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Warm and rainy 2016

Temperature

The year of 2016, with the mean air temperature of 11.4ºC, was the twelfth warmest year for Serbia in a period from 1951 up to-date, the third warmest for Sjenica and eleventh warmest for Belgrade since the commencement of the meteorological station (1888). The mean annual air temperature ranged from 10.6ºC in Pozega to 13.5ºC in Belgrade, and on the mountains from 4.6ºC at Kopaonik to 8.7ºC at Zlatibor. Departure of the mean annual air temperature relative to the 1981-2010 base period ranged from 0.6ºC in Banatski Karlovac, Veliko Gradiste, Zajecar and Krusevac to 1.2ºC in Loznica and Negotin. Based on the percentile distribution[1], the year 2016 was the in the warm category across most of Serbia, very warm in western and southwestern areas, and extremely warm in Sjenica.

10 of the 15 warmest years for Serbia have occurred since 2000 (1951-2016), and in Belgrade twelve warmest years (1888-2016).

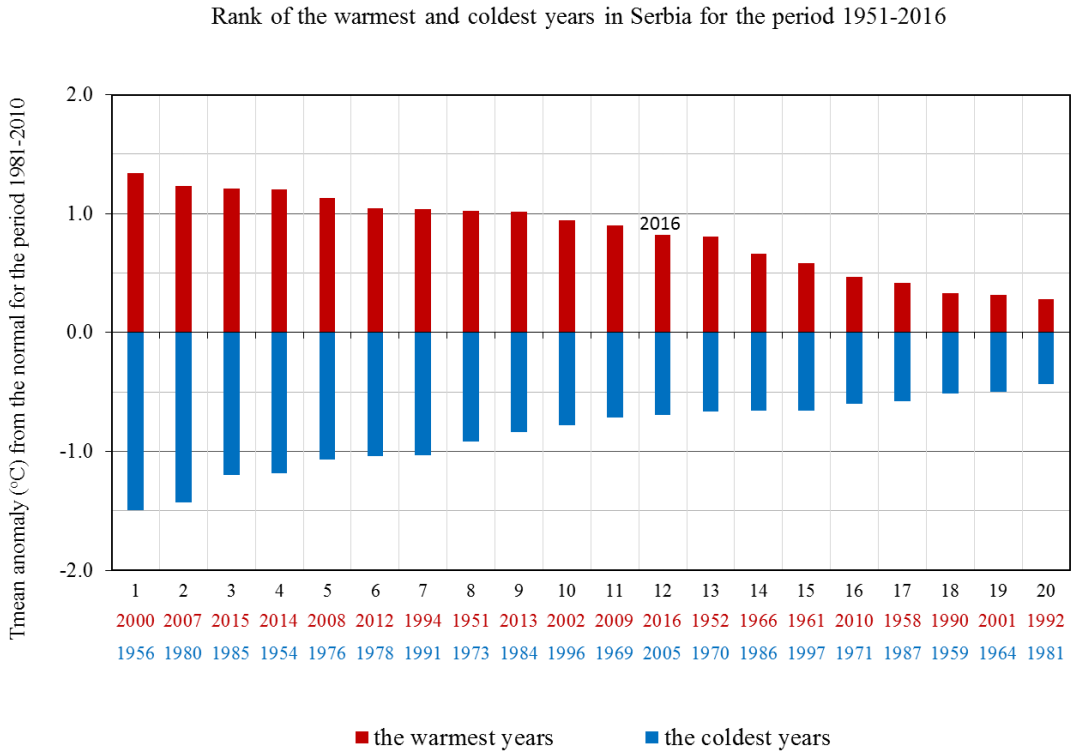


Figure 1. Rank of the warmest and coldest years in Serbia since 1951 based on the departure of the mean air temperature from the normal for the 1981-2010 period amounting to 10.6°C

[1] **n**th 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

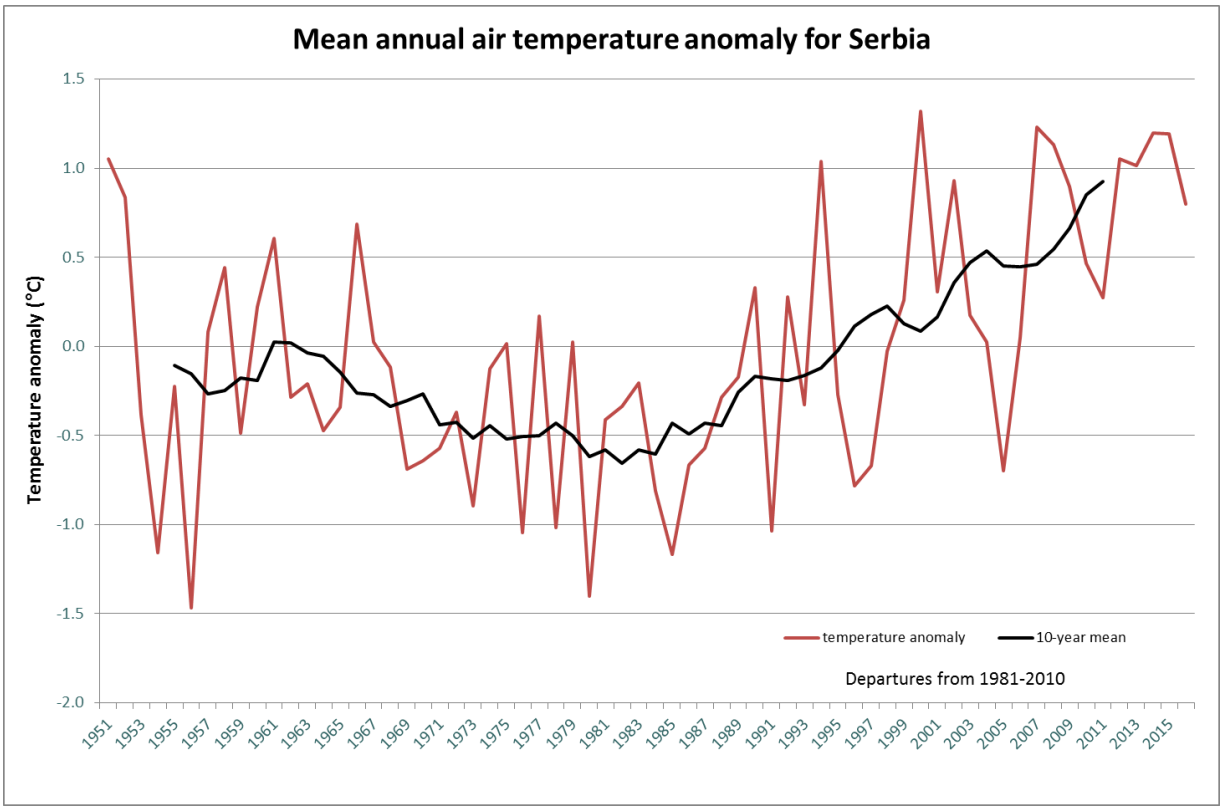


Figure 2. Trend of the mean annual air temperature anomaly for Serbia

In 2016, the highest daily air temperature of 38.0ºC was measured in Nis, on July 14. The highest number of tropical days[2] was registered in Negotin, total of 61 day, which is 17 days above the average number of tropical days for the 1981-2010 base period.

