

# VERIFICATION OF THE SEECOF-13 SUMMER 2015 CLIMATE OUTLOOK FOR THE TERRITORY OF SERBIA COMPARED TO THE 1981-2010 BASE PERIOD

## Temperature

According to the SEECOF-13 outlook for the summer 2015 in Serbia, above to near normal temperature was indicated, compared to the 1981-2010 climatological base period.

Climatological monitoring showed that the summer 2015 was warm in the entire Serbia with above normal temperature based on the tercile method (*Figure 1*).

The outlook for a warm summer was correct. Verification showed that the temperature reached upper tercile which was indicated in the outlook with the 40% probability.

## Precipitation

The SEECOF-13 climate outlook for the summer 2015 indicated approximately equal probabilities for below-, near- or above- normal conditions in whole Serbia.

Monitoring of precipitation showed dry summer conditions across the entire country (*Figure 2*).

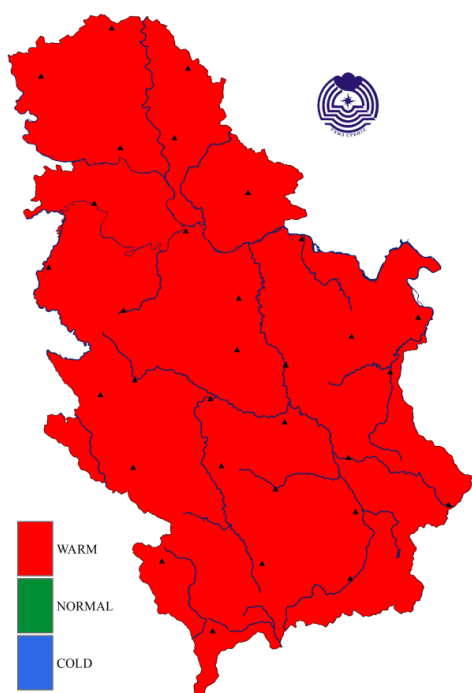


Figure 1. Monitoring of the summer 2015 temperature in Serbia using the tercile method, compared to the 1981-2010 base period

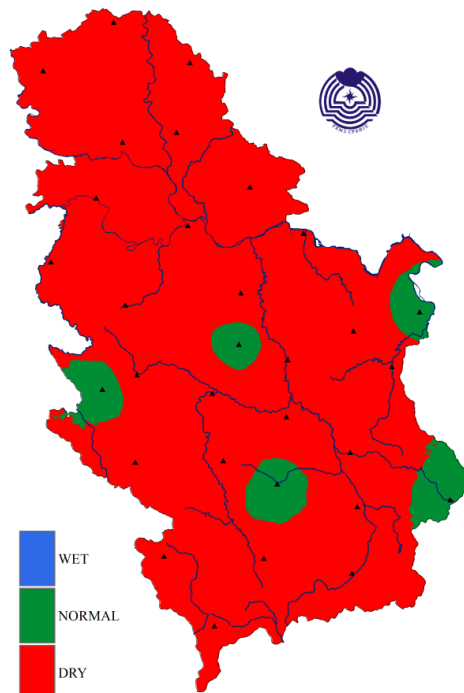


Figure 2. Monitoring of the summer 2015 precipitation in Serbia using the tercile method, compared to the 1981-2010 base period

*Summer 2015 was extremely warm; in Belgrade second warmest on record with below-average precipitation sums. 3 heat waves were observed.*

## Analysis of the 2015 summer season for Serbia compared to the 1961-1990 base period

### Temperature

Mean air temperature during summer ranged from 20,7°C in Pozega up to 24,9°C in Belgrade, and on the mountains from 13,6°C on Kopaonik up to 18,8°C on Zlatibor (*Figure 1*).

Departure of the mean air temperature from the normal<sup>1</sup>, during summer, was in a range from 2,1°C in Kursumljia and Dimitrovgrad up to 3,8°C in Belgrade and in high-lying areas from 2,4°C in Sjenica up to 3,2°C on Zlatibor (*Figure 2*).

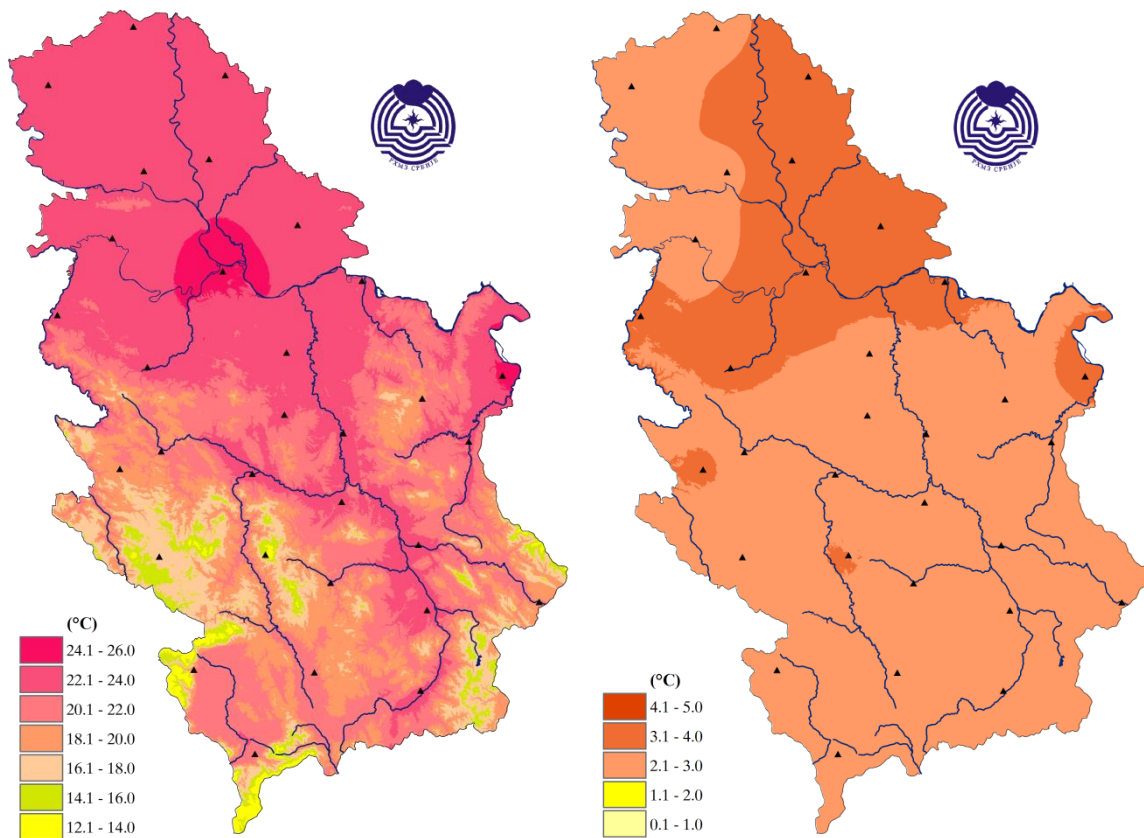


Figure 1. Spatial distribution of the mean seasonal air temperature (°C) during summer

Figure 2. Mean seasonal air temperature anomaly in Serbia during summer compared to the 1961-1990 base period

<sup>1</sup>Term *normal* refers to *climatological standard normal*, that is, the average value of a particular climate element, calculated for the period from January 1, 1961 to December 31, 1990

According to the percentile method<sup>2</sup>, mean air temperature during summer was in the extremely warm category (*Figure 3*).

According to the tercile method, mean air temperature during summer was in the warm category (*Figure 4*).

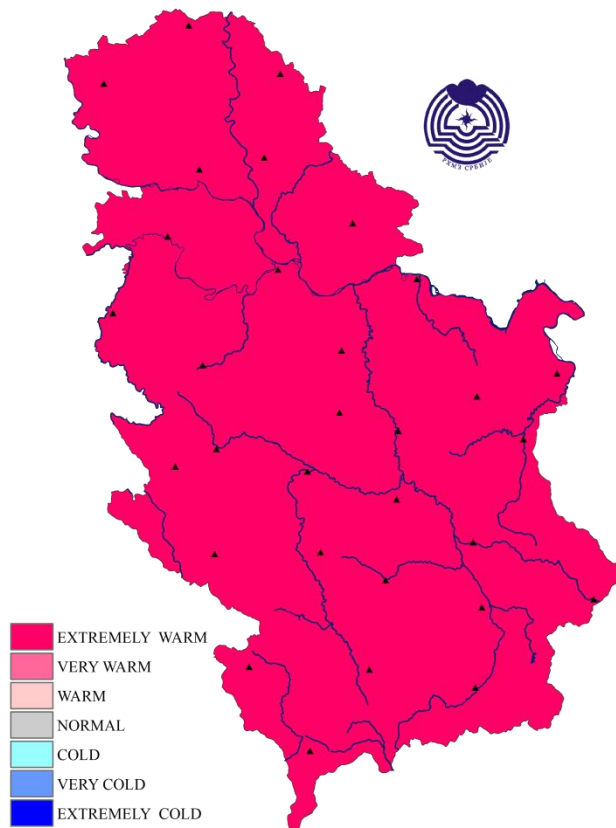


Figure 3. Air temperature assessment in Serbia during summer using percentile method compared to the 1961-1990 base period

