

Republic Hydrometeorological Service of Serbia

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MONTHLY BULLETIN FOR SERBIA

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Division for Climate Monitoring and Climate Forecast
Department of National Center for Climate Change, Climate Model Development and Disaster
Risk Assessment

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- ❖ *5th warmest July for Serbia with precipitation within the average*
- ❖ *Exceeded number of tropical days on Palic, Banatski Karlovac and Cuprija*
- ❖ *Heat wave on Palic, Kopaonik, Sremska Mitrovica and Dimitrovgrad*
- ❖ *Exceeded or equaled maximum air temperature on July 12, 13, 16 and 17 July at most main meteorological stations*
- ❖ *8th driest July in Dimitrovgrad*
- ❖ *Exceptionally strong wind gusts, particularly in the middle of the month*

AIR TEMPERATURE

Mean monthly air temperature

July 2023 ranks as **the 5th warmest** for Serbia in the period from 1951 to 2023 (*Figure 1*). July 2023 ranks as **the 2nd warmest** for Sjenica, Kursumlija and Kopaonik since the record-keeping began, only after July 2012. It was 3rd warmest for Palic and Pozega (*Table 1*).

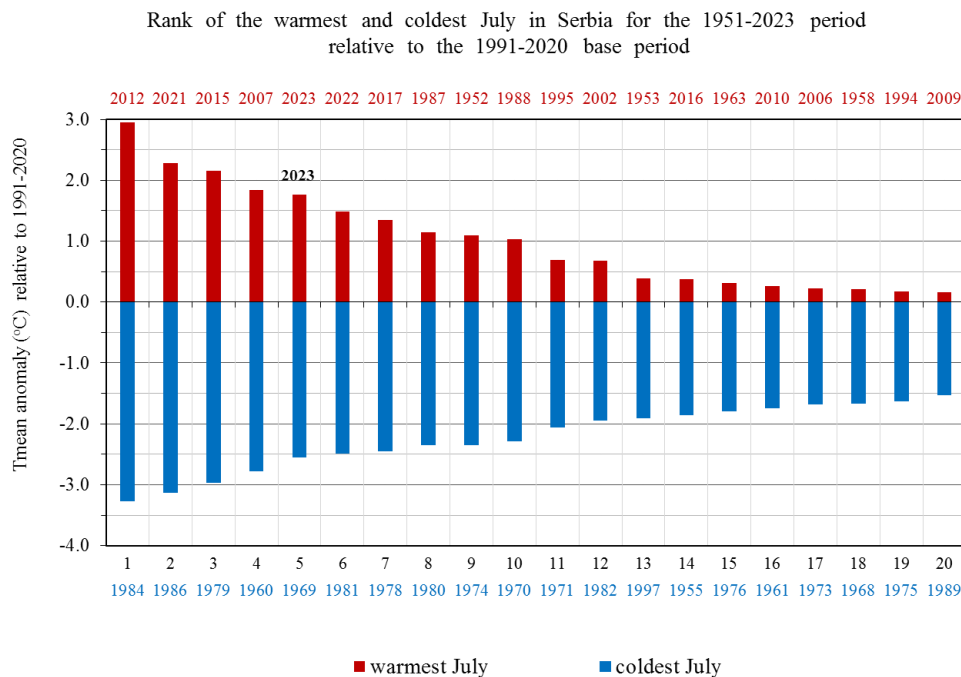


Figure 1. Rank of the warmest and coldest July in Serbia

Table 1. Ranking of July 2023 with mean air temperature, average and departure from the normal 1991-2020

STATION	historical period	Tmean (°C) July 2023	1991-2020 base period for July	temperature anomaly (°C)	ranking for July 2023
SJENICA	1946-2022	19.5	17.0	2.5	2
KOPAONIK	1950-2022	16.0	13.2	2.8	2
KURSUMLIJA	1952-2022	22.9	20.7	2.2	2
PALIC	1945-2022	24.9	22.9	2.1	3
POZEGA	1952-2022	22.1	20.5	1.7	3
KIKINDA	1948-2022	24.9	22.8	2.1	4
LOZNICA	1952-2022	24.4	22.5	1.9	4
B.KARLOVAC	1986-2022	24.2	22.4	1.7	5
BELGRADE	1888-2022	26.0	23.8	2.1	5
C.VRH	1967-2022	19.7	17.5	2.3	5
ZLATIBOR	1950-2022	20.3	18.1	2.2	5
DIMITROVGRAD	1945-2022	22.9	20.7	2.2	5
SOMBOR	1942-2022	24.1	22.5	1.6	6
NOVI SAD	1948-2022	24.7	22.5	2.2	6
CUPRIJA	1948-2022	24.4	22.3	2.1	6
LESKOVAC	1948-2022	23.8	22.3	1.5	6

