

THE ABUNDANT RAINFALLS FROM OLTENIA BETWEEN THE 18TH AND THE 23RD OF SEPTEMBER 2005

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Abstract: The present paper (a case study) aims at analyzing the synoptic conditions registered between the 18th and the 23rd of September 2005, which led to extremely abundant rainfalls fallen on 12-24 hour intervals and to severe floods in Oltenia, as well as within all the southern regions of the country. The registering of such a situation in the mentioned interval brought to the sixth flood wave in Romania, which had catastrophic consequences. Such synoptic situation usually appears in rainy years in autumn and display an unusual intensity of the precipitation phenomena once in 30-35 years. Rainy years are usually registered in the years characterized by a minimum solar activity. The study also approaches this issue from the point of view of the climatic risk. The results are important for the study of the climatic risk of the increased rainfalls as well as for the forecast activity.

Key words: floods, abundant rainfalls, synoptic situation, air masses, Azoric Anticyclone, Mediterranean Cyclone.

INTRODUCTION

During the first half of September 2005, weather in Romania was nice and warm, the general aspect being of late summer.

Starting with the 14th of September, rains gradually covered the entire country. In Oltenia, important amounts of precipitation were registered on the 14th of September (especially in Dolj and Olt counties, where they reached 40.5 l/sq m at Amărăștii de Jos, 40.3 l/sq m at Zăval, 46.4 l/sq m at Bechet etc., Table no. 1), and then in the interval September 18-24.

The rainy interval can be considered September 14-26, even if the registered precipitation amounts were not important in all the days and on the 16th, it did not even rained in Oltenia. The most important amounts were registered on the 18th and the 19th, then in the interval September 21-24.

The rainfalls registered between September 18 and 24 led to the occurring of the sixth “flood wave” in the country. They started in Oltenia, when the rainfalls registered in the night of September 18/19, 2005 generated flood in the communes of Buduhala, Telești, and Cornești from Gorj County, then the abundant rainfalls extended in the South of the country and were accompanied by severe floods. We mention some of the areas affected by floods:

- on the 19th of September 2005, in Oltenia, Dolj County, 16 settlements

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were flooded, 229 houses destroyed and 428 damaged, floods affecting more than 2,000 households; it also damaged 49 bridges, 15 kilometers of roads, clogged 230 fountains, and flooded 2,200 hectares of crops. Among these, the most affected was Başcov village belonging to Sopot commune, where part of the dwellings collapsed due to flooding water and 150 families were accommodated in tents by World Vision Organization; several hundred animals and birds drowned. The flood was so rapid that it surprised and destroyed everything.

Table no. 1

Precipitation amounts higher than 14 l/sq m fallen in Oltenia on the 14th of September 2005

Station (County)	Pp (l/sq m)	Station	Pp (l/sq m)
Craiova (DJ)	28.2	Balta	24.9
Băileşti (DJ)	16.6	<i>Slatina</i>	<i>14.0</i>
Bechet (DJ)	46.4	Caracal	19.0
Calafat (DJ)	35.0	Vişina	30.8
Amărăştii de Jos (DJ)	40.5	<i>Corbu</i>	<i>14.0</i>
Albeşti	14.5	<i>Mărunţei</i>	<i>14.0</i>
Breasta	25.0	Văleni	21.0
Podari	25.5	Obârşia	62.5
Zăval	40.3	Căzăneşti	14.8
Goicea	42.3	Drăgăneşti Olt	20.8
Afumaţi	23.4		

At the level of the entire country

- *in the night of September 20/21, 2005*, the rainfalls registered in the area of the Curvature Carpathians determined discharges of 700 cubic meters/second on the Buzău River, which destroyed the military and the pietonal bridges from Mărăcineni for the second time isolating again Moldavia from the rest of the country. On the 21st of September 2005, the mentioned discharge maintained at 500-600 cubic meters/second.

