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SEASONAL BULLETIN FOR SERBIA

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- ❖ *Serbia observed its warmest summer on record since 1951*
- ❖ *The warmest June, July and August*
- ❖ *The maximum seasonal air temperature exceeded in Sombor*
- ❖ *In most of Serbia, the highest minimum seasonal air temperature since the record-keeping began*
- ❖ *Since the record-keeping began in Serbia, record-breaking minimum daily air temperature of 30,6°C was measured in Vrsac on July 13*
- ❖ *The maximum number of summer and tropical days, as well as tropical nights has been exceeded in most of Serbia*
- ❖ *Temperature humidity index – THI (feels like temperature) was above 40°C for 23 days and above 30°C for 83 days*
- ❖ *Five heat waves, in the middle of July and middle of August very intensive*
- ❖ *4th driest summer for Novi Sad and Kopaonik, 5th driest for Cuprija, and 6th driest for Crni Vrh*

Analysis of the summer season 2024 for Serbia relative to the 1991-2020 base period

Air temperature

Summer 2024 was **the warmest on record** for Serbia in the period of meteorological record-keeping from 1951 to 2024 (*Figure 1*), with the mean seasonal air temperature of 24,2°C for the period 1951-2024 and anomaly of +3,3°C compared to the 1991-2020 average. Overall, all three summer months, June, July and August were also the warmest on record.

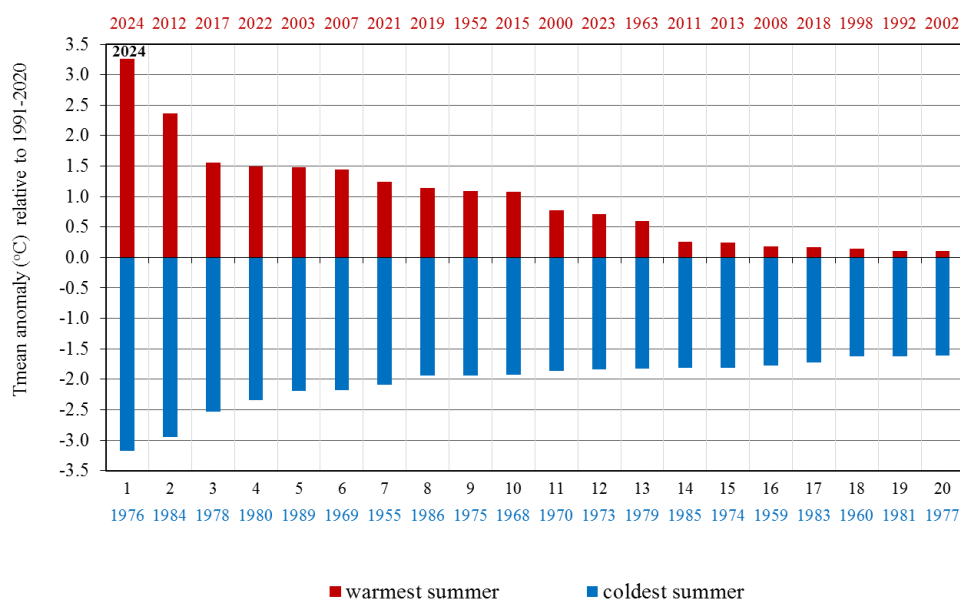
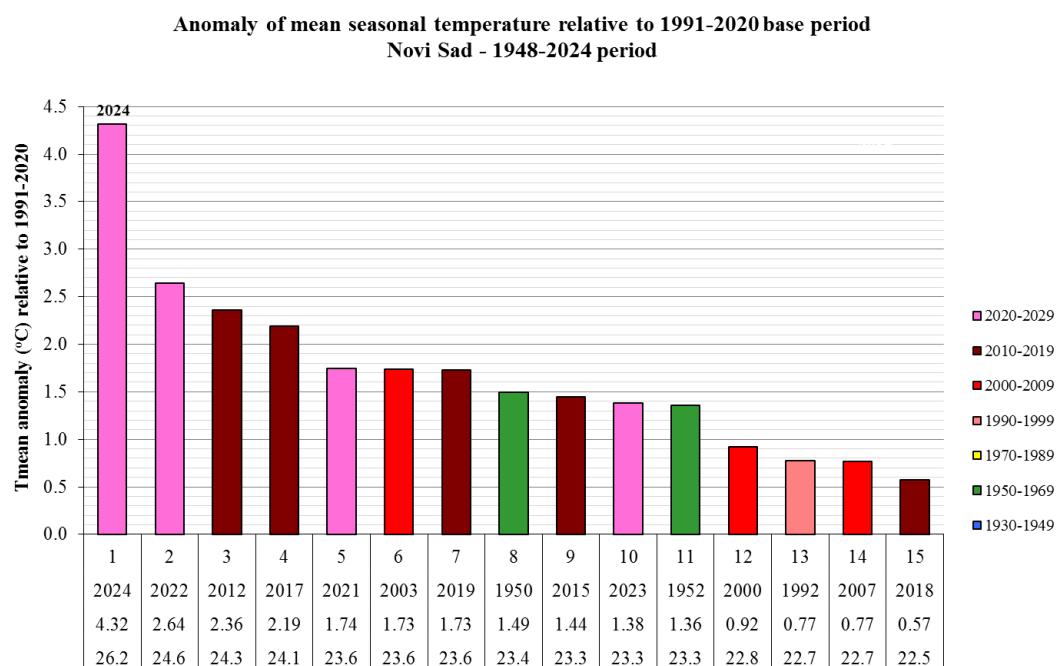


Figure 1. Rank of twenty warmest and coldest summers in Serbia for the 1951-2024 period



ranking - year - Tmean anomaly (°C) relative to 1991-2020 - Tmean

Figure 2. Rank of the warmest summers in Novi Sad

Mean summer air temperature ranged from 22,2°C in Pozega to 27,1°C in Belgrade, and on the mountains from 16,2°C at Kopaonik to 21,0°C at Crni Vrh (*Figure 3*).

Departure of the mean summer air temperature from the normal¹ ranged from +2,2°C in Zajecaru and Pozega to +4,3°C in Novi Sad, and in the upland from +2,6°C in Sjenica to +4,1°C at Crni Vrh (*Figure 4*).

Based on the percentile method², mean summer air temperature was in the extremely warm category (*Figure 5*).

Based on the tercile method, mean summer air temperature was in the warm category (*Figure 6*).

¹ Term *normal* refers to *climatological standard normal*, that is, the average value of a particular climate element, calculated for the period from January 1, 1991 to December 31, 2020

² nth 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

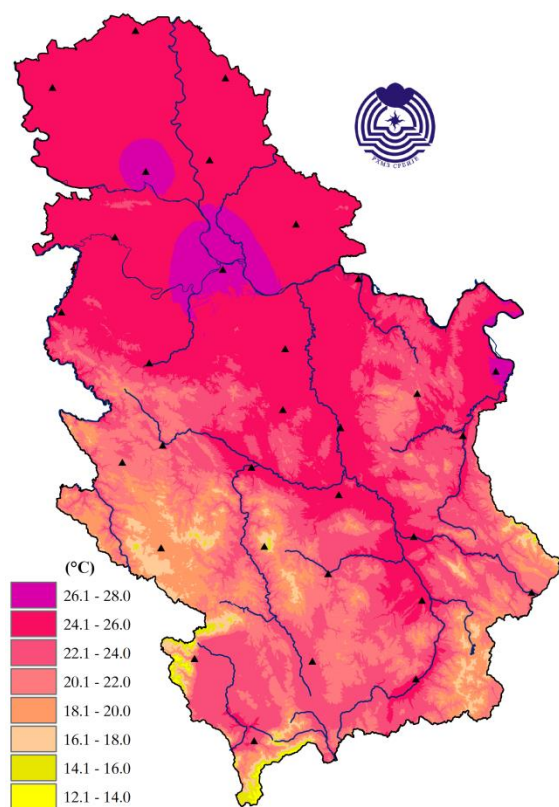


Figure 3. Spatial distribution of mean summer air temperature

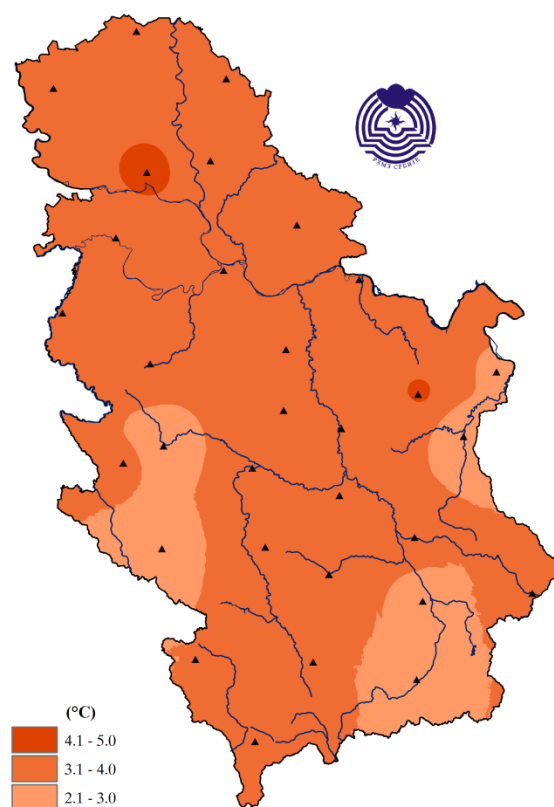


Figure 4. Spatial distribution of mean summer air temperature anomaly from the normal