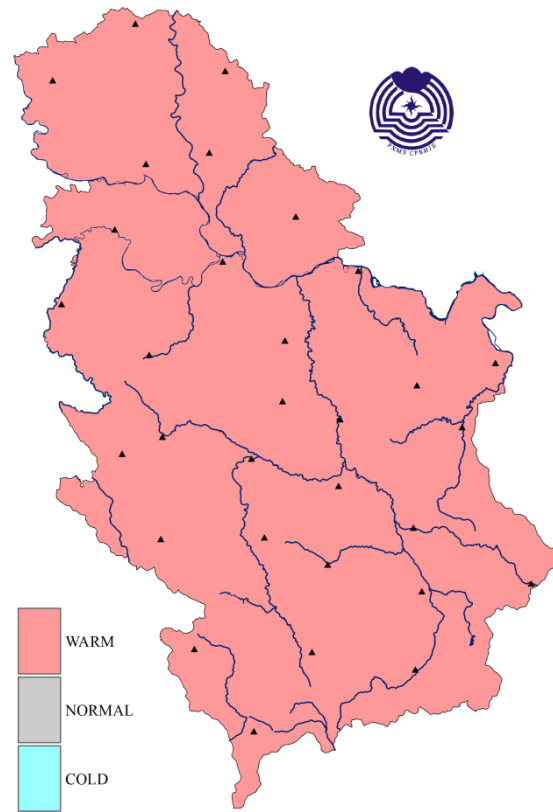


Figure 4. Air temperature assessment in Serbia during summer using tercile method compared to the 1961-1990 base period

The highest daily air temperature of 38,7°C was measured in Veliko Gradiste on August 12.

The number of summer days, with the maximum daily air temperature above 25°C, varied from 71 on Palic to 83 days in Negotin, Zajecar and Banatski Karlovac, and in the mountain areas from 1 to 46 days on Zlatibor. The observed number of summer days in Belgrade was 79, which is 17 days above the average. There was record-breaking number of summer days compared to the average for 1961-1990 in most of Serbia. The highest positive deviation of the number of summer days from the average was registered on Zlatibor, total of 31 day (*Figure 5*).

The number of tropical days with the maximum air temperature above 30°C, ranged from 42 in Pozega up to 56 days in Zajecar and in the mountain areas from 2 at Crni Vrh up to 10 days on Zlatibor and Sjenica. The number of registered tropical days ranged from 42 in Pozega up to 56 days in Zajecar, and on the mountains from 2 at Crni Vrh up to 10 days on Zlatibor and Sjenica. The registered number of tropical days in Belgrade was 48. There was record-breaking

<sup>2</sup>n<sup>th</sup> percentile of a variable refers to the value of the observed variable below which there is n percent of data previously arranged in an ascending order

number of tropical days compared to the average for 1961-1990 in most of Serbia. The highest positive deviation of the number of tropical days from the average was recorded in Veliko Gradiste, total of 32 days (*Figure 6*).

Most of Serbia observed tropical nights with the minimum air temperature above 20°C. The highest number of tropical nights, total of 41 night, was registered in Belgrade.

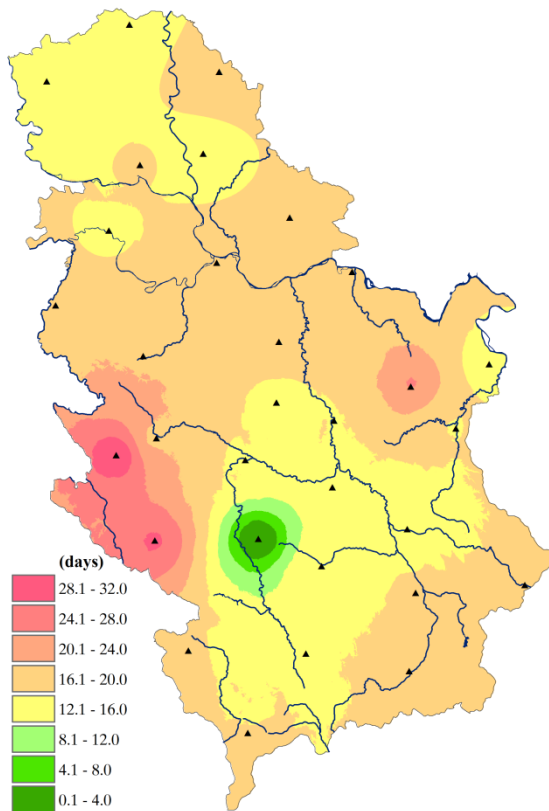


Figure 5. Deviation of the number of summer days compared to 1961-1990. base period

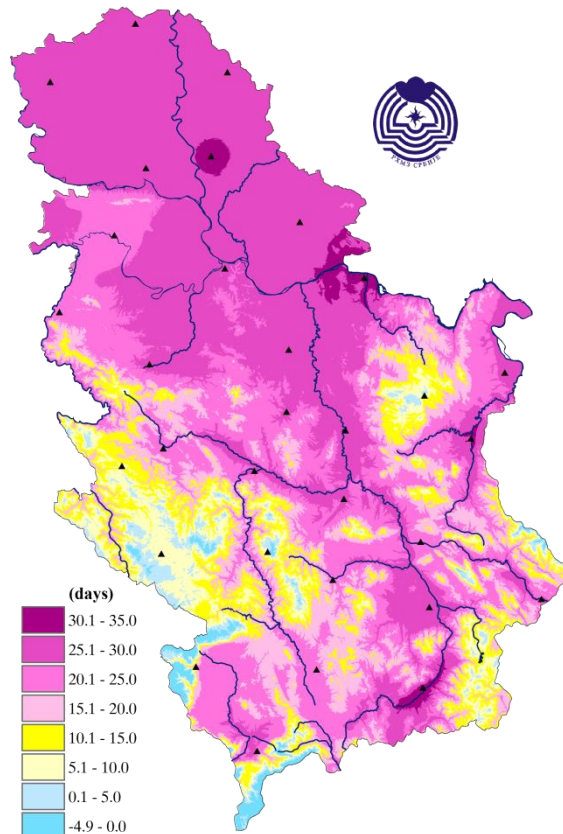


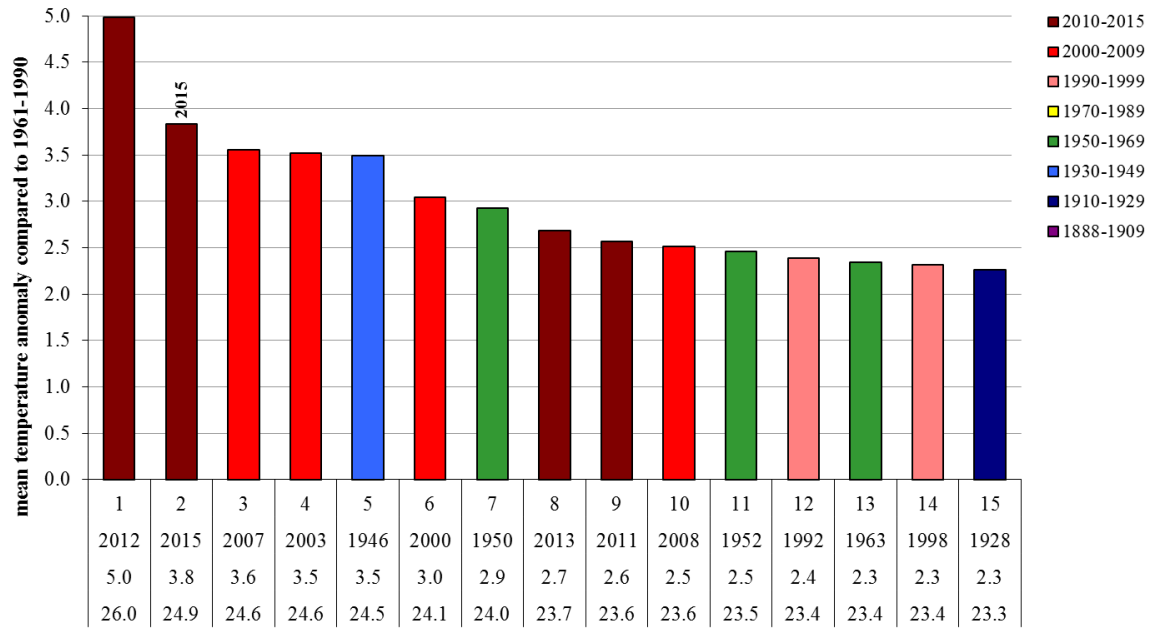
Figure 6. Deviation of the number of tropical days compared to 1961-1990. base period

The lowest air temperature during summer of 1,7°C was measured on Kopaonik on June 25.

