throughout the year was 28.5 l/m² and it was registered on September 27th, 2015. Autumn rains were produced by powerful Mediterranean cyclones evolving over Romania. In Figure 4, it is presented the synoptic representation on September 28th, 2015 at 00 o'clock UTC, of the Mediterranean cyclone formed in the altitude thalweg of the Icelandic cyclone, which has evolved over the Balkan Peninsula and southern Romania, stopping above our country and determining the most intense precipitations. The autumn precipitations have greatly contributed to the achievement of the

² The Voineasa and Băcleș meteorological stations, being autonomous, have the precipitation sensor covered in winter and the climatic parameter does not record it, that is why they are not taken into account in the calculations, but they were included in the table, for guidance. The rainy time (Tp) = the sum of the number of months for types of PP, P, FP and EP. The drought time (T) = the sum of the number of months for types PS, S, FS, ES.

annual amounts of precipitations in 2015, which ranged between 554.8 l/m² at Băilești to 988.6 l/m² at Apa Neagră.

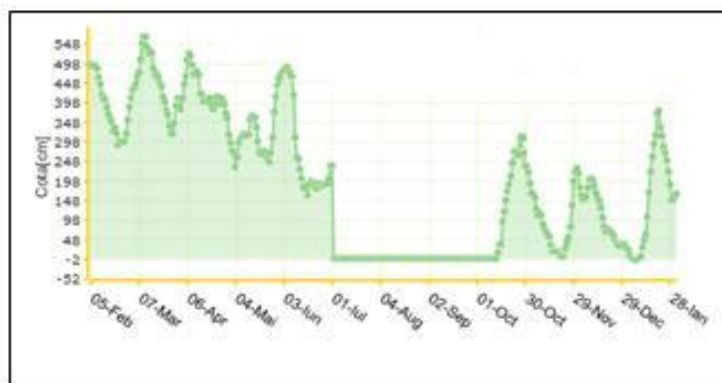


<http://www1.wetter3.de/Archiv/>

Figure 4. The synoptic situation at the ground level, superimposed on the 500 hPa altitude level and the relative baric TR 500/1000 topography, at 00 o'clock UTC, on November 28th, 2015

4 CONCLUSIONS

The monthly precipitation amounts recorded in July were between 1.6 l/m² at Băilești, in the Oltenia Plain and 65.8 l/m² in the intra-Carpathian basin of Voineasa, while their deviations from the annual average were between -96.4 % at Băilești and -25.7 % at Voineasa, causing the classification for the precipitation time types of an exceptionally dry month (ES) in most of the region. The monthly average precipitation amounts, calculated for the whole region, was 26.2 l/m², and its deviation from the annual average was of -59.7 %, confirming that, in average, July was an exceptionally dry month. The severe drought, associated with the heat, was extended until July 15th, as a continuing heat wave, which was interrupted between July 17th and July 24th. In 2015, in Oltenia, *the climatic variability has been particularly high*, the dry time alternating with the rainy one. The warm time alternated with the normal thermic one. The drought associated with the hot temperatures summed up 40 days, only in the months July to September (during: July 6th – July 9th; July 16th – July 30th; August 4th – August 16th; August 29th – September 5th). The drought interal with effects on the agricultural crops were recorded both in April and May. The drought affected a large area of the continental Europe and thus, within July 1st – October 15th, the Danube water levels have dropped significantly, registering a *minimum leakage* and provoking problems for the Danube navigation (Figure 5).



After www.edelta.ro

Figure 5. The Danube water levels at Bechet within February 5th, 2015 and February 28th, 2016

As a result of the excessive drought in July and August from Oltenia, the agricultural productions obtained in the autumn 2015 were assessed as the lowest in the last half-century, the heat wave and drought being comparable to those in the years 1946 – 1947. Besides the high temperatures and the lack of precipitations, there have also been added the hail, storms and diseases specific to the crop plants

(<http://ziarullumina.ro/bilantul-secetei-si-inundatiilor-cea-mai-scazuta-productie-agricola-din-ultimii-50-de-ani-64605.html>, 2016). Until August 10th, there have been affected 900 000 hectares of grain throughout the whole country (<http://economie.hotnews.ro/stiri-companii-20347725-aproape-900-000-hectare-teren-agricol-fost-afectate-seceta-pana-acum-meteorologii-anunta-deprecierea-situatiei-culturilor-porumb-floarea-soarelui-cartof.htm>, 2016).