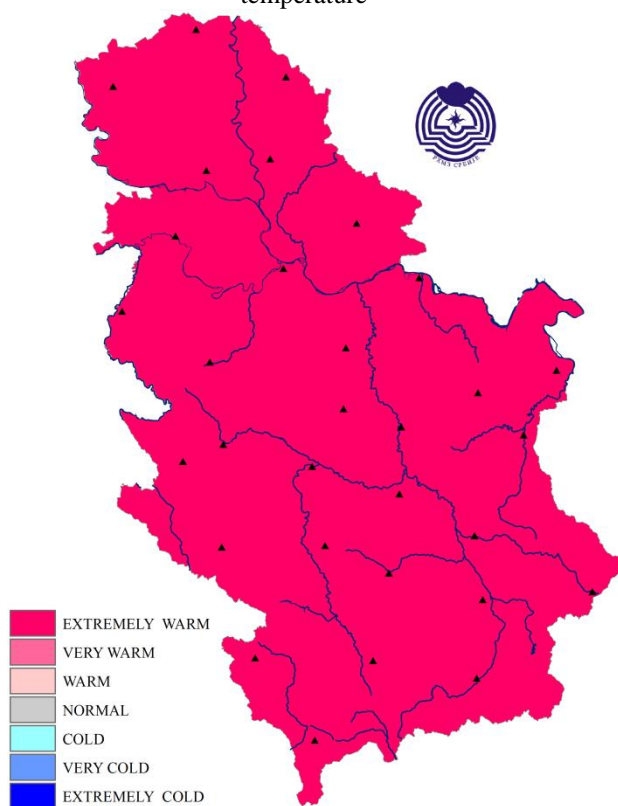


Figure 5. Spatial distribution of mean summer air temperature according to the percentile method

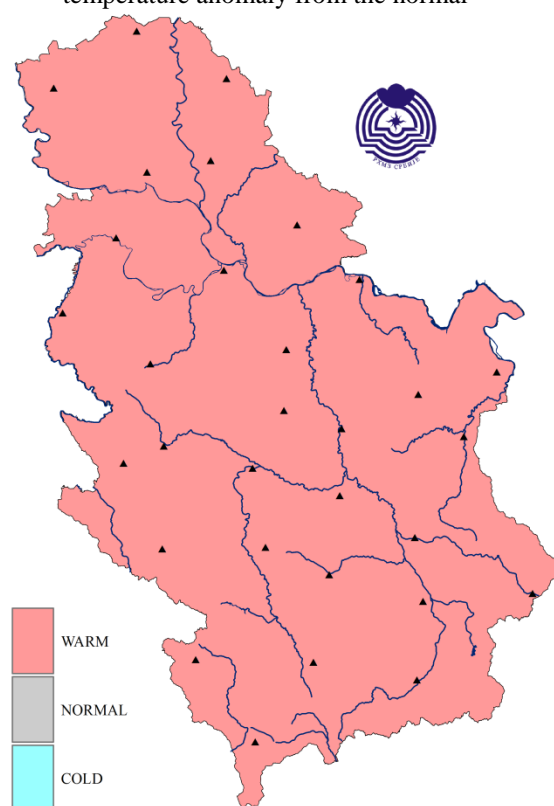


Figure 6. Spatial distribution of mean summer air temperature according to the tercile method

The highest summer daily air temperature of 41,8°C was measured in Cuprija on July 17. On August 14, Sombor observed record-breaking air temperature of 40,6°C thereby **breaking the previous seasonal record** of 40,3°C set on July 20, 2007.

Most of Serbia saw **the highest** minimum seasonal air temperature since the record-keeping began (*Table 1*). The lowest summer air temperature of 4,0°C was measured in Sjenica on July 31, whereas in the lowland, Dimitrovgrad recorded 7,3°C on June 15. **Record high minimum daily air temperature** since the record-keeping began was measured in Vrsac on July 13 amounting to 30,6°C.

Table 1. Record-breaking minimum summer air temperatures

MMS station	2024		Previous record Tmin	Date of the previous record Tmin
	Tmin summer	Date Tmin		
PALIC	11.4	15.VI	11.3	11,18.VII 2022.
SOMBOR	10.8	15.VI	10.4	29.VIII/12,27.VIII/15.VI;18.VII 1946/2003/2022.
NOVI SAD	12.3	14. i 15.VI	11.7	12.VIII 2003.
ZRENJANIN	11.4	14.VI	10.8	2.VIII 2007.
KIKINDA	11.9	15.VI	11.5	1.VI 2007.
B.KARLOVAC	11.0	15.VI	10.7	2.VIII 2007.
VALJEVO	11.6	15.VI	izj.	2.VI/16.VI;12.VII 2019/2022.
KRAGUJEVAC	10.6	15.VI	10.5	3.VI 2002.
S.PALANKA	10.0	15.VI	9.6	12.VIII/16.VIII 2003/2019.
CRNI VRH	8.6	14.VI	8.0	12.VIII 2016.
ZLATIBOR	8.8	14.VI	8.1	12.VII 2022.
POZEGA	9.0	31.VII	izj.	6.VI/13.VIII 2004/2023.
KRALJEVO	10.9	15.VI	10.7	22.VI;15.VII 2003.
KOPAONIK	5.4	4.VII	3.4	12.VII 2007.
KURSUMLIJA	9.2	15.VI	8.6	15.VII 2003.
NIS	10.9	15.VI	10.5	19,20.VIII 1931.

The absolute maximum of the number of summer days³ was either **surpassed or equaled** at the majority of the stations, while the absolute number of tropical days⁴ was either **surpassed or equaled** at nearly all stations (*Table 2*).

Number of summer days ranged from 85 in Sremska Mitrovica and Pozega to 92 days in Zajecar, and on the mountains, from 16 at Kopaonik to 67 in Sjenica. Belgrade recorded 87 summer days, which is 14 days above the average. Deviation of the number of summer days was above the average, from 10 days in Negotin to 20 days in Kursumlija. As for the upland, number of summer days was above the average, from 14 days at Kopaonik to 37 days at Crni Vrh (*Figure 7*).

Number of tropical days ranged from 58 days in Pozega to 78 days in Zajecar, and on the mountains, from none at Kopaonik to 25 in Sjenica. Belgrade observed 67 tropical days, which is 29 days above the summer average. The observed number of tropical days was significantly above the average, from 27 days in Nis to 43 days in Novi Sad (*Figure 8*).

³ Summer day is defined as the day with the maximum daily air temperature of 25°C and above

⁴ Tropical day is defined as the day with the maximum daily air temperature of 30°C and above

Table 2. Record-breaking number of summer and tropical days during summer 2024

MMS station	Number of summer days summer 2024	Record summer days	Year of the record summer days	Number of tropical days summer 2024	Record Tropical days	Year of the record Tropical days
PALIĆ	-	-	-	65	54	2012
SOMBOR	-	-	-	73	61	2012
NOVI SAD	87	equaled	2003	77	60	2012
ZRENJANIN	-	-	-	73	63	2022
KIKINDA	88	equaled	2022	69	58	2022
B.KARLOVAC	-	-	-	68	61	2022
LOZNICA	87	86	2003/2012	68	62	2012
S.MITROVICA	-	-	-	66	63	1927
VALJEVO	88	84	2003/2012	65	60	2012
BEOGRAD	-	-	-	67	62	2012
KRAGUJEVAC	90	87	2012	68	62	1927
S.PALANKA	89	88	2012	71	61	2012
V.GRAĐIŠTE	90	equaled	2022	75	67	2022
CRNI VRH	59	44	2000/2012	17	14	2000
NEGOTIN	-	-	-	76	izj.	1928
SJENICA	67	64	2012	-	-	-
POŽEGA	85	84	2003/2012	58	56	2012
KRALJEVO	88	87	2012	67	63	2012
KOPAONIK	16	14	2007	-	-	-
KURŠUMLIJA	-	-	-	70	65	2012
KRUŠEVAC	90	equaled	2012	74	65	2012
ČUPRIJA	91	90	2012	77	65	2012
NIŠ	-	-	-	74	72	2012
LESKOVAC	-	-	-	77	73	2012
ZAJEČAR	92	91	2012	78	68	2012
DIMITROVGRAD	89	88	2012	72	61	1946/2012
VRANJE	90	equaled	2012	72	65	2012

The highest number of tropical nights⁵, total of 60, was measured in Belgrade, which is 36 above the average; in the upland, Crni Vrh recorded 16 tropical nights, which is 13 above the summer average. **The maximum number of tropical nights was exceeded** at most stations (Table 3). The recorded number of tropical nights was from 19 to 34 days above the average, elsewhere it was 17 days above the average (Figure 9).