Summer 2015 in Belgrade was the second warmest on record with the mean air temperature of 24,9°C (*Figure 7*). During most of summer period, mean, maximum and minimum air temperature was above multiannual average (*Figure 8*).

Three-month course of the daily air temperature for Belgrade, Kopaonik and Nis during summer 2015 is shown in Figures 9, 10 and 11.

**Mean temperature anomaly compared to 1961-1990  
Belgrade - period 1888-2015**



serial number of the year in descending order - year - mean temperature anomaly to 1961-1990 - Tmean

Figure 7. Ranking of the warmest summers

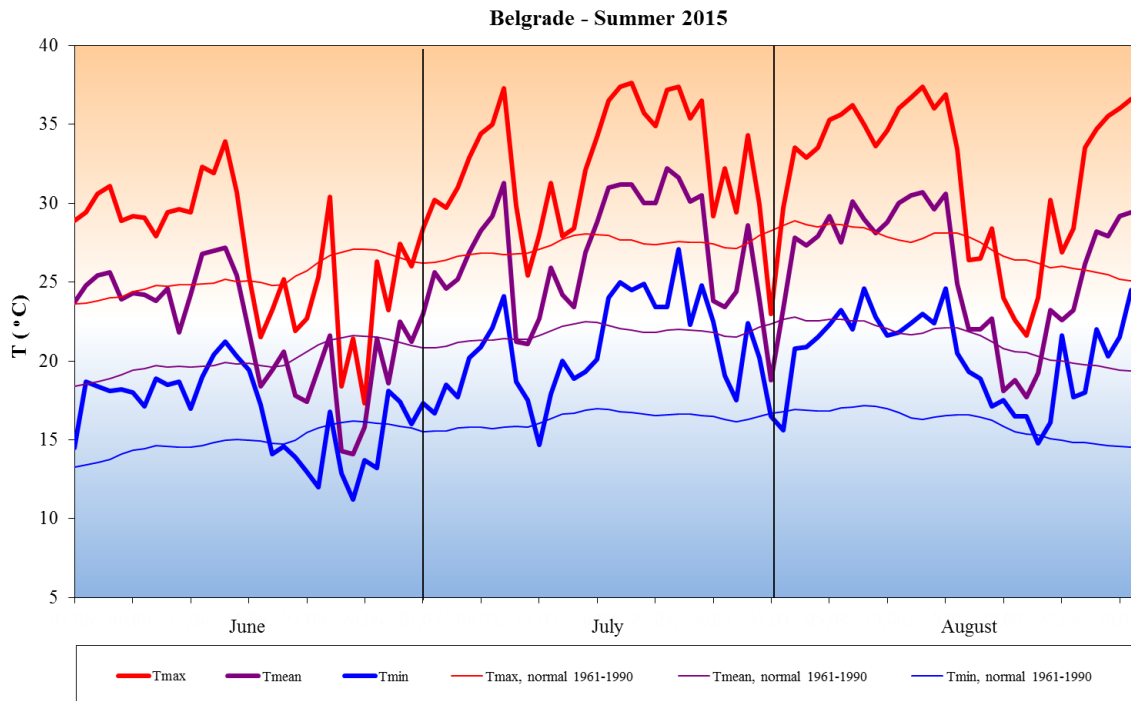


Figure 8. Three-month course of the mean, maximum and minimum air temperature in Belgrade