- *on the 22nd of September 2005*, it was flooded and destroyed the Costineşti tourist resort and flooded the settlement of Tuzla. In many settlements from Constanţa County, people were evacuated by force. On the route Constanţa-Mangalia, road traffic was interrupted in 23 August commune where water was more the 1.5 meters deep in many places; the same situation was registered on the NR 1D between Buzău and Ploieşti, in the area of Bărbuleşti train passage. The European Road 85, which links Muntenia to Moldavia, was blocked in Moviliţa commune, Ialomiţa County, as it was covered by water. In Ilfov County and Bucharest, about 2,500 houses were flooded and more than 190 people evacuated.

- *on the 23rd of September 2005*, large areas of Bucharest were flooded; the level of the lakes Plumbuita, Tei, Cişmigiu, Pantelimon, Buftea, Colentina, Herăstrău etc., located in the area of the capital, exceeded the height of the shores jeopardizing certain districts. According to the locals' sayings, such a situation has not occurred in the last forty years. In the neighbourhood of Buftea Lake, more than 30 houses were flooded and the water was more than 1 meter deep. Giuleşti

Sârbi district was severely flooded. The rainfalls registered up to this date affected the following counties: Gorj, Dolj, Teleorman, Argeş, Ialomiţa, Prahova, Dâmboviţa, Ilfov, Covasna, and Bucharest Municipality. In all these counties, except for Gorj, classes were suspended in 34 schools, 3 of them being nursery schools; 201 schools from 8 counties and Bucharest Municipality were affected.

In Oltenia, there occurred landslides that destroyed and damaged any dwellings (for example, in Bucovăţ commune from Dolj County). Landslides also occurred in Gorj, Vâlcea, and Buzău counties.

Among the most severe effects, we mention: 200 bridges and footbridges were broken, 260 people were evacuated, 138 of them only in Gherghiţa commune, Prahova County, 240 settlements were affected, more than 2,500 animals and birds downed, 9,530 hectares of crops and pasturelands were destroyed, and in Slănic Prahova, the water supply pipes were destroyed by landslides, the settlement being supplied by tank cars. These rainfalls delayed the autumn sowings with at least 2 weeks. In the proximity of the capital, there appeared openings, breakings, and discharges at the piscicultural ponds located on the Pasărea Valley, the Mostiştea Valley, the Călnău Valley, the Saulei Valley, the Snagov Valley, which generated floods.

A special situation occurred *at the heap of debris from Slănic village, Aninoasa Commune, Argeş County*, with a volume of many millions of cubic meters of debris deposited by Câmpulung mining exploitation during many decades; because of the rainfalls, the heap of debris was continuously affected by landslides for more than one year destroying the houses in the area.

- on the 24th of September 2005, in Teleorman County, the communes Plosca and Peretu were severely flooded, while Bărbuleşti village from Armăşeşti commune, located at the confluence of the Ialomiţei with the Prahova, was entirely covered by water. More than 1,000 hectares of agricultural fields and 1,050 houses were flooded in the area.

- on the 25th of September 2005, the floods in the South of the country affected 32,000 hectares of crops, 19,000 hectares being maize crops. The floods registered between September 19 and 26, 2005, determined the death of 6 persons (5 of them in Costineşti) and the disappearance of another 3. On the 25th of September 2005, a severe flood was registered on the Ialomiţa River towards Slobozia. At Cosâmbeşti, a 10-12 kilometers long protection dam was made with the help of the army, but it was broken. At Cosâmbeşti, the discharge of the Ialomiţa was of 400 cubic meters/second, while the ordinary discharge is of 100 cubic meters/second. This was even greater than the one registered in 1975 and has an occurring frequency of once in 100 years. The precipitation registered in the interval September 19-22, 2005, summed 280 l/sq m in the area of the capital. Starting with September 25 the intensity of the rainfalls decreased.

- on the 26th of September 2005, the fish died in the lakes from Bucharest (especially Pantelimon Lake) due to asphyxiation generated by the lack of oxygen, phenomena induced by the discharge of dirty water in the lakes; thus, the investors that had leased the lakes lost billions.