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⁵ Tropical night is defined as the day with the minimum daily air temperature of 20°C and above

Table 3. Record-breaking number of tropical nights during summer 2024

MMS station	Number of tropical nights summer 2024	Previous record	Year of the previous record
PALIĆ	36	20	2023
SOMBOR	26	12	2023
NOVI SAD	36	18	2021
ZRENJANIN	28	24	2017
KIKINDA	27	18	2015
B.KARLOVAC	31	14	2021
LOZNICA	39	17	2021/2023
S.MITROVICA	21	12	1946
VALJEVO	30	18	2021
BEOGRAD	60	51	2012
KRAGUJEVAC	16	11	2010
S.PALANKA	15	9	1988
V.GRAĐIŠTE	15	13	1946
CRNI VRH	16	13	2007/2012
ZLATIBOR	7	5	2007/2021
KRALJEVO	17	7	2007/2021
KURŠUMLIJA	2	1	-
KRUŠEVAC	9	6	1946/2007/2012
ČUPRIJA	13	8	2017/2021
NIŠ	23	17	2012

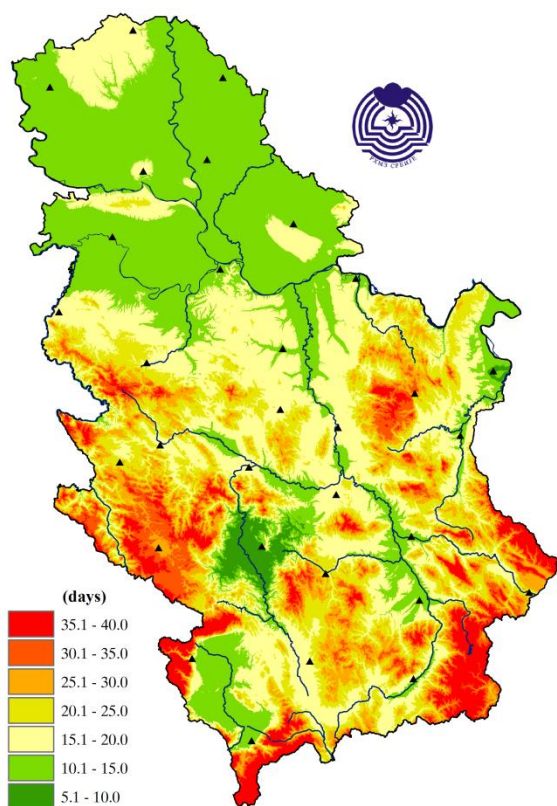


Figure 7. Deviation of the number of summer days from the normal

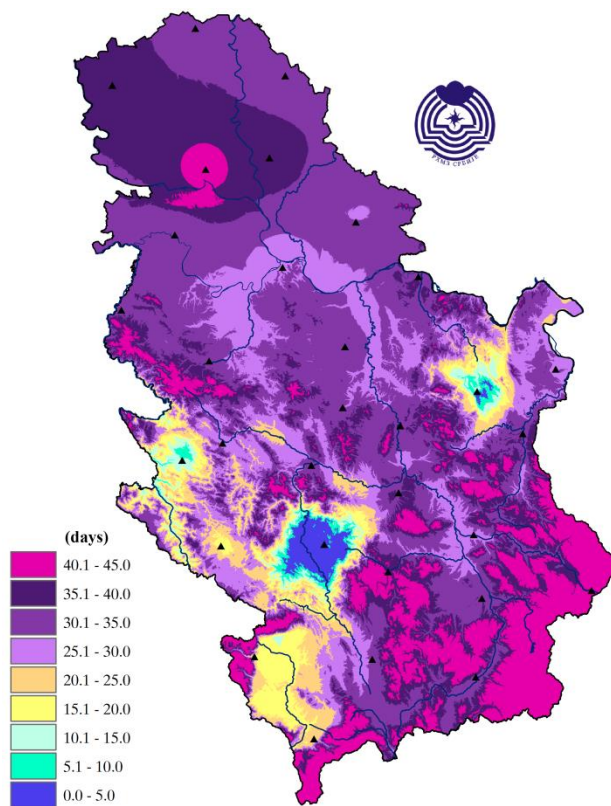


Figure 8. Deviation of the number of tropical days from the normal

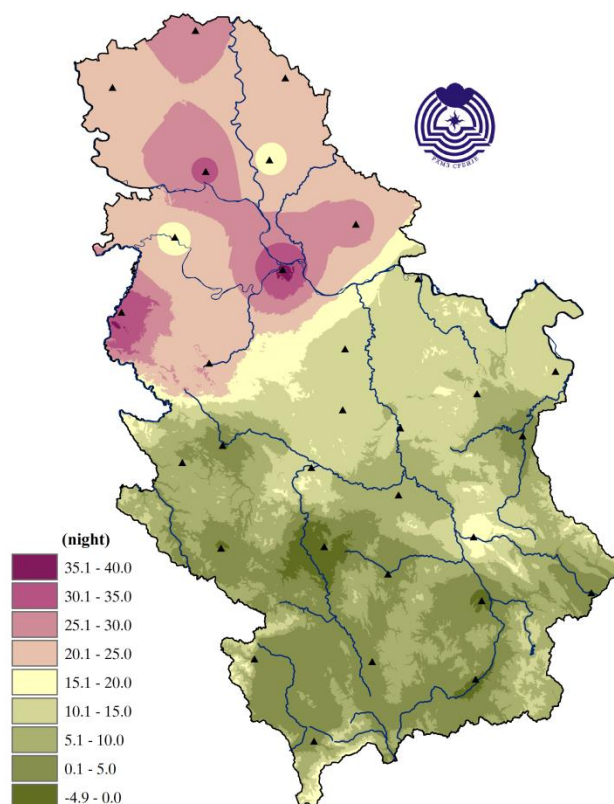


Figure 9. Deviation of the number of tropical nights from the normal

In Belgrade, mean, maximum and minimum air temperature were above the multiannual average most of the summer, and below the average in the middle of June, beginning and end of July and beginning of August (*Figure 10*).

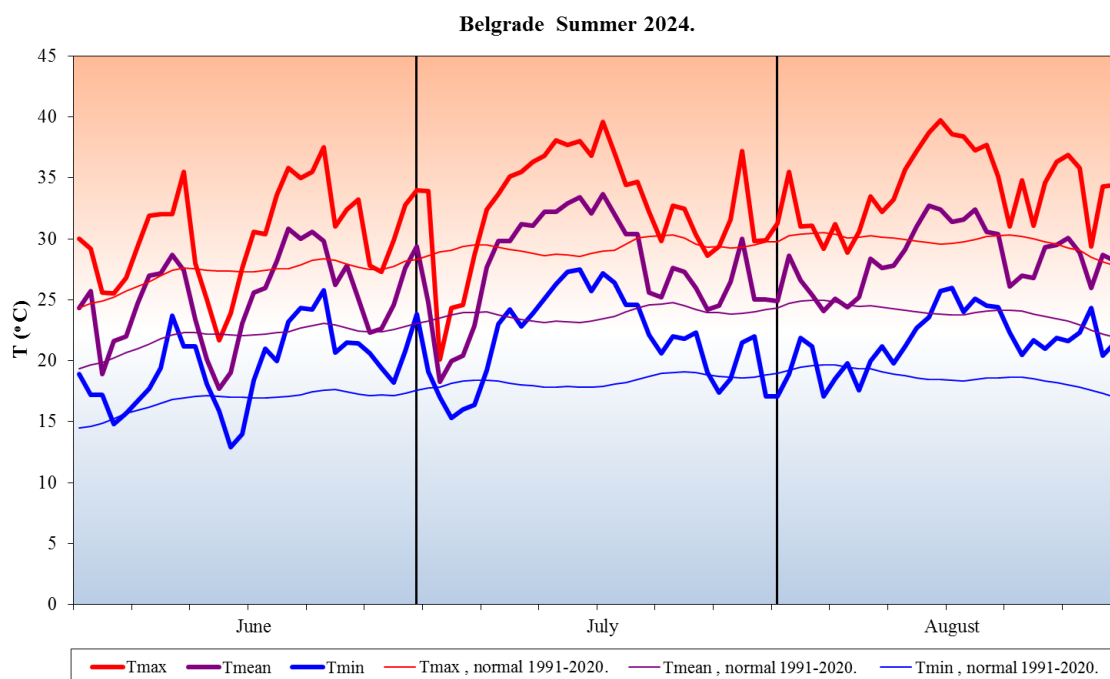


Figure 10. Three – month course of mean, maximum and minimum daily air temperature in Belgrade