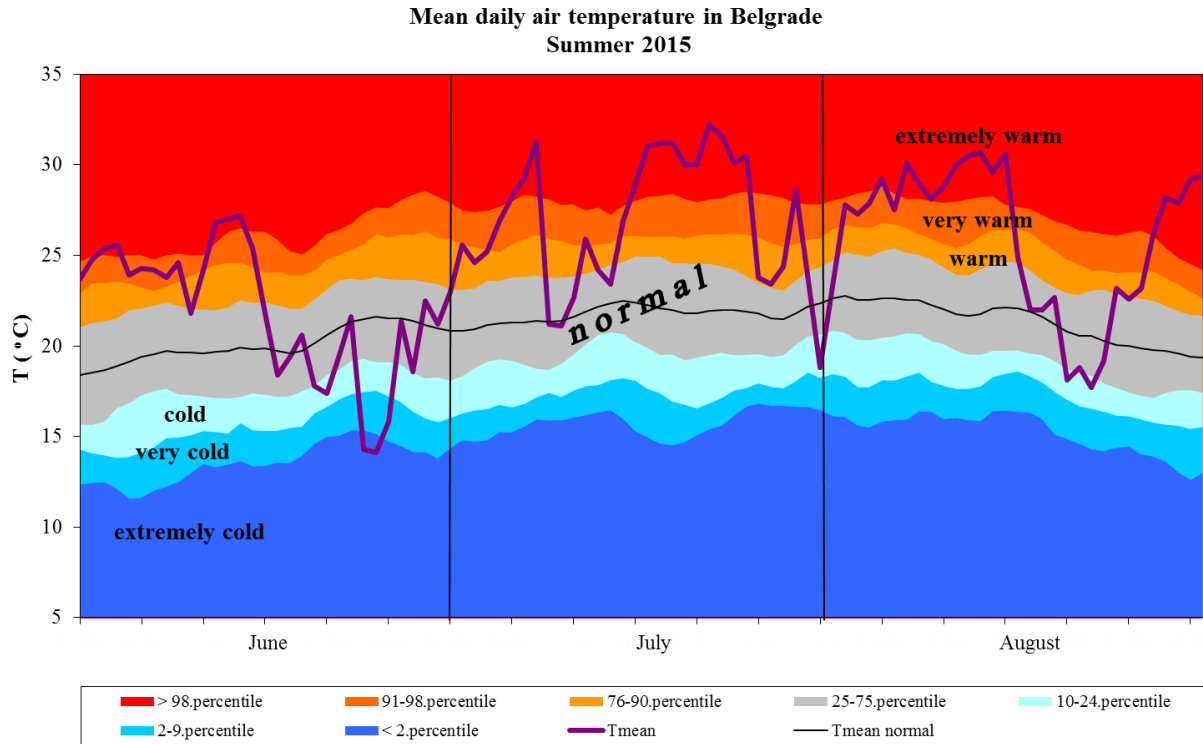


Figure 9. Three-month course of the mean daily air temperature in Belgrade

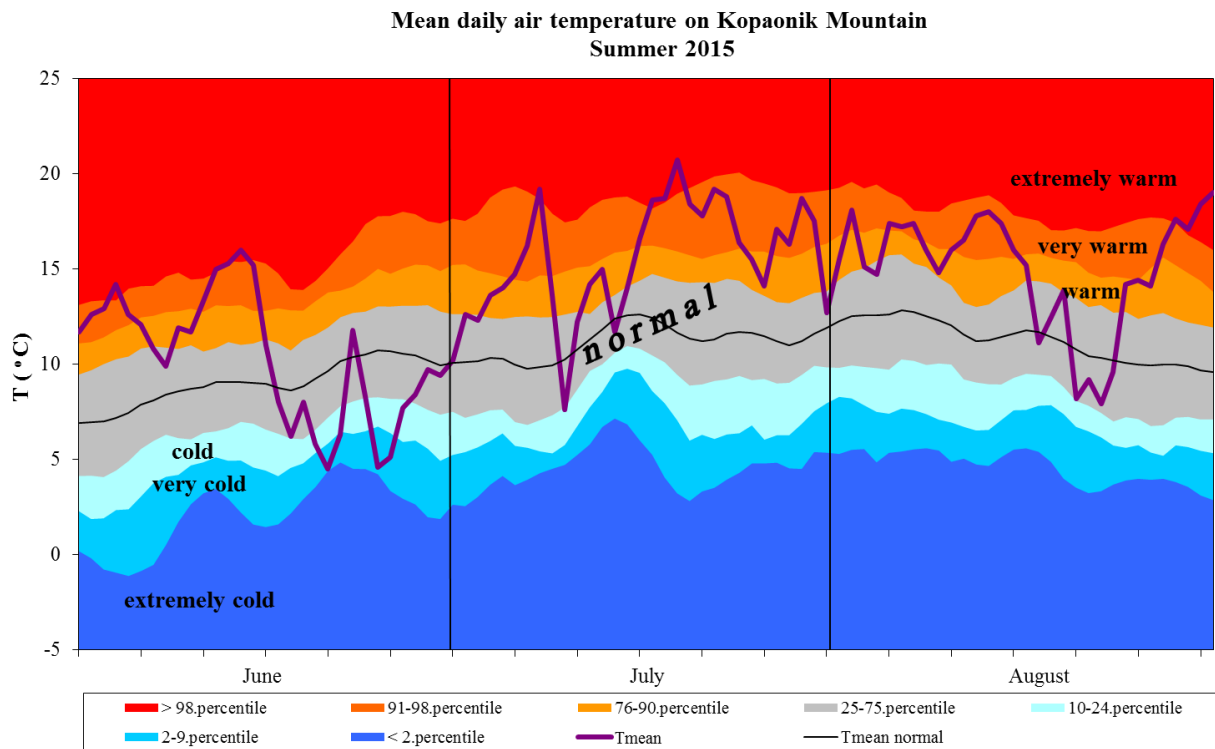


Figure 10. Three-month course of the mean daily air temperature at Kopaonik

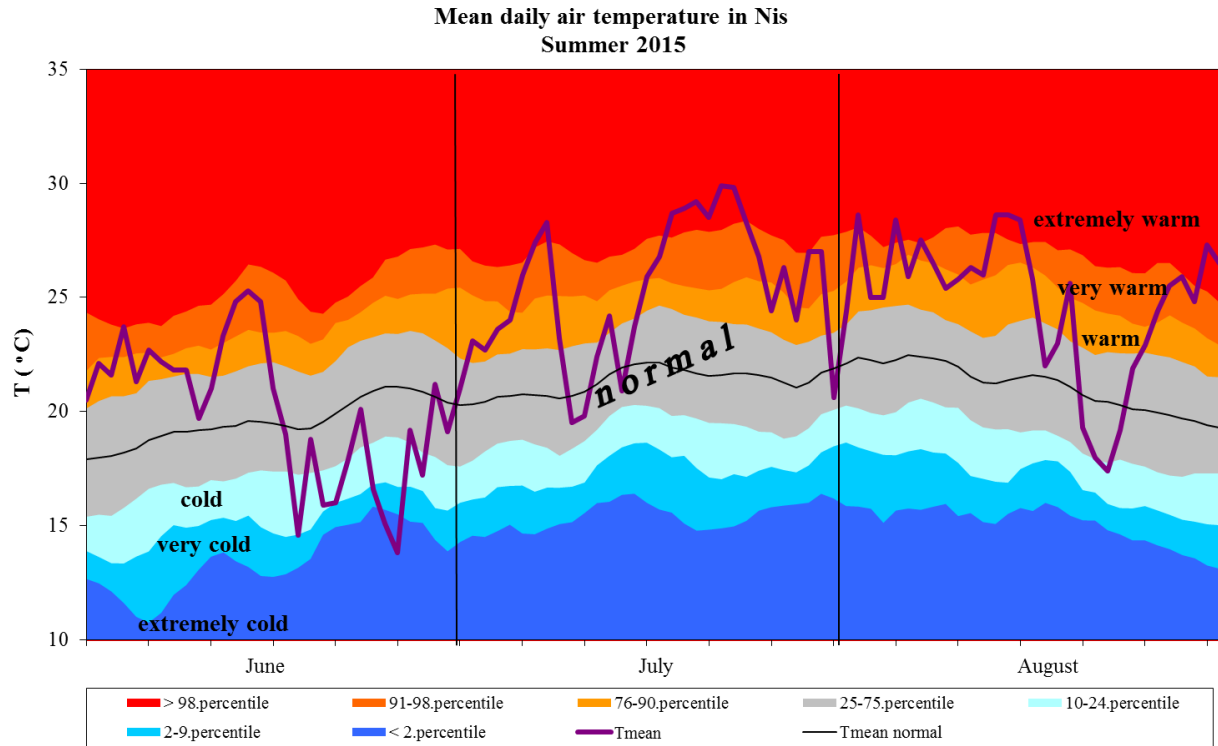


Figure 11. Three-month course of the mean daily air temperature in Nis

## Precipitation

Below-average precipitation sums during summer were recorded in most of Serbia compared to the normal for the 1961-1990 base period. Precipitation sums compared to the normal ranged from 25% in Veliko Gradiste up to 89 % on Zlatibor (*Figure 12*).

According to the percentile method, precipitation sums were in the dry and very dry category in most of Serbia and extremely dry in Kikinda and Veliko Gradiste (*Figure 13*).

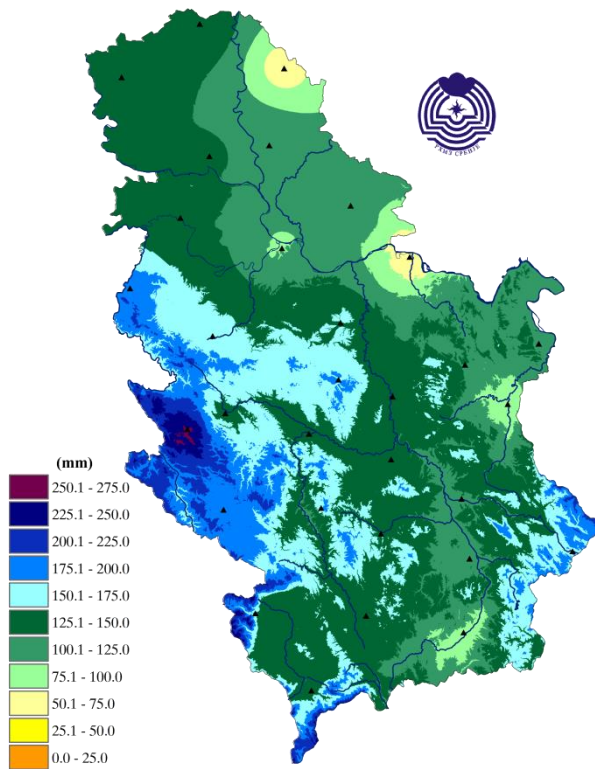


Figure 12. Spatial distribution of the precipitation sums during summer

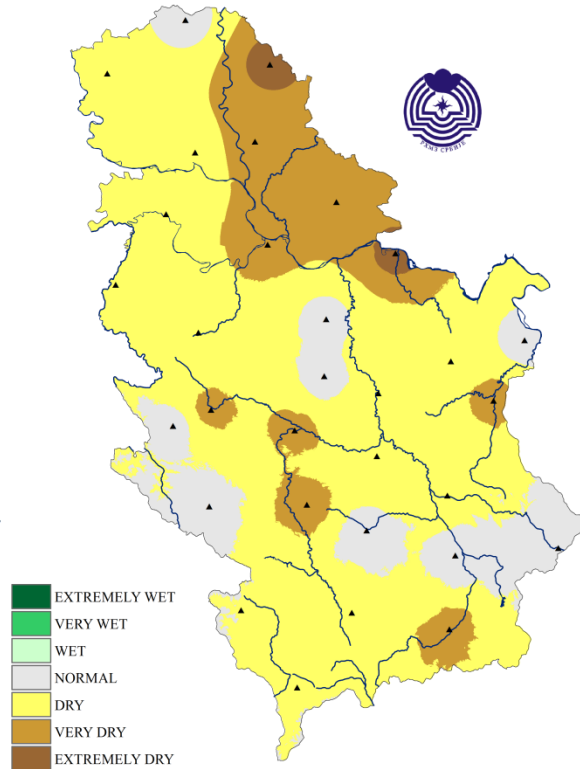


Figure 13. Precipitation sums assessment using percentile method during summer compared to the 1961-1990 base period



According to the tercile method, precipitation sums were below average in most of Serbia (Figure 14).

The highest daily precipitation total of 63,6 mm was registered in Novi Sad on August 20.

The highest negative deviation of the number of days with precipitation of 1mm and above was observed in Novi Sad and Veliko Gradiste, which is 12 days below the average for the summer (Figure 15).

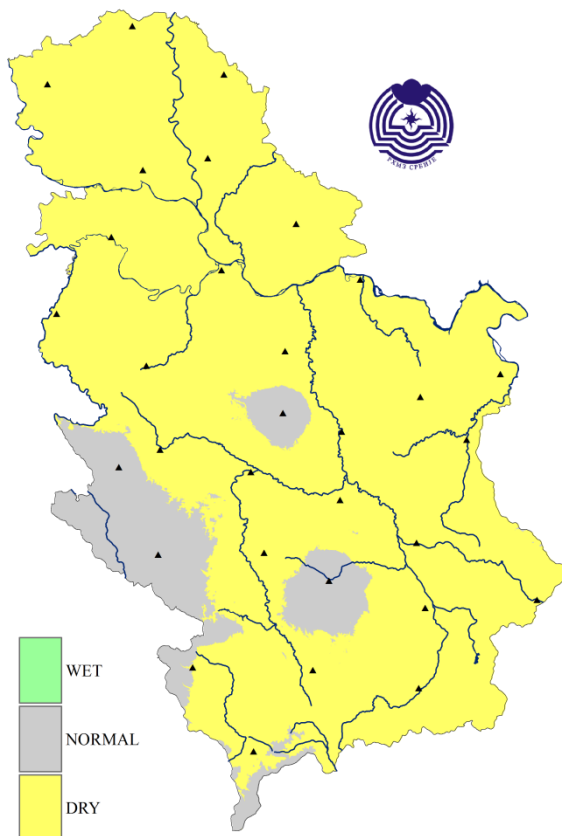


Figure 14. Precipitation sums assessment using tercile method during summer compared to the 1961-1990 base period

