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Warm and dry 2017

Temperature

The year of 2017 ranks as the 12th warmest for Serbia in a period from 1951 up-to-date, with the mean air temperature of 11.5°C, **the 4th warmest on record for Loznica and Cuprija**, 5th warmest for Negotin and 7th warmest for Belgrade since the national records began (1888). The mean annual air temperature ranged from 10.4 °C in Pozega up to 13.9°C in Belgrade, and on the mountains from 4,4°C at Kopaonik to 8,6°C on Zlatibor. Departure of the mean annual air temperature relative to the 1981-2010 base period ranged from 0.5°C in Sjenica and Zajecar to 1.3°C in Zrenjanin, Loznica, Belgrade and Cuprija. Based on the percentile distribution, 2017 was in the following categories: warm category across most of Serbia, very warm in northwestern and northeastern regions, normal in Sjenica, and extremely warm in Cuprija.

Eleven out of fifteen warmest years for Serbia were registered after 2000 (in a 1951-2017 period), and twelve warmest years for Belgrade (1888-2017).

Rank of the warmest and coldest years in Serbia for the period 1951-2017

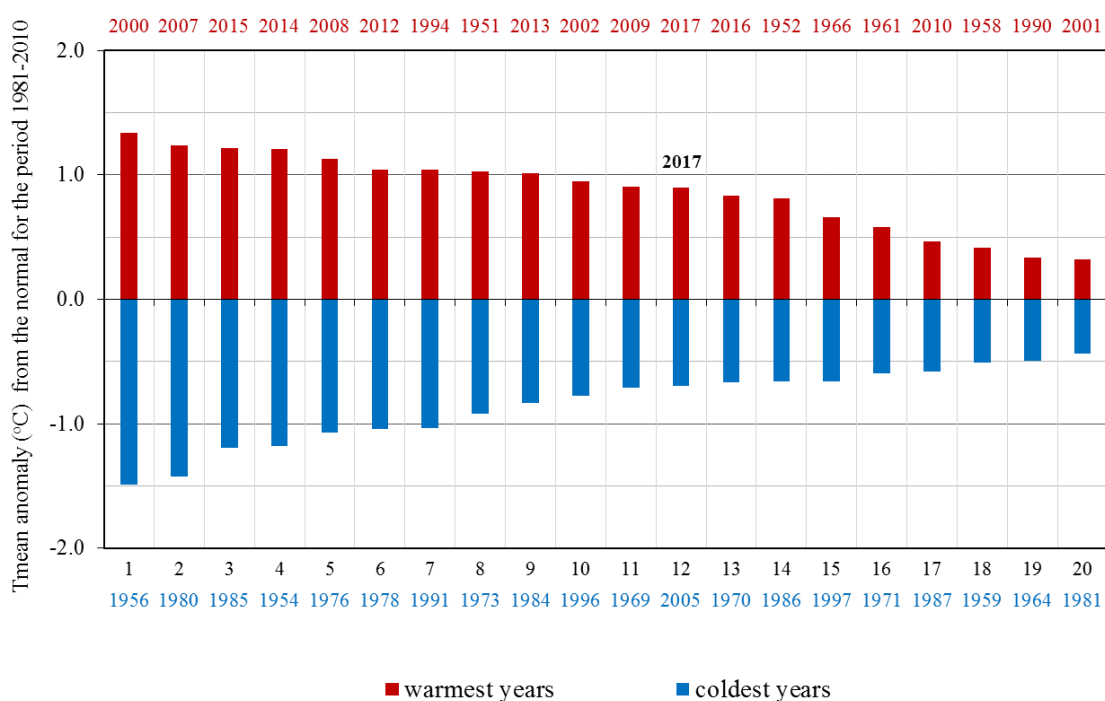


Figure 1. Rank of the warmest and coldest years for Serbia

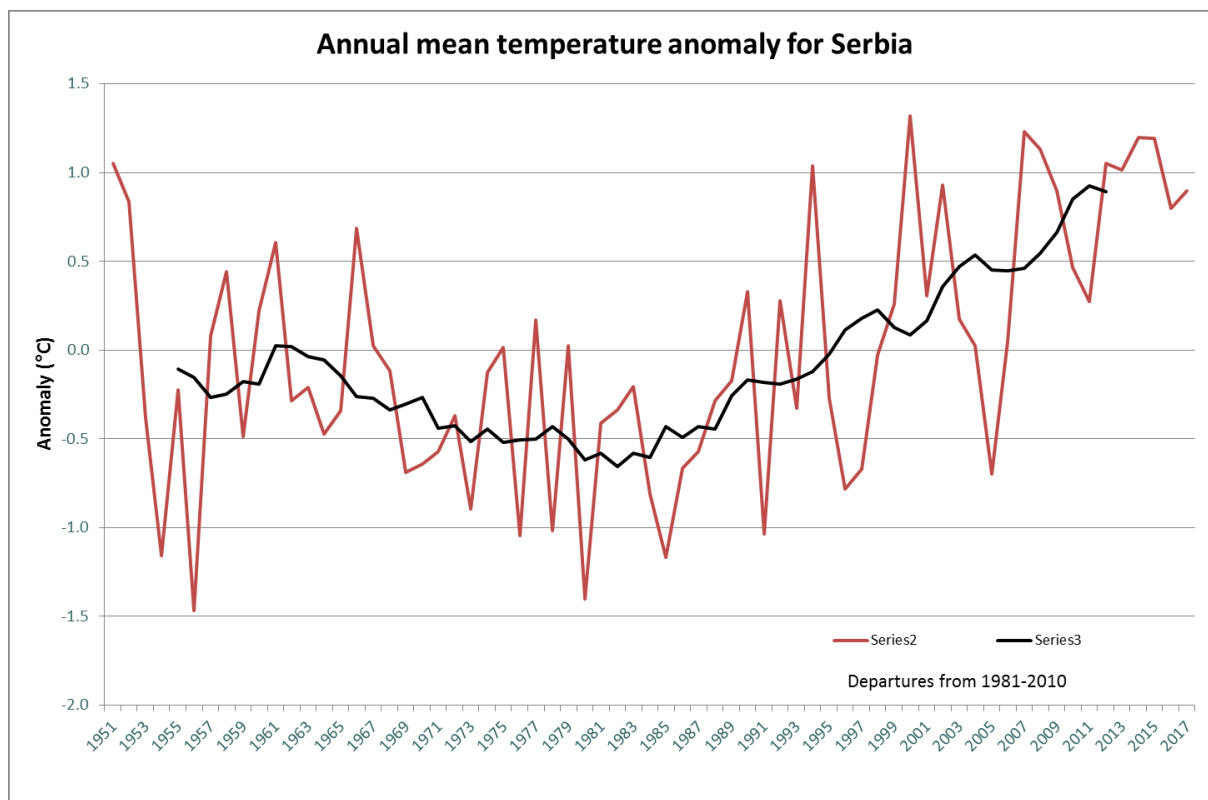


Figure 2. Trend of the departure of the mean annual air temperature in Serbia

In 2017, the highest daily air temperature of 41.6°C was measured in Cuprija on August 6. Most of the country observed 17-25 tropical days above the average number for the 1981-2010 base period. The highest number of tropical days¹ was recorded in Negotin, total of 68 days, which is 24 days above the average number of tropical days for that station.

Belgrade observed 63 tropical days which is 26 days above the average for Belgrade. Moreover, Belgrade recorded 39 tropical nights², which is 22 nights above the average, Zrenjanin observed 25 tropical nights, which is 19 nights above the 1981-2010 average. The higher number of tropical nights is recorded in north, parts of eastern, western and central Serbia.

The lowest daily air temperature of -27.6°C was measured in Sjenica, on January 8. Most of Serbia observed 2 to 12 days with severe frost³ below the average. In the lowland, the number of days with severe frost ranged from 7 days in Belgrade to 21 days in Leskovac, and on the mountains from 12 to 35 days.