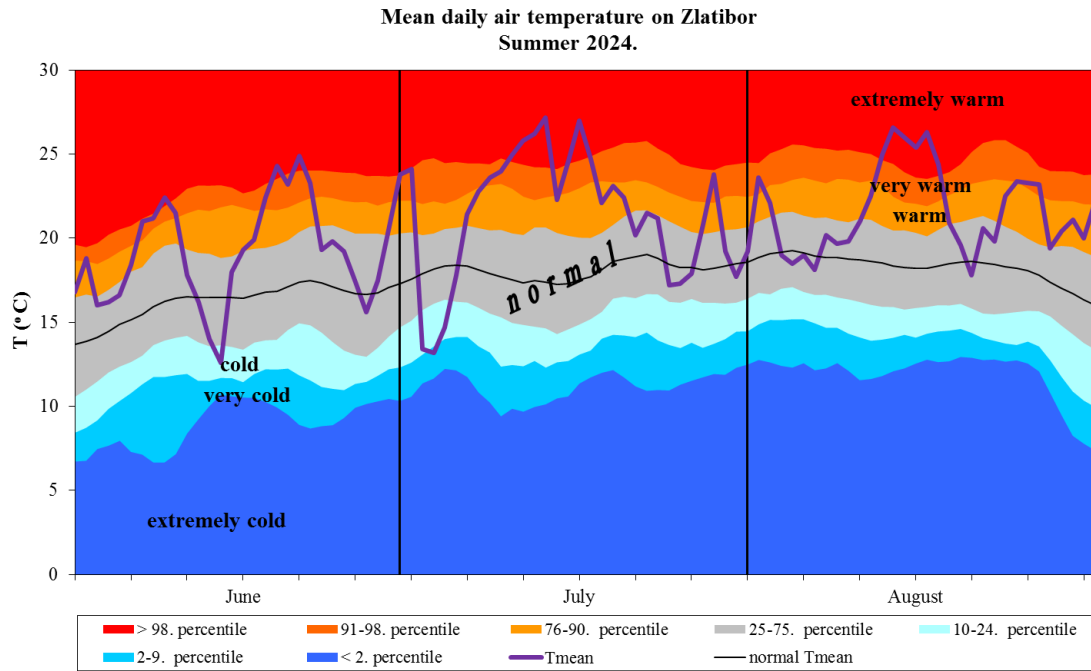


Figure 11. Three – month course of mean daily air temperature at Zlatibor

Figures 12 and 13 show assessment of the mean, maximum and minimum air temperature and precipitation sums for Serbia during summer based on the tercile distribution compared to the 1991-2020 base period. It can be noted that summer 2024 was **the warmest on record** with the mean minimum and maximum air temperature significantly above the upper tercile. Precipitation sums are below the lower tercile threshold.

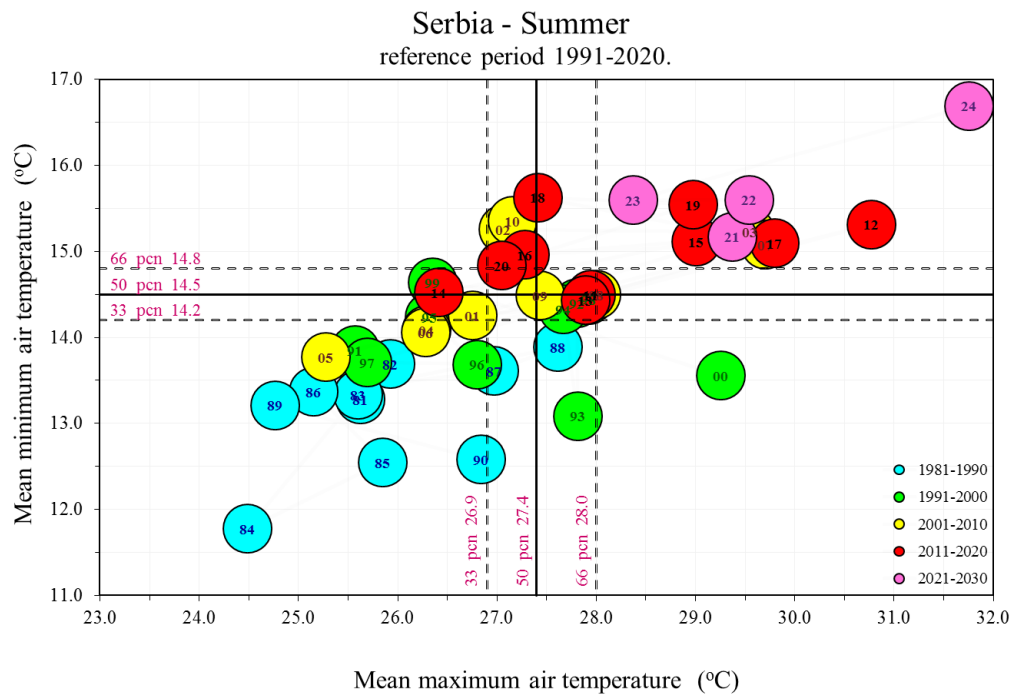


Figure 12. Assessment of maximum and minimum air temperature for summer in Serbia based on the accompanying terciles relative to the 1991-2020 base period

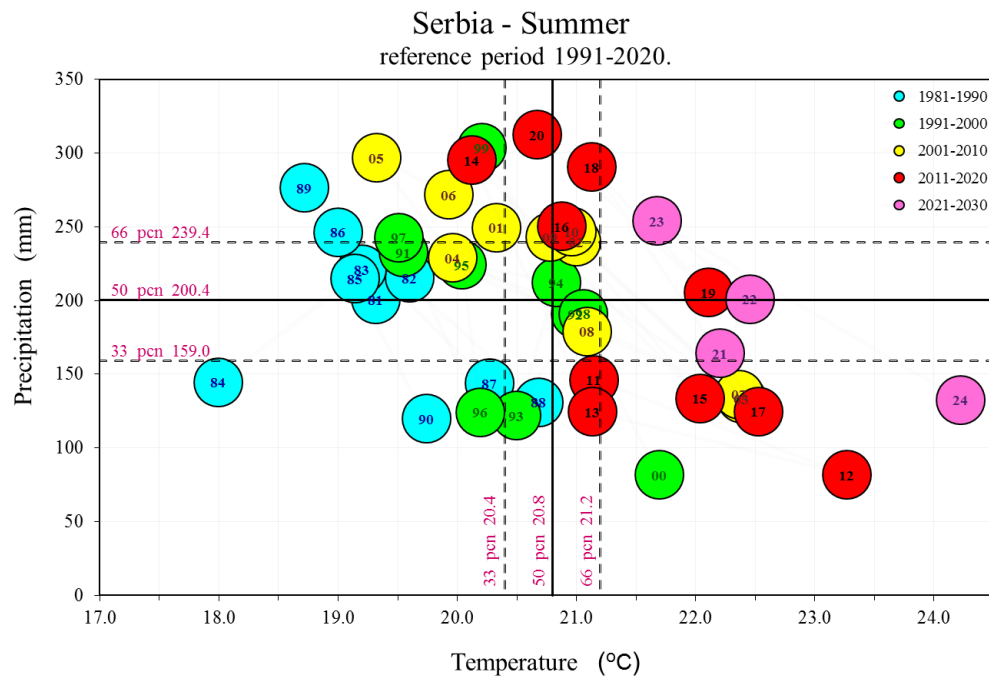


Figure 13. Assessment of precipitation sums and mean air temperature for summer in Serbia based on the accompanying terciles relative to the 1991-2020 base period

Departure of the Temperature Humidity Index (THI) ⁶ was positive most of the summer (*Figure 14*). The highest disparity between the feels like temperature and the maximum daily air temperature was measured on July 17 amounting to **9,1°C** (*Figure 15*). On that day, the maximum air temperature was 37,1°C while the feels like temperature was **46,2°C** which concurrently makes it the maximum THI for the summer. There were 23 days with the THI above 40°C and 83 days with the air temperature above 30°C.

⁶ Temperature Humidity Index (THI) is a measure of the subjective feeling of heat, or a measure of relative discomfort due to prolonged exposure of the human body to extreme heat and humidity. It indicates the likelihood of heat stroke, sunstroke, or other acute symptoms of body stress

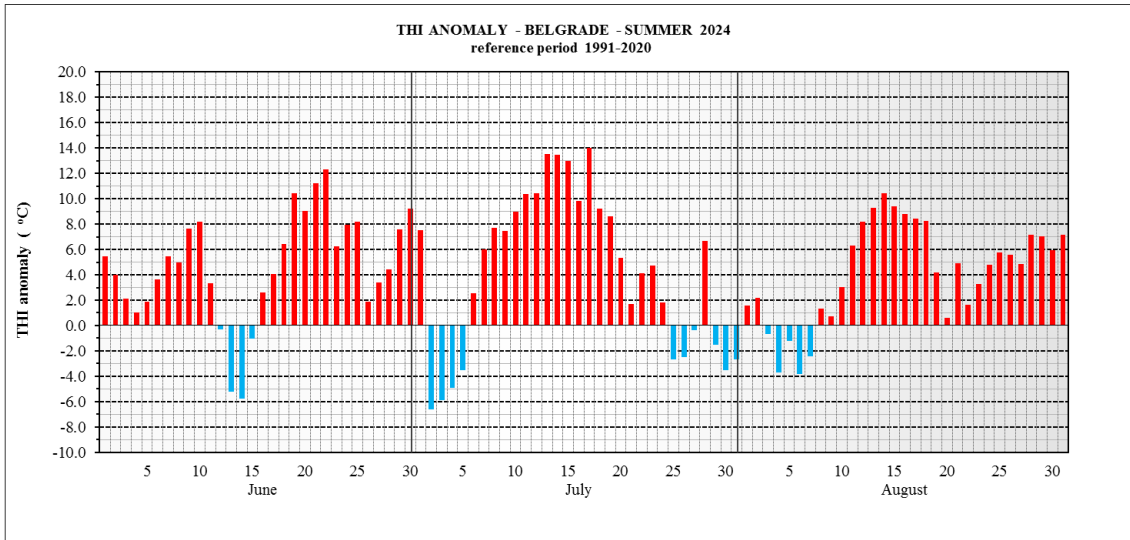


Figure 14.