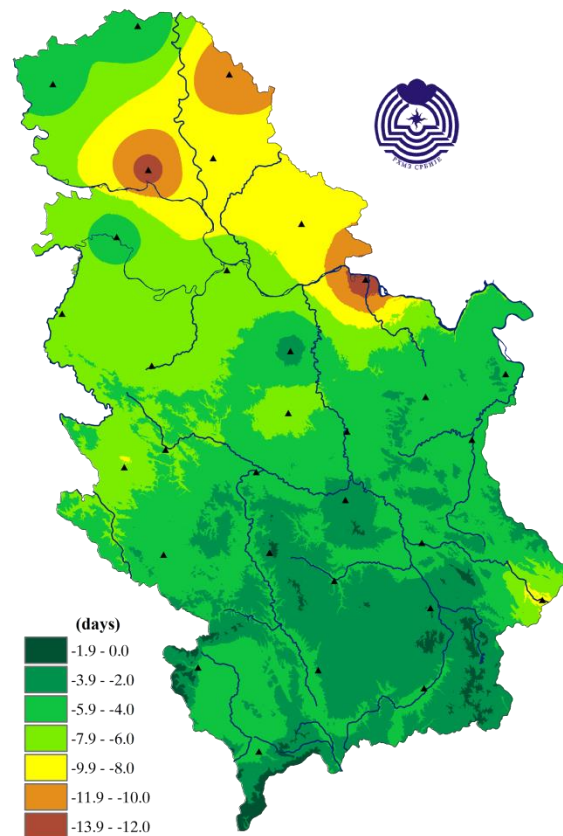


Figure 15. Deviation of the number of days with precipitation from 1mm and above during summer

Cumulative precipitation sums for Belgrade and Novi Sad during summer and per month compared to the average cumulative precipitation sums are shown in Figures 16 and 17.

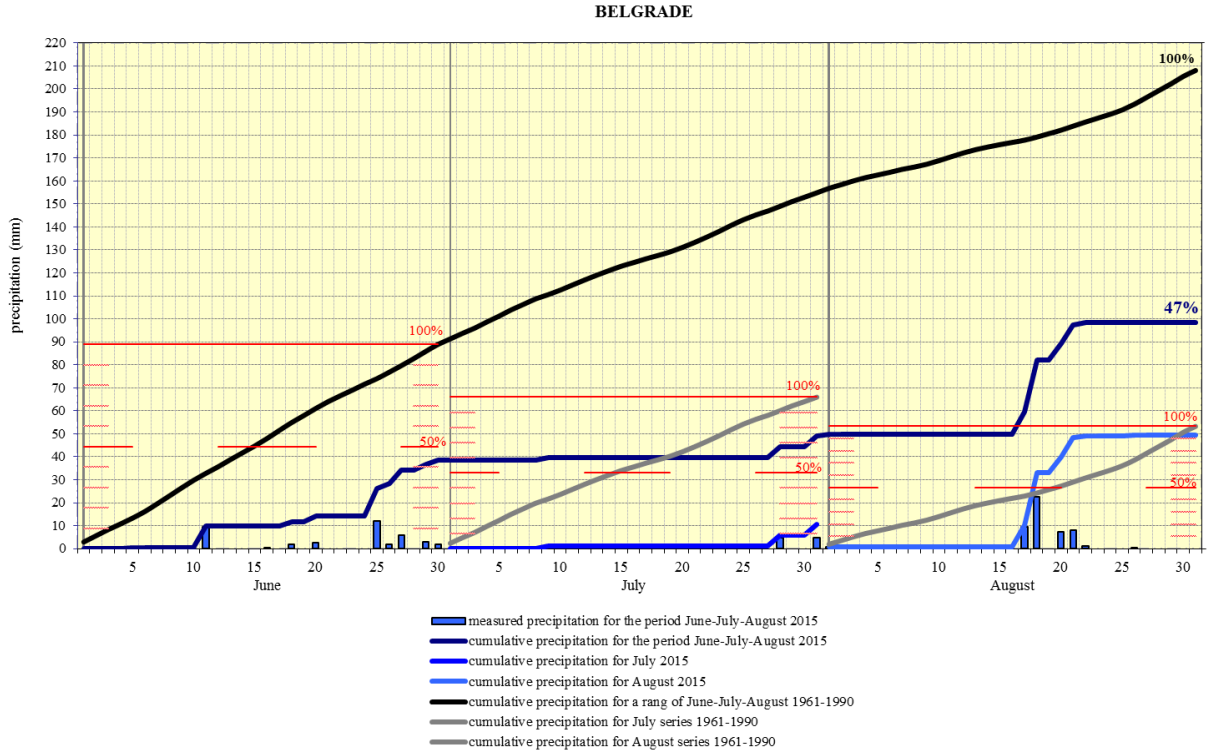


Figure 16. Cumulative precipitation sums for Belgrade

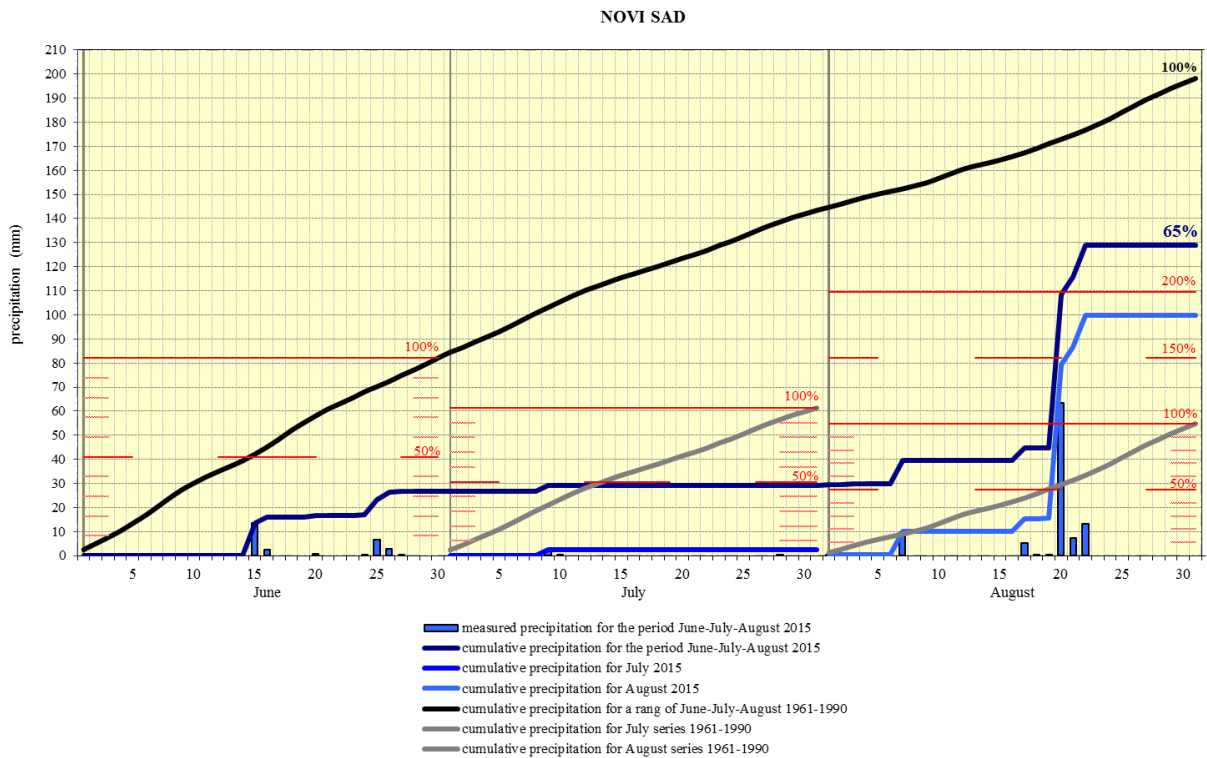


Figure 17. Cumulative precipitation sums for Novi Sad

## Sunshine duration (Insolation)

During summer, sunshine duration was within the average values in most of Serbia. Insolation ranged from 727,5 hours in Zajecar up to 964,2 hours in Novi Sad (*Figure 18*).

Sunshine duration, compared to the normal for the 1961-1990 base period ranged from 88% in Zajecar up to 133% in Kursumlija (*Figure 19*).