Mean air temperature in July ranged from 22,1°C in Pozega and Kursumlija to 26,0°C in Belgrade, and on the mountains from 16,0°C at Kopaonik to 20,3°C at Zlatibor (*Figure 2*).

Departure of the mean monthly air temperature from the normal¹ for the 1991-2020 base period ranged from +0,8°C in Zajecar to +2,8°C at Kopaonik (*Figure 3*).

Mean July air temperature, based on the percentile method² was in the categories of warm and very warm in most of the country and extremely warm on Palic and Sjenica (*Figure 4*).

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 *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

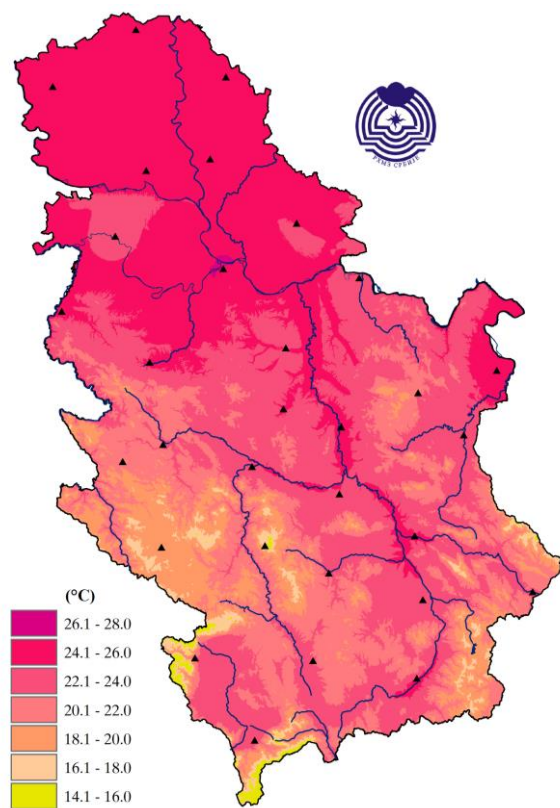


Figure 2. Spatial distribution of mean monthly air temperature (°C)

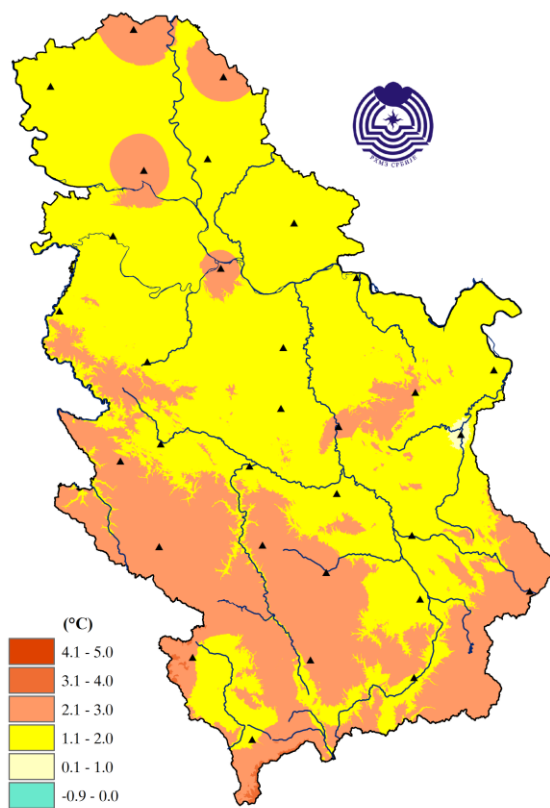


Figure 3. Spatial distribution of mean monthly air temperature anomaly (°C)

