



VERIFICATION OF THE SEECOF-23 SUMMER 2020 CLIMATE OUTLOOK AND SEASONAL BULLETIN FOR SERBIA

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Temperature

The SEECOF-23 outlook for the summer of 2020 in Serbia indicated warmer than normal temperature in Serbia with 60% probability, relative to the 1981–2010 climatological base period (*Figure A*).

Climatological monitoring showed that the summer of 2020 was warm, with above-normal temperature based on the tercile method, in the northern as well as parts of western, central, southeastern and eastern Serbia, where the outlook for a warm summer was correct. Elsewhere it was in the normal category (*Figure B*).

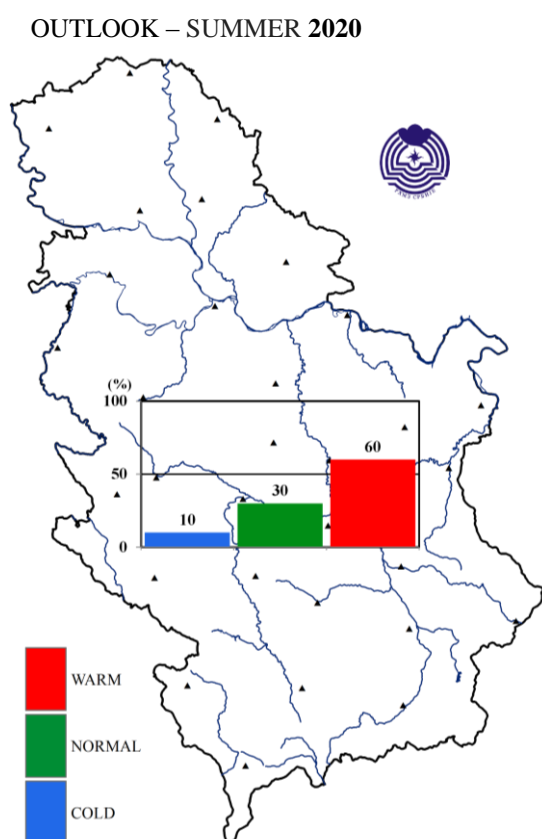


Figure A. SEECOF-23 - summer temperature outlook

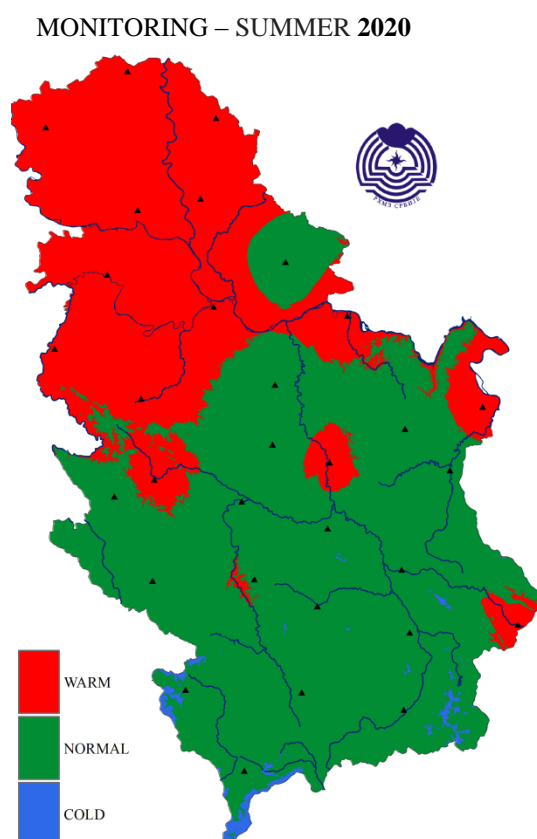


Figure B. Monitoring of the 2020 summer temperature using tercile method compared to the 1981-2010 base period

Precipitation

The SEECOF-23 climate outlook for the summer of 2020 indicated dry conditions in Serbia with the probability of 50%, relative to the 1981–2010 climatological base period (*Figure C*). Monitoring of precipitation showed above the average totals, based on the tercile method, across almost the entire country apart from Sremska Mitrovica where it was normal and in Kikinda where it was below the average (*Figure D*). The outlook was not correct for the greater part of Serbia.

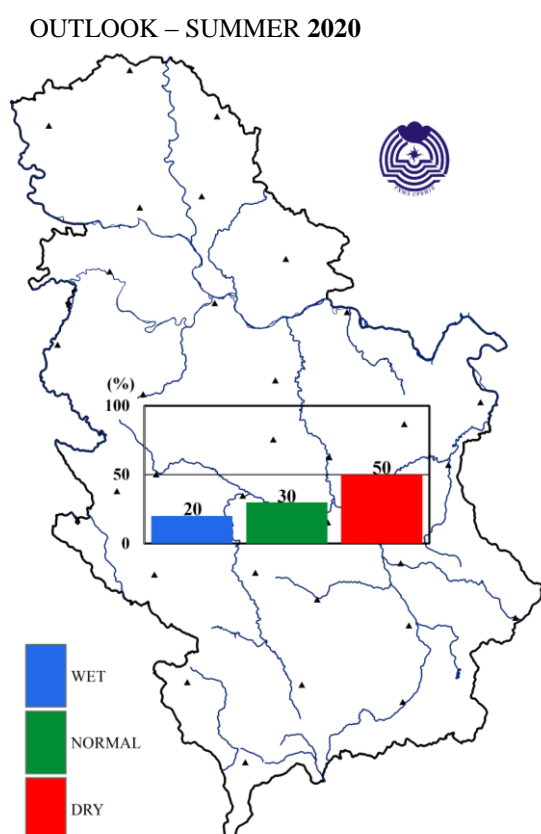


Figure C. SEECOF-23 - summer precipitation outlook

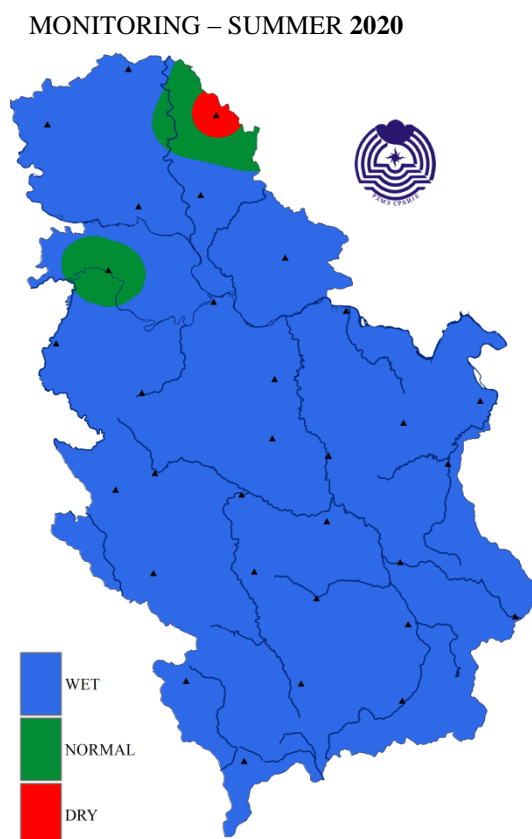


Figure D. Monitoring of the 2020 summer precipitation using tercile method relative to the 1981-2010 base period

Summer 2020			Air Temperature (°C)			
Station	Rank*	Rank**	33	50	66	Observed value
Beograd (1888-2020)	22	16	21.6	22.0	22.9	23.2
Palić (1945-2020)	19	16	20.9	21.3	21.9	22.1
Sombor (1942-2020)	16	13	20.6	21.0	21.3	21.9
Novi Sad (1948-2020)	15	12	20.8	21.0	21.6	22.1
Zrenjanin (1946-2020)	17	13	21.0	21.2	21.7	22.4
Kikinda (1948-2019)	13	11	20.8	21.3	21.7	22.6
Banatski Karlovac (1986-2020)	19	19	20.9	21.3	21.8	21.6
Loznica (1952-2020)	16	15	20.7	21.0	21.7	21.8
Sremska Mitrovica (1925-2020)	28	16	20.5	20.8	21.2	21.6
Valjevo (1926-2020)	23	16	20.5	20.9	21.6	21.8
Kragujevac (1925-2020)	33	20	20.6	21.2	21.6	21.5
Smederevska Palanka (1939-2020)	27	21	20.8	21.3	21.8	21.7
Veliko Gradište (1926-2020)	24	16	20.4	21.1	21.4	21.8
Crni Vrh (1967-2020)	23	23	15.9	16.3	16.6	16.4
Negotin (1927-2020)	20	15	22.0	22.7	23.1	23.4
Zlatibor (1950-2020)	27	22	16.3	16.8	17.3	16.9
Sjenica (1946-2020)	30	24	15.3	15.9	16.2	15.9
Pozega (1952-2020)	22	18	18.9	19.4	19.5	19.6
Kraljevo (1926-2020)	32	20	20.6	21.0	21.5	21.3
Kopaonik (1950-2020)	25	21	11.5	12.1	12.5	12.4
Kursumlija (1952-2020)	27	22	19.0	19.4	19.9	19.6
Krusevac (1927-2020)	40	24	20.7	21.1	21.5	21.0

Cuprija (1948-2020)	14	11	20.3	21.0	21.3	21.8
Nis (1925-2020)	47	26	21.2	21.9	22.2	21.5
Leskovac (1948-2020)	34	24	20.4	20.9	21.1	20.9
Zajecar (1929-2020)	44	27	20.9	21.8	22.0	21.0
Dimitrovgrad (1945-2020)	25	17	18.8	19.4	19.7	19.9
Vranje (1926-2020)	50	28	20.3	21.1	21.3	20.8

*Rank – period of stations work (warmest season)

**Rank – 1981-2020 period (warmest season)

Summer 2020			Precipitation sums (mm)			
Station	Rank*	Rank**	33	50	66	Observed Value
Beograd (1888-2020)	21	7	169.3	222.8	264.1	285.8
Palić (1945-2020)	14	8	161.4	197.6	219.0	253.2
Sombor (1942-2020)	16	8	180.2	187.8	215.1	257.5
Novi Sad (1948-2020)	3	3	174.5	187.8	236.8	376.7
Zrenjanin (1946-2020)	15	8	155.3	175.6	222.8	259.9
Kikinda (1948-2020)	66	29	152.4	174.9	205.7	<u>137.3</u>
Banatski Karlovac (1946-2020)	16	8	146.6	198.6	246.0	281.3
Loznica (1926-2020)	13	6	237.8	256.5	309.0	375.6
Sremska Mitrovica (1925-2020)	35	13	173.9	189.4	226.1	218.3
Valjevo (1926-2020)	25	13	214.0	233.9	286.7	294.8
Kragujevac (1925-2020)	7	2	154.8	195.4	230.6	328.5
Smederevska Palanka (1939-2020)	5	3	168.2	201.5	231.6	341.1
Veliko Gradište (1926-2020)	25	13	129.4	173.9	238.6	262.2