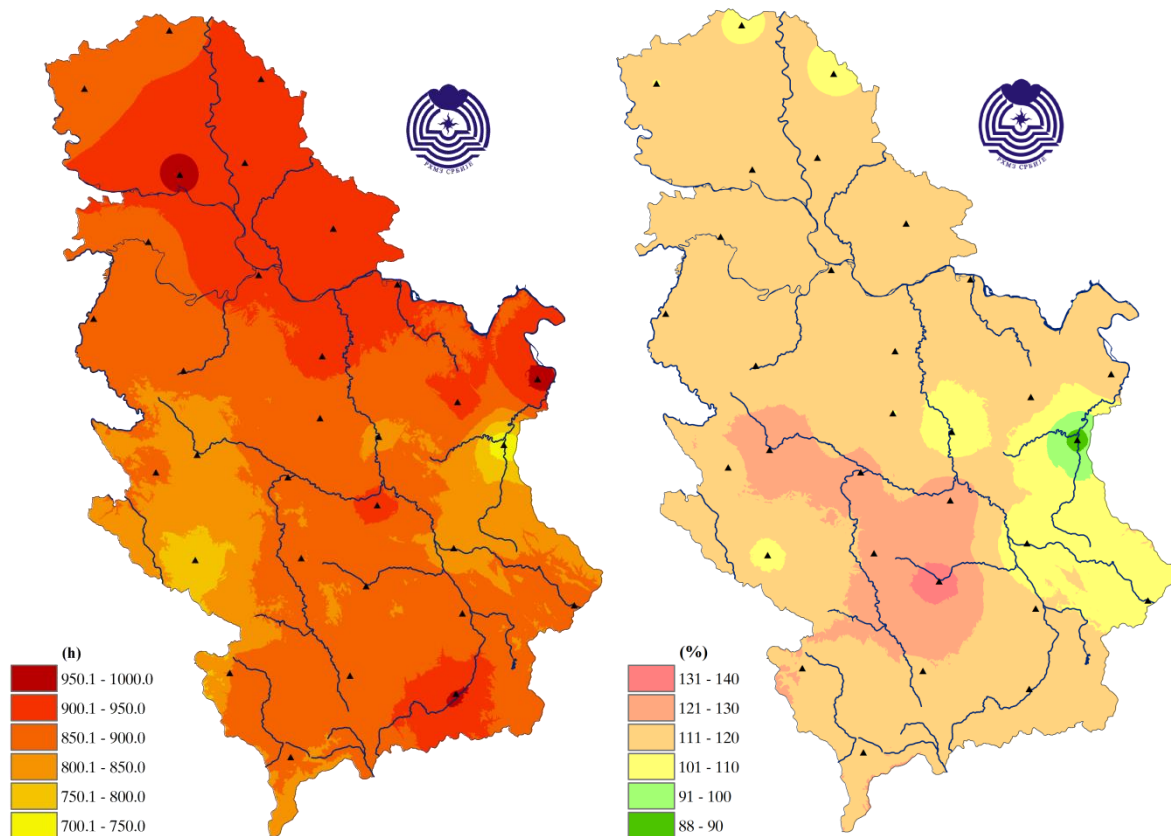


Figure 18. Insolation expressed in hours during summer

Figure 19. Insolation expressed in the percentages of normal during summer

## Heat waves during summer 2015

From the beginning of the June, the entire Serbia observed three heat waves (Chart 1). The onset of the first heatwave was observed in second half of the June, the second heat wave was registered at the beginning of August whereas the third heatwave was recorded at the end of August. Kikinda and Zrenjanin observed the fourth heat wave in first half of June.

Spatial distribution of the heat waves<sup>3</sup> in Serbia is shown in Figure 20.

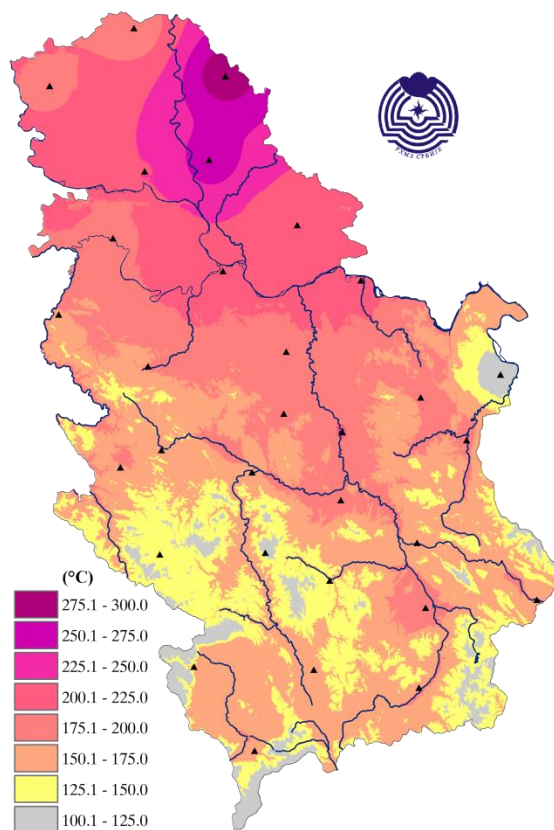


Figure 20. Spatial distribution of heat wave intensity during summer 2015 in Serbia

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<sup>3</sup> Heat wave intensity indicates sum of departures of maximum air temperature (days encompassed by heat wave) from the mean maximum air temperature for the reference climatological period



# Analysis of the 2015 summer season for Serbia compared to the 1971-2000 base period

## Temperature

Departure of the mean air temperature from the normal, during summer, for the 1971–2000 base period ranged from 1,7°C in Zajecar up to 3,4°C in Belgrade, and on the mountains from 2,2°C at Kopaonik up to 2,8°C on Zlatibor (*Figure 21*).

According to the percentile method, the mean air temperature during summer was in the extremely warm category, and very warm category in Zajecar (*Figure 22*).

According to the tercile method, mean air temperature during summer was above the average in the entire Serbia.

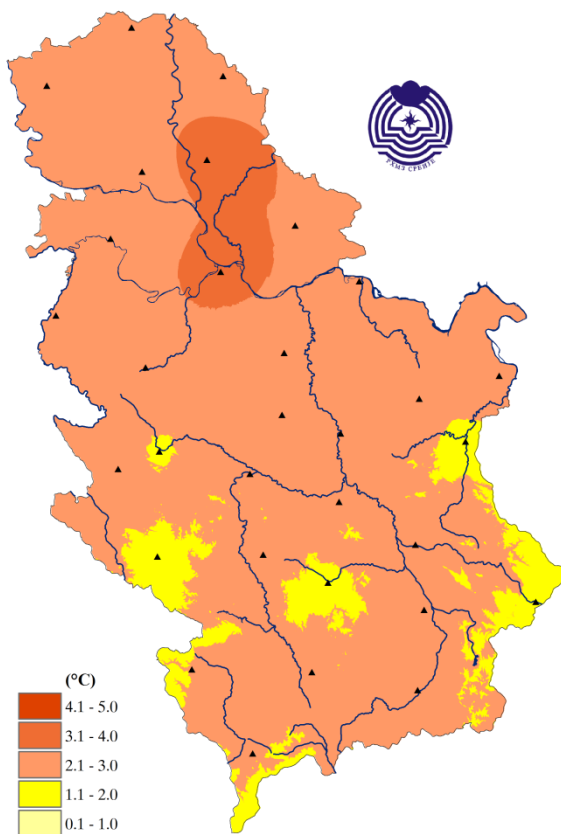


Figure 21. Mean seasonal air temperature anomaly in Serbia during summer compared to the 1971-2000 base period

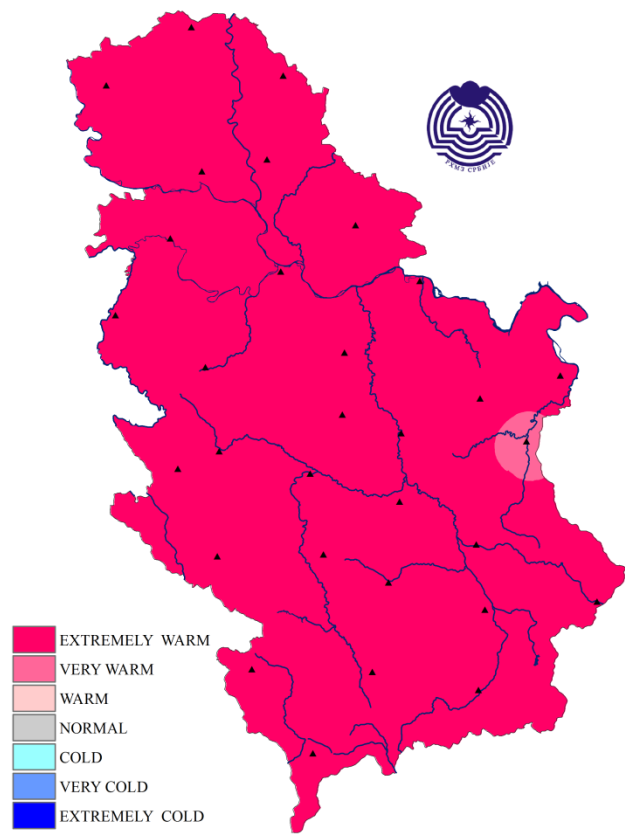


Figure 22. Air temperature assessment in Serbia during summer using percentile method compared to the 1971-2000 base period

## Precipitation

Precipitation sums during summer across most of Serbia were below the average compared to the normal for the 1971-2000 base period. Precipitation sums compared to the normal ranged from 24 % in Veliko Gradiste up to 89% on Zlatibor and Dimitrovgrad (*Figure 23*).

According to the percentile method, precipitation sums during summer were in the categories of dry and very dry in most of Serbia, and extremely dry in Kikinda, Veliko Gradiste and Pozega (*Figure 24*).

According to the tercile method, precipitation sums were below the average in most of Serbia.