- on September 28, 29, and 30, 2005, the weather was nice, but starting with the evening of 30 the rainfalls began one more time. These rainfalls had a high intensity especially in the East of the country and on the 2nd of October, some districts of the capital were flooded and here we mention Giulești Sârbi that was severely flooded for the second time. These rainfalls were considered the seventh rain wave (secondary) that determined floods.

- in the agricultural areas from the South of the country the soil moisture excess led to important damages of the maize and sunflower crops (depreciation and impossibility of harvesting), as water maintain many weeks in certain areas. As the aquifers had been excessively fed by the rainfalls registered in summer, they made water persist at the soil surface even after the rains stopped.

- on the 2nd of October 2005, torrential rainfalls affected the capital again generating severe floods. They were considered the seventh “secondary wave” of floods in Romania for the warm season 2005.

DATA AND METHODS

In the present paper, I used the data from the meteorological station from Oltenia and the South of the country, the synoptic maps from Oltenia RMC and from the international centers of weather forecast, the satellite data and the results of the mathematical models.

THE SYNOPTIC SITUATION REGISTERED ON THE 13TH AND 14TH OF SEPTEMBER 2005

On the 13th of September 2005, at 06 UTC, when the meteorological forecast became available (Fig. no. 1), at the surface level, there can be noticed a vast anticyclone area extended from the Atlantic Ocean, above the Western and then North-eastern Europe to the Novaia Zemlia Islands.

At the 500 hPa level (the mentioned figure), there can be noticed a vast geopotential thalweg located above the Mediterranean Sea, where it is individualized a close nucleus (the isohypse of 564 damgp) with the -15°C isotherm closed.

Afterwards, this altitude depression that did not have a correspondent at the surface level moved towards Romania positioning above Serbia. The permanent supply with warm and moist air from the Mediterranean area, as well as the interaction of the air mass with the multi-leveled landforms of Oltenia triggered the occurring of abundant rainfalls, which acquired a torrential aspect from time to time.

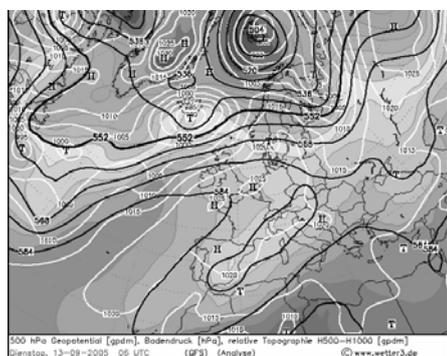


Fig. no. 1. The synoptic situation at surface and in altitude at the 500 hPa level on September 13, 2005, 06 UTC, initial phase (after Kartenarchiv).

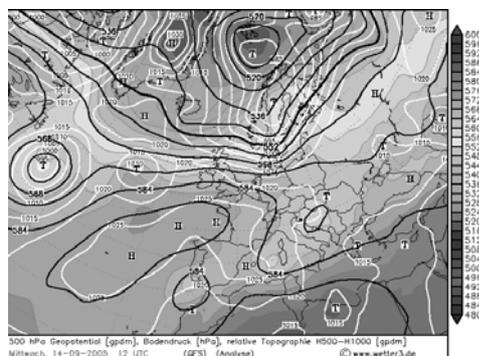


Fig. no. 2. The synoptic situation at surface and in altitude at the 500 hPa level on September 14, 2005, 12 UTC, active phase (after Kartenarchiv)

THE ABUNDANT RAINFALLS REGISTERED BETWEEN THE 18TH AND THE 23RD OF SEPTEMBER 2005

In the interval September 18-23, there were registered important amounts of precipitation, which exceeded 100 l/sq m at 45 measuring points from 105 (namely 42.8 percent), while for amount of more than 90 l/sq m, the percent was of 50.5 of the measuring points (Table no. 2).

The precipitation was more abundant in the interval September 18-23 when they exceeded 90 l/sq m at 36 measuring points (34.3 percent of the total). In Oltenia, they determined slow floods, stagnation of water and moisture in the soil; they interrupted the seasonal land works and damaged the crops of maize, sunflower, grapes, apples etc.