Crni Vrh (1967-2020)	20	11	169.4	196.9	249.3	282.3
Negotin (1927-2020)	16	9	105.8	138.2	188.9	211.8
Zlatibor (1950-2020)	6	4	230.7	288.4	313.0	466.3
Sjenica (1946-2020)	2	1	191.2	213.6	229.3	452.3
Pozega (1952-2020)	6	2	178.0	218.5	238.1	376.2
Kraljevo (1926-2020)	6	2	209.6	244.4	272.7	392.7
Kopaonik (1950-2020)	1	1	224.1	279.6	323.8	<u>533.8</u>
Kursumlija (1952-2020)	5	4	129.2	175.7	208.0	308.0
Krusevac (1927-2020)	2	1	137.0	172.5	209.9	392.6
Cuprija (1948-2020)	27	12	143.8	185.8	204.9	209.7
Nis (1925-2020)	1	1	125.9	150.2	178.7	344.2
Leskovac (1948-2020)	2	1	126.2	150.3	179.6	283.5
Zajecar (1929-2020)	4	1	115.7	156.2	172.8	350.8
Dimitrovgrad (1945-2020)	23	10	150.2	175.7	203.5	235.2
Vranje (1926-2020)	14	7	112.0	144.3	179.9	235.2

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

**Rank – 1981-2020 period (highest seasonal precipitation)

Country	Seasonal temperature JJA		Seasonal precipitation JJA		High Impact Events
	Observed	SEECOF-23 climate outlook for temperature	Observed	SEECOF-23 climate outlook for precipitation	
Serbia (1)	Above normal / Normal	Above-normal (10, 30, 60) in entire Serbia	Above normal in almost entire Serbia	Below-normal (50, 30 20) in entire Serbia	<p>* Summer 2020 The 2nd wettest summer for Serbia in the last 70 years. The wettest summer for Nis and Kopaonik, 2nd wettest for Sjenica, Krusevac and Leskovac. Record-breaking daily precipitation sums for Kopaonik and Sjenica. Record-breaking number of days in summer with the precipitation sums above 20 mm in Sjenica and Nis, and above 50 mm in Kraljevo and Kopaonik.</p> <p>* June Record-breaking daily precipitation sums in Kragujevac on June 11 and in Nis on June 16. Maximum number of days with precipitation above 20 mm exceeded at Zlatibor.</p> <p>* August Wettest August in Sjenica since record-keeping began.</p>

SEASONAL BULLETIN FOR SERBIA - SUMMER 2020

2nd wettest summer for Serbia in the last 70 years. Summer air temperature slightly above the average. The wettest summer for Nis and Kopaonik, 2nd wettest for Sjenica, Krusevac and Leskovac. Record-breaking daily precipitation sums for Kopaonik and Sjenica. Record-breaking number of days in summer with the precipitation sums above 20 mm in Sjenica and Nis, and above 50 mm in Kraljevo and Kopaonik.

Analysis of the 2020 summer season for Serbia relative to the 1981-2010 base period

Temperature

Mean summer air temperature ranged from 19.6°C in Kursumlija and Pozega to 23.4°C in Negotin, and on the mountains from 12.4°C at Kopaonik to 16.9°C at Zlatibor (Figure 1).

Departure of the mean summer air temperature from the normal¹ ranged from -0.5°C in Zajecar to +1.2°C in Kikinda, and in the upland from +0.1°C at Zlatibor and Sjenica to +0.2°C at Kopaonik (Figure 2).

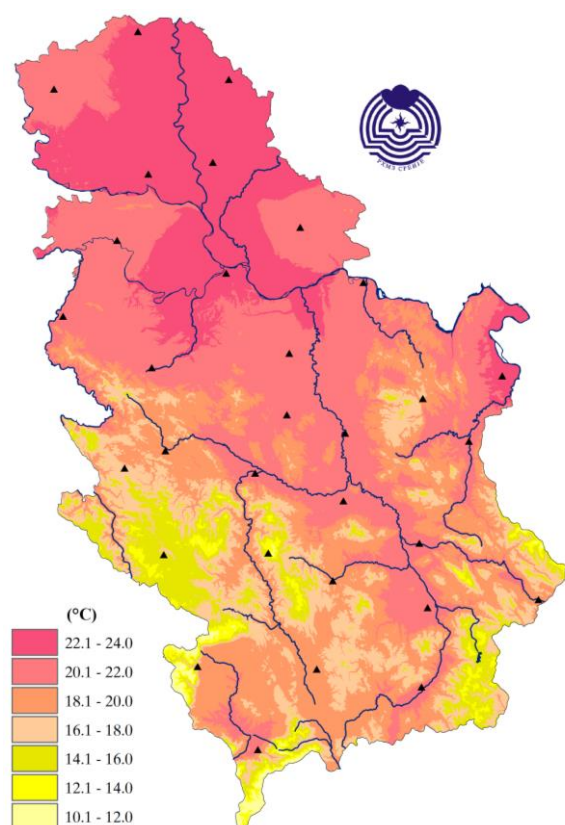


Figure 1. Spatial distribution of mean seasonal air temperature

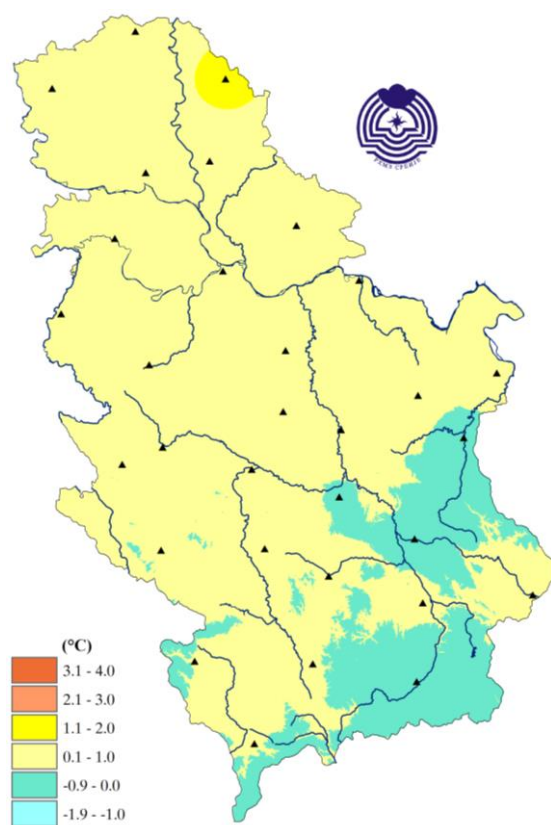


Figure 2. Spatial distribution of mean seasonal air temperature anomaly from the normal

¹ Term normal refers to climatological standard normal, that is, the average value of a particular climate event, calculated for the period from January 1, 1981 to December 31, 2010

Based on the percentile method², mean summer air temperature was in the warm category in the northern, as well as parts of western, central and eastern Serbia. Elsewhere it was in the normal category (*Figure 3*).

Based on the tercile method, mean summer air temperature was in the warm category in the northern as well as parts of western, central, southeastern and eastern Serbia. Elsewhere it was in the normal category (*Figure 4*).

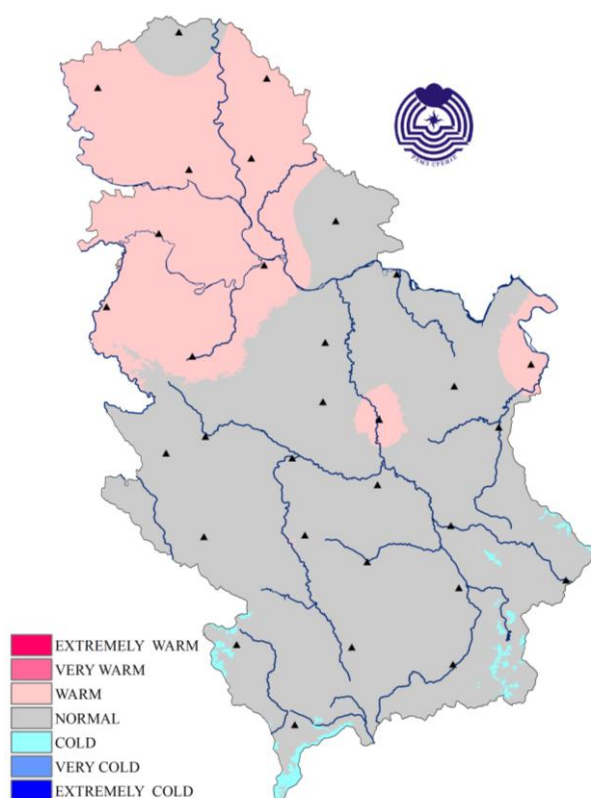


Figure 3. Spatial distribution of mean seasonal air temperature according to the percentile method

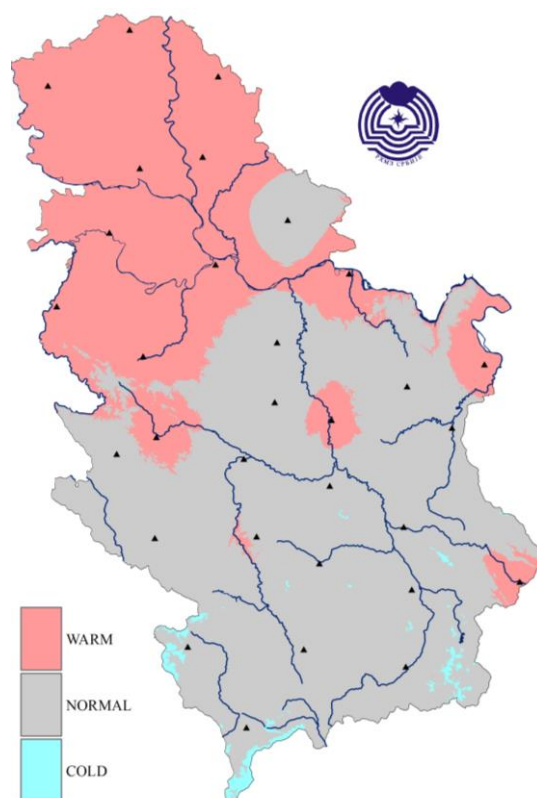


Figure 4. Spatial distribution of mean seasonal air temperature according to the tercile method

Summer 2020 ranks as the 23rd warmest summer for Serbia in the record-keeping period from 1951 to 2020. The summer of 2012 was the warmest on record. The fifteen warmest summer seasons were registered in the last 20 years since 2000.