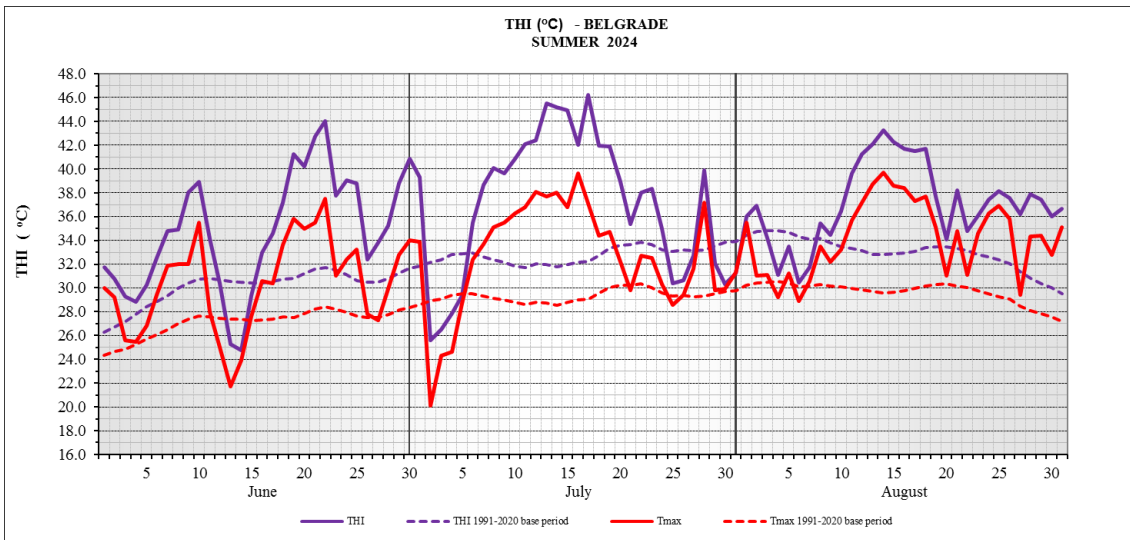


Figure 15.

Heat waves during summer season 2024

Serbia saw 5 heat waves⁷ during summer 2024 (*Table 4*). The first was registered at the end of the first and beginning of the second decade of June in Cuprija, Negotin, Zaječar, Vranje, Dimitrovgrad and Leskovac; the second was observed at the end of the second and beginning of the third decade of June affecting most of Serbia. The third heat wave lasted from 8 to 20 July in most of the country, with the longest duration in Kragujevac, total of 14 days, lasting from 7 to 20 July. The fourth heat wave affected the entire country lasting from 10 to 19 August, and the onset of the fifth heat wave was registered in Sombor on August 23, and in Palic on August 24, in Zrenjanin and Novi Sad on August 28, and in Loznica on August 29, in the remainder of the northern and certain parts of central and eastern Serbia from 31 August. Heat waves that were registered in the middle of July and middle of August were very intense, with the anomaly above 10°C compared to the 1991-2020 base period.

Table 4.

[illegible]

⁷ Heat wave is, according to the percentile method, is a period during which maximum daily air temperature is in the warm and very warm categories for 5 consecutive days or longer

Precipitation

Summer precipitation totals ranged from 70,3 mm in Negotin to 205,2 mm in Belgrade (Figure 16). Precipitation sums compared to the normal ranged from 40% in Novi Sad to 102% in Vranje (Figure 17).

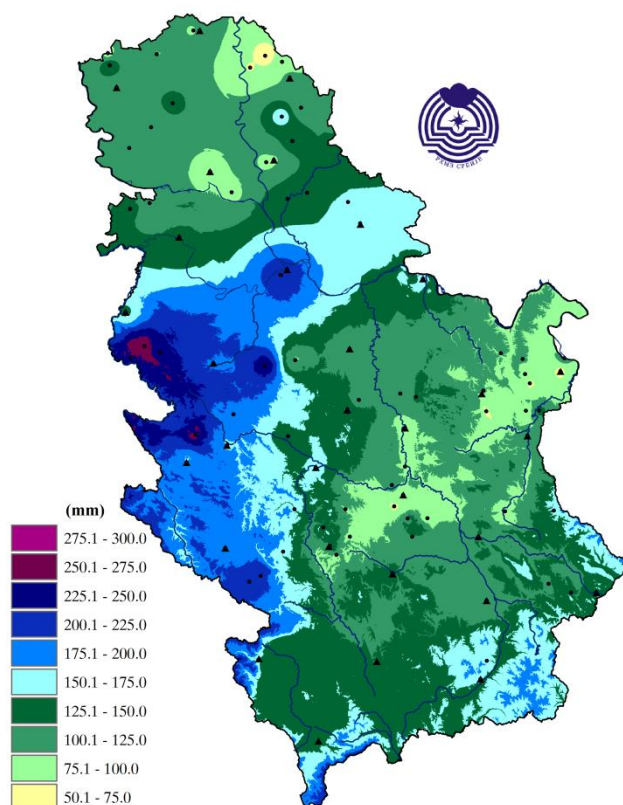


Figure 16. Spatial distribution of summer precipitation sums based on data from 28 principal, 13 climatological and 47 rain gauge stations

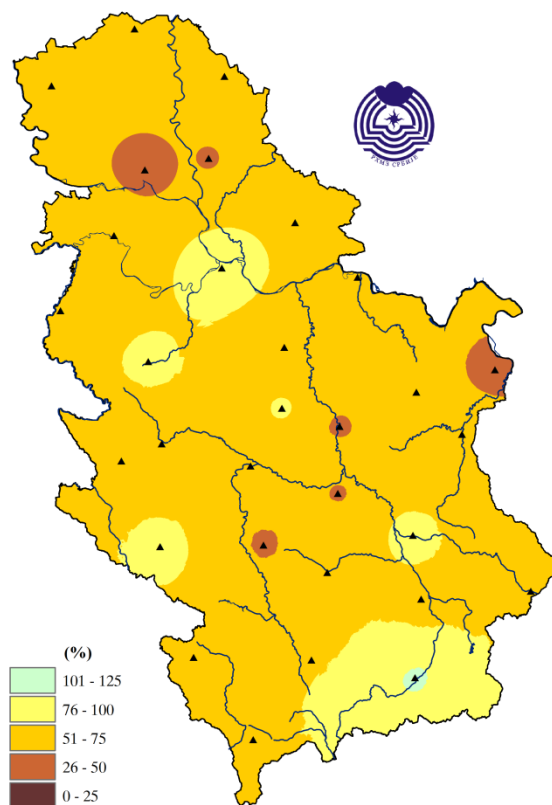


Figure 17. Spatial distribution of summer precipitation sums in percentage of normal

Based on the percentile method, summer precipitation sums were in the following categories: normal and dry in most of Serbia, very dry in Sombor, Novi Sad, Zrenjanin, Smederevska Palanka, Krusevac, Cuprija and Kopaonik (Figure 18).

Precipitation sums based on the tercile method were in the normal category in Banatski Karlovac, Valjevo, Belgrade, Kraljevo, Nis and Vranje, elsewhere in the dry category (Figure 19).

The maximum daily precipitation sum of 82,5 mm was recorded in Belgrade on June 28. Precipitation sum of 78,8 mm was measured in Sremska Mitrovica on July 2.

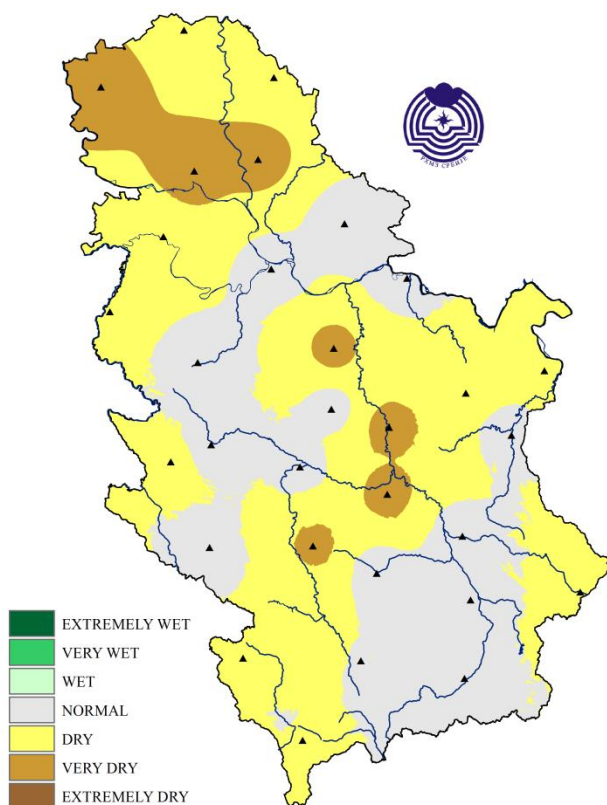


Figure 18. Summer precipitation sums according to the percentile method

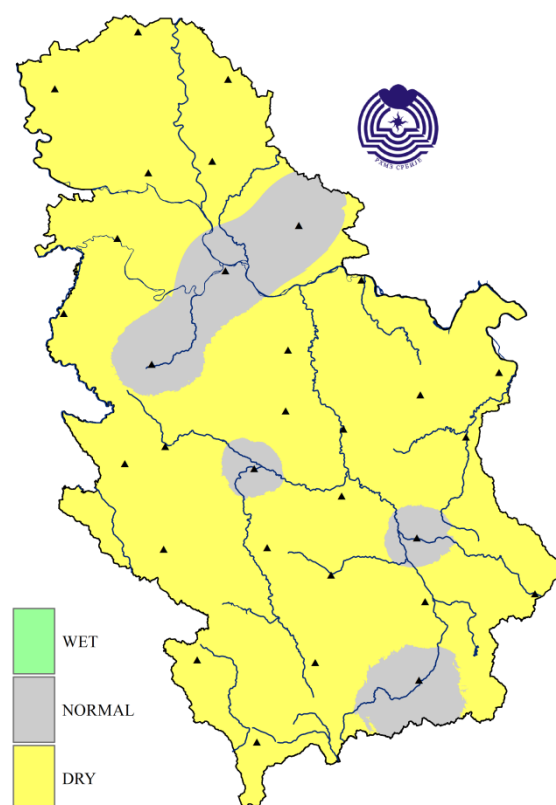


Figure 19. Summer precipitation sums according to the tercile method

This summer was the **4th driest** for Novi Sad and Kopaonik (*Figures 20 and 21*). Summer 2024 was 5th driest and 6th driest for Crni Vrh.