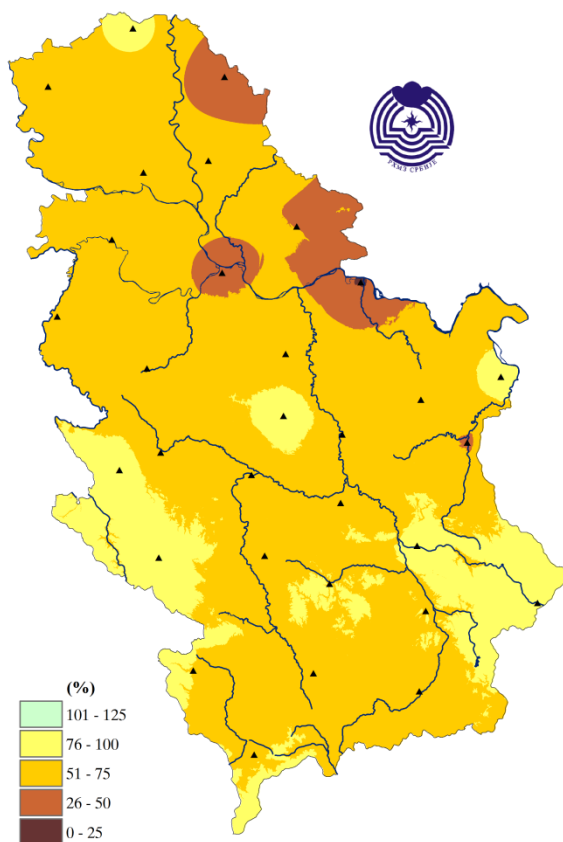


Figure 23. Spatial distribution of the precipitation sums expressed in the percentages of normal during summer compared to the 1971-2000 base period

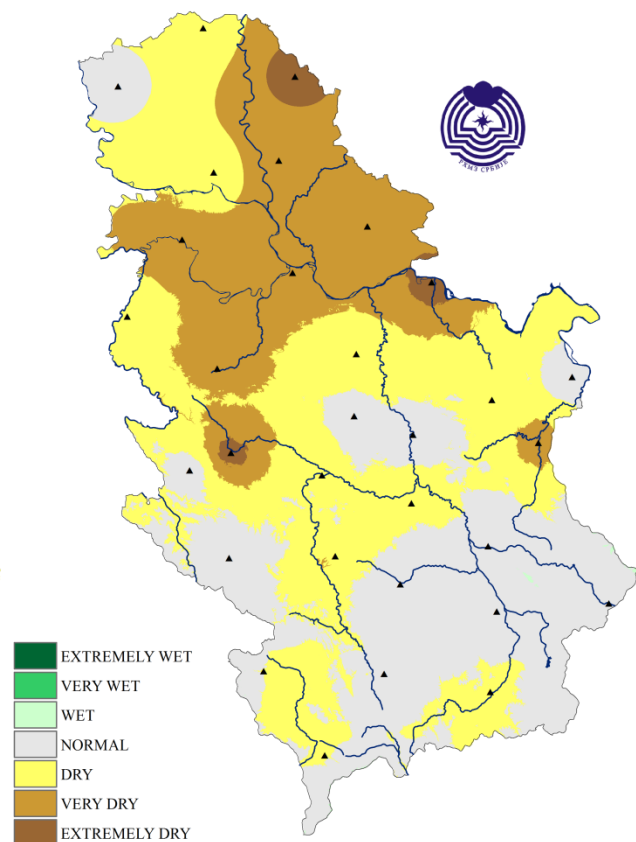


Figure 24. Precipitation sums assessment during summer using percentile method compared to the 1971-2000 base period

# Analysis of the 2015 summer season for Serbia compared to the 1981-2010 base period

## Temperature

Departure of the mean air temperature from the normal for 1981–2010 base period during summer ranged from 0,9°C in Zajecar up to 2,6°C in Belgrade and Zrenjanin, and on the mountains from 1,6°C at Kopaonik to 2,0°C on Zlatibor (*Figure 25*).

According to the percentile method, mean air temperature was in the very warm category across most of Serbia (*Figure 26*).

According to the tercile method, the mean air temperature was above the average in the entire Serbia.

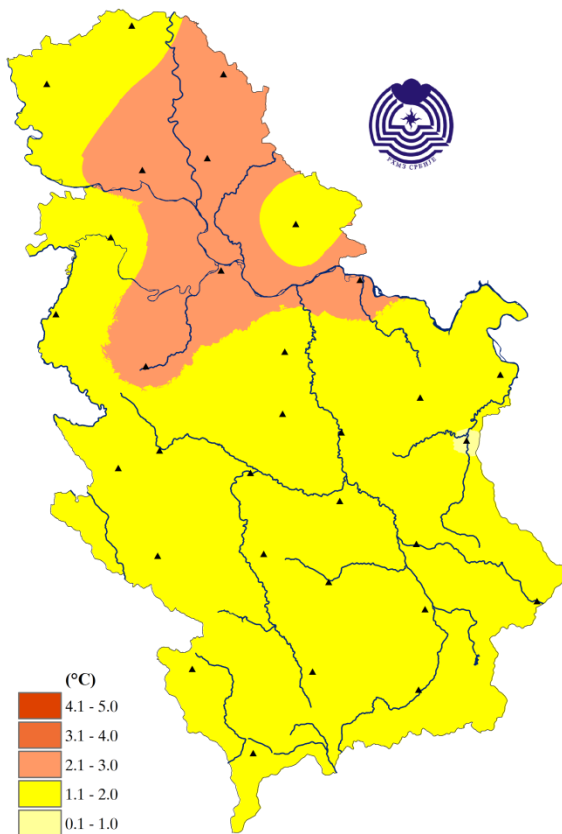


Figure 25. Mean seasonal air temperature anomaly in Serbia during summer compared to the 1981-2010 base period

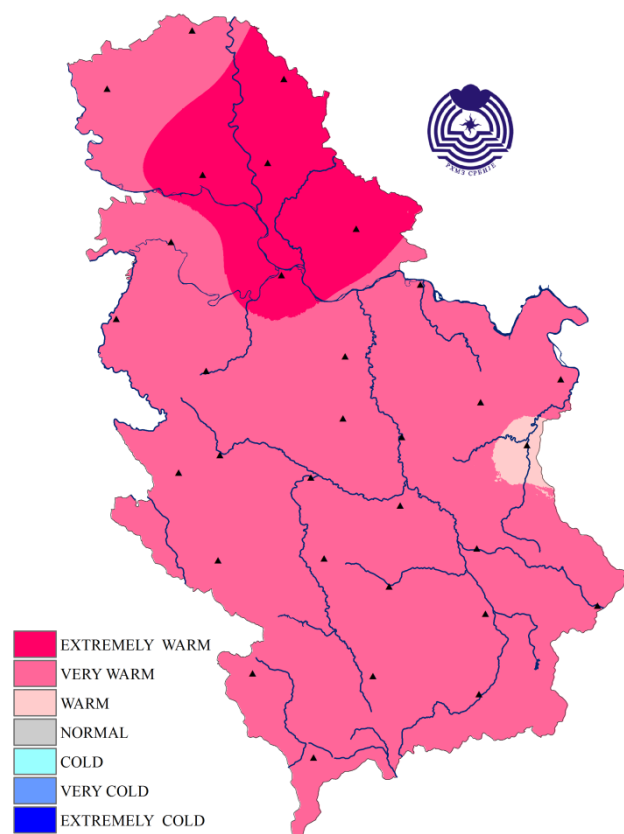


Figure 26. Air temperature assessment in Serbia during summer using percentile method compared to the 1981-2010 base period



## Precipitation

Precipitation sums during summer were below the average across most of Serbia compared to the normal for the 1981-2010 base period. Precipitation sums compared to the normal ranged from 23% in Zajecar up to 112% in Sjenica (*Figure 27*).

According to the percentile method, precipitations sums during summer were in the following categories: dry and very dry in most of Serbia and extremely dry in Kikinda and Veliko Gradiste (*Figure 28*).

According to the tercile method, precipitation sums were below the average across most of Serbia.