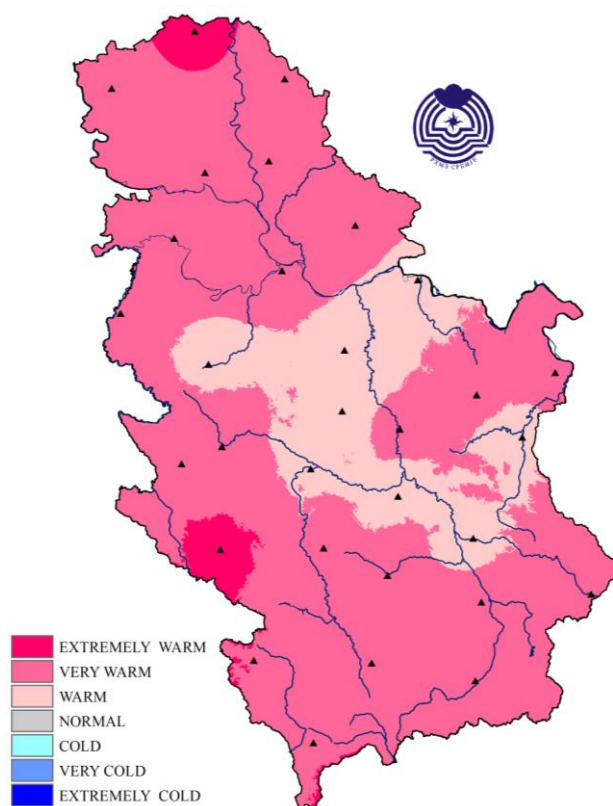


Figure 4. Spatial distribution of the mean monthly air temperature using percentile method

Mean daily air temperature in Belgrade, based on the percentile method, was in the categories spanning from warm to extremely warm in mid-July. In the middle of the first and beginning of third decade, it was in the warm category and in the middle of the third decade of the month it was in the cold category (*Figure 5*). Daily course of the mean daily air temperature and the accompanying percentiles for the stations Sombor, Novi Sad, Loznica, Negotin, Kragujevac, Zlatibor, Nis and Vranje are given in the [Appendix](#).

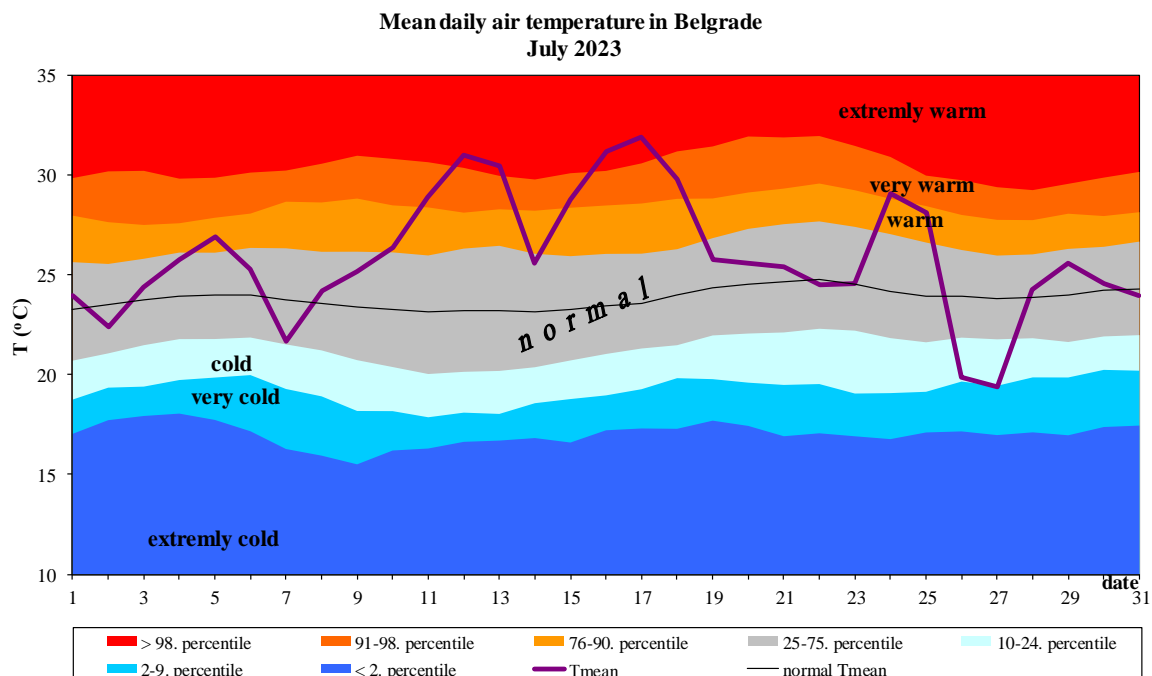


Figure 5. Daily course of the mean daily air temperature and accompanying percentiles for Belgrade