Belgrade observed 41 tropical days, which is 4 days above the average. The total number of registered tropical nights[3] was 27, which is 10 days above the average.

The lowest daily air temperature of -25.6ºC.was measured in Sjenica on January 20. Most of Serbia observed below-average number of days with severe frost[4]. In the lowland, their number ranged from 1 day in Belgrade, Novi Sad and Zrenjanin to 13 days in Zajecar, and on the mountains from 10 to 26 days.

[2] Tropical day is defined as a day with maximum air temperature 30°C and above
[3] Tropical night is defined as a day with minimum daily air temperature 20°C and above
[4] Day with severe frost is defined as a day with the minimum daily air temperature of -10°C and above

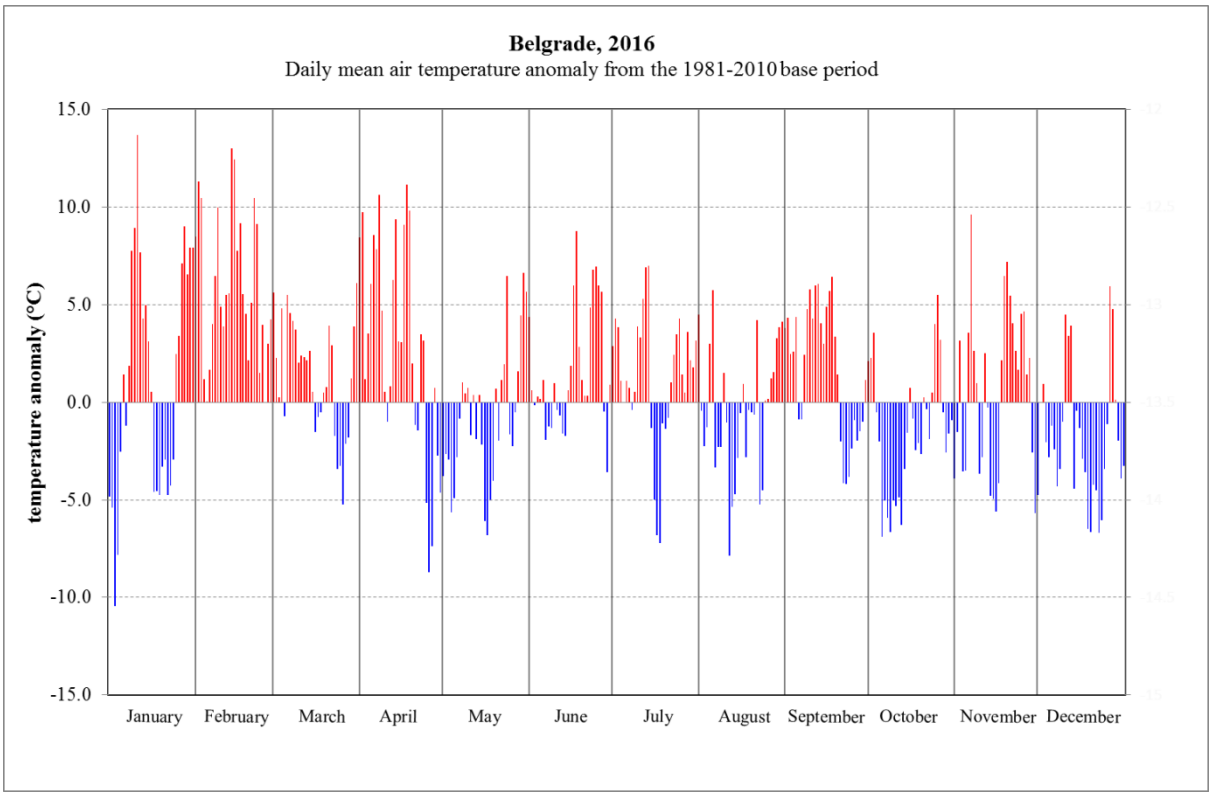


Figure 3. Daily departure of the mean air temperature in Belgrade relative to the 1981-2010 normal

In 2016, the number of ice days[5] ranged from 6 in Zajecar to 18 days in Kikinda and Dimitrovgrad, and in the upland from 21 days in Sjenica to 55 days at Kopaonik. Zajecar observed 11 days below the average number of 17 ice days, whereas Crni Vrh recorded 21 day below the average number of 63 ice days for the 1981-2010 base period.

Precipitation

The year of 2016 was rainy across most of Serbia, and extremely rainy in parts of western, southern and northeastern Serbia. Precipitation totals ranged from 613.6 mm in Sremska Mitrovica to 992 mm in Pozega, and on the mountains from 905.2 mm at Crni Vrh to 1440 mm at Kopaonik. The precipitation percentage relative to the 1981-2010 normal ranged from 100 in Sremska Mitrovica to 149 in Krusevac.

The highest daily precipitation sum of 137.1 mm was recorded in Negotin, on July 16.

The number of days with snow cover ranged from 5 days on Palic and Kikinda to 35 days in Dimitrovgrad and on the mountains from 60 days on Zlatibor to 141 days at Kopaonik. The greatest snow depth of 78 cm was measured at Kopaonik on January 18. In the lowland, the greatest snow depth of 42 cm, was observed in Cuprija on January 5.

[5] Ice day is defined as the day with the maximum daily air temperature below 0°C