In the summer of 2020, the highest daily air temperature of 36.9°C was recorded in Cuprija on August 31.

Heat wave³ was recorded only in Dimitrovgrad in the period from August 28 to September 1.

In the summer of 2020, the lowest daily air temperature of 0.6°C was measured at Kopaonik on July 3 whereas in the lowland, Kursumlija observed air temperature of 4.1°C on the same day.

² 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

³ Heat wave, according to the percentile method, is a period during which maximum daily air temperature is in the very warm and extremely warm categories for 5 days or longer

Number of summer days⁴ ranged from 67 in Kuršumlija to 81 in Negotin, and on the mountains from 10 at Crni Vrh to 33 in Sjenica. Kopaonik didn't observe any summer days, which is 2 days below the average. Deviation of the number of summer days from the average ranged from 9 days below the average in Crni Vrh to 10 days above the average in Kikinda. Belgrade recorded 76 summer days, which is 8 days above the average.

Number of tropical days⁵ ranged from 23 in Pozega to 47 in Negotin. Tropical days were not recorded on the mountains apart from Sjenica where 2 tropical days were registered. The recorded number of tropical days was 6 days below the average in Nis, to 8 days above the average in Zrenjanin (*Figure 6*).

In the southern, parts of eastern and western as well as mountain regions there weren't any tropical night⁶, whilst elsewhere in Serbia their number ranged from 1 in Banatski Karlovac (3 nights below the average) to 28 in Belgrade (12 tropical nights above the summer average).

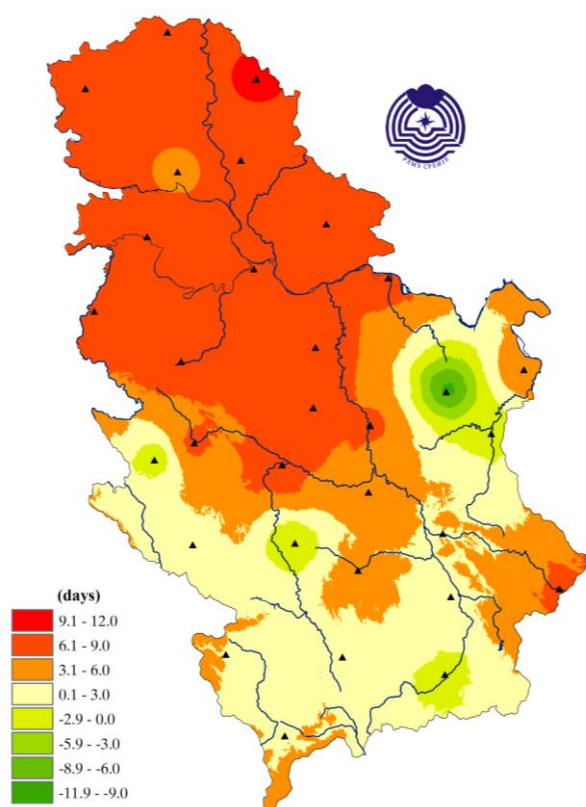


Figure 5. Deviation of the number of summer days from the normal

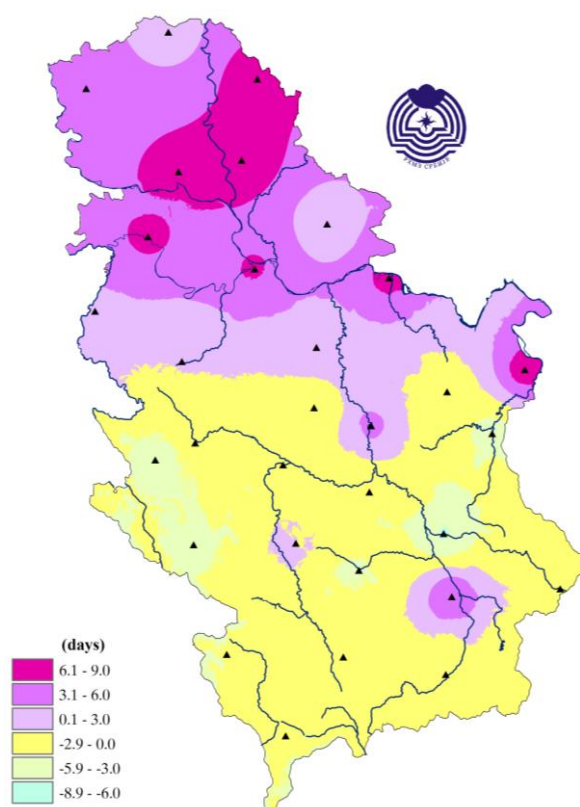


Figure 6. Deviation of the number of tropical days from the normal

⁴ Summer day is defined as the day with the maximum air temperature of 25°C and above

⁵ Tropical day is defined as the day with the maximum air temperature of 30°C and above

⁶ Tropical night is defined as the day with the daily air temperature of 20°C and above

**Mean daily air temperature on Kopaonik
Summer 2020.**

The chart displays the mean daily air temperature on Kopaonik during the summer of 2020, comparing actual conditions to a normal distribution. The data is presented as a time series from June to August, with the background color-coded by temperature percentile ranges.

Temperature Percentile Ranges (Background Colors):

- > 98. percentile (Red)
- 91-98. percentile (Orange)
- 76-90. percentile (Yellow)
- 25-75. percentile (Grey)
- 10-24. percentile (Light Blue)
- 2-9. percentile (Cyan)
- < 2. percentile (Dark Blue)

Temperature Categories (Labels):

- extremely cold
- very cold
- cold
- normal
- warm
- very warm
- extremely warm

Time Series Data:

- Tmean (Mean Temperature):** Represented by a purple line, showing daily fluctuations. It frequently exceeds the normal range, particularly in July and August.
- normal Tmean (Normal Mean Temperature):** Represented by a black line, showing the expected mean temperature for the period.

Monthly Trends:

- June:** The Tmean is generally below the normal range, indicating cooler than average conditions.
- July:** The Tmean fluctuates significantly, often exceeding the normal range, indicating warmer than average conditions.
- August:** The Tmean remains above the normal range, indicating warmer than average conditions.

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Figures 9 and 10 show assessment of the mean, maximum and minimum air temperature along with the precipitation sums for Serbia in the summer based on the tercile distribution relative to the 1981-2010 base period. It can be noted that the summer 2020 was characterized by the mean air temperature slightly above the average and precipitation sums significantly above the average, minimum air temperature above and maximum air temperature within the medium tercile, that is, within the average.

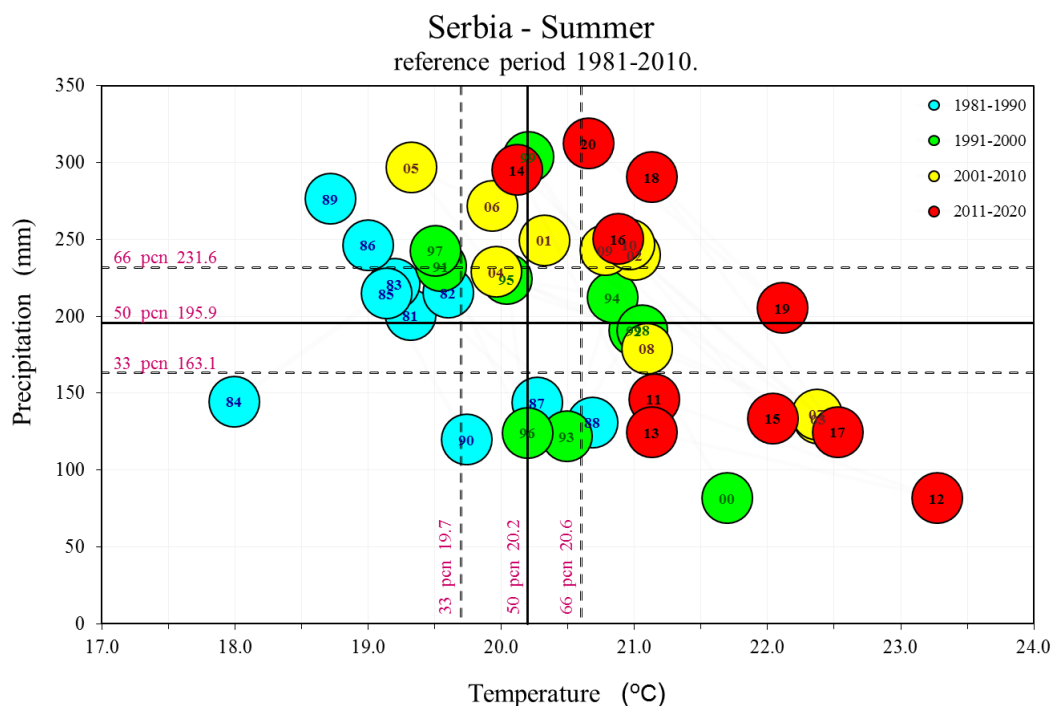


Figure 9. Assessment of mean air temperature and precipitation sums for summer in Serbia with the accompanying terciles compared to the 1981-2010 normal

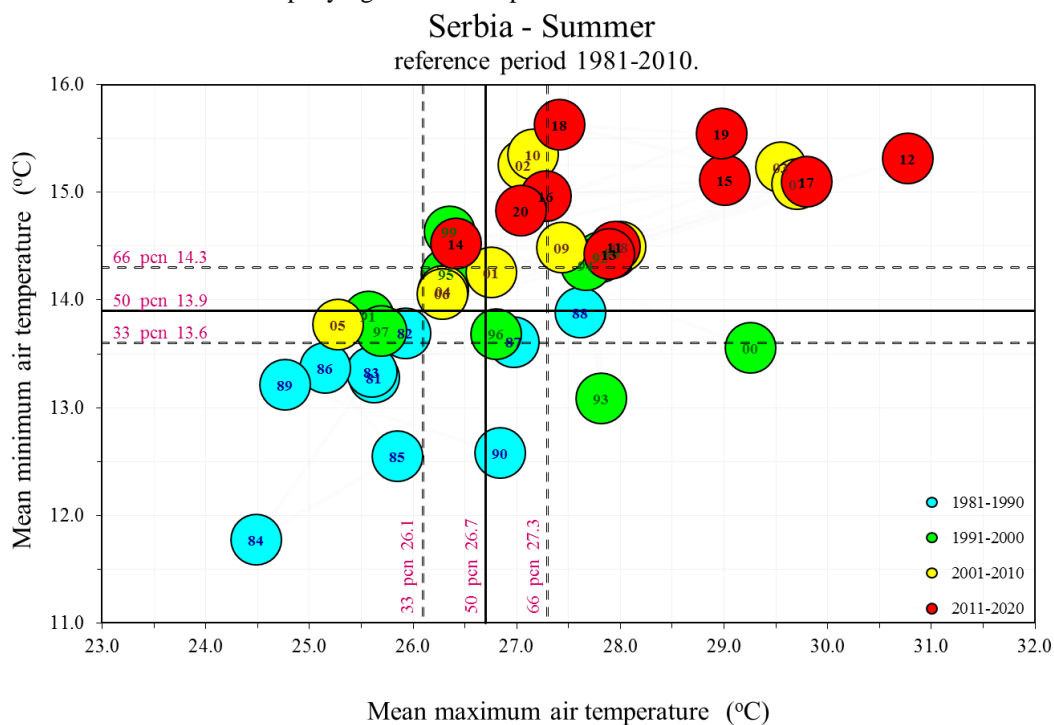


Figure 10. Assessment of maximum and minimum air temperature for summer in Serbia with the accompanying terciles compared to the 1981-2010 normal