Maximum air temperature

Mean maximum air temperature in July ranged from 30,2°C in Pozega to 32,6°C in Leskovac, whilst Belgrade observed air temperature of 31,8°C. On the mountains, the mean maximum July air temperature ranged from 21,0°C at Kopaonik to 27,2°C in Sjenica.

Based on the percentile method, mean maximum monthly air temperature was in the categories of warm and very warm.

The highest maximum daily air temperature of 39,0°C was measured in Dimitrovgrad on July 25, whilst Belgrade observed 37,4°C on July 17.

Number of summer days in July ranged from 29 to 31 summer days³. Significantly fewer days were recorded on the mountains, only 3 summer days at Kopaonik, 15 days at Crni Vrh, 21 days at Zlatibor, 22 summer days in Sjenica. In most of the country, number of recorded summer days was 4 to 8 days above the July average.

Number of tropical days⁴ ranged from 15 in Pozega to 28 in Negotin. Kopaonik didn't observe any tropical days, Crni Vrh observed 2 days, Zlatibor 8 while Sjenica recorded 10. The

³ Summer day refers to a day with maximum daily air temperature 25°C and above

⁴ Tropical day refers to a day with maximum daily air temperature 30°C and above

recorded number of tropical days was 4 to 9 days above the July average at most places. Palic, Banatski Karlovac and Cuprija saw **record-breaking number of tropical days** for July (Table 2).

Table 2. Record-breaking number of tropical days

MMS station	Number of tropical days July 2023	New record	Year
PALIC	21	20	-
B.KARLOVAC	23	22	2012/2015/2021
CUPRIJA	25	24	2007

Heat wave⁵ was observed in the period from July 15 to 19 on Palic, Kopaonik, Sremska Mitrovica and Dimitrovgrad.

On July 12, 13, 16 and 17, **maximum air temperature** at most meteorological stations was either **exceeded or equaled** as given in the following charts.

station	the previous date Tmax		Tmax 12.7.2023.	
	12.7.2023.	year		
SOMBOR	35.0	1991	35.4	exceeded
NOVI SAD	34.7	1984	35.1	exceeded
ZRENJANIN	35.0	1959	35.3	exceeded
KIKINDA	34.7	1959	34.9	exceeded
LOZNICA	36.2	1984	37.0	exceeded
S.MITROVICA	35.1	2016	36.0	exceeded
S.PALANKA	35.4	2008	36.4	exceeded
V.GRADISTE	35.4	1984	35.4	equaled
CRNI VRH	28.3	1984	28.7	exceeded
SJENICA	31.2	2012	31.2	equaled
KRALJEVO	34.9	2016	35.4	exceeded
KRUSEVAC	35.0	2021	35.8	exceeded
ZAJECAR	36.6	2002	36.7	exceeded

station	the previous date Tmax		Tmax 13.7.2023.	
	13.7.2023.	year		
KRAGUJEVAC	37.0	2021	37.0	equaled
S.PALANKA	37.2	2021	37.6	exceeded
V.GRADISTE	36.4	2021	36.8	exceeded
CRNI VRH	30.7	1984	31.0	exceeded
NEGOTIN	36.0	2021	37.8	exceeded
ZLATIBOR	31.6	1984	32.4	exceeded
SJENICA	32.0	1984	32.1	exceeded
CUPRIJA	38.0	2021	38.2	exceeded
ZAJECAR	35.9	1984	37.2	exceeded
DIMITROVGRAD	35.8	2021	36.2	exceeded
VRANJE	35.6	1984	36.2	exceeded

station	the previous date Tmax		Tmax 16.7.2023.	
	16.7.2023.	year		
SOMBOR	35.4	2001	36.4	exceeded
NOVI SAD	36.2	1958	36.2	equaled
ZRENJANIN	35.6	2001 / 2007	35.9	exceeded
KIKINDA	35.2	1958	36.2	exceeded
S.MITROVICA	36.0	1933	36.4	exceeded
S.PALANKA	36.3	2002	37.3	exceeded
SJENICA	30.6	2007	31.6	exceeded
POZEGA	34.8	2001	35.0	exceeded
CUPRIJA	37.7	2002	38.7	exceeded