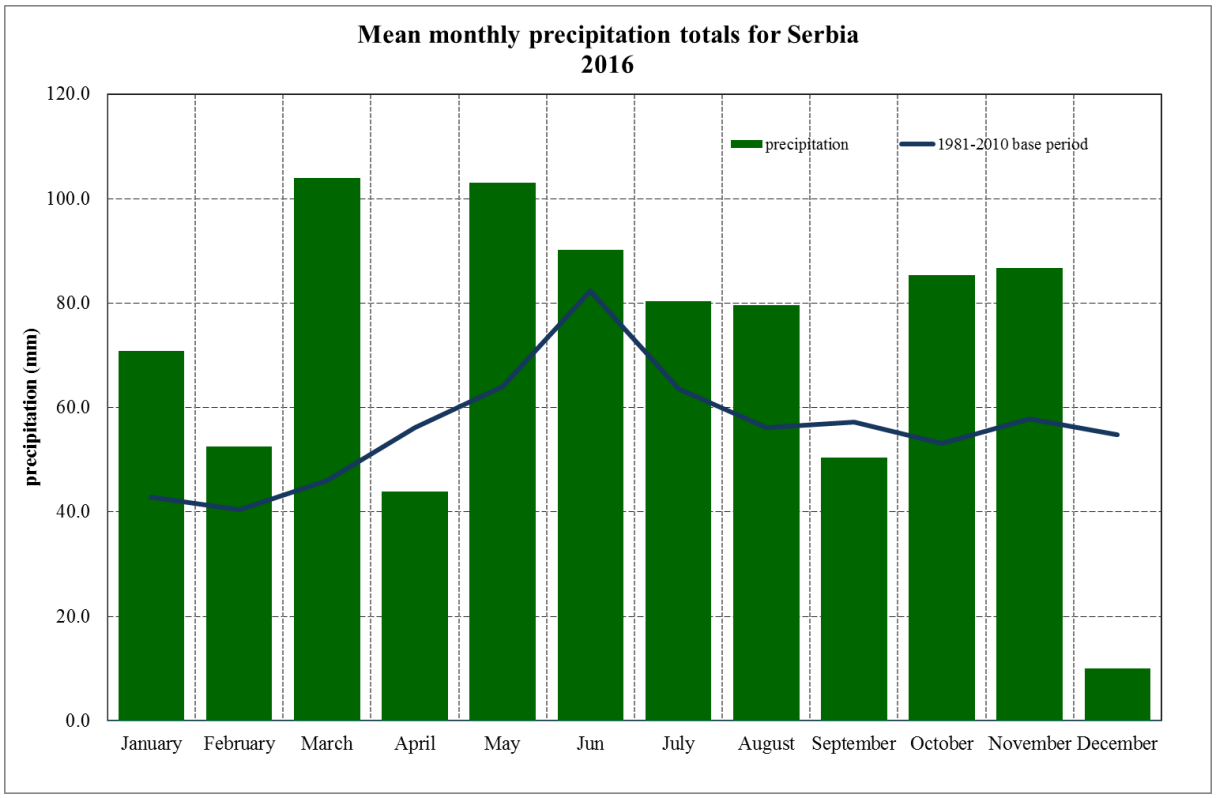


Figure 4. Mean monthly precipitation totals for Serbia

Cold and heat waves

In 2016, three cold waves[6] were recorded. The first one was observed at Crni Vrh, with the 6-day duration at the beginning of January. The second heat wave affected most of Serbia during third decade of January, with the total duration of 7 days. The thirst heat wave was registered during the third decade of September in parts of northeastern and southern Serbia.

At the end of March and beginning of April, most of Serbia observed heat wave[7], lasting up to 9 days. During winter, certain parts of Serbia observed three heat waves. In June, Vranje and Dimitrovgrad recorded heat wave with the total duration of 8 days. Additionally, 2 heat waves, lasting up to 6 days, were observed during September, the first in Sombor and Palic, and the second one in Negotin.

[6] Cold wave is defined as five or more consecutive days with the minimum daily air temperature in the very cold and extremely cold category based on the statistical percentile method

[7] Heat wave is defined as five or more consecutive days with the maximum daily air temperature in the very warm and extremely warm category.

Monthly and seasonal overview of the climate characteristics and observed temperature and precipitation records in 2016

January – In January 2016, Nis and Zajecar observed the highest precipitation totals since the records at these main meteorological stations began. The previous January record of 98.1 mm for Nis was set in January 2012, whilst the current January record measures 101.3 mm. In January 2016, Zajecar received 105.6 mm of precipitation surpassing the previous January record of 94.7 mm set in 1987.

February – The warmest February since national records began. February maximum air temperatures surpassed at 12 main meteorological stations (Table 1). The second wettest for Palic and the fourth wettest for Sombor.

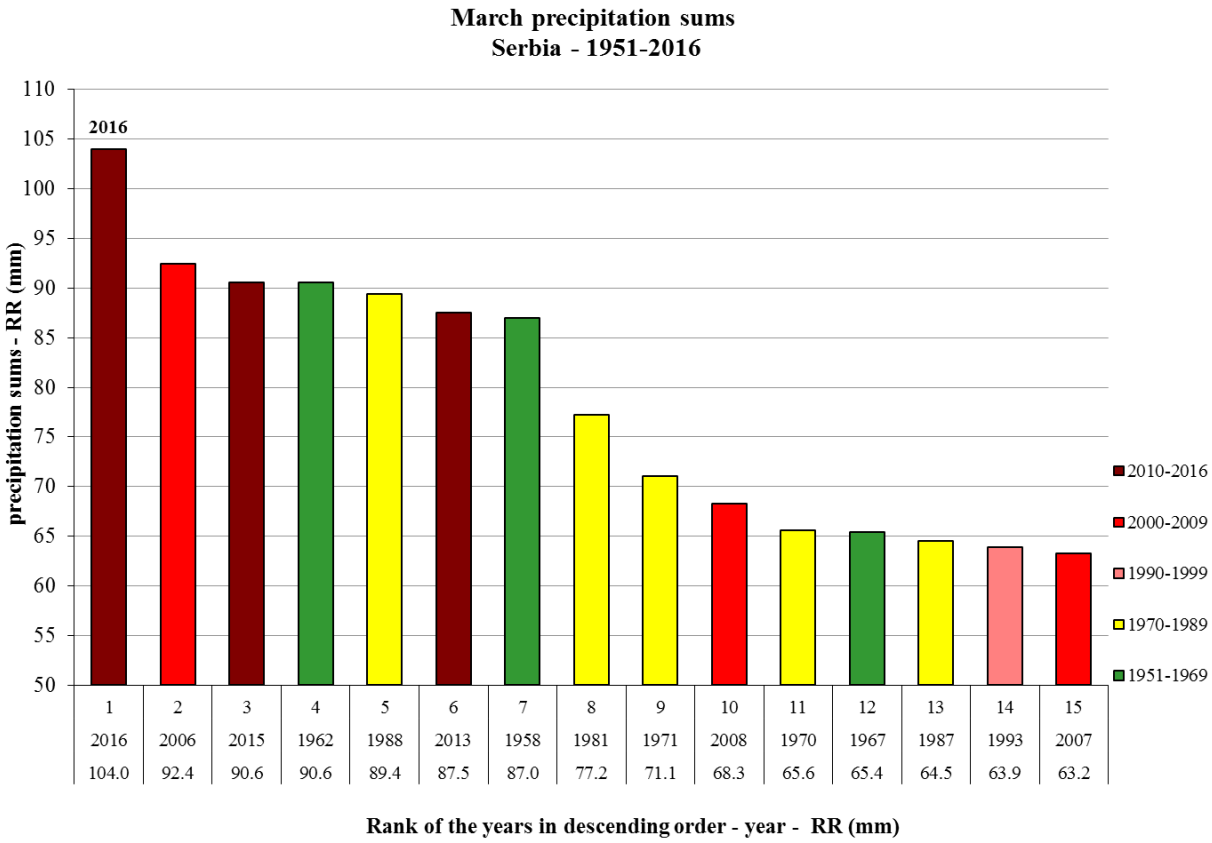
Table 1. Record-breaking maximum air temperatures

MMS	Tmax February 2016	Date Tmax	Previous record	Date of the previous record
KRAGUJEVAC	**25.2**	15	24.2	25. II 2008
S.PALANKA	**24.9**	15	24.4	25. II 2008
CRNI VRH	**18.8**	22	18.3	23. II 1977
NEGOTIN	**23.5**	23	22.4	26. II 1990
ZLATIBOR	**20.3**	17	19.9	26. II 2008
SJENICA	**20.6**	17	19.4	12. II 1979
KURSUMLIJA	**24.7**	16	23.2	23. II 1977
KRUSEVAC	**25.5**	15	24.2	23. II 1977
CUPRIJA	**25.5**	15	23.8	23. II 1977
NIS	**23.9**	15	23.5	25. II 2008
LESKOVAC	**24.8**	16	23.0	23. II 1977
DIMITROVGRAD	**23.6**	15	23.0	23. II 1977

March - The wettest March for Serbia (Figure 5). March maximum precipitation sums surpassed in Valjevo, Smederevska Palanka, Pozega, Zlatibor and Kopaonik. Maximum daily precipitation sums in March exceeded at Zlatibor, Sjenica and Pozega (Table 2).