¹ Tropical day is defined as the day with the maximum daily air temperature above 30°C and above

² Tropical night is defined as the day with the minimum daily air temperature of 20°C and above

³ Day with the severe frost is defined as the day with the minimum daily air temperature of -10°C and below

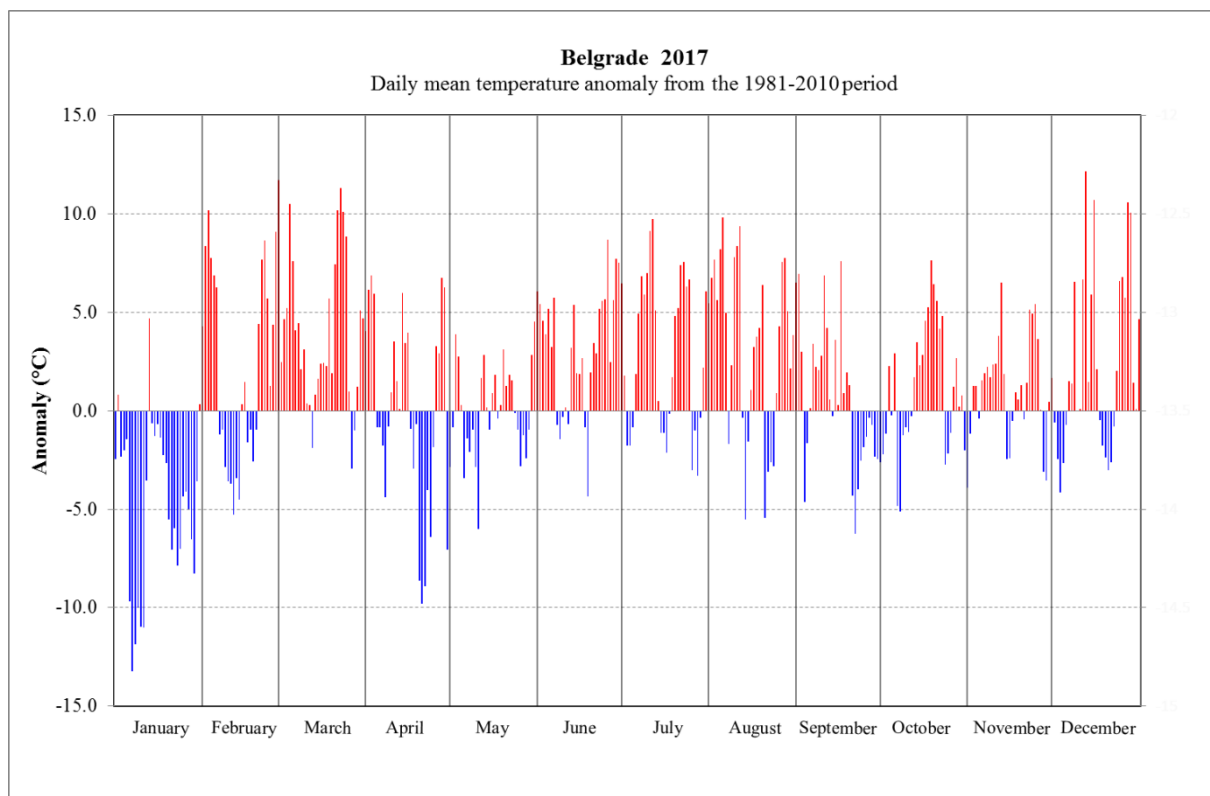


Figure 3. Daily mean air temperature anomaly for Belgrade relative to the normal for the 1981-2010 base period

In 2017, the number of ice days⁴ ranged from 12 in Smederevska Palanka to 23 days in Sombor, and in the upland from 35 days on Zlatibor and Sjenica to 64 days at Kopaonik.

Precipitation

The year of 2017 was normal and dry in most of Serbia, very dry in Zrenjanin, Kikinda, Banatski Karlovac and Belgrade, and rainy at Kopaonik and Leskovac, whereas it was rainy in Kursumlija. The precipitation sums ranged from 368.3 mm in Zrenjanin to 894.9 mm in Loznica, and on the mountains from 622.0 mm at Crni Vrh to 1082.2 mm at Kopaonik. Percentage of the precipitation sums relative to the normal for the 1981-2010 ranged from 63 in Zrenjanin to 122 in Kursumlija. The year of 2017 was **the second driest** for Zrenjanin in a 1925-2017 period.

The highest daily precipitation sums of 80.4 mm was recorded in Veliko Gradiste on August 13.

The number of days with the snow cover ranged from 7 in Kikinda to 52 days in Dimitrovgrad, and on the mountains from 87 on Zlatibor to 176 at Kopaonik. The highest snow depth of 70 cm was measured at Crni Vrh on January 20. In the lowland, the highest snow depth of 37cm was registered in Dimitrovgrad on January 7.

⁴ Ice day is defined as the day with the maximum daily air temperature below 0°C

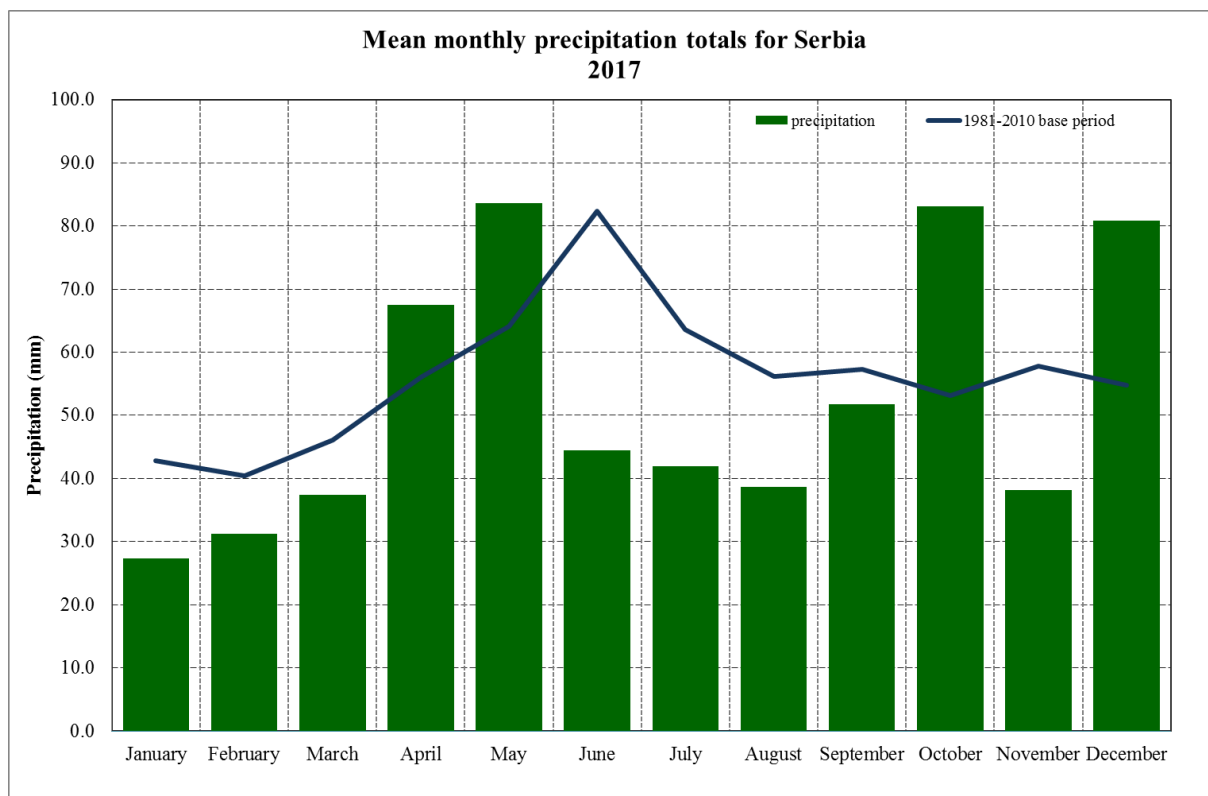


Figure 4. Mean monthly precipitation sums for Serbia

Cold and heat waves

In 2017, there were 4 cold waves⁵. The first cold wave encompassed Serbia in a period from 6 to 12 January 2017. Cold wave first affected Vojvodina and mountain regions on January 6, spreading to the entire country on January 7 and lasting until January 12, 2017. During this cold wave, the departure of the minimum daily air temperature from the mean minimum daily air temperature reached -20.4°C in Leskovac.

This cold wave was the second most intense cold wave after the cold wave recorded in February 2012, when certain places in Serbia recorded 20 and more consecutive days with extremely low minimum and maximum daily air temperatures.

The second less intensive cold wave was registered in the period from 20 to 24 January 2017 in most of Serbia, apart from northeastern, southern and mountain regions, and in Sremska Mitrovica it lasted from 19 to 24 January.

The third cold wave was recorded in a period from 27 to 31 January 2017 in Pozega, Krusevac and Sjenica.

The fourth cold wave was recorded in Loznica, Zlatibor, Kopaonik and Banatski Karlovac lasting from 18 to 22 April, with the longest duration, total of 6 days, between 20-25 April, in Sjenica.