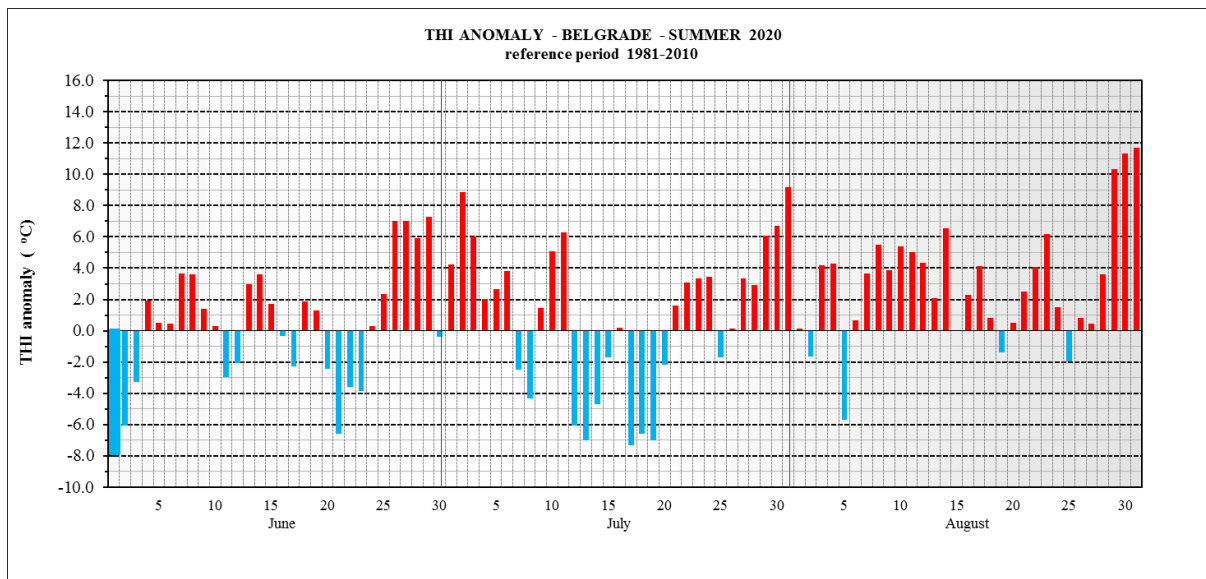


Figure 11.

Departure of the Heat Wave Index (THI)⁷ was positive most of the summer (*Figure 11*). The highest discrepancy between the apparent (*feels like*) temperature and the maximum daily air temperature was recorded at the beginning and the end of July, as well as in the middle of August (*Figure 12*) amounting to 7.7°C on July 2. The maximum daily air temperature measured that day was 33.0°C whereas apparent temperature was 40.7°C. The maximum THI for the summer of 42.0°C was measured on July 31, 2020. There were 2 days with the THI above 40°C and 65 days with the THI above 30°C.

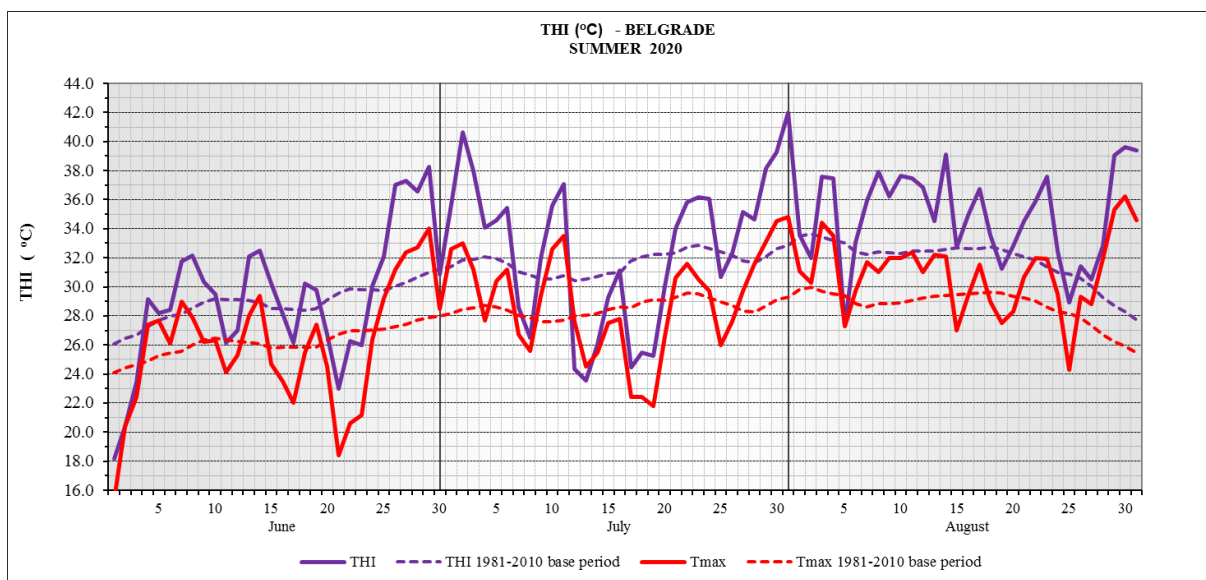


Figure 12.

⁷ THI is defined as the unit of subjective sensation of warmth, that is, unit of relative discomfort due to the prolonged exposure to extremely warm and wet weather, indicating likelihood of heatstroke, sun stroke or other acute body stress symptoms

Precipitation

Summer precipitation totals in Serbia ranged from 137.3 mm in Kikinda to 533.8 mm at Kopaonik (*Figure 13*). Precipitation sums relative to the normal ranged from 76% in Kikinda to 233% in Nis (*Figure 14*).

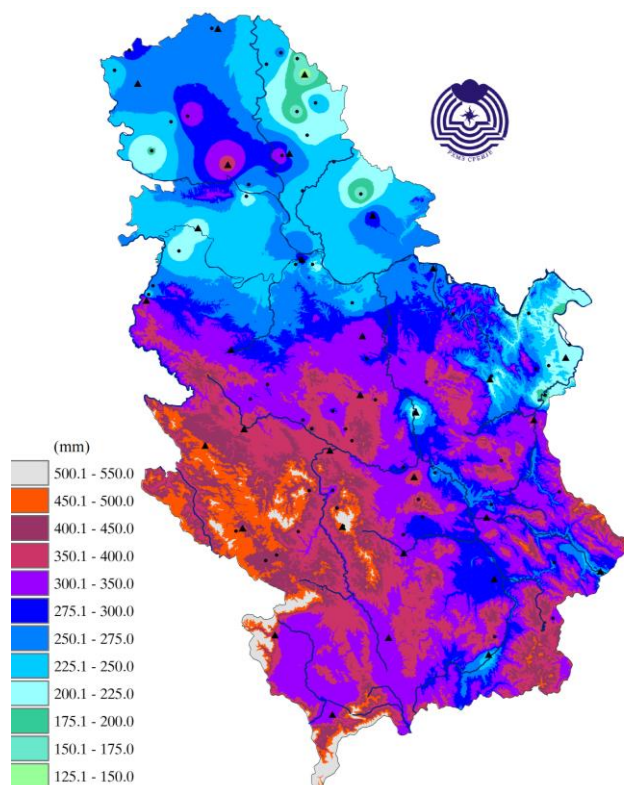


Figure 13. Spatial distribution of seasonal precipitation sums in mm according to data from 28 major meteorological, 14 climatological and 46 rain gauge stations

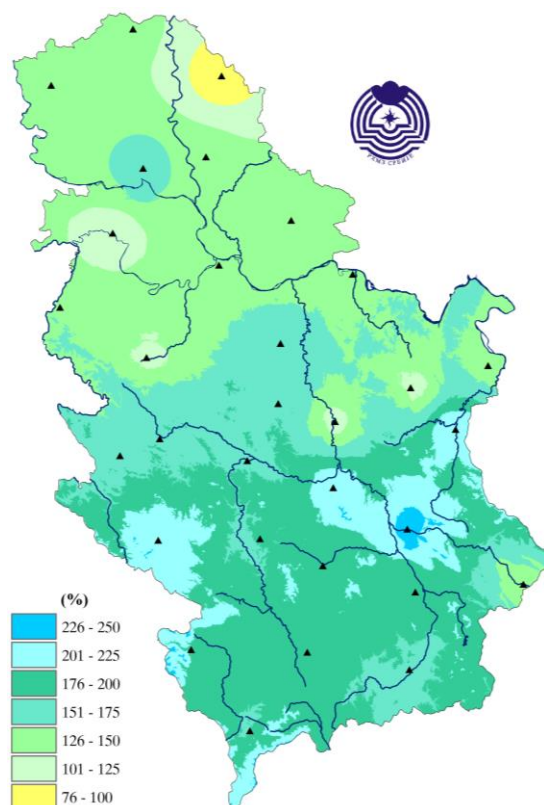


Figure 14. Spatial distribution of seasonal precipitation sums in percentage of normal

Based on the percentile method, summer precipitation sums were in the following categories: extremely rainy and very rainy in the southwest, as well as parts of northern, central and eastern Serbia and rainy in the remainder of the country. Summer precipitation sums in Sremska Mitrovica, Valjevo, Cuprija and Crni Vrh were in the normal category, and dry category in Kikinda (*Figure 15*).

Summer precipitation totals based on the tercile method were above the average across the entire country apart from Sremska Mitrovica where it was normal and in Kikinda where it was below the average (*Figure 16*).