Table 2. Record-breaking monthly precipitation sums

MMS station	**Monthly sums March 2016**	**Previous record** Entire series	**The year of the previous record RR**
VALJEVO	**145.4**	139.0	2015
S.PALANKA	**124.4**	108.8	1988
ZLATIBOR	**220.9**	190.4	2006
POZEGA	**168.6**	118.9	2006
KOPAONIK	**166.5**	140.6	2013



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2016	2006	2015	1962	1988	2013	1958	1981	1971	2008	1970	1967	1987	1993	2007
104.0	92.4	90.6	90.6	89.4	87.5	87.0	77.2	71.1	68.3	65.6	65.4	64.5	63.9	63.2

Figure 5.

The observed precipitation sums for Zlatibor, Pozega and Sjenica on March 7, 2016 surpassed the average precipitation totals for the entire March. Precipitation totals registered at these stations are the highest March precipitation sums since the records began.

- Zlatibor received 80.3 mm of precipitation, the previous daily record of 56.7 mm for Zlatibor was set on March 6, 2015
- Pozega received 76.6 mm of precipitation, the previous daily record of 46.0 mm was set on March 29, 1927
- Sjenica received 71.4 mm of precipitation besting the previous March daily record of 42.1 mm set on March 15, 2013.

April - The fourth warmest, with near- average precipitation totals across most of Serbia. On April 18, Negotin observed record-breaking daily air temperature for that month.

The highest daily maximum air temperature of 32.0ºC was registered in Loznica and Negotin, on April 17 and 18, respectively. Negotin observed **record-breaking daily precipitation sum for the month of April,** breaking the previous record of 31.0ºC set on April 27, 1930. 17 April 2016 marks as the warmest 17 April since the records at 23 main meteorological stations began.

May – The fourth wettest for Zlatibor, and fifth wettest for Pozega. In the period from 2 to 5 May, Krusevac received 76.2 mm of precipitation, which is near-average for the month of May. May air temperature was within the average and below-average. In the period from 2 to 5 May, Krusevac received 76.2 mm of precipitation which is near-average, amounting to 77.5 mm. In the same period, Kopaonik received 102.6mm of precipitation, and the average for May is amounting to 108.8 mm.

June – Fifth warmest for Serbia. Record number of tropical nights in June was registered at 8 main meteorological stations. Zrenjanin observed the highest June precipitation total since the records at that station began.

Table 3. Record-breaking number of tropical nights in June

MMS	Number of tropical nights – June 2016	Previous record	Date of the records
NEGOTIN	**8**	6	1931/2002
LOZNICA	**7**	5	2010
V.GRADISTE	**7**	3	1972/1991/2010/2011
NIS	**6**	4	2010
KIKINDA	**5**	4	2003/2013
KRALJEVO	**4**	3	2010
CUPRIJA	**4**	2	1963/1997/2010
POZEGA	**2**	1	2006

Zrenjanin observed record-breaking June precipitation total of 187 mm, besting the previous record of 173.7 mm set in June 1981.

July – The third wettest for Negotin, Leskovac and Vranje. In Vranje, all-time daily precipitation record was surpassed, whilst in Negotin and Zajecar, July daily maximum precipitation record was exceeded.

The highest daily precipitation sum of 137.1 mm in July was registered in Negotin on July 16, breaking the previous record of 67 mm set on July 5, 1970. Similarly, Zajecar observed record-breaking daily precipitation sum of 65.2 mm on July 16, besting the previous record of 64 mm set on July 9, 1940. Vranje recieved 74.2 mm of precipitation on July 16, beating the previous all-time daily record of 73.8 mm set on September 18, 1972.

August – The second wettest for Zlatibor and Pozega, fourth wettest for Banatski Karlovac. Daily maximum precipitation record for August was surpassed in Banatski Karlovac.

The highest daily precipitation total of 48.1 mm in August was recorded in Banatski Karlovac, on August 2. This bested the previous August daily precipitation record of 42.8 mm set on August 8, 2002 at this station.

September – Warm and averagely rainy September.

October – Averagely cold and rainy October. The second coldest for Crni Vrh since the records began (Figure 6).