⁵ Cold wave is defined as the period characterized by the continuous series of five and more days with the minimum daily air temperature in the category of very cold and extremely cold according to the statistical percentile method

In March and June, four heat waves⁶ were recorded. The first heat wave was recorded in most of Serbia, lasting from 20 to 24 March, followed by the second heat wave in a period from 29 March to 2 April in Vranje. Two heat waves were observed in June, in Palic, Zrenjanin and Novi Sad lasting from 20 to 25 June, and from 21 to 25 June in Sombor and Sremska Mitrovica. The second heat wave was registered in Negotin, lasting from 27 to 30 June.

Monthly and seasonal outlook of the climate characteristics and record temperatures and precipitation observed in 2017

January – 4th coldest January for Serbia, and coldest on record for Crni Vrh and Leskovac. Three cold waves were recorded. The number of ice days was exceeded in Valjevo, Sremska Mitrovica and Loznica. The majority of meteorological stations saw record-breaking number of frost days and days with snow cover.

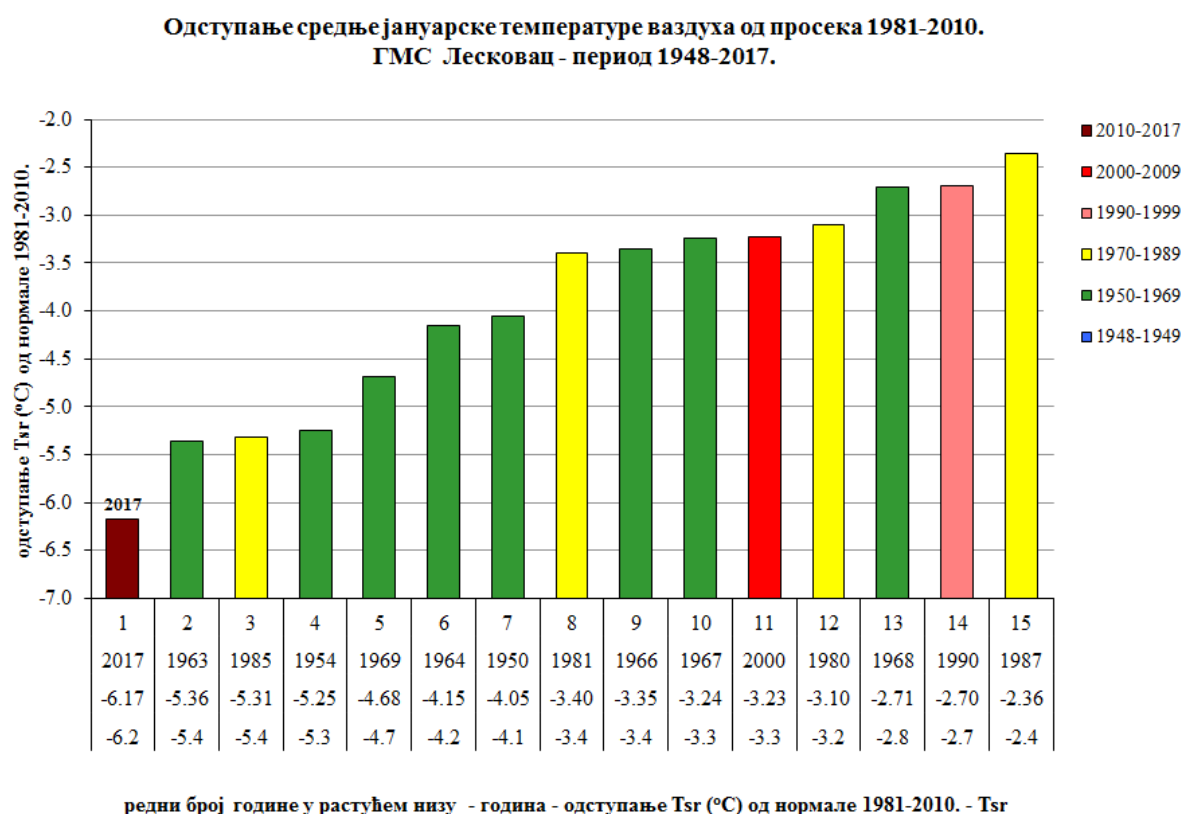


Figure 5.

February – Warm and averagely rainy February

March – 2nd warmest March for Serbia, and warmest on record for MMS Palic, Sombor and Negotin.

⁶ Heat wave is defined as the period characterized by the continuous series of five and more days when the maximum daily air temperature in the a category of very warm and extremely warm

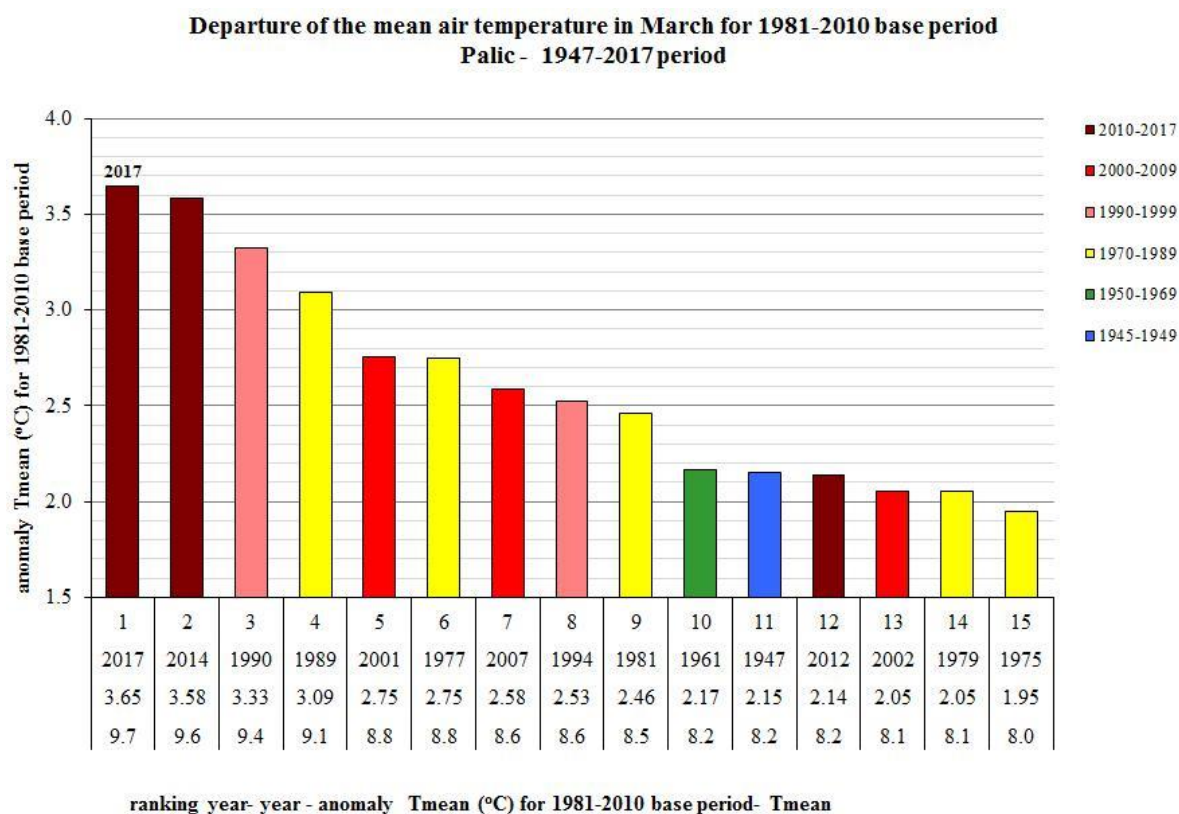


Figure 6.

April – Averagely warm April, in parts of western and southwestern Serbia rainy. Cold wave was recorded at five main meteorological stations.

May – Averagely warm May, in most of Serbia rainy.

June – 3rd warmest for Serbia, 2nd warmest for Novi Sad, Zrenjanin and Cuprija. Driest June on record for Zajecar and Sremska Mitrovica, and 4th driest for Serbia.