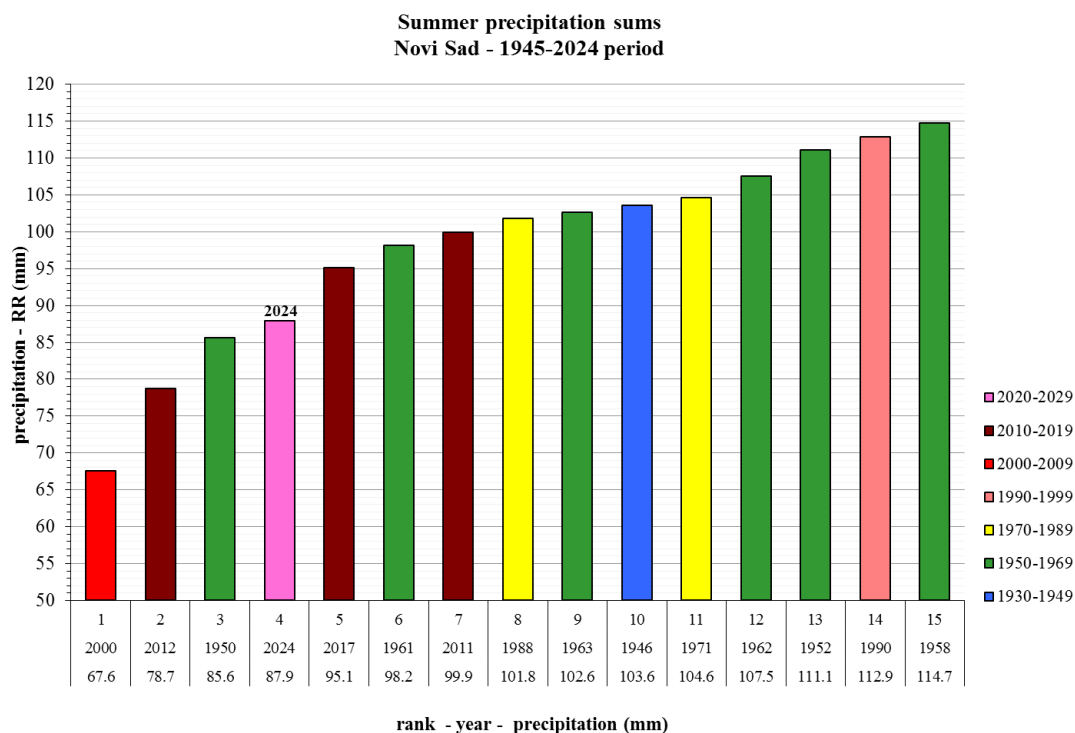


Figure 20. Rank of the wettest summers in Novi Sad

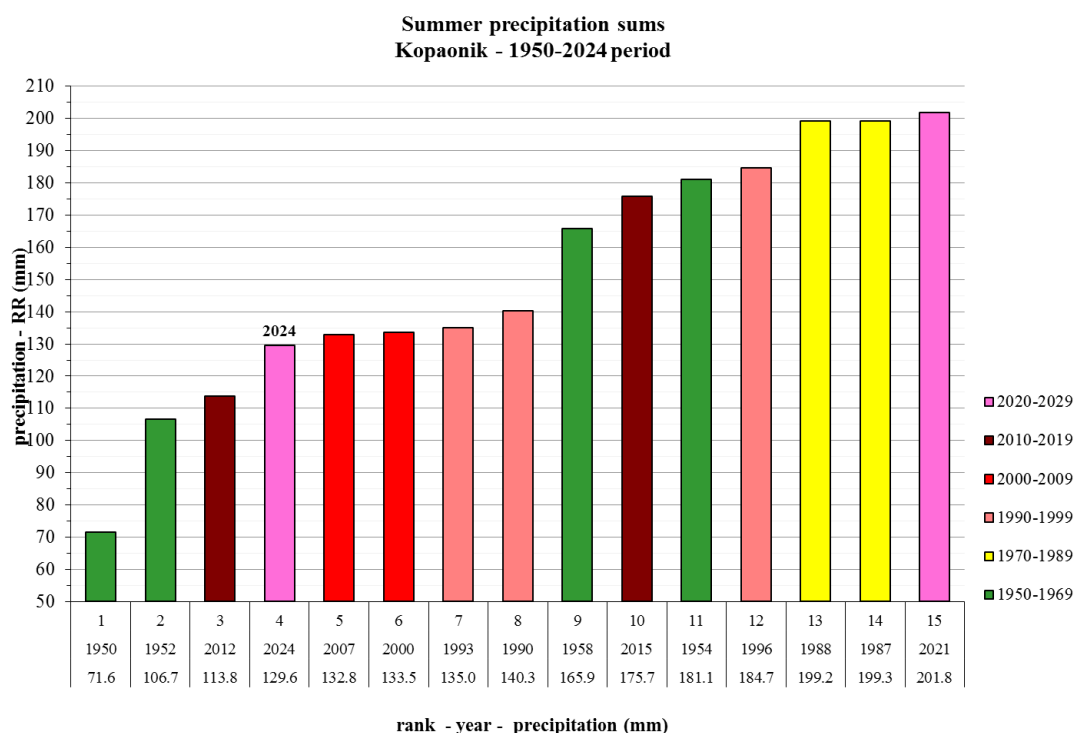


Figure 21. Rank of the wettest summers on Kopaonik

Number of days with precipitation during summer ranged from 15 days in Negotin to 32 days in Sjenica. The recorded number of days with precipitation was 5 to 13 days below the average in most of Serbia (*Figure 22*).

Entire Serbia, apart from Smederevska Palanka, Cuprija and Leskovac, saw days with daily precipitation sum above 20 mm. The highest number of days with precipitation above 20 mm, total of 4, was recorded in Banatski Karlovac. The recorded number of days was around the summer average, whereas Zlatibor, Kopaonik and Smederevska Palanka recorded 3 days with precipitation above 20 mm which is below the summer average (*Figure 23*).

One day with precipitation sum of 50 mm was observed in Belgrade and Sremska Mitrovica.

In summer, number of thunder days ranged from 9 in Negotin (10 days below the average) to 27 days in Sjenica. The departure of the number of thunder days was around the average in the west and northwest, elsewhere it was below the average, ranging from 2 in central Serbia to 10 in the east and northeast of Serbia (*Figure 24*).

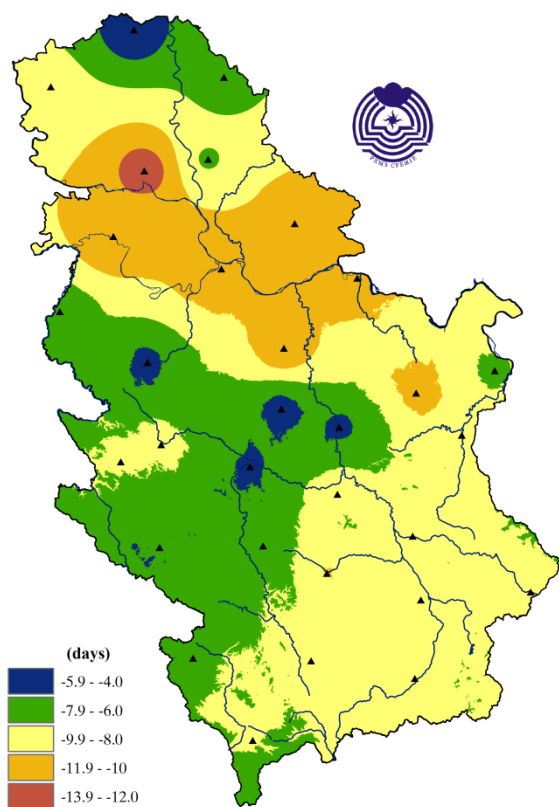


Figure 22. Deviation of number of days with precipitation of 0.1 mm and more from the normal