station	the previous date Tmax		Tmax 17.7.2023.	
	17.7.2023.	year		
PALIC	35.7	2007	36.0	exceeded
KIKINDA	37.3	2007	37.5	exceeded
CRNI VRH	30.8	2007	30.8	equaled
ZLATIBOR	31.2	2007	31.6	exceeded
KOPAONIK	25.3	2007	26.4	exceeded
DIMITROVGRAD	35.5	2007	35.7	exceeded

⁵ 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

Figure 6 shows daily course of the maximum daily air temperature and the accompanying percentiles for Belgrade in July 2023 and for the stations Sombor, Novi Sad, Loznica, Negotin, Kragujevac, Zlatibor, Nis and Vranje are given in the [Appendix](#).

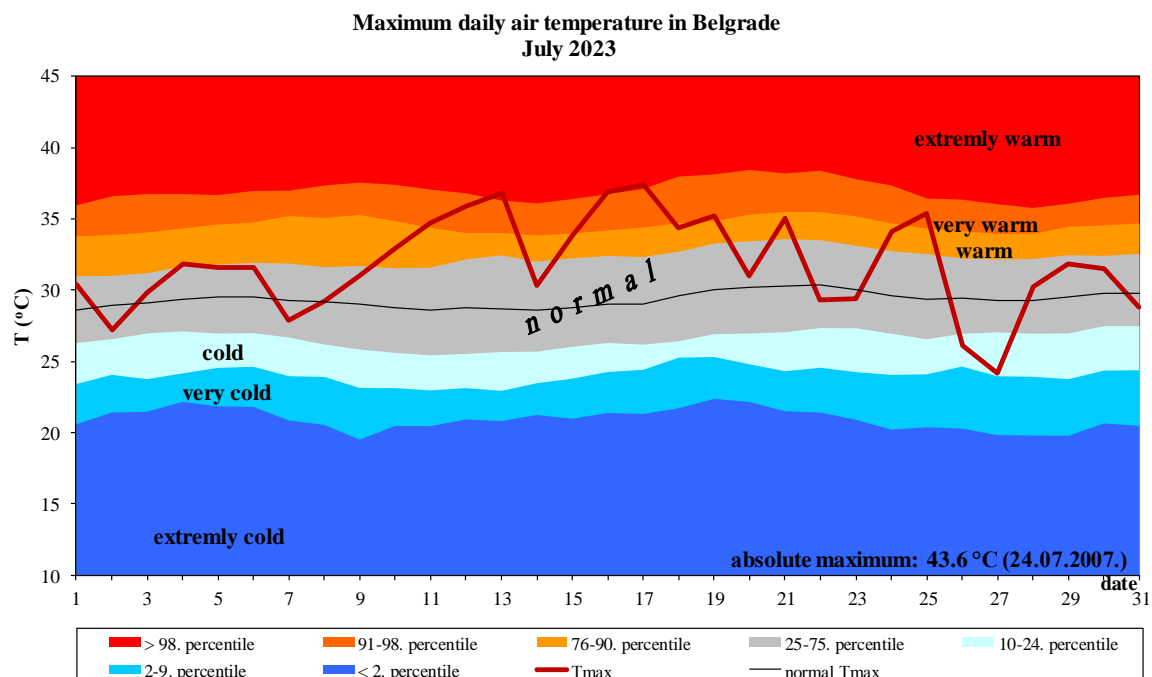


Figure 6. Daily course of the maximum daily air temperature and accompanying percentiles for Belgrade

Minimum air temperature

Mean minimum air temperature in July ranged from 15,2°C in Dimitrovgrad to 20,3°C in Belgrade. On the mountains, mean minimum air temperature ranged from 11,6°C at Kopaonik and Sjenica to 15,6°C at Crni Vrh.

Based on the percentile method, mean minimum monthly air temperature was in the following categories: very warm and extremely warm in most of the country, and very warm in Sombor, Zrenjanin, Kikinda, Veliko Gradiste, Negotin, Leskovac, Zajecar and Vranje.