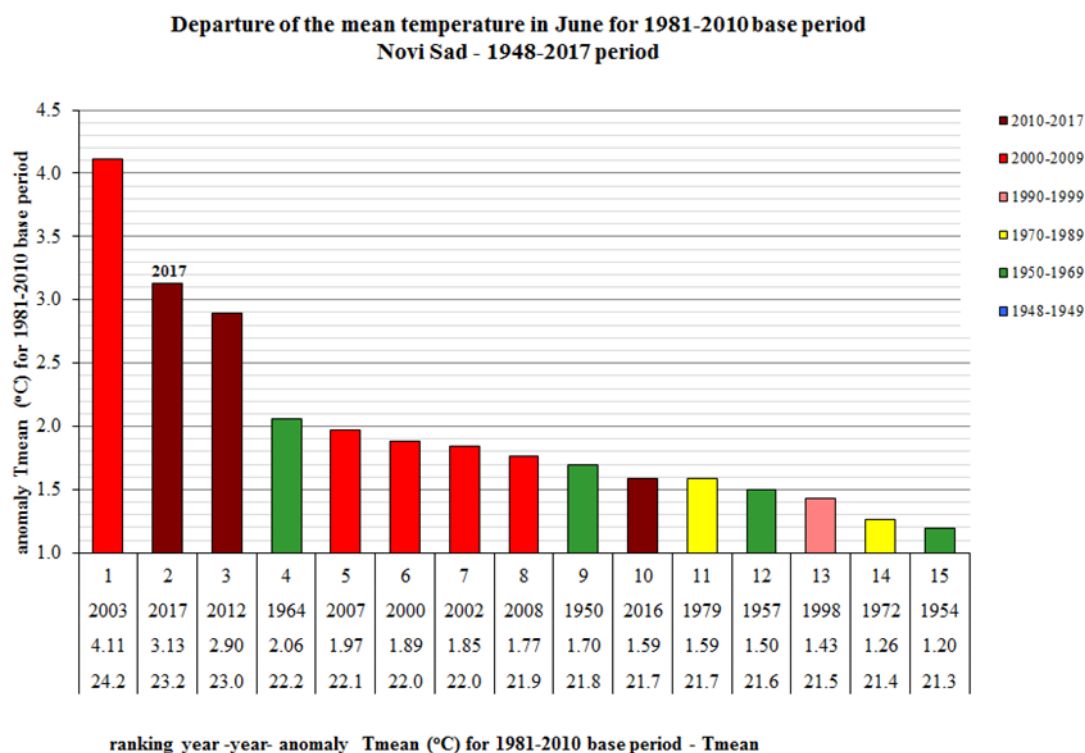


Figure 7.

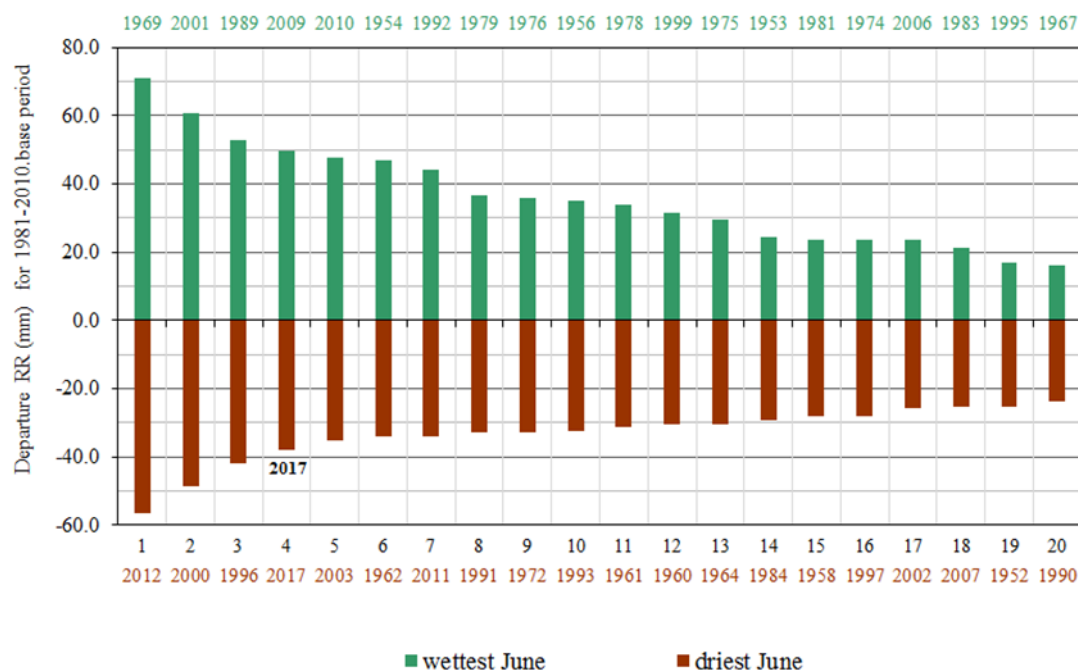


Figure 8.

July – 4th warmest for Serbia, and 3rd warmest for Smederevska Palanka and Banatski Karlovac. 3rd driest July for Zrenjanin, and 5th driest for Novi Sad and Crni Vrh. Two heat waves were recorded. Record-breaking number of tropical nights was registered in Zrenjanin.

Most of Serbia experienced 2 to 7 tropical nights. Zrenjanin observed 9 and Belgrade observed 13 tropical nights. Record-breaking number of tropical nights was observed in Zrenjanin. The previous maximum of 8 tropical nights was recorded in July 2011 and 2015.

August – 3rd warmest August for Belgrade, Cuprija, Novi Sad and Smederevska Palanka, and 7th warmest for Serbia. The highest number of days with temperatures above 38°C was recorded in August. Record-breaking daily air temperatures in August were observed in Kikinda, Banatski Karlovac and Zrenjanin. The number of tropical nights was surpassed on Palic, Sombor, Novi Sad, Zrenjanin, Loznica, Valjevo and Cuprija. Record-breaking daily precipitation sums were observed in Veliko Gradiste.

The highest daily air temperature of 39.2°C was registered in Kikinda on August 5, whereas the previous record of 39.1°C was measured on August 24, 2012. On August 6, Banatski Karlovac observed air temperature of 40.1°C thereby breaking the previous record of 39.8°C set on August 22, 2000. On August 6, Zrenjanin observed air temperature of 40.4°C besting the previous record of 39.6°C set on August 24, 2012.

The highest number of days with air temperature above 38°C in Serbia was registered in August, 8 days in Zrenjanin, 7 days in Belgrade, 6 days in Novi Sad, Valjevo, Smederevska Palanka, Kragujevac, Kraljevo, Cuprija and Leskovac. The average number of days with the air temperature above 38°C in August was one.

September - Averagely warm and averagely rainy September.

October – In Most of Serbia, averagely warm and rainy October. The 3rd wettest October for MMS Kraljevo, 5th wettest for MMS Leskovac and Krusevac.

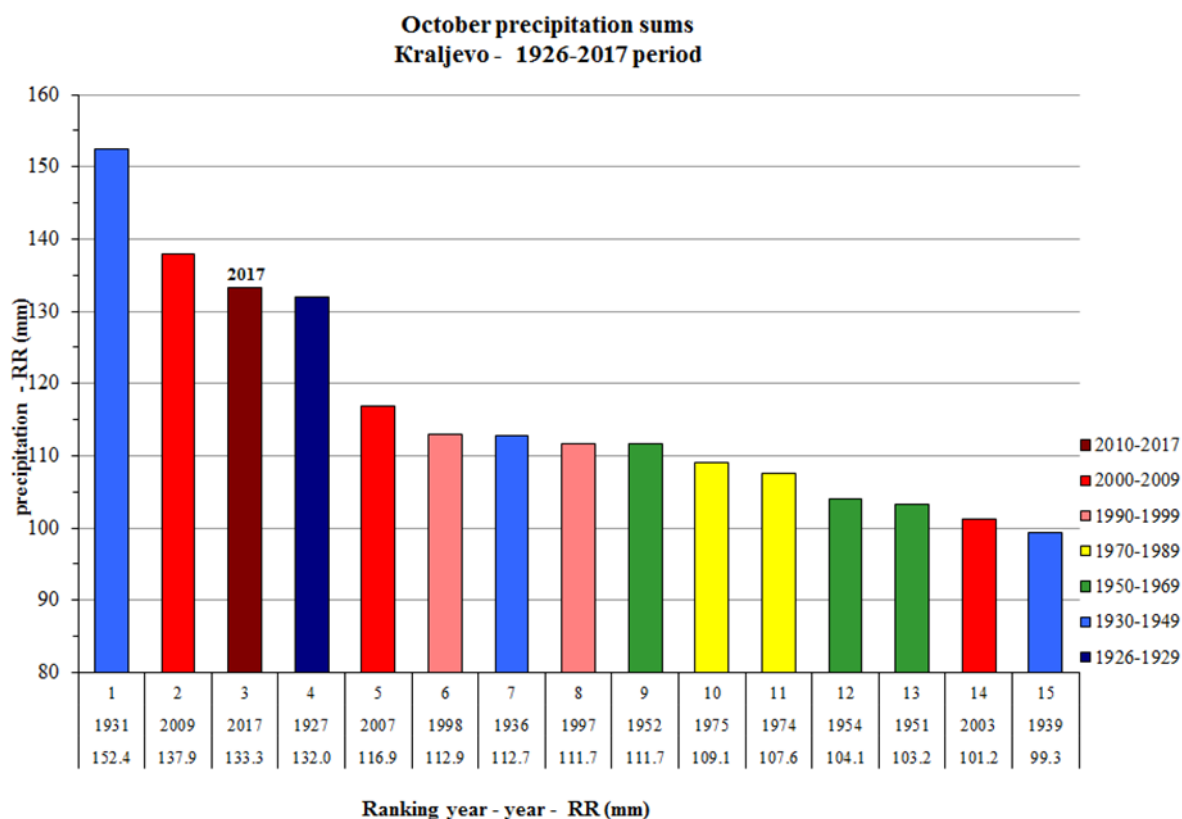


Figure 9.