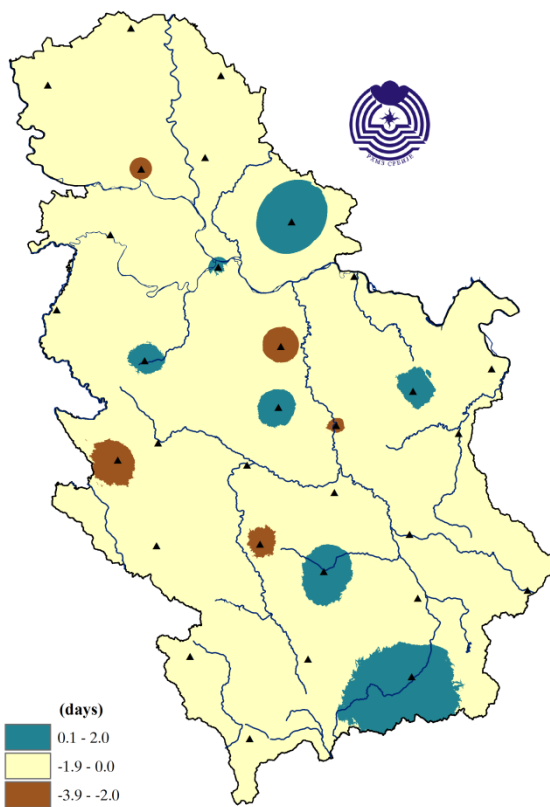


Figure 23. Deviation of number of days with precipitation of 20 mm and more from the normal

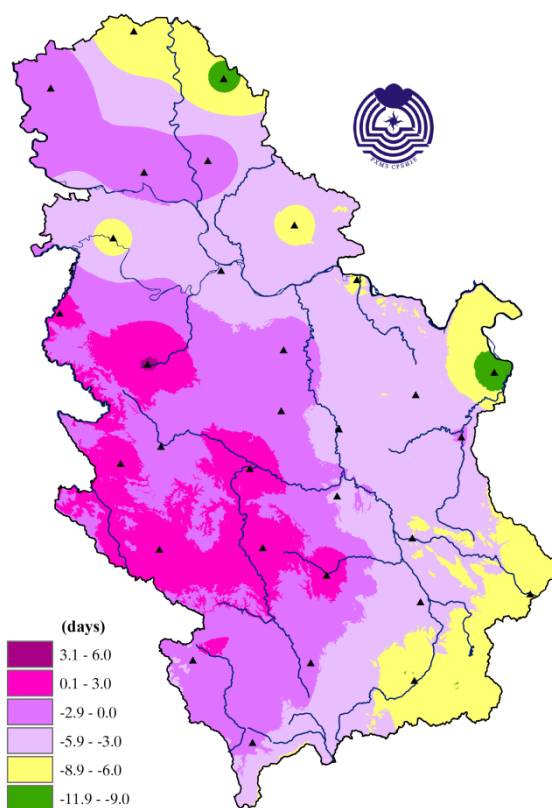


Figure 24. Deviation of number of days with thunder from the normal

Figures 25 and 26 show cumulative precipitation sums for Sremska Mitrovica and Negotin during summer per months compared to the average cumulative precipitation sums.

Cumulative precipitation sums in Sremska Mitrovica

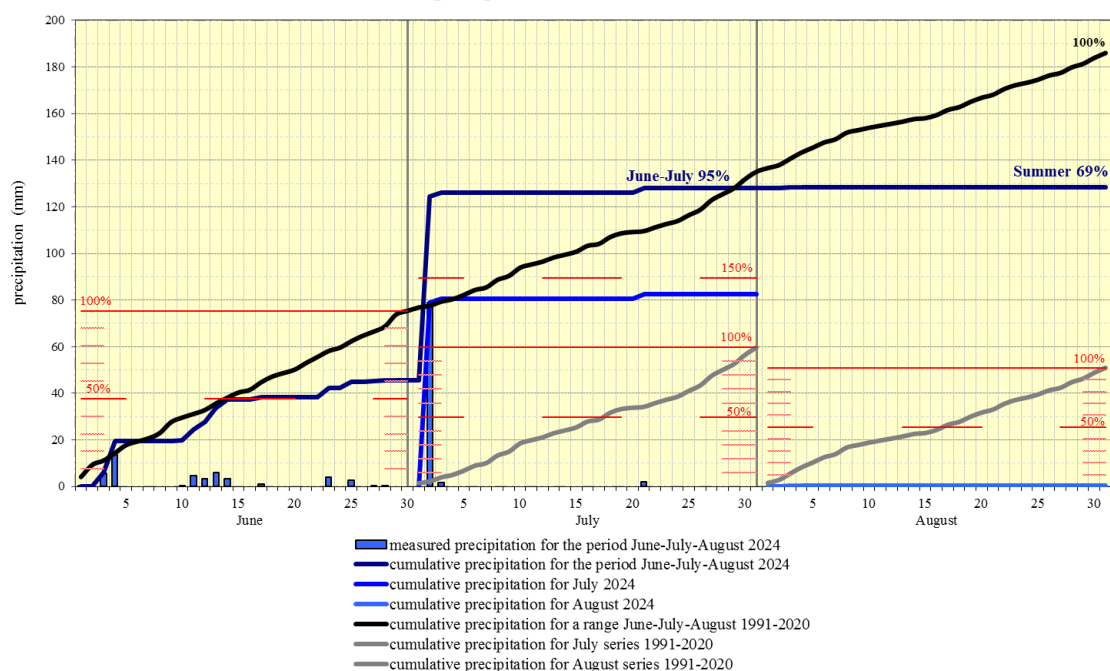


Figure 25. Cumulative precipitation sums for Sremska Mitrovica

Cumulative precipitation sums in Negotin

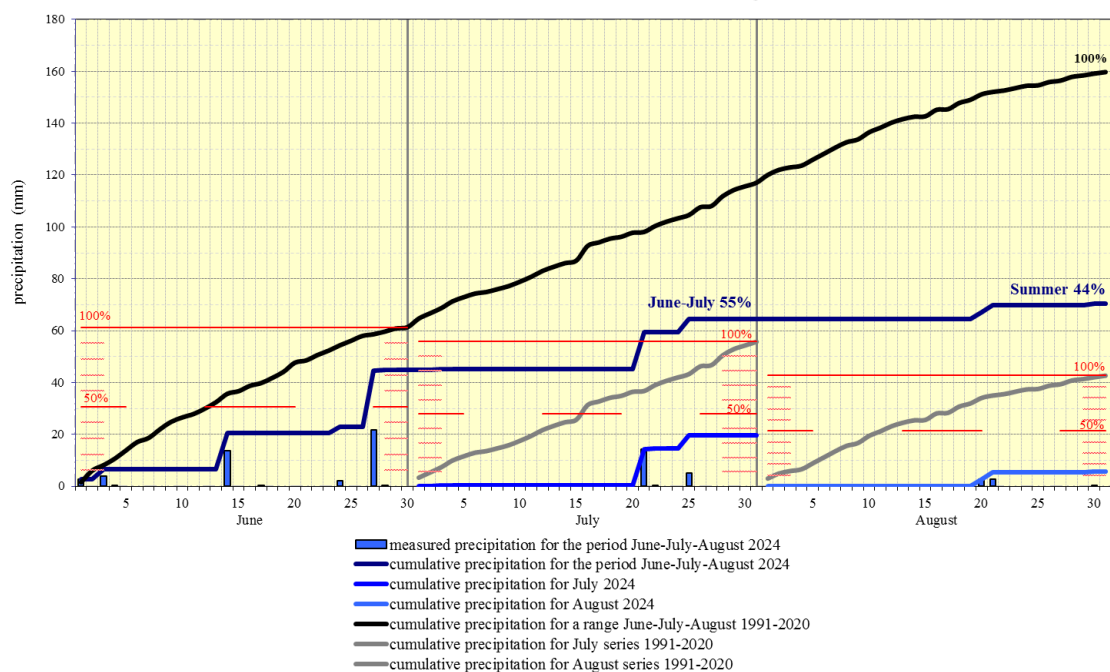


Figure 26. Cumulative precipitation sums for Negotin

Sunshine duration (insolation)

In summer, sunshine duration ranged from 836,4 hours in Sjenica to 1047,7 hours in Negotin (*Figure 27*).

Compared to the normal for the 1991-2020 base period, insolation ranged from 107% on Palic, Smederevska Palanka, Zajecar and Sombor to 130% in Pozega (*Figure 28*).