The lowest minimum daily air temperature of 4,5°C was measured at Kopaonik on July 27. In the lowland, the lowest daily air temperature of 8,0°C was measured in Dimitrovgrad on July 28. On July 27, Belgrade observed the lowest July air temperature of 15,3°C.

Tropical nights⁶ are recorded in most of the country apart from the mountains and southern regions. Most tropical nights were recorded in Belgrade, total of 13, Negotin observed 10, Palic observed 8, elsewhere their number ranged from 2 to 8 tropical nights. At most places, the recorded number of tropical nights was 2 to 5 days above the July average.

Figure 7 shows assessment of the minimum and maximum air temperature in Serbia for July based on the tercile distribution relative to the 1991-2020 base period. It can be noted that the mean minimum and mean maximum air temperature were significantly above the upper tercile boundary.

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

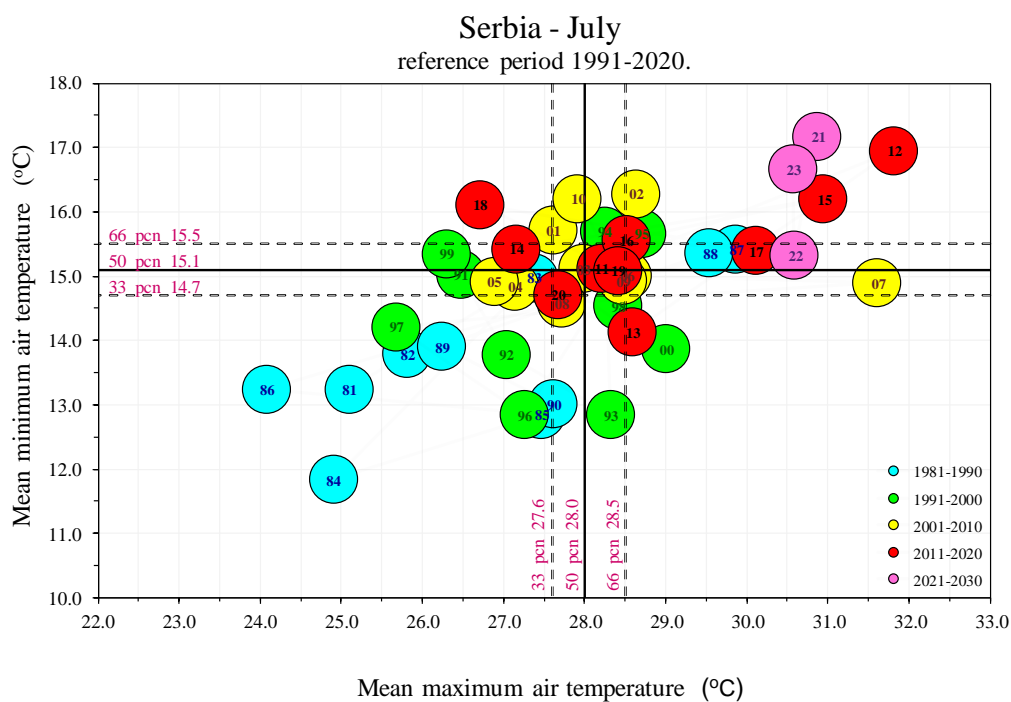


Figure 7. Assessment of minimum and maximum air temperature for Serbia with the accompanying terciles in relation to the 1991-2020 base period

Figure 8 shows daily course of the minimum daily air temperature and the accompanying percentiles for Belgrade in July 2023, and for the stations Sombor, Novi Sad, Loznica, Negotin, Kragujevac, Zlatibor, Nis and Vranje are given in the [Appendix](#).