November – Averagely warm and rainy November.

December – 4th warmest for Loznica. Two heat waves were recorded. The wettest December for Leskovac since records began. Record-breaking daily precipitation sums for Kursumlija and Dimitrovgrad.

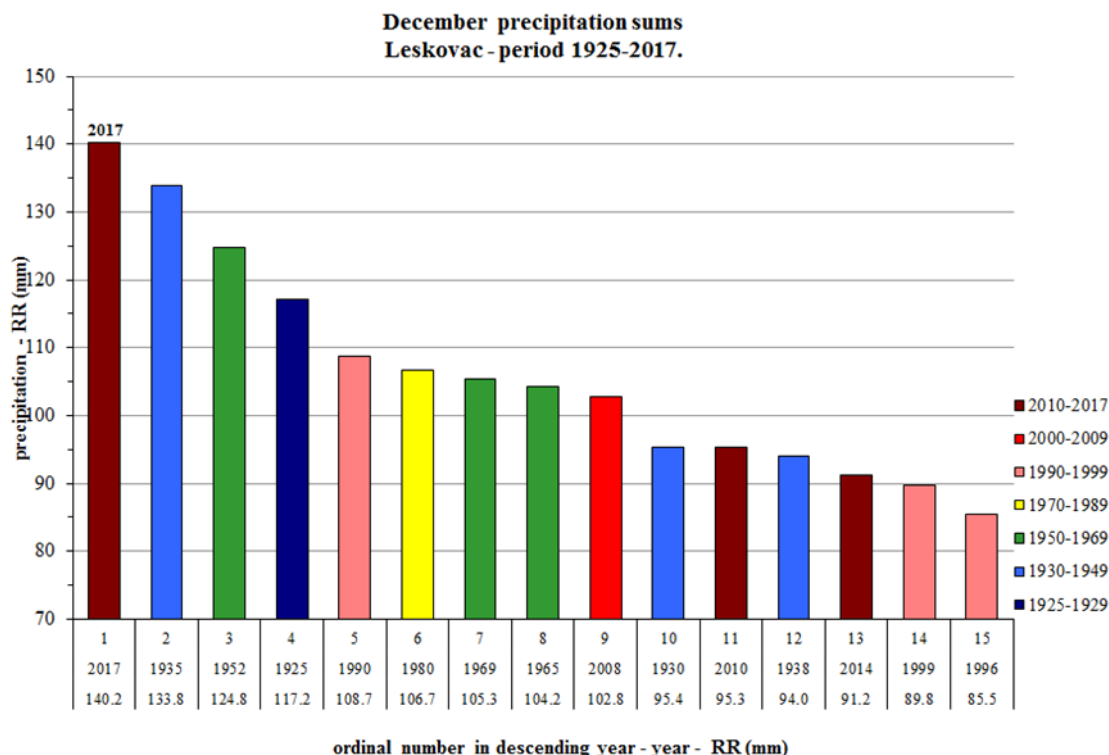


Figure 10.

Winter 2016/17 – 4th driest and 12th coldest winter for Serbia. There were four cold waves. The number of ice, frost and days with severe frost was surpassed.

The number of ice days, with the maximum daily air temperature below 0°C ranged from 15 days in Vranje to 29 days in Sremska Mitrovica, and on the mountains from 30 ice days on Zlatibor to 57 days on Crni Vrh. The recorded number of ice days was 1 to 13 days above the average, whereas at Kopaonik it was 4 days below the average.

The lowest winter air temperature of -27.6°C was measured in Sjenica on January 8.

The number of frost days, with the minimum daily air temperature below 0°C ranged from 65 days in Loznica to 81 days in Pozega, and on the mountains from 76 days at Zlatibor to 88 days at Kopaonik. The number of frost days was 2 to 18 days above the winter average.

The number of days with severe frost, with the minimum daily air temperature below -10 °C, ranged from 7 days in Belgrade to 22 days in Dimitrovgrad, and in the upland from 14 days at Zlatibor to 38 days in Sjenica. The recorded number of days with severe frost in Serbia was 1 to 12 days above the winter average.

Spring 2017 – 11th warmest spring for Serbia, and 4th warmest for Loznica, Cuprija and Banatski Karlovac

Summer 2017 – 2nd warmest summer for Serbia, and warmest on record for Banatski Karlovac and Smederevska Palanka. In most of Serbia, it was dry and very dry. 4th driest summer for Novi Sad and 5th driest for Zrenjanin.

Summer 2017 was the second warmest for Serbia, with the mean air temperature of 22.5°C. Summer 2012 ranks as the warmest summer on record for Serbia with the air temperature of 23.3°C (Figure 11). Belgrade observed air temperature of 25.4°C ranking as the second warmest summer, after summer of 2012, with the mean seasonal air temperature of 26.0°C.

The summer of 2017 was record warm for Banatski Karlovac and Smederevska Palanka, with the mean seasonal air temperature of 23.7°C and 24.0°C, respectively.

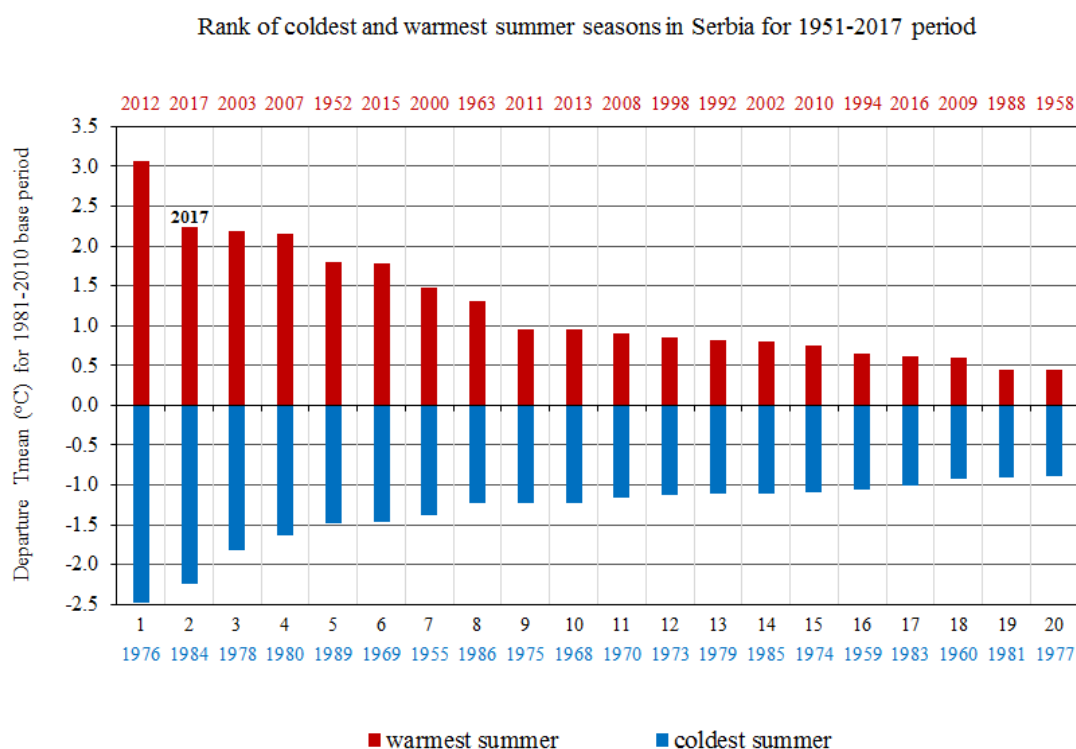


Figure 11.