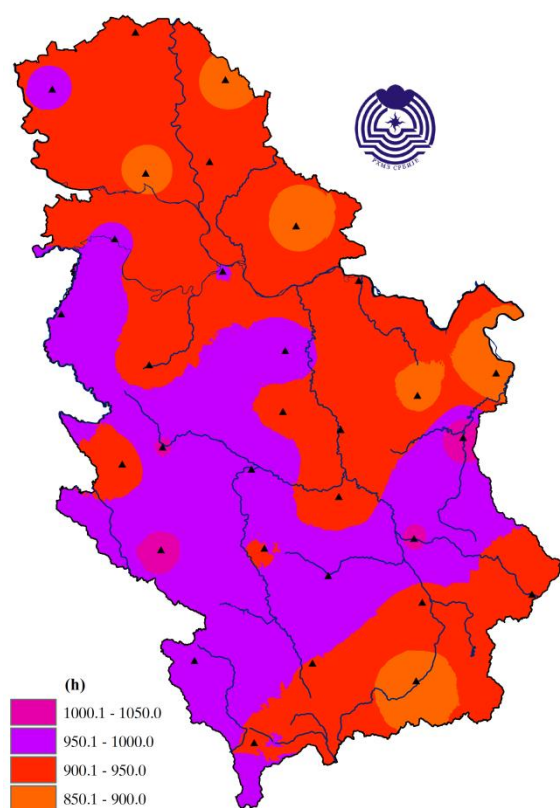


Figure 27. Insolation in hours

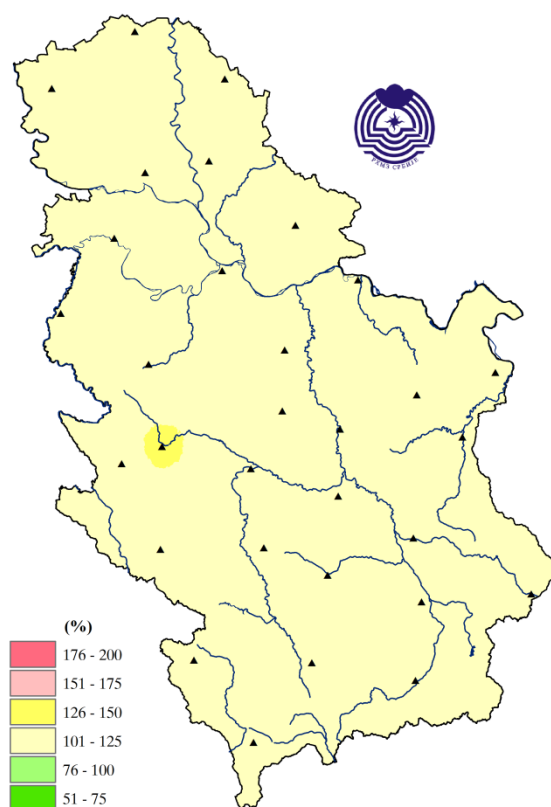


Figure 28. Insolation in percentage of normal

Analysis of the summer season 2024 for Serbia relative to the 1961-1990 base period

Air temperature

During summer, departure of the mean air temperature from the normal for the 1961-1990 base period ranged from +3,7°C in Pozega to +6,1°C in Belgrade, and on the mountains from +4,3°C in Sjenica to +5,7°C at Crni Vrh (*Figure 29*).

Based on the percentile method, mean summer air temperature was in the extremely warm category (*Figure 30*).

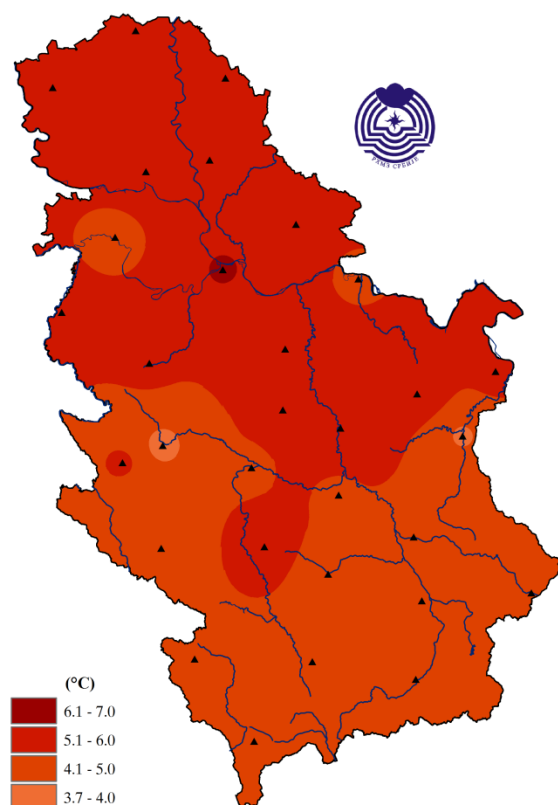


Figure 29. Spatial distribution of mean summer air temperature anomaly from the 1961-1990 normal

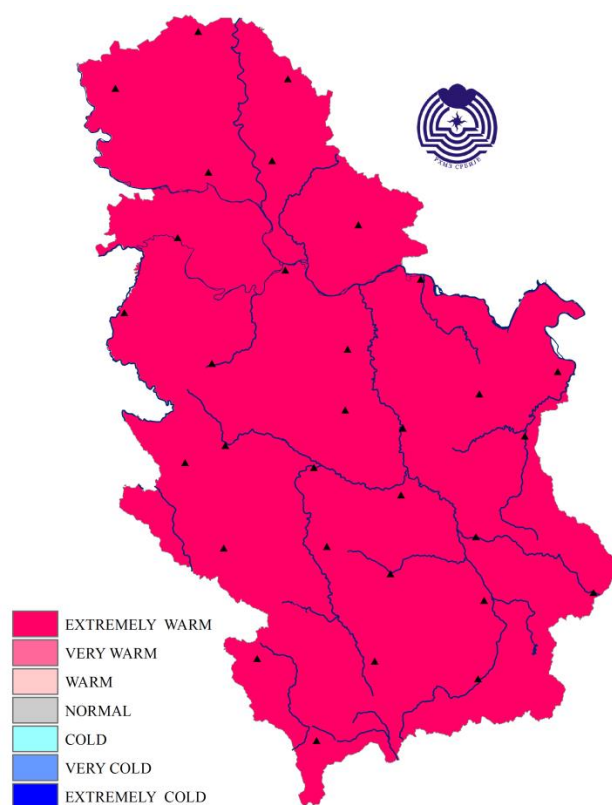


Figure 30. Spatial distribution of mean summer air temperature according to the percentile method

Precipitation

Summer precipitation sums compared to the normal for the 1961-1990 base period ranged from 41% at Crni Vrh and Kopaonik to 99% in Belgrade (*Figure 31*).

Based on the percentile method, summer precipitation totals were in the following categories: dry and very dry in most of Serbia, extremely dry in Novi Sad, Cuprija and Kopaonik, and normal category in Belgrade, Veliko Gradiste, Sjenica, Pozega, Kursumlija, Nis and Vranje (*Figure 32*).

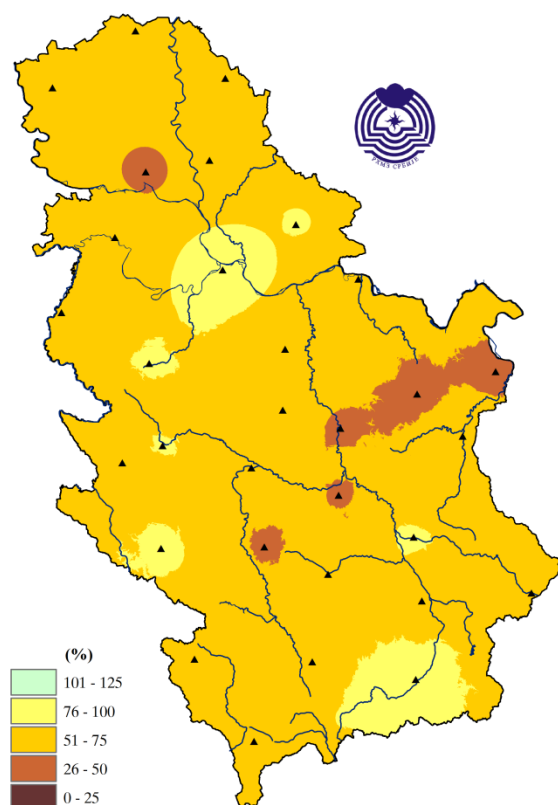


Figure 31. Spatial distribution of spring precipitation sums in percentage of the 1961-1990 normal

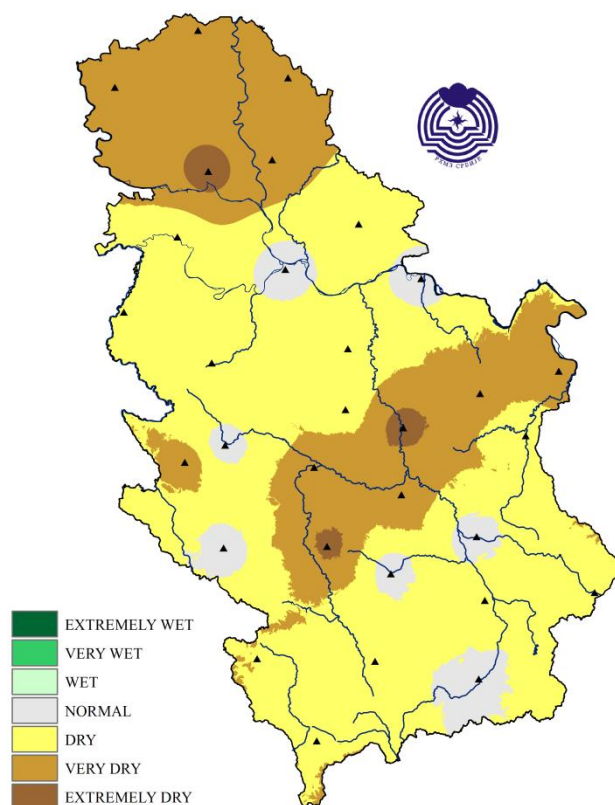


Figure 32. Summer precipitation sums according to the percentile method

Note: Climatological analysis of the meteorological elements based on the preliminary data obtained from the 28 principal meteorological stations