On the 16th, the rainfalls stopped in Oltenia even if the sky was overcast, then on the 17th they started again even if the amounts were not significant (Table no. 2).

The maximum amount registered in the interval September 18-23 was of 180.0 l/sq m, at Negoiești, Dolj County, within the Amaradia hydrographical basin, while in the interval September 14-26, the maximum reached 194.0 l/sq m in the same settlement.

We shall further analyze the synoptic situation that induced these abundant rainfalls.

The interruption of the rainfalls on the 16th of September 2005 was determined by the moving of the Mediterranean cyclone away from our country; it moved over the south of the Balkan Peninsula towards the East of the Mediterranean Sea. On the 17th of September, a new Mediterranean cyclone formed in the thalweg of the Iceland depression above Genoa bay (Fig. no. 3).

In the first 24 hours it slowly retrograded towards Central Italy and continued to amplify becoming extremely active as it was supplied with warm and moist air from the Mediterranean Sea at its anterior part and with cool and moist air

from the Atlantic Ocean at its posterior part, pushed at the periphery of the Azoric Anticyclone and at the posterior part of the altitude baric thalweg (Fig. no. 4).

Table no. 2
Precipitation amounts of more than 100 l/sq m registered in Oltenia in the interval September 14-26, 2005.

Meteo/Pluvial Station (county)	Date and precipitation amount in l/sq m														
	14	15	17	18	19	20	21	22	23	24	25	26	Total ²	Total ³	N
Craiova (DJ)	28.2	0.2	0.6	8.2	23.0	1.0	11.8	14.4	10.2	5.0	0.8	0.2	68.6	104.6	34.5
Bechet (DJ)	46.4	0.8	-	10.2	4.4	1.4	5.4	21.2	9.2	4.4	0.6	-	51.8	104.0	42.8
Amărăștii de Jos (DJ)	40.5	1.5	-	11.4	7.8	2.8	14.2	35.4	6.5	4.8	2.5	-	78.1	127.4	
Melinești (DJ)	5.0	2.2	-	10.4	71.6	1.7	12.5	10.3	20.8	10.5	-	-	137.8	145.0	
Negoiești (DJ)	6.0	-	-	6.0	104.0	5.0	19.0	20.0	26.0	7.0	1.0	-	180.0	194.0	
Răcari (DJ)	6.0	-	0.6	28.6	59.2	4.2	15.6	24.6	16.6	5.0	3.0	-	148.8	163.4	
Tg. Jiu (GJ)	0.2	0.4	4.4	38	35.0	2.4	14.0	8.8	6.0	3.0	0.2	6.6	104.2	119.0	51.5
Apa Neagră (GJ)	-	-	1.4	47.2	55.7	-	11.2	11.2	3.8	3.6	-	3	129.1	137.1	60.5
Tg Logrești (GJ)	2.0	-	-	14.4	49.6	3.8	13.0	11	8.4	2.0	-	8	100.2	112.2	38.4
Sadu (GJ)	-	17.4	-	38.7	34.4	5.0	12.5	9.0	9.7	7.7	0.2	-	109.3	134.6	
Baia de Fier (GJ)	4.5	7.4	-	22.4	33.2	16.1	30.2	33.5	16.3	15.4	6.2	3.8	151.7	189.0	
Runcu (GJ)	-	0.4	-	61.9	26.5	3.0	12.5	14.3	42.7	7.3	-	-	160.9	168.6	