The number of tropical days ranged from 42 on Palic to 61 days in Negotin. In the upland, the highest number of tropical days, total of 17, was registered in Sjenica, which is 12 days above the average. In Belgrade, there were 55 tropical days, which is 23 days above the average.

The highest number of tropical nights, total of 39 nights, is recorded in Belgrade, which is 23 days above the average. Record-breaking number of tropical nights was observed in Zrenjanin, Novi Sad, Banatski Karlovac and Cuprija. In summer 2017, the number of tropical nights in Zrenjanin was 25, whereas the previous record of 18 days tropical nights was recorded in summer 2015. Novi Sad observed 15 tropical days thereby breaking the previous record of 10 nights from 2010 and 2012. The previous record of 10 tropical nights observed in 2007 and 2010 in Banatski Karlovac was bested with the 13 nights registered in summer 2017. Cuprija observed 9 tropical nights breaking the previous record of 6 nights from 1963 and 1988.

Autumn 2017 – Averagely warm and rainy autumn

Appendix

Chart 1.

MEAN MONTHLY AND ANNUAL AIR TEMPERATURE (°C)													
station/month	January	February	March	April	May	June	July	August	September	October	November	December	Year
PALIC	-4.7	2.7	9.7	11.1	17.7	23.0	23.8	23.6	16.7	12.0	6.6	3.1	12.1
SOMBOR	-5.3	3.3	9.6	11.3	17.7	22.8	23.2	23.3	16.4	11.7	6.7	3.3	12.0
NOVI SAD	-4.9	4.2	9.9	11.4	17.6	23.2	24.3	24.8	16.9	12.5	7.1	3.8	12.6
ZRENJANIN	-4.3	4.1	9.8	11.6	18.1	23.7	24.8	25.4	17.4	12.5	7.2	3.5	12.8
KIKINDA	-4.5	3.6	9.7	11.2	17.8	23.1	23.9	24.3	17.0	11.9	6.8	3.2	12.3
B.KARLOVAC	-4.4	3.7	10.1	12.0	17.8	23.0	24.0	23.9	17.3	11.9	7.2	3.3	12.5
LOZNICA	-4.4	5.7	10.5	11.7	17.7	23.0	24.0	24.0	17.0	13.0	7.5	5.2	12.9
S.MITROVICA	-5.5	3.8	9.7	11.6	17.7	22.8	23.0	23.5	16.6	12.1	6.7	3.2	12.1
VALJEVO	-4.8	4.6	10.2	11.6	17.1	22.9	24.5	24.1	17.4	12.6	6.8	4.7	12.6
BELGRADE	-3.3	5.4	11.5	12.7	18.3	24.3	25.9	26.1	18.4	13.8	8.4	4.8	13.9
KRAGUJEVAC	-4.4	4.5	10.0	11.4	16.7	22.7	24.3	24.1	17.5	12.1	7.5	4.0	12.5
S.PALANKA	-4.3	4.5	10.1	11.7	17.2	22.8	24.6	24.5	17.5	11.9	7.3	3.8	12.6
V.GRADISTE	-3.9	3.2	10.1	11.7	17.1	22.7	24.4	23.2	17.1	11.3	7.0	2.8	12.2
CRNI VRH	-8.7	-0.4	5.1	5.9	11.3	17.0	18.8	19.3	12.7	8.3	2.1	-0.5	7.5
NEGOTIN	-4.1	2.5	11.2	12.3	18.0	24.4	25.0	24.6	18.8	13.2	7.4	3.7	13.1
ZLATIBOR	-7.1	2.0	6.0	6.5	12.5	18.1	19.4	20.3	13.3	9.0	3.5	-0.2	8.6
SIENICA	-10.3	1.8	4.6	6.0	11.6	16.7	18.0	18.2	12.6	6.9	2.4	-1.0	7.3
POZEGA	-6.7	2.9	8.5	9.5	15.3	20.4	21.5	21.0	15.7	10.1	4.5	2.2	10.4
KRALJEVO	-5.0	4.5	10.3	11.2	16.2	22.2	24.0	24.2	17.7	11.9	6.8	3.6	12.3
KOPAONIK	-9.2	-1.5	1.1	1.9	7.4	13.1	14.4	15.3	9.1	4.5	0.3	-3.3	4.4
KURSUMLIJA	-5.2	4.7	8.8	10.1	15.1	20.6	22.0	21.1	16.6	10.6	6.1	3.2	11.2
KRUSEVAC	-5.2	4.1	10.2	11.6	16.6	22.4	23.9	23.4	17.9	11.8	7.1	3.5	12.3
CUPRIJA	-4.5	3.7	9.9	11.8	17.1	22.8	24.2	24.2	18.0	11.8	6.9	3.3	12.5
NIS	-4.3	4.9	10.7	11.5	16.9	22.8	24.6	24.4	18.7	12.1	7.3	3.4	12.8
LESKOVAC	-6.2	4.1	9.7	10.8	16.4	22.1	23.6	23.2	17.5	10.6	6.4	2.9	11.8
ZAJECAR	-5.2	2.4	9.4	10.8	15.8	21.9	23.2	22.7	17.1	11.4	6.2	3.2	11.6
DIMITROVGRAD	-5.8	3.4	8.6	9.6	14.5	20.3	21.8	21.4	16.3	9.8	5.7	1.7	10.6
VRANJE	-5.2	4.1	9.8	10.7	16.2	21.4	23.4	23.4	17.6	11.2	6.5	1.8	11.8

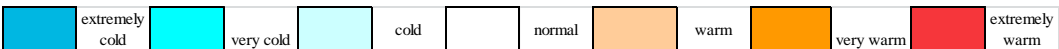


Chart 2.

MONTHLY AND ANNUAL PRECIPITATION SUM (mm)													
station/month	January	February	March	April	May	June	July	August	September	October	November	December	Year
PALIC	14.2	29	26.6	47.2	25.8	53.6	46.6	40.8	57.2	38.8	36.9	47.3	464
SOMBOR	21.8	45.5	44.8	46.2	55	51.8	55.6	24.3	69.4	48.7	33.5	46.1	542.7
NOVI SAD	18.5	17.5	30.5	57	82.9	65.7	12	17.4	81.5	38.9	40.3	48.3	510.5
ZRENJANIN	11.1	12.9	20	52.5	29.4	42.2	8.9	23.7	54.8	36.4	24	52.4	368.3
KIKINDA	8.1	13.3	18.9	52.9	22.9	56.3	28.1	25.3	52.1	35	34.6	43.8	391.3
B.KARLOVAC	14.5	18.8	21.2	49.4	73.4	25.7	32.1	60.6	46.9	43.4	20.1	43.1	449.2
LOZNICA	52.4	69.8	67.7	115.6	89.2	54.5	74.9	61.7	62.7	111.9	53	81.5	894.9
S.MITROVICA	12.8	22.2	30.3	55.2	90.2	14.8	69.3	25.4	83.7	41.6	36.1	51.6	533.2
VALJEVO	37	50.1	62.1	67.8	109.3	49	41.8	49.5	60.4	114.2	33.3	63.2	737.7
BELGRADE	23.4	23.5	27	51.8	86.1	53	26.4	19.5	45.8	65.9	41.2	45.2	508.8
KRAGUJEVAC	23.4	24.5	40.8	67.2	91.7	31.5	30.6	38.8	46.5	95.8	19.3	56.9	567
S.PALANKA	24.3	27.5	36	58.2	91.7	23.4	27	43.7	64.8	66.4	24.4	62.2	549.6
V.GRADISTE	18.6	24.7	25	50.6	82.3	40.4	51.2	87.9	56.9	41	27	69.9	575.5
CRNI VRH	33.2	23.2	37.1	49.8	105.9	39.9	14.8	77.4	46.6	93	36.9	64.2	622
NEGOTIN	29.4	33.9	18.8	62	73.2	25.6	38.7	43.1	31.1	86.1	45.1	77.3	564.3
ZLATIBOR	47.3	46.4	49.9	127.6	100.3	80.4	83.5	38.2	81.2	98.5	58	103.4	914.7
SIENICA	34	45.2	34.6	53.7	65.1	62.3	70.8	19.3	31.9	97.1	35.9	105	654.9
POZEGA	19.9	30.9	35.8	76.7	75.9	84.2	55.9	43.3	41.7	108.1	29.8	68.8	671
KRALJEVO	22.1	35.3	57.7	82.1	99.9	56.2	35.2	29.1	43.9	133.3	32.4	55.6	682.8
KOPAONIK	38.9	32.1	80.9	141.1	112.8	77.5	99.3	42.1	124	161.6	68.9	103	1082.2
KURSUMLIJA	37.8	20.4	30.3	67.2	134.5	36.9	68.9	52.8	35.1	103.5	52.3	141.5	781.2
KRUSEVAC	24.6	24	44.3	61.9	77.7	51.4	15.7	48.4	16.5	112	28.7	79.8	585
CUPRIJA	26.2	29.1	35.7	64.8	120.6	30.6	18.8	50.1	43.8	100.1	24.7	106.6	651.1
NIS	16.6	33.6	37.5	77	88.8	26	23.2	15.1	26.6	87.5	35	142.3	609.2
LESKOVAC	44	38.3	39	68.6	82	19	34.5	20.4	47.3	116.7	72.7	140.2	722.7
ZAJECAR	42.6	18.2	33.6	64.1	91	4.3	58.7	24.6	9.2	86	31	110.3	573.6
DIMITROVGRAD	47.8	32.7	44.8	71.6	85.8	35.5	39.2	48.6	35.4	90.6	56.5	119.6	708.1
VRANJE	19.1	52.3	16.9	48.8	98.4	54.5	11.5	12	53.8	74	35.9	134.9	612.1