The maximum daily precipitation sum of **86.6 mm** was recorded on August 7 at **Kopaonik** thereby breaking the previous record of 70.9 mm set on June 9 in 1969. **Record-breaking daily precipitation sum for summer of 77.2 mm** was observed in **Sjenica** on August 15 thereby besting the previous record of 66.4 mm from June 17, 1999.

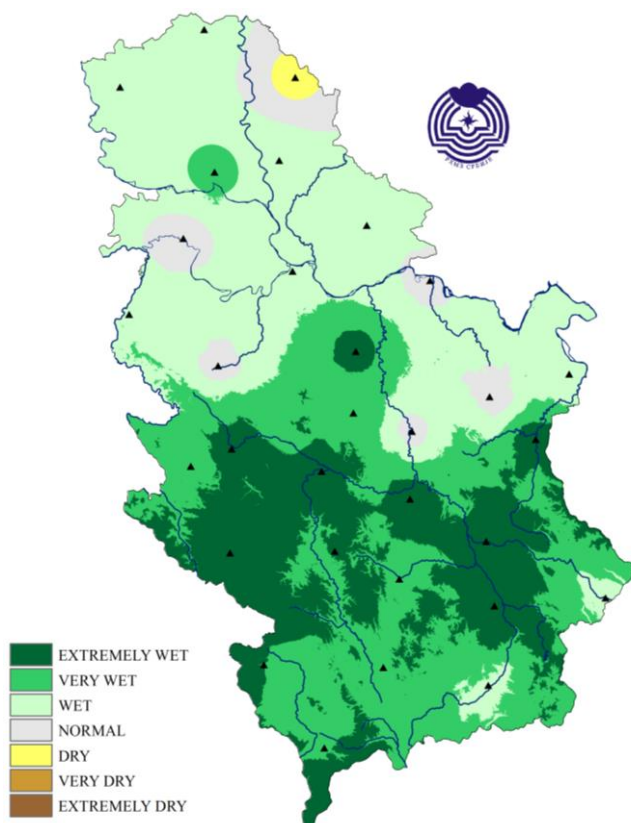


Figure 15. Seasonal precipitation sums according to the percentile method

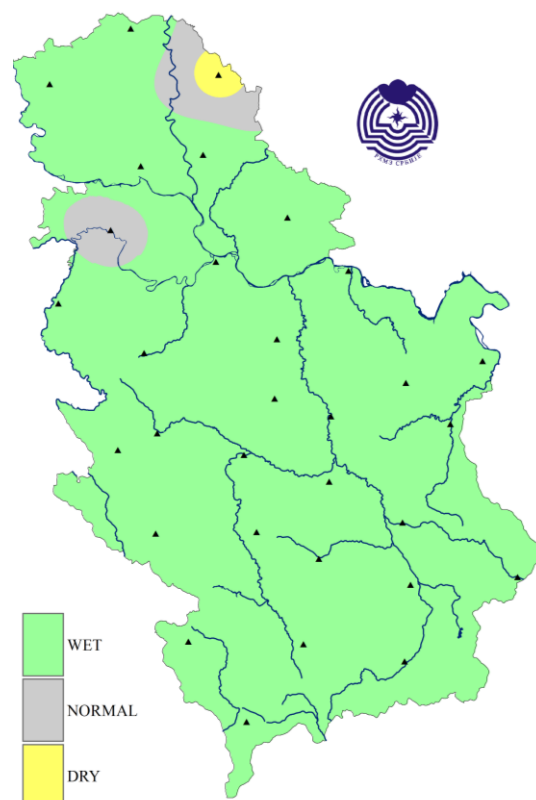


Figure 16. Seasonal precipitation sums according to the tercile method

Summer 2020 was **the 2nd wettest summer** for Serbia in the last 70 years (Figure 17), only behind the summer of 1975.



Figure 17. Rank of the wettest and driest summer seasons for Serbia for the 1951-2020 period, compared to the 1981-2010 normal

Number of days with precipitation in the summer ranged from 28 days in Sremska Mitrovica and Negotin to 55 days in Sjenica. The recorded number of days with precipitation was above the average in the entire country, up to 19 days above the average in Sjenica. The only exceptions are Sremska Mitrovica and Novi Sad, where the number of days with precipitation was 3 and 1, respectively (*Figure 18*).

The entire country, apart from Kikinda recorded days with **daily precipitation sums above 20mm**, there were even up to 9 days on Zlatibor. That number was mostly above the average (*Figure 19*) even up to 6 days above the average in **Sjenica, where the previous record from 1976 was broken** by 1 day. **Nis** observed 6 days besting the previous record from 1940, and Krusevac recorded 7 days which corresponds the record set in 1955.

Kraljevo observed 3 days with the **daily precipitation sum above 50mm**, and Kopaonik and Sjenica recorded 2 days. Sombor, Novi Sad, Banatski Karlovac, Loznica, Belgrade, Kragujevac, Smederevska Palanka, Krusevac, Nis and Zlatibor recorded 1 day. In Belgrade, Smederevska Palanka, Sjenica, Krusevac, Nis and Zlatibor it was equal to the previous record whilst **record-breaking number of days was recorded in Kraljevo and Kopaonik**.

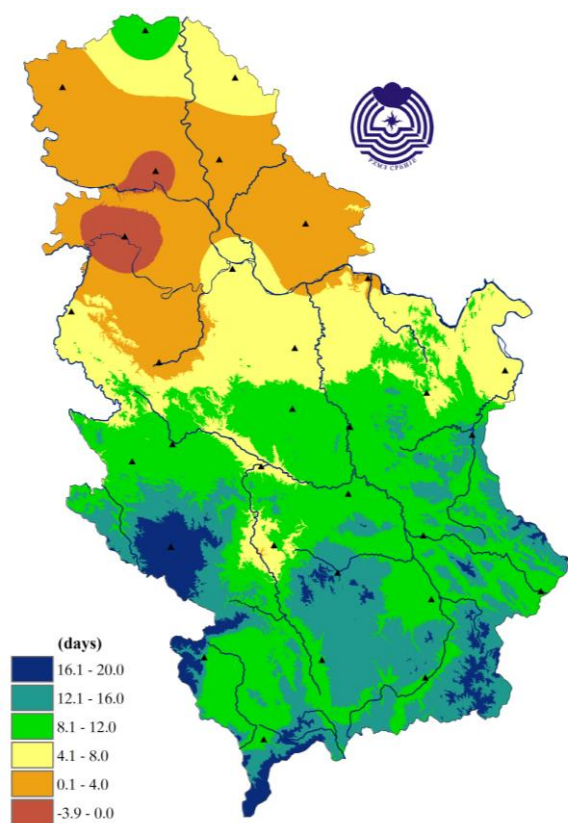


Figure 18. Deviation of number of days with precipitation of 0.1 mm and above during summer from the normal

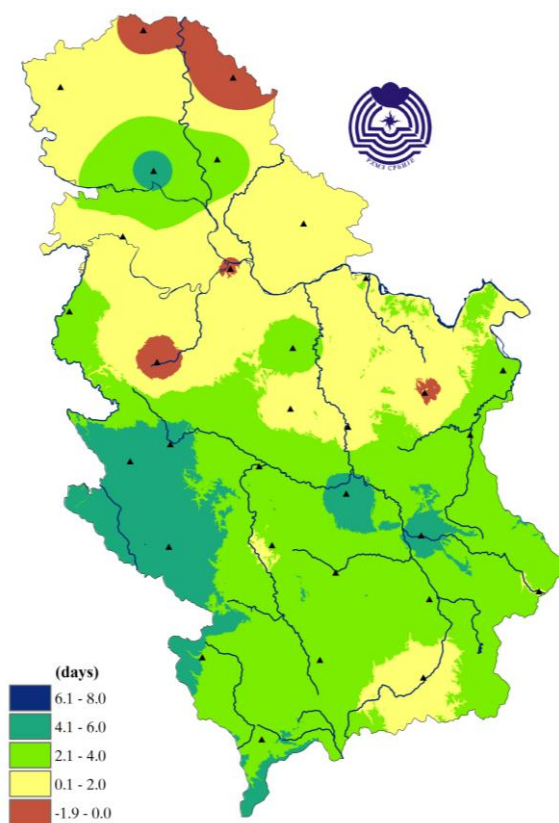


Figure 19. Deviation of number of days with precipitation of 20 mm and above during summer from the normal

In summer, number of thunder days ranged from 16 in Sremska Mitrovica to 37 on Zlatibor, which is 14 days above the average. In most of Serbia number of thunder days was above the average, apart from Banatski Karlovac, Sremska Mitrovica, Kikinda and Veliko Gradiste where 1, 3, 4 and 5 days below the summer average were recorded, respectively (*Figure 20*).

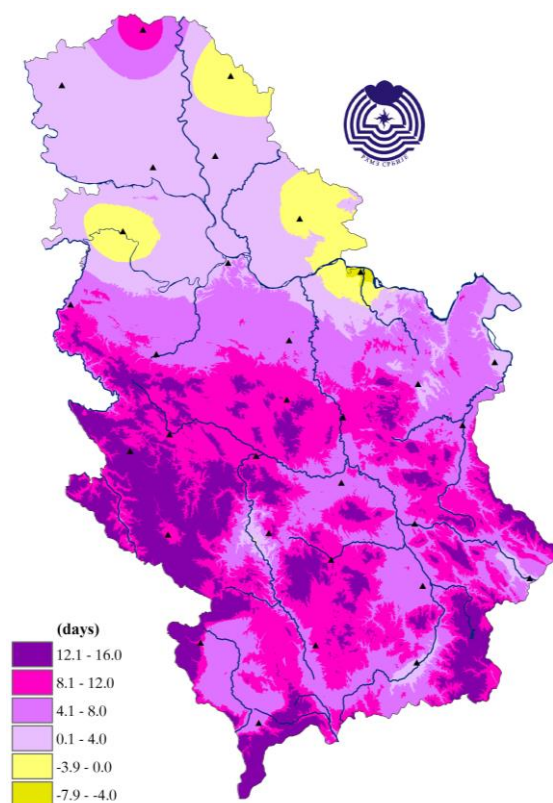


Figure 20. Deviation of number of days with thunder during summer from the normal

For Nis (Figure 21) and Kopaonik (Figure 22) the summer of 2020 ranks as **the wettest summer on record** and the **2nd wettest** for Sjenica, Krusevac and Leskovac since the record-keeping began.