Tismana (GJ)	-	-	30.2	61.2	35.5	-	14.6	7.8	13.6	3.7	2.5	0.3	132.7	169.4	
Stolojani (GJ)	-	-	-	66.5	55.2	3.0	12.5	8.5	5.0	-	0.5	1.5	150.7	152.7	
Godinești (GJ)	0.2	-	-	52.0	24.7	0.5	10.5	7.5	8.5	0.5	1.7	3.0	103.7	109.1	
Rovinari (GJ)	-	-	-	67.3	-	1.5	10.0	11.3	6.5	1.1	3.3	1.0	96.6	102.0	
Halânga (MH)	1.7	0.0	2.5	36	31.4	1.2	15.1	4.5	2.1	3.1	1.8	6.5	90.3	105.9	44.6
Balta (MH)	24.9	-	3.7	28.5	21.2	-	13.0	6.4	3.8	1.9	2.1	3.8	72.9	109.3	
Prunisor (MH)	0.2	-	1.4	53.3	21.4	1.7	17.8	6.6	7.1	3.9	5.5	2.1	107.9	121.0	
Slatina (OT)	14.0	0.4	-	1.6	28.2	7.6	19.0	21	13.2	8.2	-	-	90.6	113.2	38.4
Caracal (OT)	19.0	2.6	-	7.4	7.6	1.8	14.0	39.6	11.0	4.4	-	2	81.4	109.4	35.1
Vișina (OT)	30.8	3.8	-	22.5	5.5	-	17.5	23.0	7.5	4.3	-	-	76.0	114.9	
Reșca (OT)	9.6	-	-	6.3	20.9	7.2	26.6	16.0	32.1	6.1	-	-	109.1	124.8	
Corbu (OT)	14.0	-	-	1.5	35.0	7.0	12.5	13.8	14.2	7.2	-	-	84.0	105.2	
Mărunței (OT)	14.0	2.5	-	1.2	7.8	7.8	29.2	35.5	19.2	7.3	-	-	100.7	124.5	
Pleșoiu (OT)	8.7	2.5	-	3.8	33.4	4.7	23.5	17.2	12.0	5.0	-	-	94.6	110.8	
Corbu Buzești (OT)	6.0	2.0	-	1.0	2.0	13.0	34.0	21.0	20.0	11.0	0.5	-	91.0	110.5	
Văleni (OT)	21.0	5.0	-	2.0	5.0	11.0	29.0	28.0	16.0	8.0	-	-	91.0	125.0	
Obârșia (OT)	62.5	2.5	-	6.0	8.5	2.0	19.0	27.0	6.0	2.0	1.0	-	69.5	137.5	
Căzănești	14.8	5.5	-	2.8	59.1	6.1	17.7	8.3	14.3	7.4	-	-	108.3	136.0	
Drăgănești Olt (OT)	20.8	3.1	-	4.2	10.3	2.9	18.8	42.7	9.5	7.2	-	-	88.4	119.5	
Rm. Vâlcea (VL)	0.2	-	-	4.2	48.6	19.8	11.8	10.4	7.2	8.6	1.0	0.2	102.0	112.0	53.2
Drăgășani (VL)	4.8	1.6	-	5	70.0	6.8	14.4	17.4	8.4	7.4	0.4	0.4	122.0	136.6	
Vaideeni (VL)	6.0	0.9	-	20.0	37.0	9.0	13.0	15.0	5.5	10.0	3.5	11.0	99.5	130.9	
Govora Băi (VL)	-	-	-	4.0	44.0	12.0	18.0	12.0	14.0	7.0	1.7	-	104.0	111.7	
Oteșani (VL)	-	-	-	6.3	57.5	8.5	16.0	7.7	11.5	5.6	1.2	1.0	107.5	115.3	
Genuneni (VL)	-	-	-	6.5	61.7	8.4	15.0	10.7	9.4	6.5	1.6	0.9	111.7	120.7	
Băbeni (VL)	-	-	-	2.5	60.4	16.7	20.8	13.6	8.4	10.1	-	-	122.4	132.5	
Milcoiu (VL)	2.0	0.2	-	7.7	56.0	20.0	19.5	5.0	9.2	8.6	1.8	-	117.4	130.0	
Piscu Mare (VL)	0.3	-	-	9.2	39.6	15.4	18.6	12.6	7.6	6.4	2.8	4.2	103.0	116.7	
Zlătărei (VL)	10.0	5.0	-	3.9	59.0	7.5	7.2	14.9	8.3	7.9	0.2	0.2	100.8	124.1	
Roșiile (VL)	1.2	-	-	9.1	70.9	6.7	17.0	11.8	24.5	4.3	-	6.4	140.0	151.9	
Berbești (VL)	-	-	-	11.4	56.3	4.7	12.2	5.6	11.0	4.8	-	2.3	101.2	108.3	
Zătreni (VL)	4.2	1.6	-	12.6	61.5	-	16.3	20.8	8.2	7.9	-	3.9	119.4	137.0	
Călimănești (VL)	1.2	-	-	-	54.8	41.3	23.6	21.4	9.2	7.3	1.3	-	150.3	160.1	