From September, the monthly maximum air temperature decreased from 37.7 °C at Calafat, on September 1st to 1.4 °C at Voineasa, on November 26th. The value of 26.2 °C, recorded on September 18th, 2015 at the Parâng meteorological station became the absolute climatic record of the month of September, for this station, being the highest recorded so far, surpassing by 1.0 °C, after 71 years, the old record of 25.2 °C (recorded in 1944).

For Oltenia, the month of September 2015 was, in average, the third warmest month since meteorological measurements are made. In September, there were days of summer, tropical, with heat and hot days and thus it was confirmed the climatic warming and the expanding of summer towards the autumn season. The highest temperature deviations were recorded in November, which contributed significantly to the general classification of a warm autumn. The autumn was warm in the whole region and the big quantity of precipitations favored the strong development of the autumn crops.

REFERENCES

- Dumitrescu, A., Bojariu, R., Birsan, M.V., Marin, L., Manea, A. (2015). Recent climatic changes in Romania from observational data (1961 – 2013), *Theoretical and Applied Climatology*, **122**, 111-119.
- Marinică, I. (2006). *Fenomene climatice de risc în Oltenia [Climate phenomena of risk in Oltenia]*, Edit. Autograf MJM, Craiova, 386p. [in Romanian]
- Marinică, F.A., Constantin (Oprea), D.M., Marinică, I., Vătămanu, V.V. (2014). Considerations regarding the exceptional climatic variability in south-western Romania in 2013, pp.315-320. In Gastescu, P., Lewis, W., Bretcan, P. (Eds.) *Conference Proceedings Water resources and wetlands, 14-16 September, Tulcea, Romania*, 648p.
- Mitrică, B., Mateescu, E., Dragotă, C.S., Grigorescu, I., Dumitrașcu, M., Popovici, E.A. (2015). Climate change impacts on agricultural crops in the Timiș Plain, Romania, *Romanian Agricultural Research*, **32**, 93-101.
- Sandu, I., Mateescu, E., Marinică, I., Vătămanu, V.V., (2012). Considerații privind clima Olteniei și tendințe actuale, [Considerations climate on the Oltenia and current trend], *Analele Universității din Craiova*, **XVII**, 44-80. [in Romanian]
- <http://www1.wetter3.de/Archiv/>. Accessed 17 January 2016
- <https://www.wmo.int/media/content/2015-hottest-year-record#overlay-context=fr/content/l'omm-confirme-2015-est-lannée-la-plus-chaude-jamais-enregistrée>. Accessed 20 January 2016
- <http://www.agerpres.ro/mediu/2016/01/25/omm-media-temperaturii-globale-in-2015-cu-un-grad-mai-mare-decat-in-epoca-preindustrială-18-34-05>. Accessed 20 January 2016
- <http://climate.nasa.gov/news/2391/>. Accessed 20 January 2016
- <http://www.edelta.ro/cotele-apelor-dunarii/cotele-din-ultimele-365-de-zile>. Accessed 26 January 2016
- <http://www.gandul.info/stiri/romania-lovita-de-cea-mai-severa-seceta-din-ultimii-50-de-ani-efectele-temperaturilor-record-din-acest-an-14675978>. Accessed 26 January 2016
- <http://ziarullumina.ro/bilantul-secetei-si-inundatiilor-cea-mai-scazuta-productie-agricola-din-ultimii-50-de-ani-64605.html>. Accessed 26 January 2016
- <http://economie.hotnews.ro/stiri-companii-20347725-aproape-900-000-hectare-teren-agricol-fost-afectate-seceta-pana-acum-meteorologii-anunta-deprecierea-situatiei-culturilor-porumb-floarea-soarelui-cartof.htm>. Accessed 26 January 2016
- www.meteoromania.ro. Accessed 17 January 2016