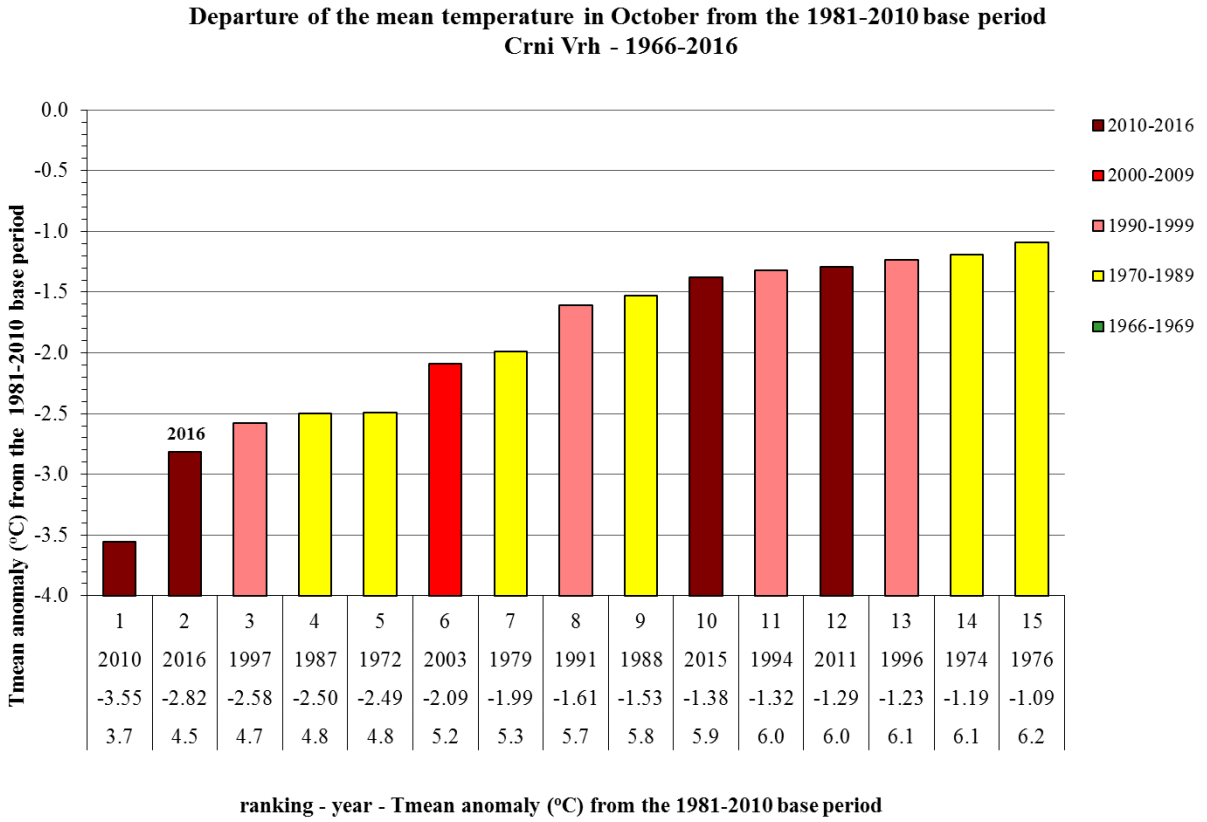


Figure 6.

November – The second wettest November for Kopaonik and Nis, the third wettest for Leskovac. In the first 13 days of November, precipitation sums in southern, eastern and southwestern parts of the country were two times higher than the average for the entire month. On November 8, Kursumlija observed record-breaking daily maximum precipitation sums for November. Air temperature within the average.

On November 8, Kursumlija observed record-breaking November daily precipitation sum of 57.7 mm.

December – Cold and extremely dry, in Negotin and Sremska Mitrovica the driest since the records began, and the fourth driest for Serbia. At the beginning of December, Sombor experienced cold wave.

Winter 2014/15 - The least number of frost days in Pozega.

Spring 2016 – The third wettest spring for Serbia. On March 7, 2016, Zlatibor, Pozega and Sjenica observed the highest daily precipitation sums in spring since the records at these stations began.

Summer 2016 – Warm summer across most of Serbia, averagely warm in northern areas. The third wettest summer for Zrenjanin. Above – average precipitation sums in northern Serbia, and below-average in central parts of the country.

Autumn 2016 – Autumn air temperature within the multiannual average. Precipitation sums within the average in most of Serbia, and in the very rainy category in southern areas. On November 8, Kursumlija observed record-breaking daily maximum precipitation sum in autumn.

On November 8, Kursumlija received 57.7 mm of precipitation, besting the previous autumn daily precipitation record of 54.6 mm set on September 1, 1978.

Appendix

Table 4.

MEAN MONTHLY AND ANNUAL AIR TEMPERATURE (°C)

station/month	January	February	March	April	May	June	July	August	September	October	November	December	Year
PALIC	0.0	6.2	7.4	13.4	16.5	21.7	23.3	21.0	18.2	10.0	5.8	-0.2	11.9
SOMBOR	0.7	6.5	7.4	13.5	16.4	21.5	22.7	20.5	17.7	10.1	5.6	-0.3	11.9
NOVI SAD	1.3	7.5	7.8	14.2	16.9	21.7	22.8	21.0	18.4	10.2	6.3	-0.1	12.3
ZRENJANIN	0.8	7.7	7.9	14.4	16.9	21.8	23.3	21.3	18.5	10.2	6.4	-0.2	12.4
KIKINDA	0.4	7.0	7.6	13.9	16.4	21.7	23.1	21.1	18.2	10.1	5.7	-0.3	12.1
B.KARLOVAC	0.6	7.6	7.8	14.8	16.8	21.8	22.5	20.8	17.8	10.3	6.2	-0.3	12.2
LOZNICA	2.6	8.5	8.6	14.1	16.6	21.9	23.2	20.8	18.2	11.0	7.6	1.2	12.9
S.MITROVICA	0.9	7.2	7.6	13.8	16.8	21.5	22.5	20.5	17.7	10.3	6.4	-0.2	12.1
VALJEVO	1.5	8.3	7.9	13.8	16.2	21.8	23.2	20.6	18.0	10.8	7.0	0.8	12.5
BELGRADE	2.5	9.0	9.1	15.5	17.5	22.5	24.4	22.3	19.7	11.2	7.7	0.9	13.5
KRAGUJEVAC	1.2	8.8	7.7	13.9	15.7	21.5	22.9	20.5	17.4	10.8	7.3	0.1	12.3
S.PALANKA	1.0	8.4	7.9	14.2	16.3	21.7	23.1	20.8	17.6	10.4	7.0	-0.1	12.4
V.GRADISTE	-0.1	7.7	7.6	14.0	15.9	21.6	22.5	20.7	17.3	10.3	6.3	-0.8	11.9
CRNI VRH	-3.0	3.0	2.3	10.6	10.6	16.5	17.8	16.5	14.5	4.5	1.7	-3.8	7.6
NEGOTIN	-0.8	7.4	8.6	15.0	17.3	23.2	24.6	22.8	19.5	10.8	5.9	2.3	13.0
ZLATIBOR	-0.8	5.1	3.1	10.7	11.1	16.9	18.5	16.2	13.7	7.5	4.1	-1.6	8.7
SJENICA	-2.0	4.6	2.8	9.7	10.4	16.4	17.6	15.6	12.0	7.7	2.9	-3.7	7.8
POZEGA	-1.2	6.6	6.5	12.3	14.2	19.9	21.1	18.7	15.7	9.7	4.6	-1.3	10.6
KRALJEVO	-0.1	8.8	7.8	14.2	15.5	21.2	23.1	20.6	17.6	10.6	6.7	0.0	12.2
KOPAONIK	-4.6	1.0	-1.5	6.4	6.2	12.3	13.9	12.3	8.8	4.2	0.7	-4.4	4.6
KURSUMLIJA	0.9	8.4	7.0	13.4	14.2	20.2	21.4	19.1	15.7	10.0	6.0	-0.4	11.3
KRUSEVAC	-0.3	8.6	8.0	14.2	15.6	21.5	22.6	20.3	17.0	10.6	6.5	-0.4	12.0
CUPRIJA	-0.2	8.0	7.7	14.0	15.8	21.7	22.8	20.3	16.8	10.2	6.8	-0.5	12.0
NIS	0.3	8.9	8.3	14.9	15.6	22.6	23.4	21.3	18.1	11.0	7.1	-0.6	12.6
LESKOVAC	-0.4	8.6	7.7	14.2	15.4	22.0	22.8	20.5	16.6	10.6	5.9	-1.0	11.9
ZAJECAR	-0.6	7.0	7.2	13.8	15.6	21.3	22.5	20.5	17.0	9.7	4.9	0.4	11.6
DIMITROVGRAD	-1.3	7.4	6.4	13.2	13.8	20.3	21.4	19.9	15.8	10.3	5.6	-1.6	10.9
VRANJE	0.6	8.2	7.6	14.0	14.8	21.1	22.6	20.9	17.1	11.5	5.8	-0.5	12.0

Table 5.

