

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.

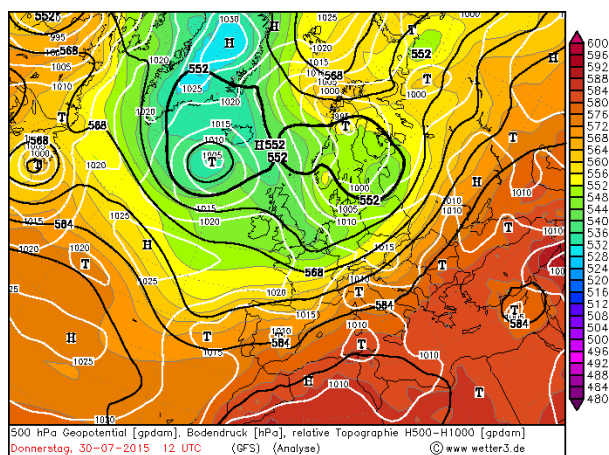
The precipitation time types matrix in Oltenia, in 2015, calculated using the Hellmann criterion (Table 3) shows that the rainy time (Tp) has prevailed, with an extension of space-time of 49.4 % , the drought (T) had a space-time expansion of 41.1 % , while the normal precipitation time (Tn) was of 9.5 % . 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).

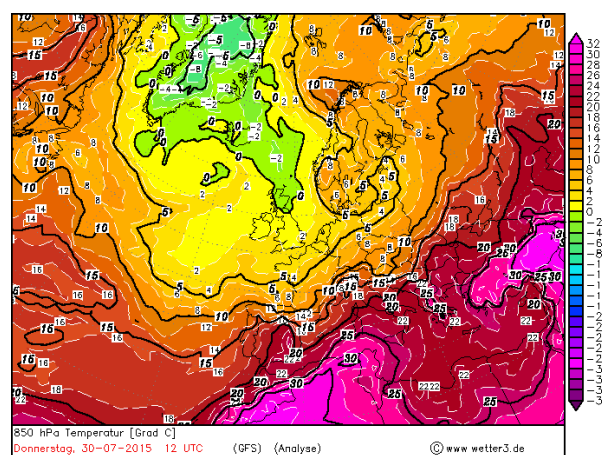
Table 2. The extreme air and ground surface temperatures (°C), registered in the hottest months of July, August and September 2015, in Oltenia

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).

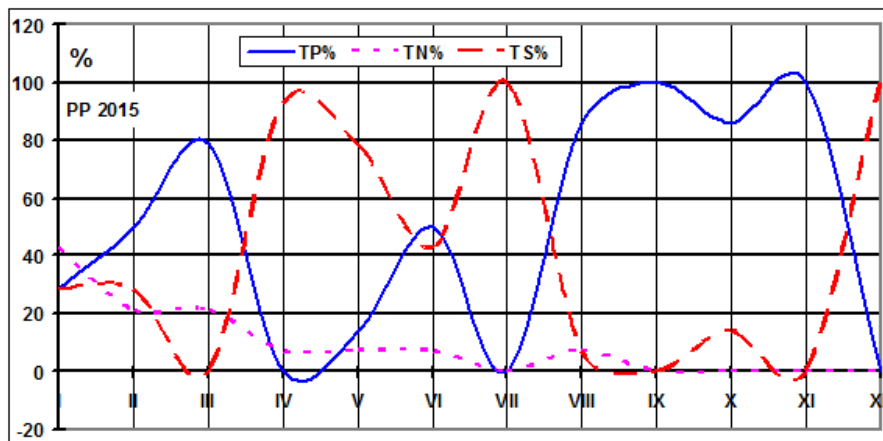
The rainiest season of 2015 was autumn, and the seasonal precipitations were between 188.1 l/m² at Voineasa and 464.8 l/m² at Apa Neagră, values that characterize the secondary pluviometric maximum, the percentage deviations from the multiannual averages ranged between 52.6 % at Bechet and 160.0 % at 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



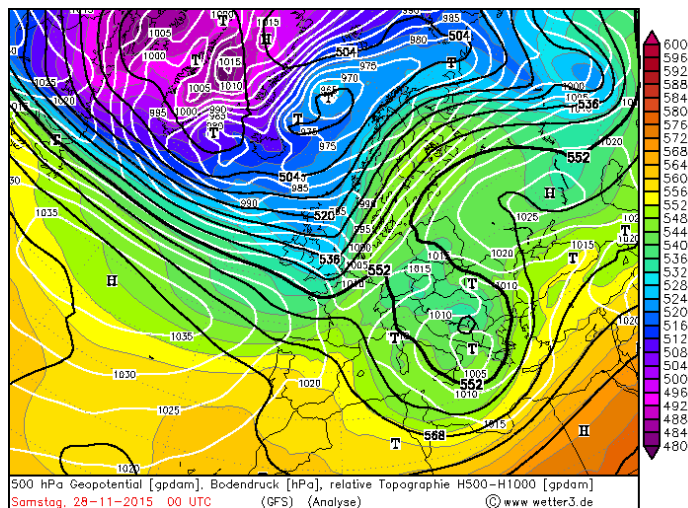
Source: processed data from the records of the WRM Oltenia

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.

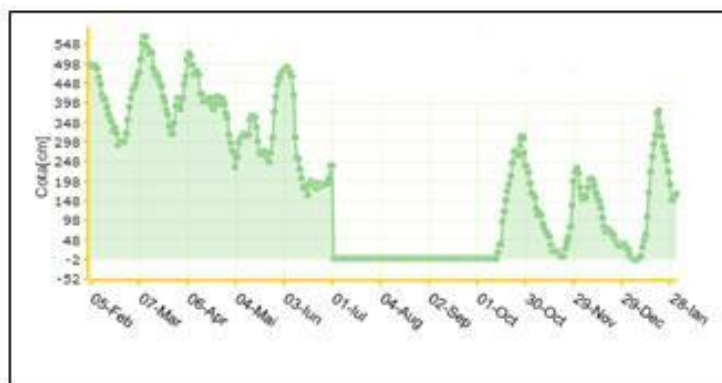


<http://www1.wetter3.de/Archiv/>

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.

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