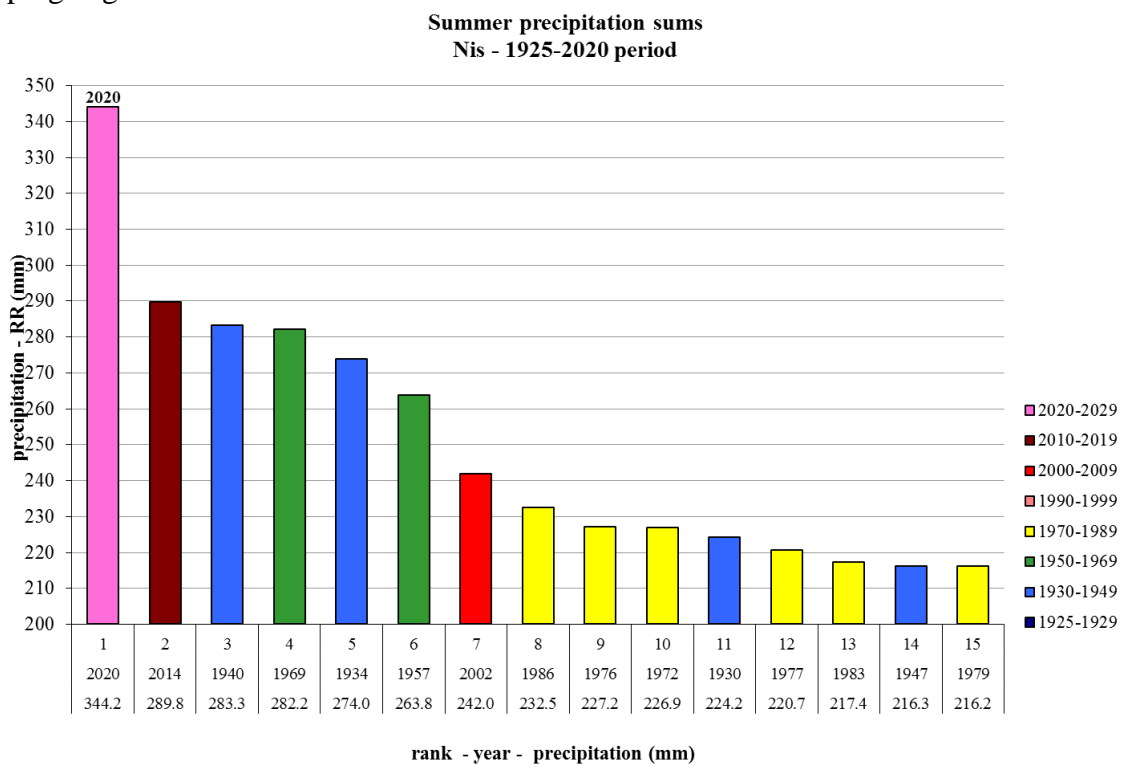


Figure 21. Rank of wettest summers in Nis

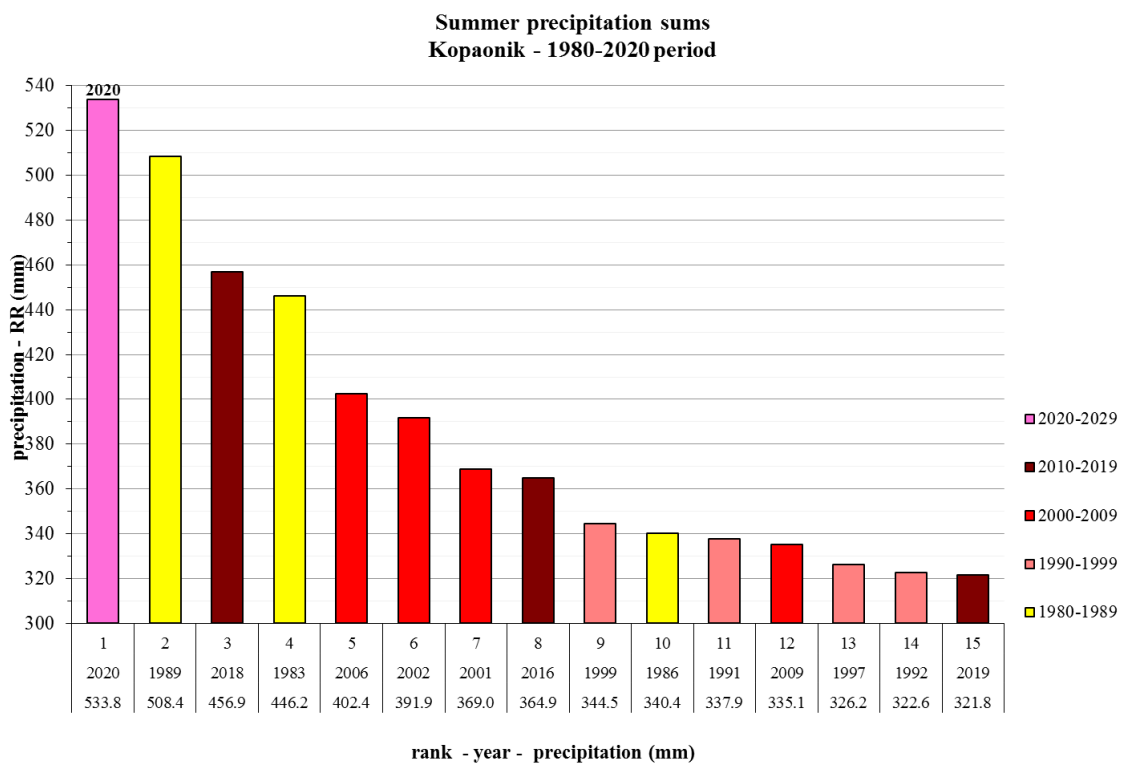


Figure 22. Rank of wettest summers at Kopaonik

Figures 23, 24 and 25 show cumulative precipitation sums for Nis, Kopaonik and Sjenicu in summer per months relative to the average cumulative precipitation sums.