MONTHLY AND ANNUAL PRECIPITATION (mm)

station/month	January	February	March	April	May	June	July	August	September	October	November	December	Year
PALIC	40.1	94.3	49.8	24.9	60.0	73.7	54.5	97.2	69.3	90.4	28.9	1.8	684.9
SOMBOR	48.3	82.9	54.8	23.0	62.0	101.2	115.2	81.5	68.7	77.7	44.9	2.4	762.6
NOVI SAD	51.3	49.2	65.5	74.5	85.0	143.2	68.4	45.8	33.7	84.8	67.1	2.2	770.7
ZRENJANIN	43.2	40.4	73.8	31.0	48.8	182.7	92.2	68.9	46.6	70.3	49.3	3.4	750.6
KIKINDA	47.8	64.6	39.6	14.3	80.7	136.1	52.6	47.6	74.8	95.6	53.1	3.5	710.3
B.KARLOVAC	35.1	40.0	70.7	67.4	105.8	63.1	63.2	146.7	42.5	71.3	63.0	5.3	774.1
LOZNICA	76.5	47.0	135.5	65.5	91.7	138.7	97.8	108.5	44.6	72.3	77.7	5.6	961.4
S.MITROVICA	44.1	37.2	68.9	38.6	52.2	85.4	68.8	30.0	67.5	62.3	57.1	1.5	613.6
VALJEVO	79.2	51.9	145.4	58.7	82.9	134.2	63.4	125.4	82.8	78.5	65.3	8.2	975.9
BELGRADE	46.3	38.5	102.6	53.9	71.2	152.2	35.0	60.8	47.8	76.8	71.8	2.8	759.7
KRAGUJEVAC	90.1	42.5	111.5	43.3	124.0	59.4	58.3	85.2	40.3	84.4	68.8	10.7	818.5
S.PALANKA	56.2	37.7	124.4	54.3	100.7	81.7	48.4	65.9	28.9	77.4	61.4	8.0	745.0
V.GRADISTE	47.3	45.7	87.9	60.1	134.8	105.7	152.5	52.2	37.7	79.8	70.4	18.2	892.3
CRNI VRH	65.5	53.7	98.1	56.4	136.0	119.0	63.6	70.2	28.3	103.1	88.1	23.2	905.2
NEGOTIN	78.8	57.9	94.1	31.5	102.0	30.8	138.3	23.7	18.3	83.9	87.6	0.0	746.9
ZLATIBOR	85.0	54.9	220.9	64.7	162.6	127.1	110.0	162.4	54.2	111.4	111.9	20.0	1285.1
SJENICA	62.8	73.4	146.9	31.6	118.2	90.4	58.2	138.0	99.1	98.2	121.7	15.5	1054.0
POZEGA	57.3	30.4	168.6	46.6	145.4	74.8	72.4	180.2	43.8	77.6	85.9	9.0	992.0
KRALJEVO	86.2	52.6	157.9	39.9	113.5	48.6	29.1	63.4	49.8	84.1	77.6	9.4	812.1
KOPAONIK	112.0	81.3	166.5	60.0	230.5	99.6	108.0	157.3	89.6	113.4	168.6	53.2	1440.0
KURSUMLIJA	48.3	46.9	107.4	35.8	116.7	49.5	64.8	84.1	40.3	81.3	122.5	3.7	801.3
KRUSEVAC	89.5	48.6	86.0	63.2	144.7	77.4	102.4	70.2	50.9	84.6	111.6	5.3	934.4
CUPRIJA	108.4	50.8	79.7	65.0	118.9	47.7	76.7	88.7	55.1	70.5	70.8	19.3	851.6
NIS	101.3	45.1	73.7	31.2	90.6	37.3	88.4	31.4	43.6	89.5	129.6	9.1	770.8
LESKOVAC	84.1	50.4	93.4	24.2	69.6	63.0	113.6	29.5	56.3	82.5	131.4	12.3	810.3
ZAJECAR	105.6	41.0	104.2	17.2	69.2	85.4	65.4	31.3	32.5	103.5	124.7	1.1	781.1
DIMITROVGRAD	119.0	55.1	92.8	29.2	88.3	68.8	79.1	28.0	35.5	79.7	91.7	9.8	777.0
VRANJE	73.5	56.3	90.2	24.1	78.9	48.2	108.5	54.2	31.1	104.5	125.2	15.5	810.2

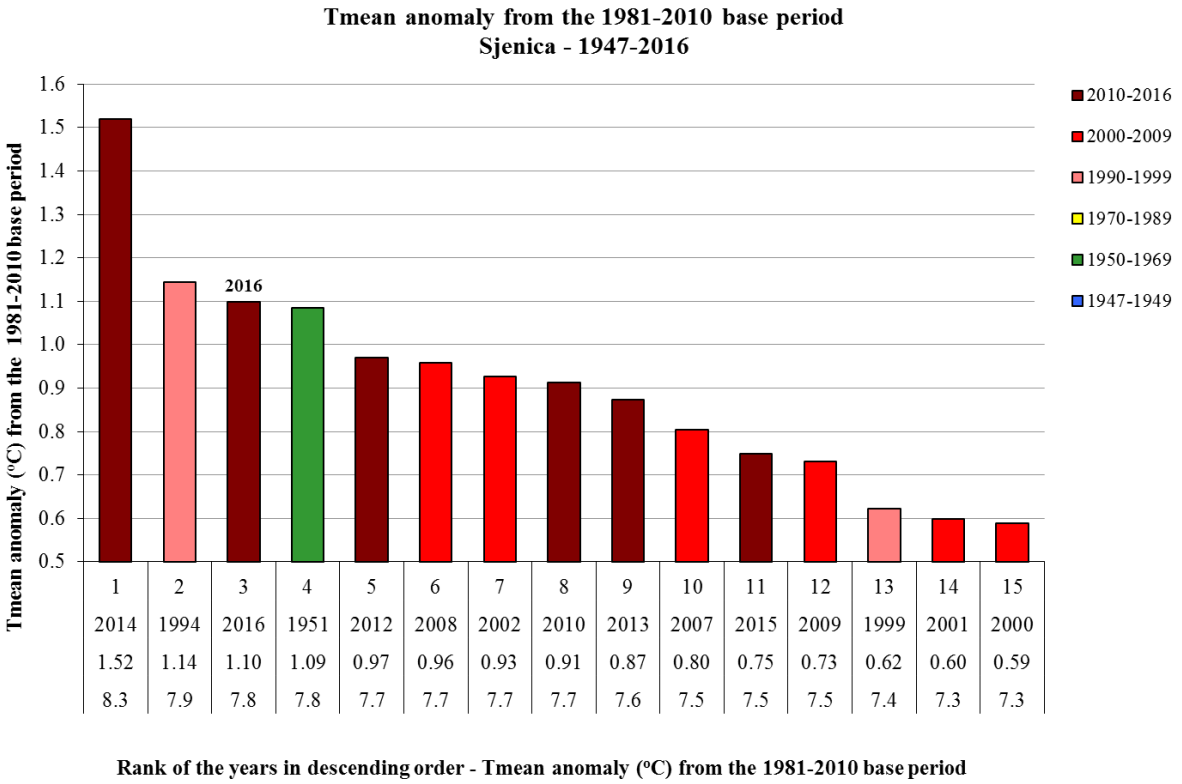


Figure 7. Rank of the warmest years on record in the descending order for Sjenica