Where N = normal precipitation values for September

² This is the total precipitation amount in l/sq m for the interval September 18-23, 2005

³ This is the total precipitation amount in l/sq m for the interval September 14-26, 2005

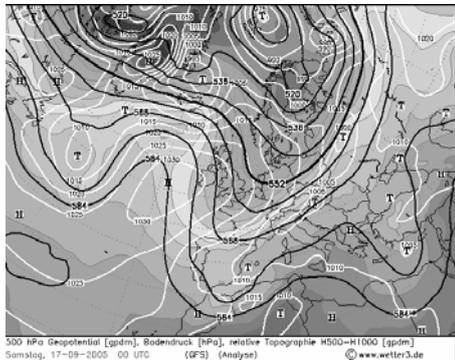


Fig. no. 3. The synoptic situation at surface and in altitude at the 500 hPa level on September 17, 2005, 00 UTC, initial phase (after Kartenarchiv).

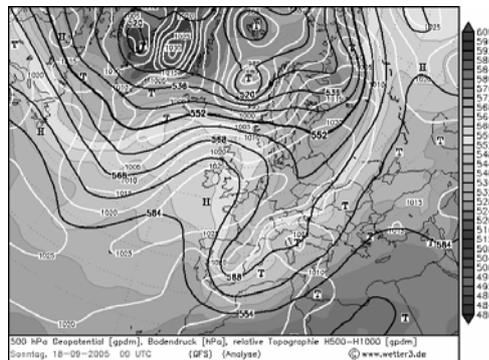


Fig. no. 4. The synoptic situation at surface and in altitude at the 500 hPa level on September 18, 2005, 00 UTC, active phase (after Kartenarchiv).

The evolution of this cyclone was very slow; it had some stationary moments and even slow retrograding.

On the 22nd of September 2005, even in the occlusion phase (fig. no. 5), the precipitation phenomena in the South of the country were extremely intense, especially on the sea shore; this is also the date when Costinești resort was flooded. The cloud system (fig. no. 6) extended from the East of the Black Sea, above the South of Romania, Hungary, to the Dalmatian Coast and determined heavy rainfalls on vast surfaces. The supply with warm and moist air from the Black Sea led to the intensification of the rainfalls.

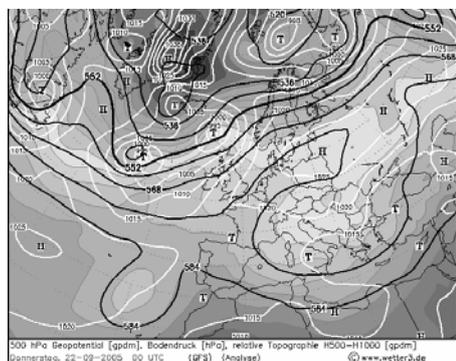


Fig. no. 5. The synoptic situation at surface and in altitude at the 500 hPa level on September 22, 2005, 12 UTC, active phase (after Kartenarchiv).

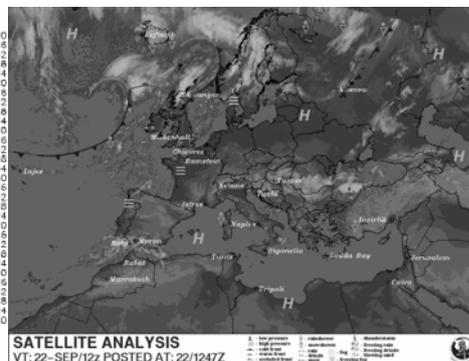


Fig. no. 6. Position of the cloud system on September 22, 2005, 12 UTC, active phase – when Costinești resort was flooded (after Kartenarchiv).