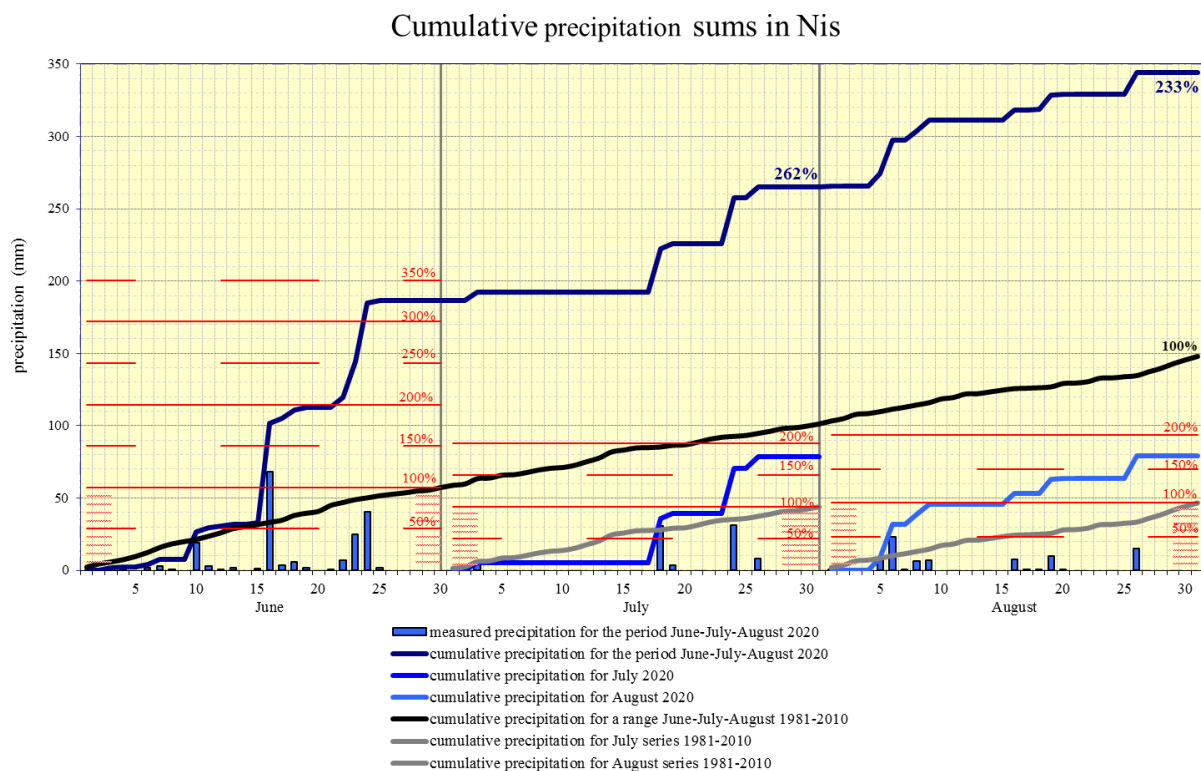


Figure 23. Cumulative precipitation sums in Nis

Cumulative precipitation sums in Kopaonik

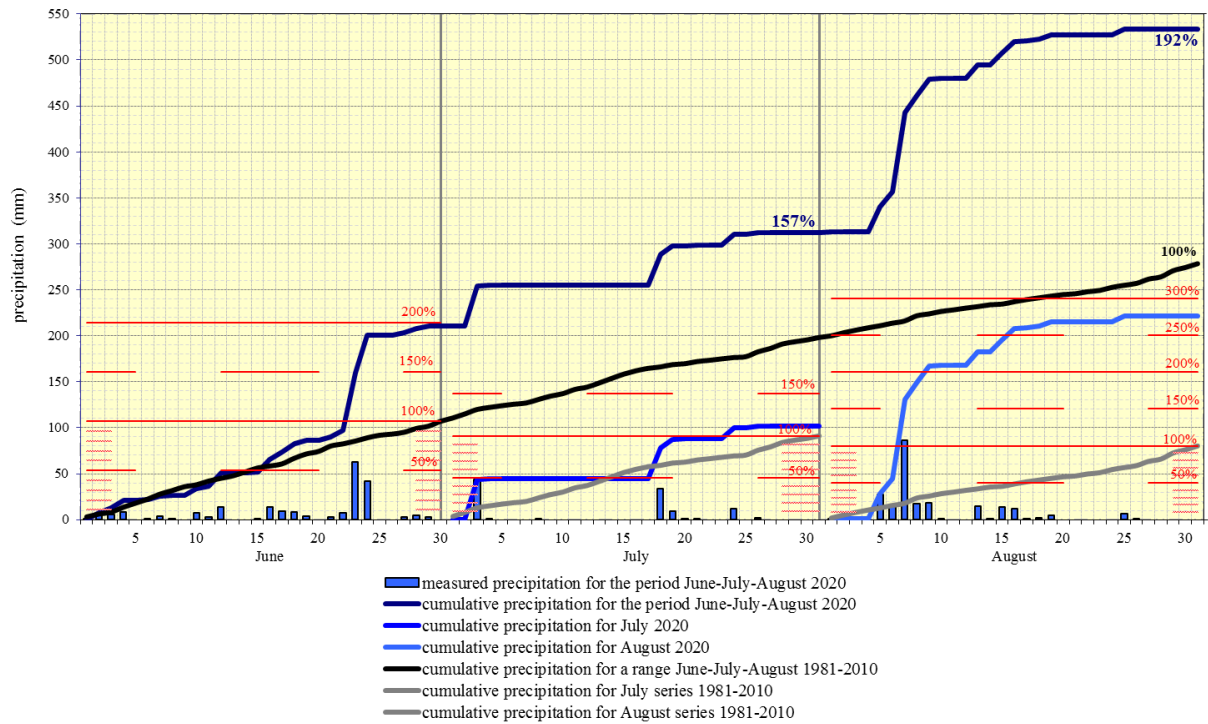


Figure 24. Cumulative precipitation sums at Kopaonik

Cumulative precipitation sums in Sjenica

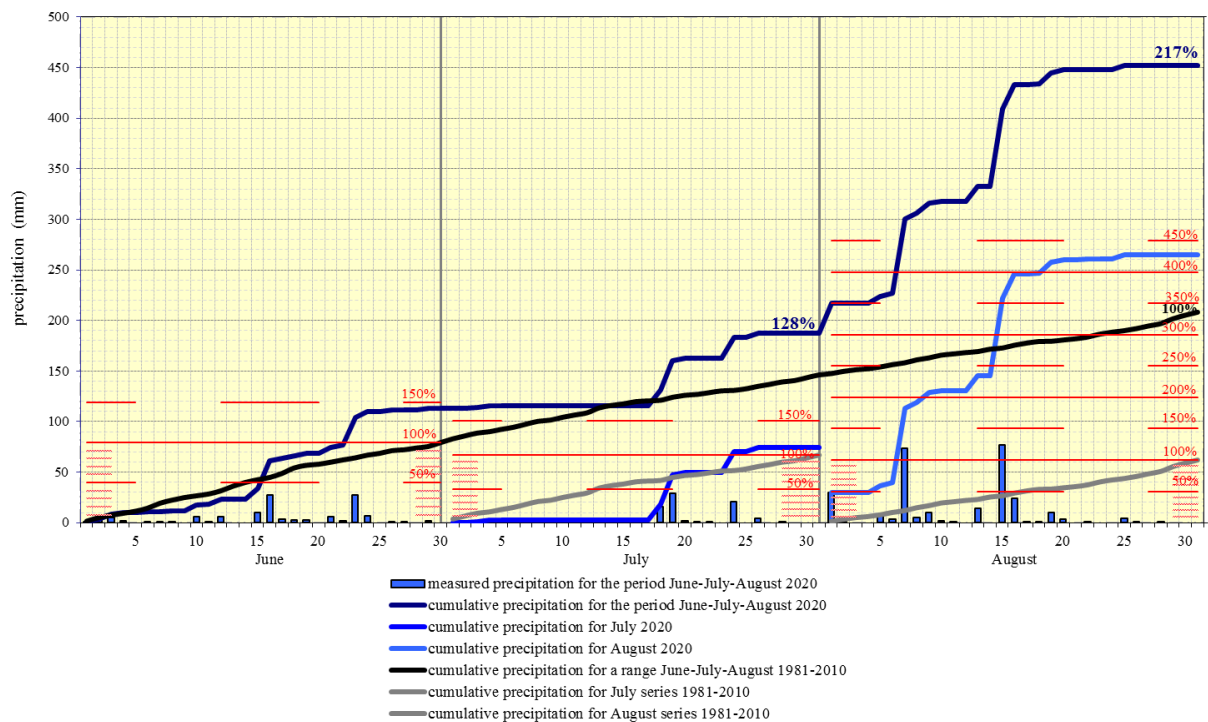


Figure 25. Cumulative precipitation sums in Sjenica

Cloud cover, bright and cloudy days

Mean summer cloud cover was above the average in most of Serbia, ranging from 4/10 in Negotin (*Figure 26*) to 6/10 in Pozega (*Figure 27*).

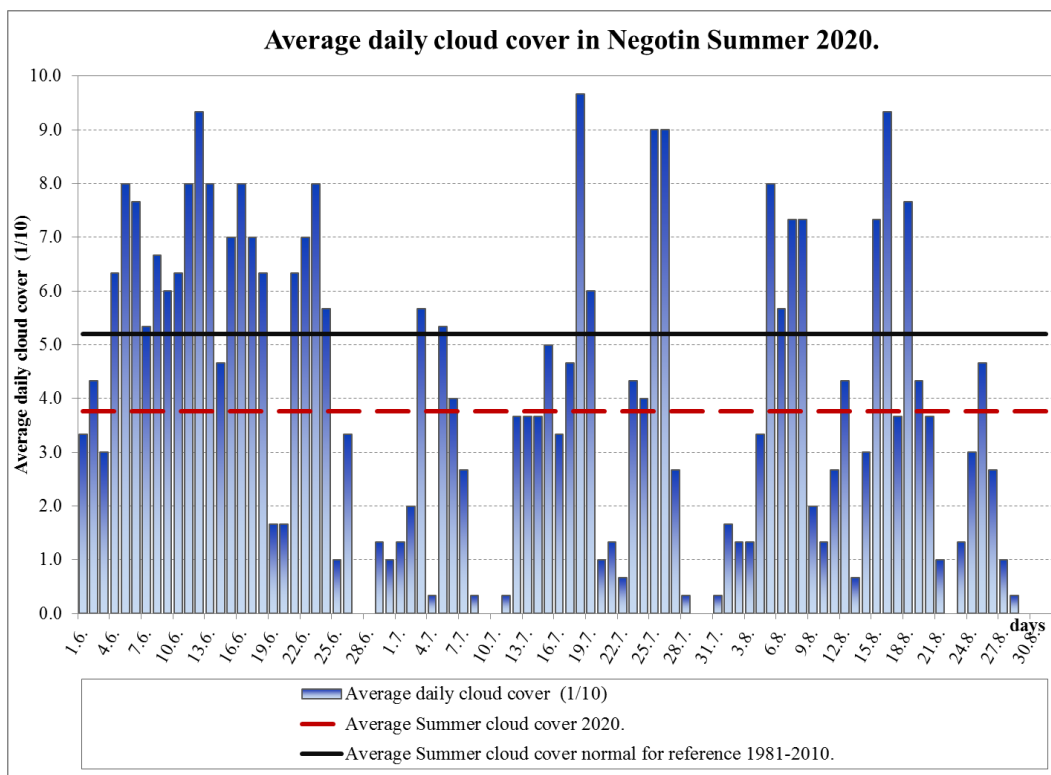


Figure 26. Average daily cloud cover in Negotin

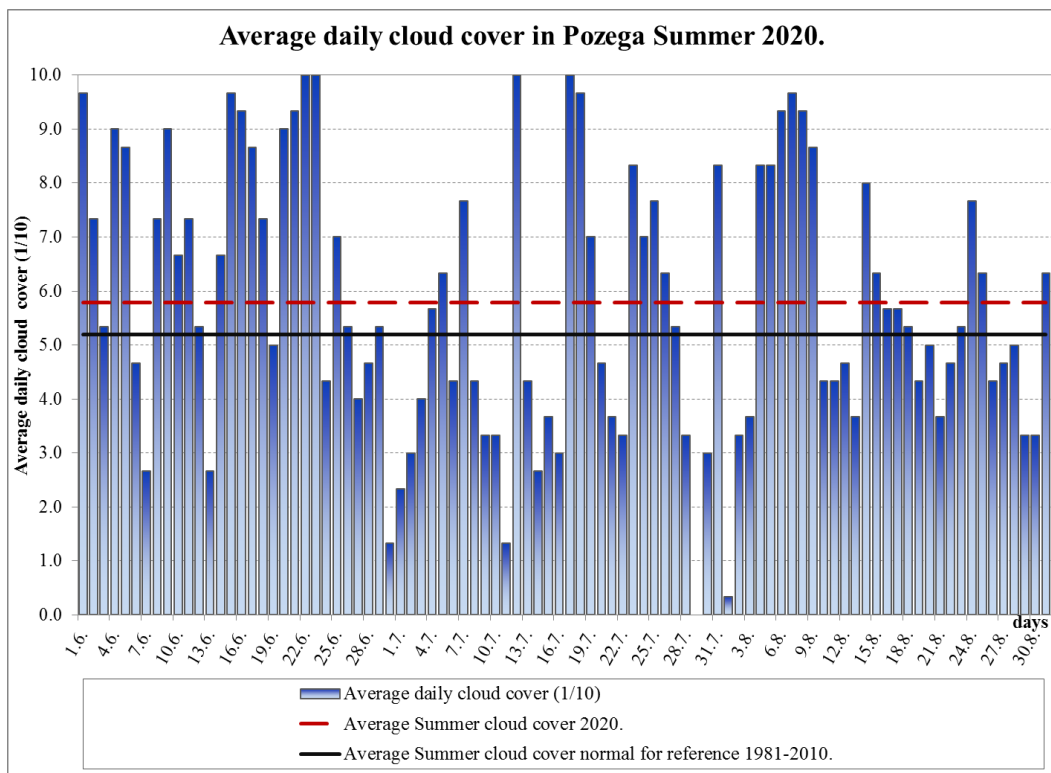


Figure 27. Average daily cloud cover in Pozega

In summer, number of bright days⁸ ranged from 4 in Sjenica and Pozega (which is 14 and 10 days below the average, respectively) to 33 bright days in Negotin. Even though departure of the observed number of bright days for summer was negative in most of Serbia, Kragujevac recorded 6, and Sremska Mitrovica 3 days above the average. Number of cloudy days⁹ ranged from 5 days in Negotin to 27 days in Kopaonik, which is 10 days above the average. **Banatski Karlovac** recorded **19 cloudy days thereby breaking the previous record for the summer** by 2 days.

Sunshine duration (insolation)

In summer, insolation ranged from 613.8 hours at Kopaonik to 875.4 hours in Negotin (*Figure 28*).

Relative to the normal for the 1981-2010 base period, sunshine duration ranged from 82% at Kopaonik to 108% in Krusevac (*Figure 29*).