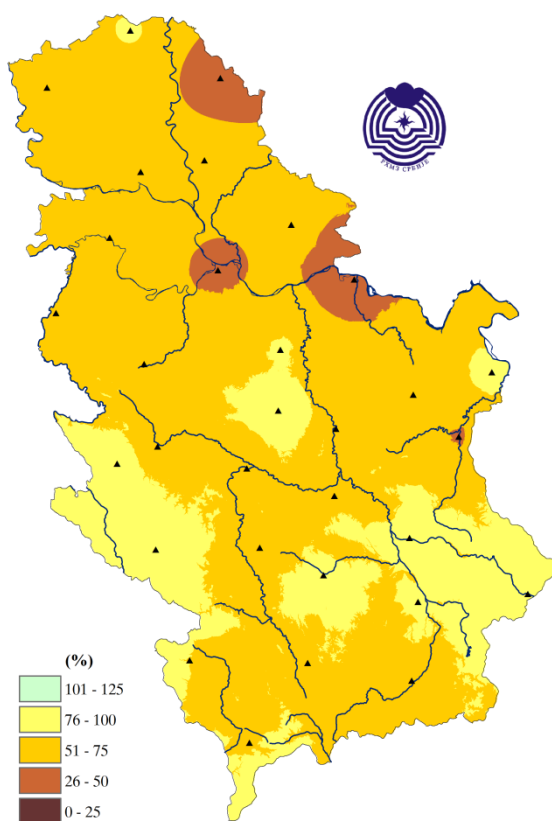


Figure 27. Spatial distribution of the precipitation sums during summer expressed in the percentages of normal compared to the 1981-2010 base period

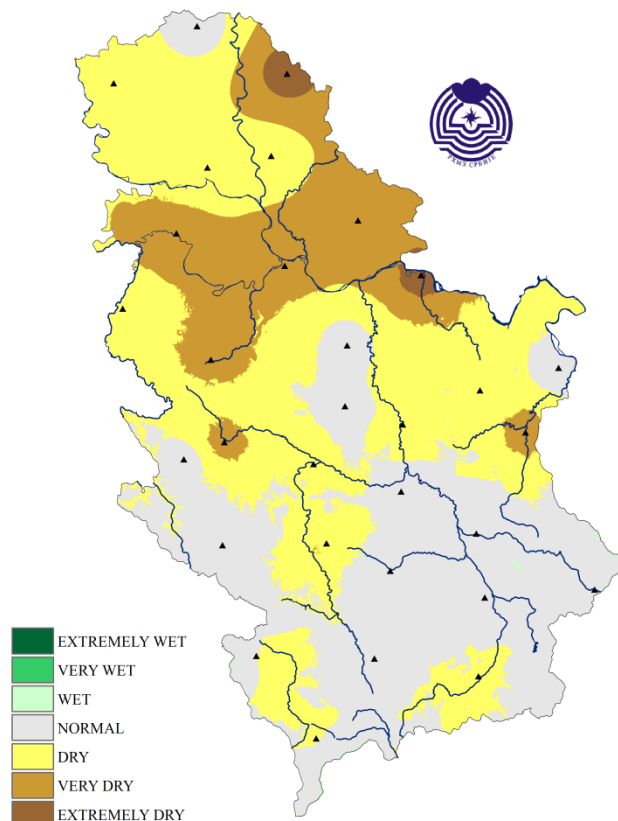


Figure 28. Precipitation sums assessment during summer using percentile method compared to the 1981-2010 base period

Summer 2015			Air Temperature (°C)			
Station	Rank*	Rank**	33	50	66	Observed value
<b>Beograd</b> (1888-2015)	2	2	21.6	22.0	22.9	24.9
<b>Palić</b> (1946-2015)	3	3	20.9	21.3	21.9	23.3
<b>Sombor</b> (1942-2015)	6	3	20.6	21.0	21.3	22.8
<b>Novi Sad</b> (1949-2015)	4	3	20.8	21.0	21.6	23.3
<b>Zrenjanin</b> (1944-2015)	3	2	21.0	21.2	21.7	24.0
<b>Kikinda</b> (1949-2015)	3	3	20.8	21.3	21.7	23.7
<b>Banatski Karlovac</b> (1986-2015)	3	3	20.9	21.3	21.8	23.1
<b>Loznica</b> (1923-2015)	3	3	20.7	21.0	21.7	23.1
<b>Sremska Mitrovica</b> (1926-2014)	7	3	20.5	20.8	21.2	22.7
<b>Valjevo</b> (1927-2015)	4	3	20.5	20.9	21.6	23.3
<b>Kragujevac</b> (1926-2015)	10	5	20.6	21.2	21.6	22.6
<b>Smederevska Palanka</b> (1940-2015)	7	4	20.8	21.3	21.8	23.2
<b>Veliko Gradište</b> (1927-2015)	4	3	20.4	21.1	21.4	23.4
<b>Crni Vrh</b> (1967-2015)	5	5	15.9	16.3	16.6	18.1
<b>Negotin</b> (1928-2015)	8	4	22.0	22.7	23.1	24.5
<b>Zlatibor</b> (1951-2015)	4	4	16.3	16.8	17.3	18.8
<b>Sjenica</b> (1947-2015)	5	4	15.3	15.9	16.2	17.0
<b>Pozega</b> (1953-2015)	4	4	18.9	19.4	19.5	20.7
<b>Kraljevo</b> (1927-2015)	10	5	20.6	21.0	21.5	22.7
<b>Kopaonik</b> (1950-2015)	3	3	11.5	12.1	12.5	13.6
<b>Kursumlija</b> (1953-2015)	5	4	19.0	19.4	19.9	20.8
<b>Krusevac</b> (1931-2015)	10	5	20.7	21.1	21.5	22.6

<b>Cuprija</b> (1949-2015)	6	4	20.3	21.0	21.3	22.6
<b>Nis</b> (1926-2015)	9	4	21.2	21.9	22.2	23.4
<b>Leskovac</b> (1949-2015)	6	4	20.4	20.9	21.1	22.6
<b>Zajecar</b> (1930-2015)	11	6	20.9	21.8	22.0	22.4
<b>Dimitrovgrad</b> (1946-2015)	9	4	18.8	19.4	19.7	20.8
<b>Vranje</b> (1927-2015)	10	4	20.3	21.1	21.3	22.8

\*Rank –period of stations work (warmest season)

\*\*Rank – 1981-2014 period (warmest season)

Summer 2015			Precipitation sums (mm)			
Station	Rank*	Rank**	33	50	66	Observed Value
<b>Beograd</b> (1888-2015)	118	32	169.3	222.8	264.1	98.5
<b>Palić</b> (1945-2015)	53	23	161.4	197.6	219.0	147.4
<b>Sombor</b> (1942-2015)	63	26	180.2	187.8	215.1	144.9
<b>Novi Sad</b> (1948-2015)	54	27	174.5	187.8	236.8	129
<b>Zrenjanin</b> (1946-2015)	77	30	155.3	175.6	222.8	114.4
<b>Kikinda</b> (1948-2015)	89	34	152.4	174.9	205.7	62.2
<b>Banatski Karlovac</b> (1946-2015)	64	32	146.6	198.6	246.0	108.5
<b>Loznica</b> (1925-2015)	70	28	237.8	256.5	309.0	184.6
<b>Sremska Mitrovica</b> (1925-2015)	77	31	173.9	189.4	226.1	128.3
<b>Valjevo</b> (1926-2015)	74	29	214.0	233.9	286.7	154.8
<b>Kragujevac</b> (1925-2015)	53	18	154.8	195.4	230.6	175.9
<b>Smederevska Palanka</b> (1939-2015)	61	23	168.2	201.5	231.6	150.9

<b>Veliko Gradište</b> (1926-2015)	88	34	129.4	173.9	238.6	52.1
<b>Crni Vrh</b> (1967-2015)	40	26	169.4	196.9	249.3	138.6
<b>Negotin</b> (1927-2015)	46	20	105.8	138.2	188.9	122.1
<b>Zlatibor</b> (1950-2015)	37	20	230.7	288.4	313.0	254.3
<b>Sjenica</b> (1946-2015)	36	23	191.2	213.6	229.3	182.3
<b>Pozega</b> (1952-2015)	80	32	178.0	218.5	238.1	132.5
<b>Kraljevo</b> (1926-2015)	74	28	209.6	244.4	272.7	136.1
<b>Kopaonik</b> (1950-2015)	58	30	224.1	279.6	323.8	175.5
<b>Kursumlija</b> (1952-2015)	59	21	129.2	175.7	208.0	136.2
<b>Krusevac</b> (1927-2015)	66	25	137.0	172.5	209.9	126.9
<b>Cuprija</b> (1948-2015)	66	26	143.8	185.8	204.9	128.5
<b>Nis</b> (1925-2015)	66	23	125.9	150.2	178.7	117.6
<b>Leskovac</b> (1948-2015)	64	22	126.2	150.3	179.6	118.4
<b>Zajecar</b> (1929-2015)	81	31	115.7	156.2	172.8	77.1
<b>Dimitrovgrad</b> (1945-2015)	56	20	150.2	175.7	203.5	163.5
<b>Vranje</b> (1926-2015)	76	28	112.0	144.3	179.9	78.4

\* Rank –period of stations work (highest seasonal precipitation)

\*\* Rank – 1981-2014 period (highest seasonal precipitation)

Country	Seasonal temperature JJA		Seasonal precipitation JJA		High Impact Events
	Observed	SEECOF-13 climate outlook for temperature	Observed	SEECOF-13 climate outlook for precipitation	
Serbia (1)	Above normal	<b>Above to near normal</b> (20, 40, 40)  whole Serbia	Below normal	<b>No predictive signal</b> (33, 34, 33)  whole Serbia	<p><b>Summer 2015</b> was extremely warm; in Belgrade second warmest on record. 3 heat waves were observed.</p> <p><b>July 2015</b> was the second warmest and the second driest July on record. In Zrenjanin July 2015 was as warm as the warmest July of 2012. Two heat waves were recorded, with exceptionally high mean daily air temperature anomalies. July 2015 was the driest July on record at five principal meteorological stations.</p>