In *Oltenia*, the rainfalls were extremely intense on the 18th and especially on the 19th of September, when it was registered the amount of 104.0 l/sq m at Negoiești (Dolj County) and frequently more than 30 l/sq m; on the 20th of September, it occurred a diminution of the precipitation amounts as the cloudy system was located

above the northeast of the country. On the 22nd, the 23rd and the 24th of September 2005, there occurred an increase of the precipitation amounts, but they remained moderate (table no. 2); even though, the water resulted from rainfalls continued to generate floods as the soil was moist and did not favoured infiltration and the aquifers full. The occlusion process was long and in the eastern part of the Black Sea the rainfalls continued till September 28.

During this interval, the normal monthly amounts of precipitation were exceeded 2 or 3 times at certain meteorological stations; at Craiova for example, the amount of 104.6 l/sq m is 3 times higher than the normal. The total amount for September 2005 at this station is of 113.5 l/sq m, namely 3.3 higher than the normal.

CONCLUSIONS

The analysed synoptic situation is characterized by an unusual persistence of the cyclone, 11 days, from its appearance to its total occlusion in the eastern part of the Black Sea Basin. The precipitation phenomena covered a large surface starting from the Adriatic Sea and the North of Italy to the eastern half of the Black Sea (fig. no. 6).

In Romania, the maximum rainfalls occurred on the 22nd, the 23rd, and the 24th of September when the southeast of the country was flooded (Costinești resort and the capital, especially the periphery districts), while in Oltenia the maximum registered on the 18th and the 19th of September 2005. Registered only two weeks after the abundant and intense rainfalls from August, this situation generated heavy floods and considerable material damages in the South of the country as the soil was already moist and the aquifers full of water. They were extremely important especially in the southeast where the input of warm and moist air from the Black Sea intensified the rainfalls.

Above Bucharest, the extreme intensity of the rainfalls can be also explained by its chimney effect, which led to a stronger development of the cloud systems, and by the presence of a larger number of condensation nuclei due to the industrial activities.

In Oltenia and especially in Mehedinți County, the rainfalls displayed an acid character completely destroying vegetable crops, vineyards, and orchards.

As well as in the summer of 2005, the main features of these Mediterranean cyclones were their formation above Genoa Bay or the Mediterranean Sea, in the altitude thalweg of the Iceland Depression, the slow evolution within the Mediterranean Sea at the southern periphery of the anticyclone extended from the din Atlantic Ocean to the northeast of the Ural Mountains or to the southeastern periphery of the Azoric Anticyclone (when the anticyclone is interrupted at the surface level by this thalweg).

In this case, above the Balkan Peninsula there interact two extremely moist air masses, namely the moist and cool air masses coming from the Atlantic Ocean at the posterior part of the altitude thalweg and the warm and moist air masses coming from the Mediterranean Sea pushed to the anterior part of the formed

Mediterranean Cyclone (which in certain situation evolves only at intermediary altitudinal levels without having a well-formed correspondent at the surface level).

The respective cloud systems display a specific consistency and often have a persistent cyclonic movement above the Balkan Peninsula inducing repeated showers that generate rapid floods. The maximum occurring frequency of such situations in the warm season is once at 50-60 years and the intensity of the precipitation depends on the interaction between the air masses and the local landforms and conditions.

The precipitation amounts registered not only in Oltenia, but in the entire country, to the 1st of October 2005, makes 2005 *the rainiest year since instrumental meteorological measurements have been performed*; for example, the precipitation amounts registered at Craiova sum in the first nine month of the year 943.4 l/sq m, exceeding with 151.0 l/sq m the former record annual value of 792.4 l/sq m registered in 1972.

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