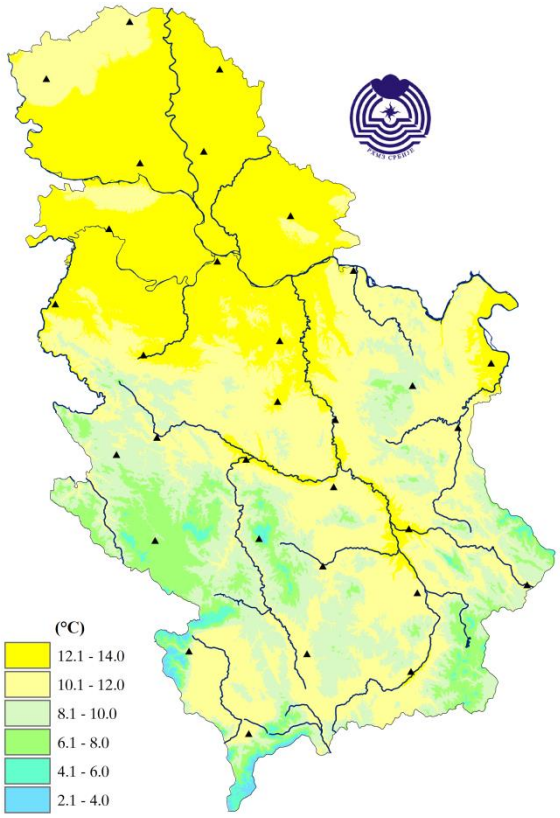


Figure 8. Spatial distribution of the mean annual air temperature (°C)

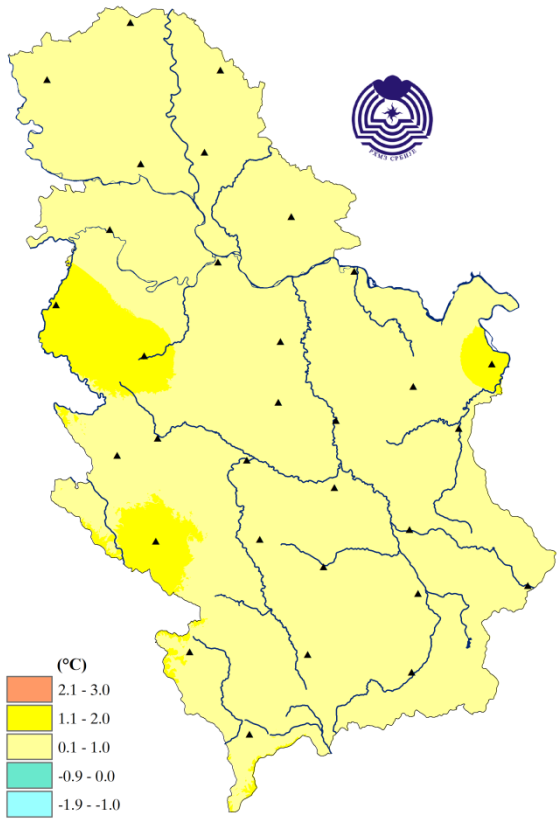


Figure 9. Spatial distribution of the mean annual air temperature anomaly (°C)

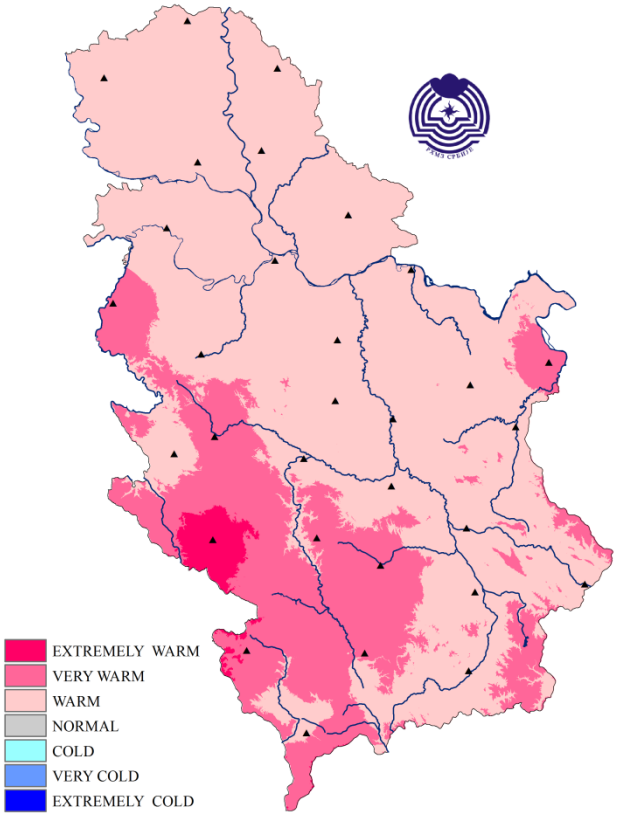


Figure 10. Spatial distribution of the mean annual air temperature based on percentile method