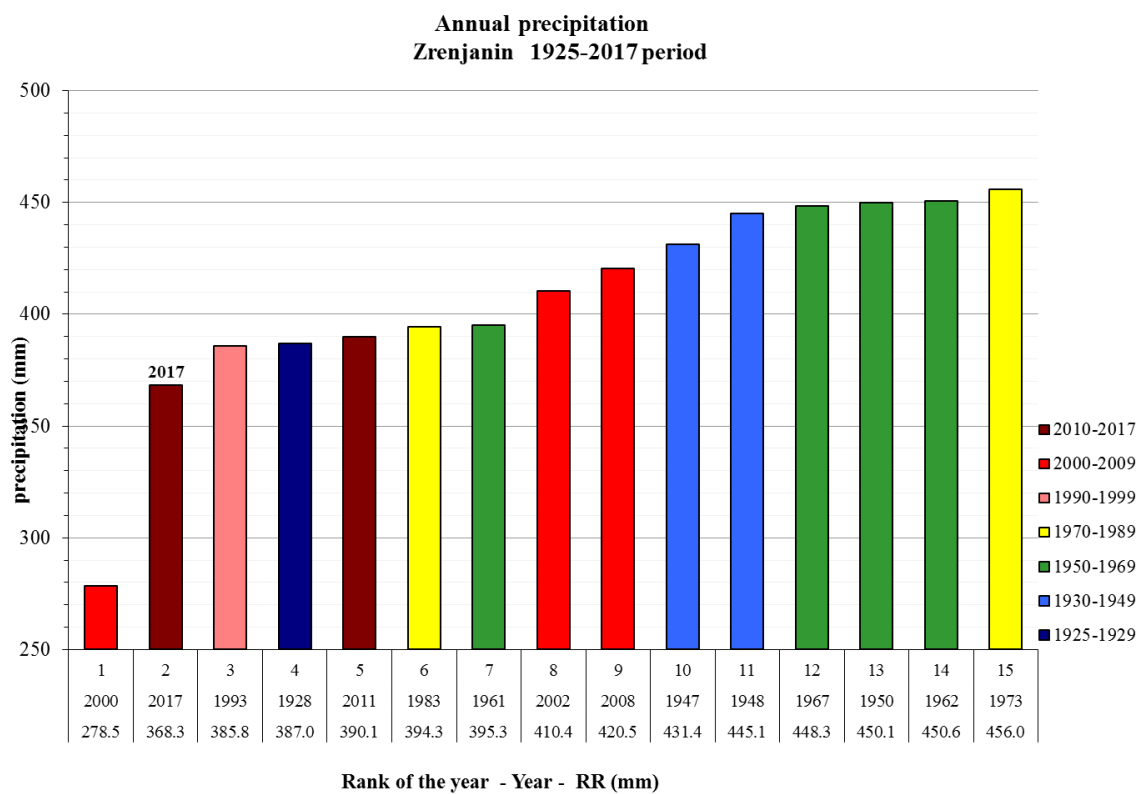


Figure 12. Rank of the driest years on record for Zrenjanin

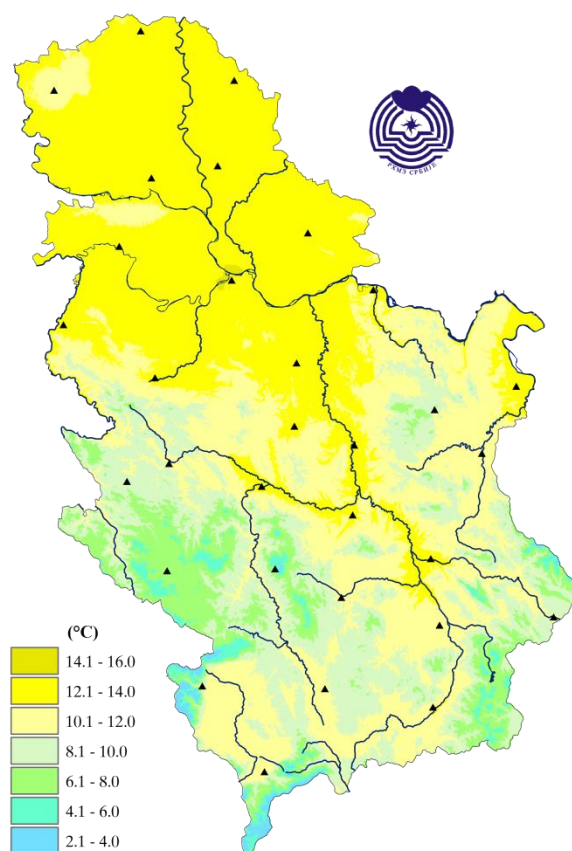


Figure 13. Spatial distribution of the mean annual air temperature (°C)

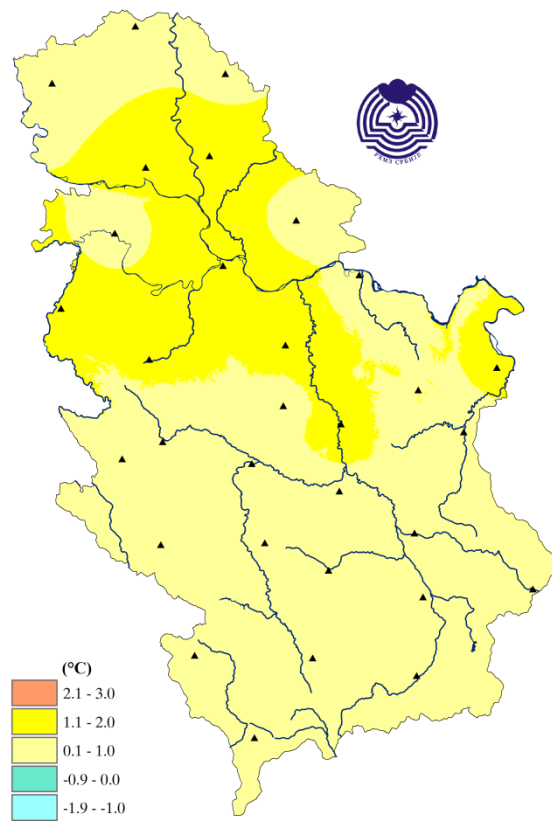


Figure 14. Spatial distribution of the mean annual air temperature anomaly (°C)

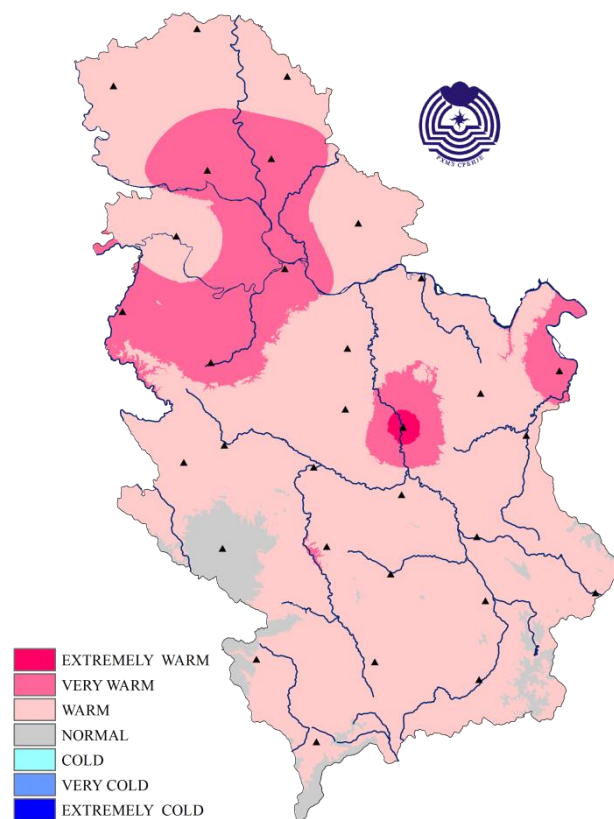


Figure 15. Spatial distribution of the mean annual air temperature based on the percentile method