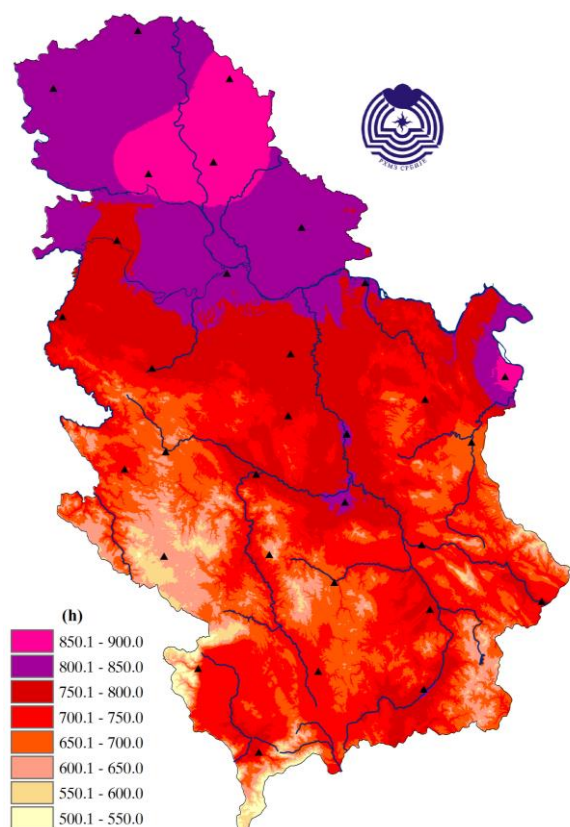


Figure 28. Insolation in hours

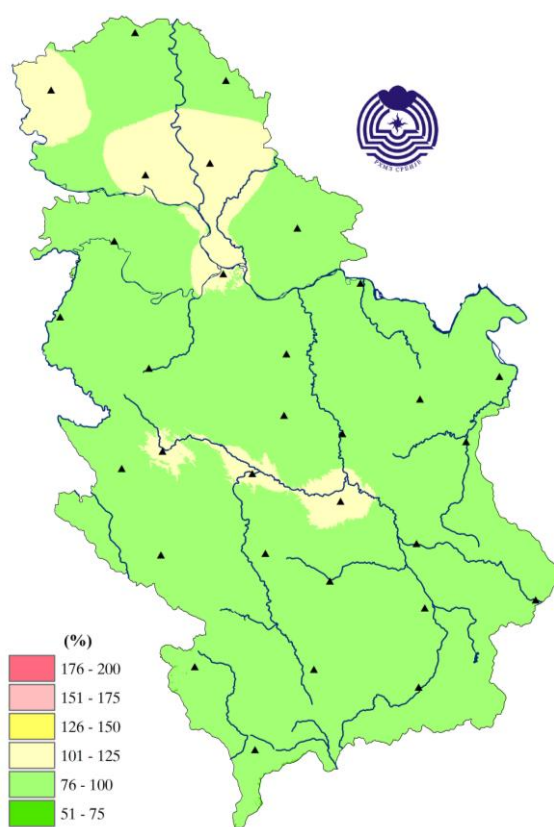


Figure 29. Insolation in percentage of normal

⁸ Bright day is a day with average daily cloud cover of less than 2/10

⁹ Cloudy day is a day with average daily cloud cover of more than 8/10

Analysis of the 2020 summer season for Serbia relative to the 1961-1990 base period

Temperature

In summer, departure of the mean air temperature from the normal for the 1961-1990 base period ranged from +0.8°C in Vranje and Zajecar to +2.2°C in Kikinda and Negotin, on the mountains from +1.1°C at Crni Vrh to +1.7°C at Kopaonik (*Figure 30*).

Based on the percentile method, mean summer air temperature was in the extremely warm and very warm category in most of Serbia apart from Nis, Zajecar and Vranje where it was in the warm category (*Figure 31*).

Based on the tercile method, mean summer air temperature was in the warm category across the entire country.

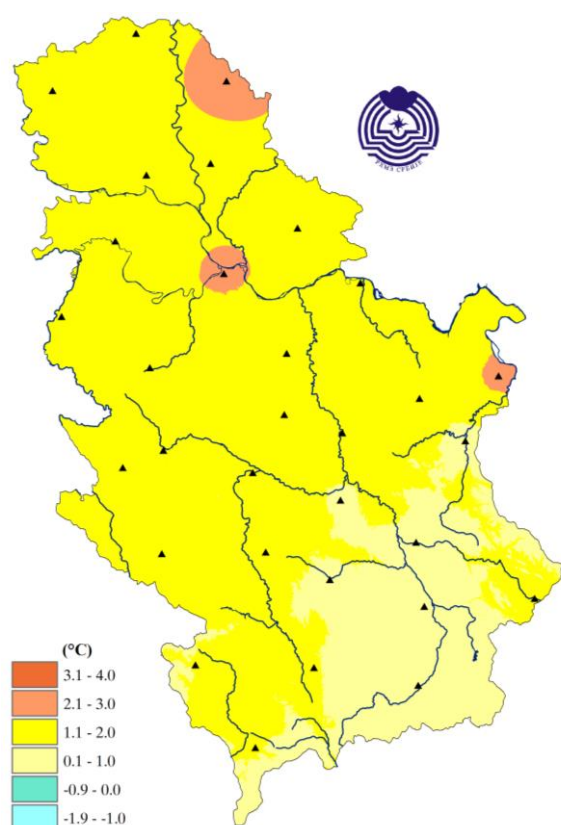


Figure 30. Spatial distribution of mean seasonal air temperature anomaly from the normal

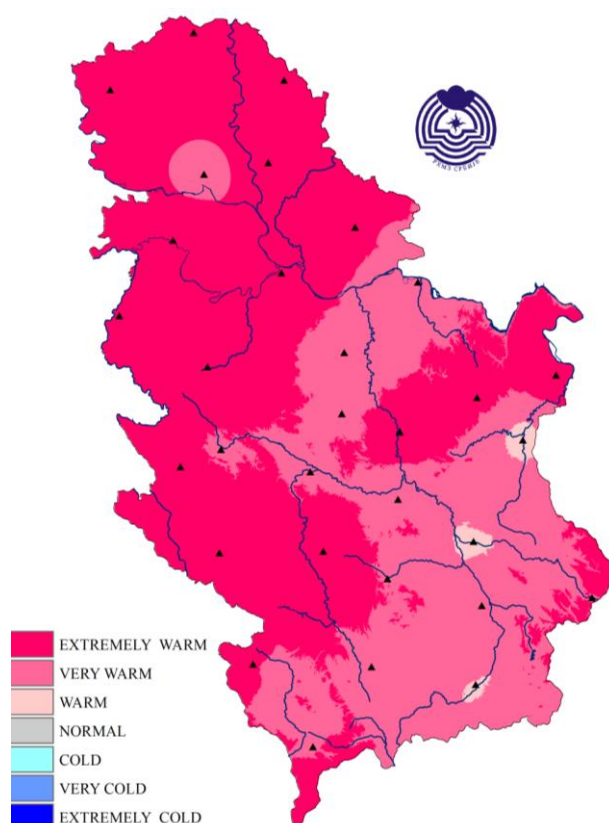


Figure 31. Spatial distribution of mean seasonal air temperature according to the percentile method

Precipitation

Precipitation sums in summer relative to the normal for the 1961-1990 base period ranged from 77% in Kikinda to 220% in Nis (*Figure 32*).

Based on the percentile method, summer precipitation sums in the northwest, south, as well as parts of western, central and eastern Serbia were in the categories of extremely rainy and very rainy. Elsewhere it was rainy, apart from Kikinda, Sremska Mitrovica, Veliko Gradiste, Cuprija and Crni Vrh where summer precipitations sums were in the normal category (*Figure 33*).

Precipitation sums based on the tercile method were above the average across entire Serbia.

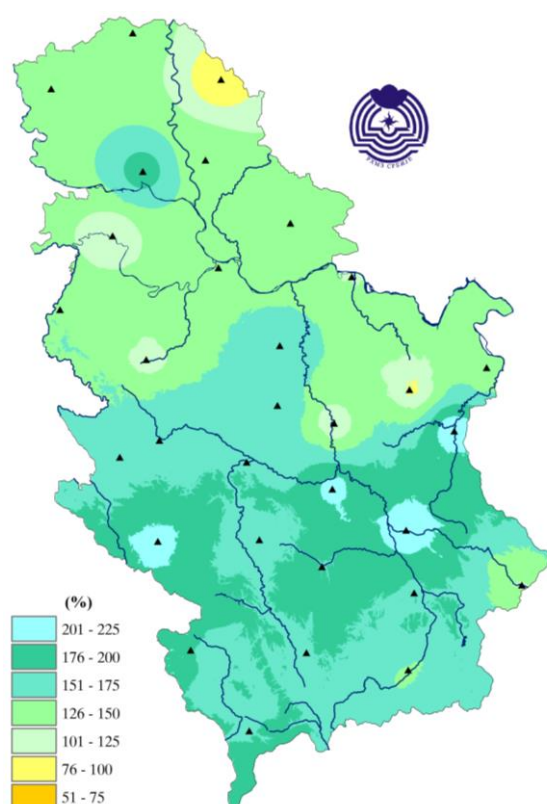


Figure 32. Spatial distribution of seasonal precipitation sums in percentage of normal

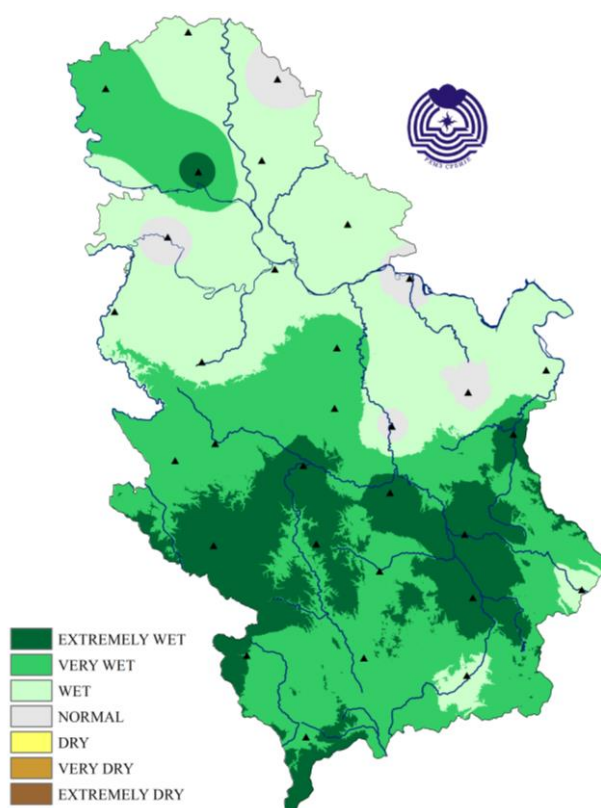


Figure 33. Seasonal precipitation sums according to the percentile method

Note: Climatological analysis of the meteorological elements was performed based on the provisional data obtained from 28 main meteorological stations