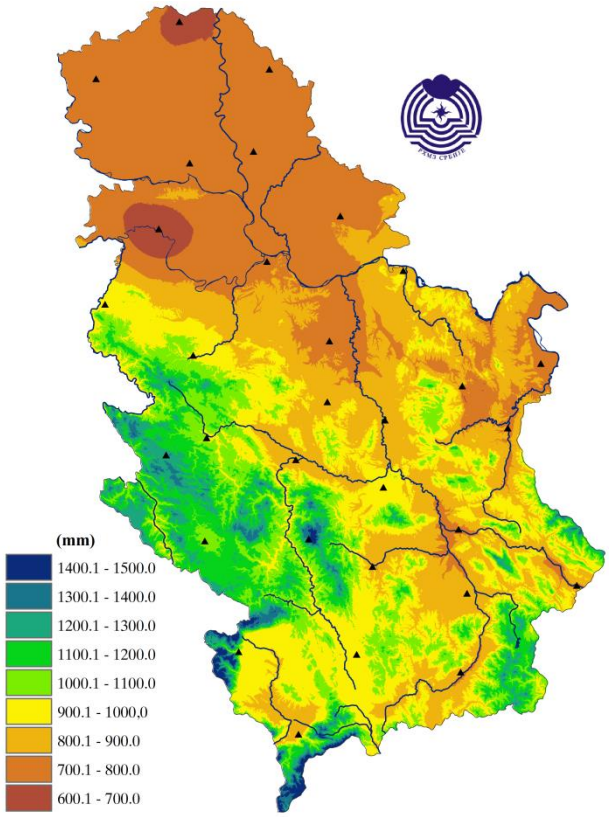


Figure 11. Spatial distribution of the annual precipitation sums expressed in mm

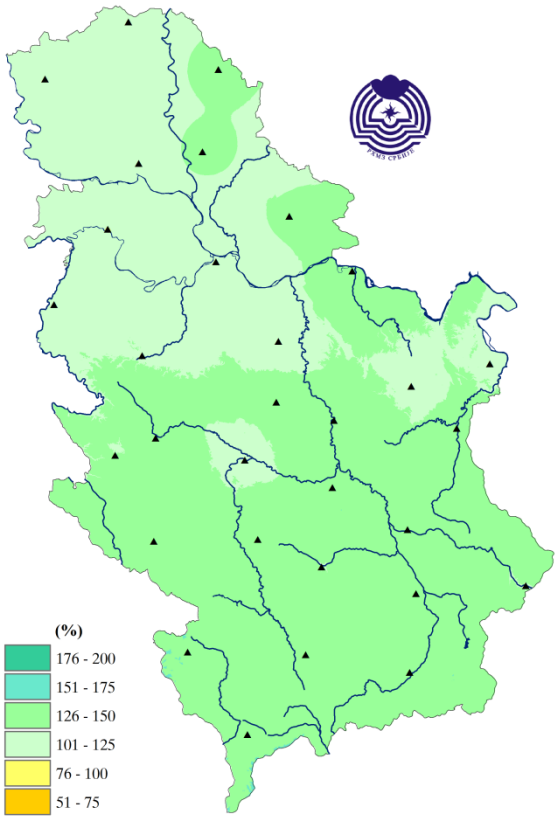


Figure 12. Spatial distribution of the annual precipitation sums in the percentages of normal for the 1981-2010 base period

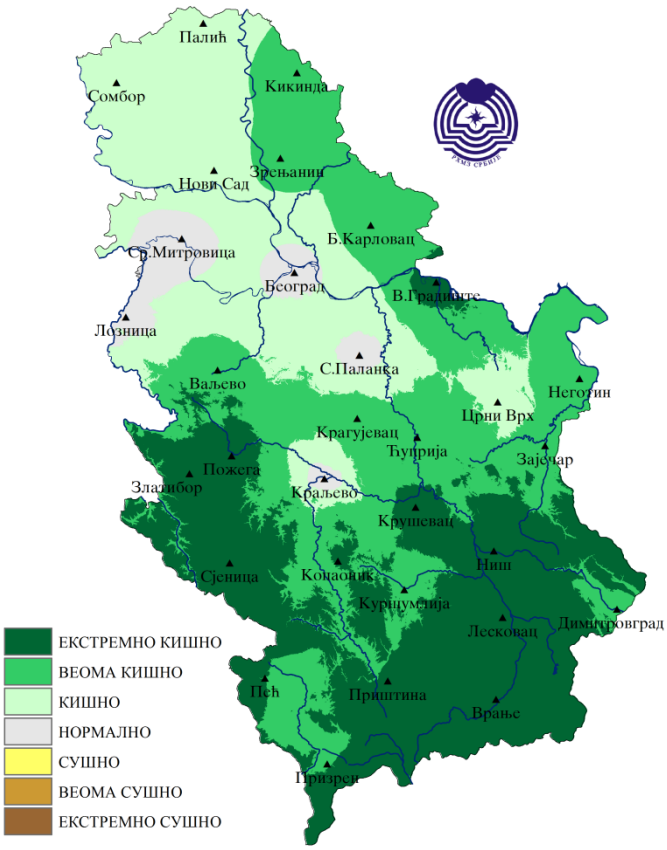


Figure 13. Spatial distribution of the annual precipitation sums based on the percentile method

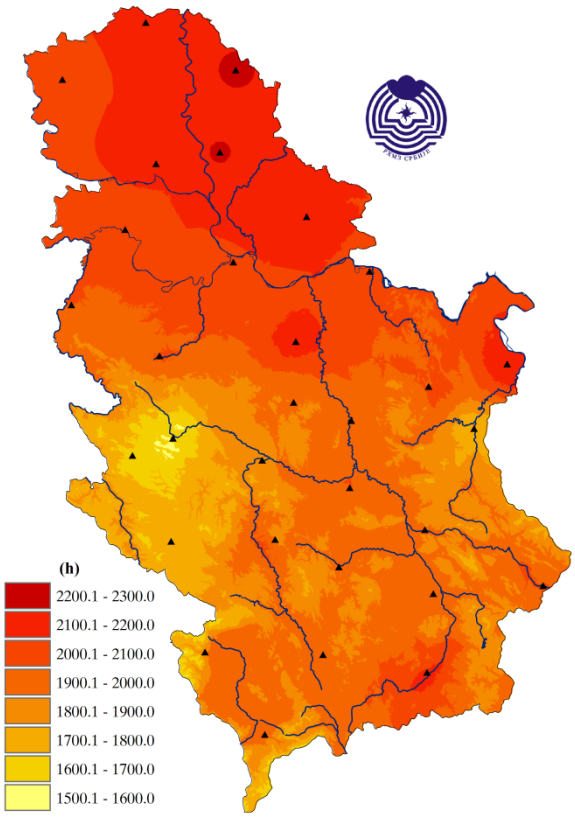


Figure 14. Sunshine duration expressed in hours

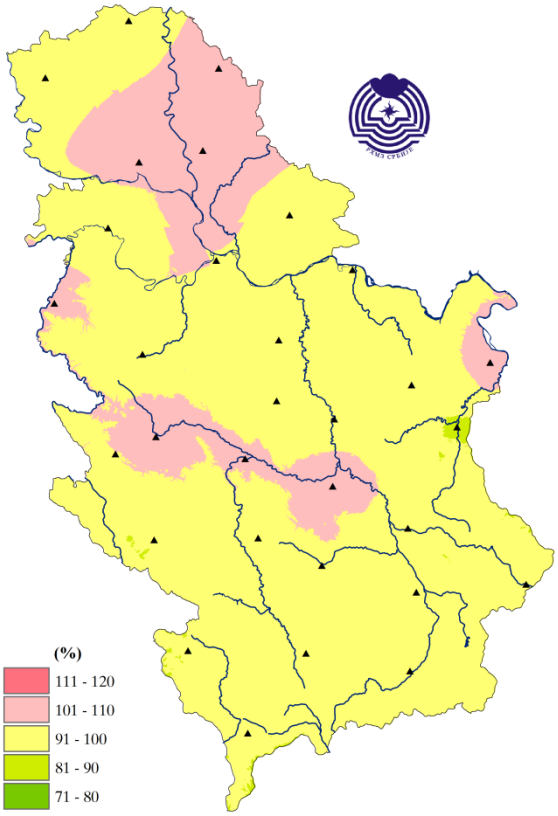


Figure 15. Sunshine duration in the percentages of normal for the 1981-2010 base period