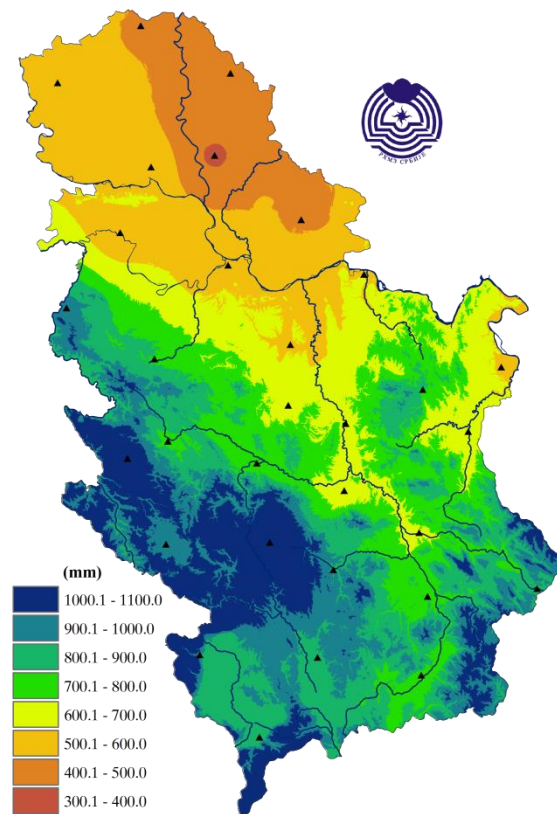


Figure 16. Spatial distribution of the annual precipitation expressed in mm

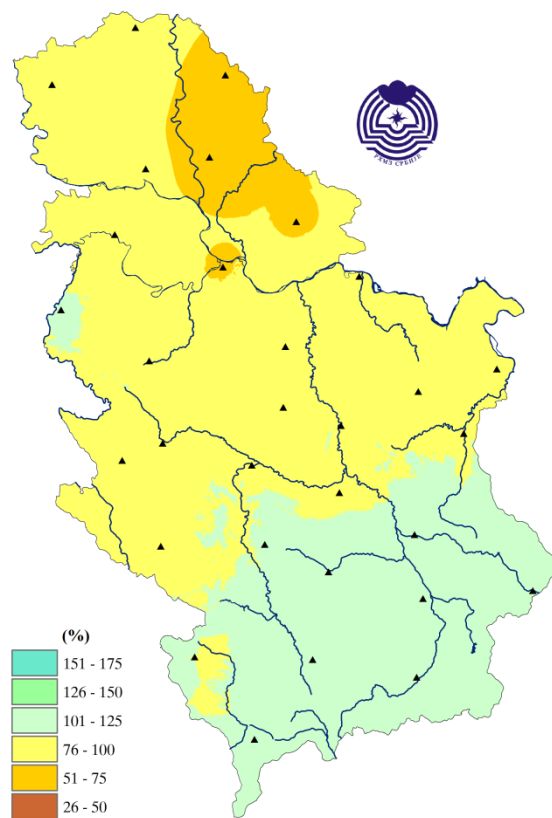


Figure 17. Spatial distribution of the annual precipitation sums expressed in a percentages of normal for the 1981-2010 base period

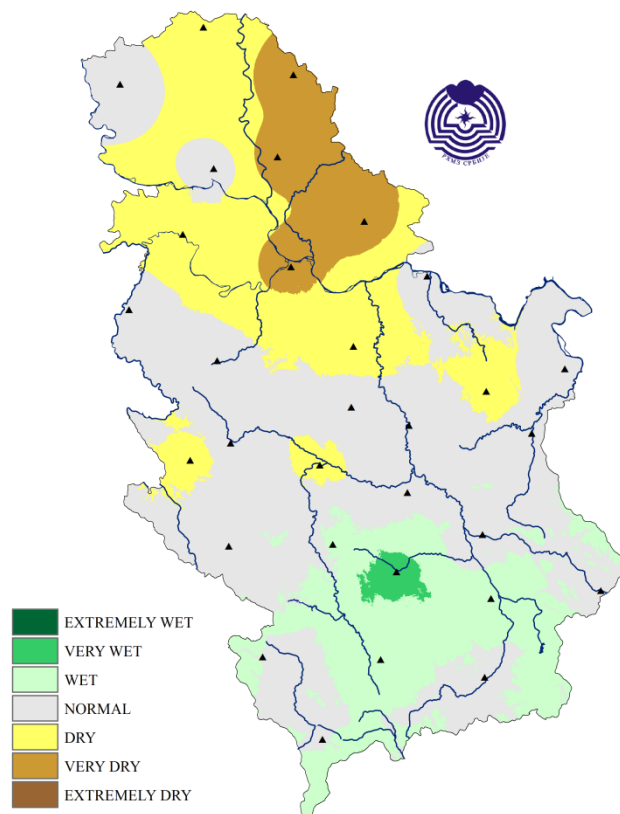


Figure 18. Spatial distribution of the annual precipitation sums based on percentile method

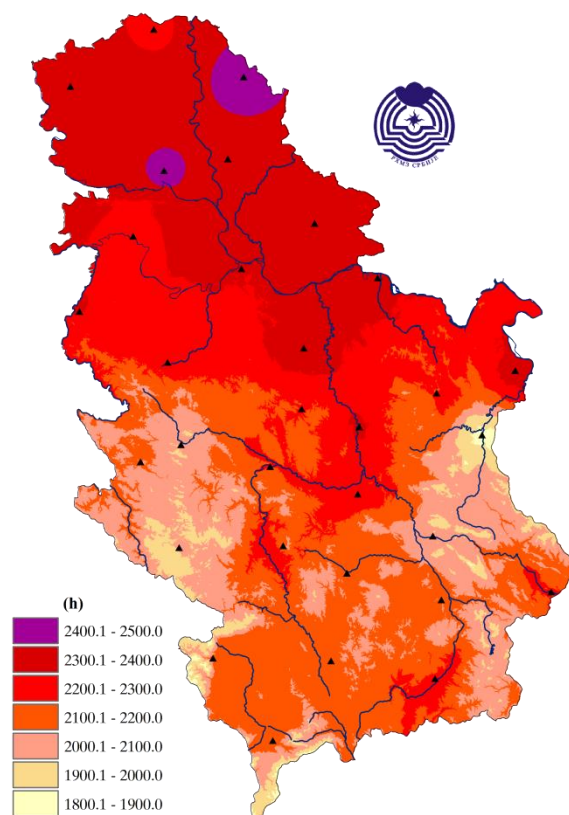


Figure 19. Insolation expressed in hours

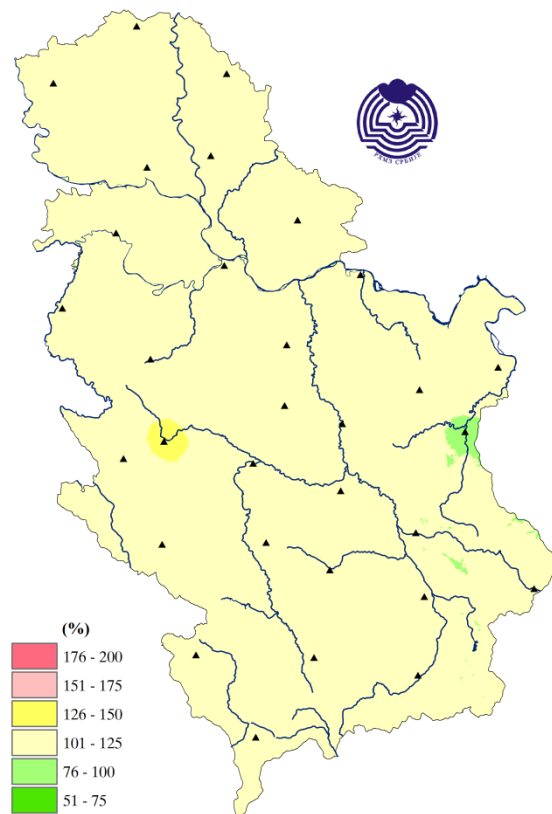


Figure 20. Insolation expressed in a percentages of normal for the 1981-2010 base period