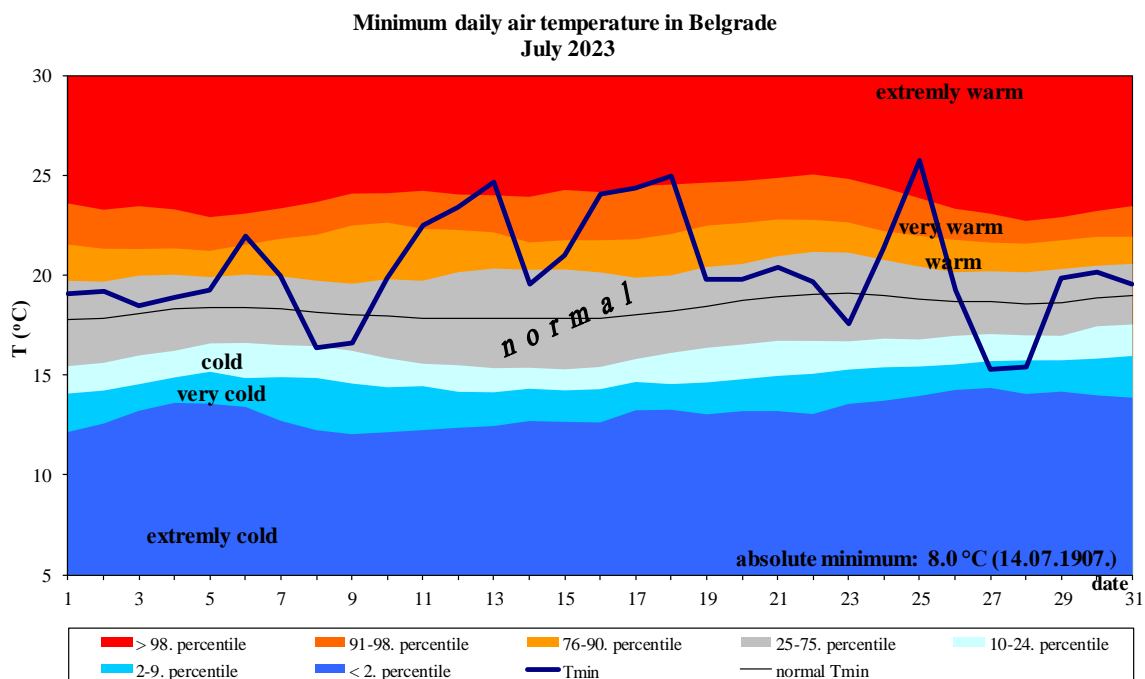


Figure 8. Daily course of the minimum daily air temperature and accompanying percentiles for Belgrade

PRECIPITATION

Precipitation sums recorded in July ranged from 7,3 mm in Dimitrovgrad to 151,6 mm in Krusevac, while Belgrade recorded 46,8 mm of precipitation (*Figure 9*).

Precipitation totals relative to the normal for the 1991-2020 base period ranged from 12% in Dimitrovgrad to 233% in Krusevac (*Figure 10*).

Based on the percentile method, precipitation sums were in the following categories: normal in most of the country, very rainy in Krusevac, rainy in Sremska Mitrovica, Smederevska Palanka and Negtin, dry in Sombor, Loznica, Sjenica, Kursumlija, Zajecar and Vranje, and very dry in Dimitrovgrad (*Figure 11*).

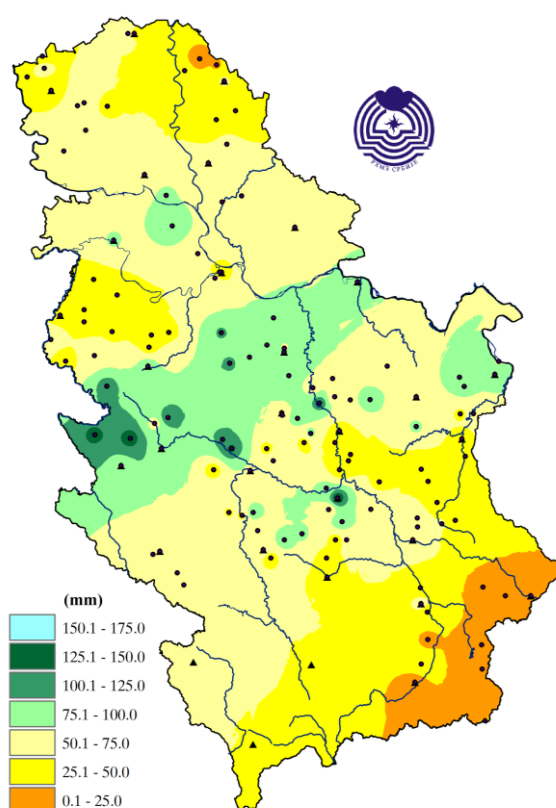


Figure 9. Spatial distribution of the monthly precipitation sums (mm) according to data from 28 major meteorological, 24 climatological and 82 rain gauge stations

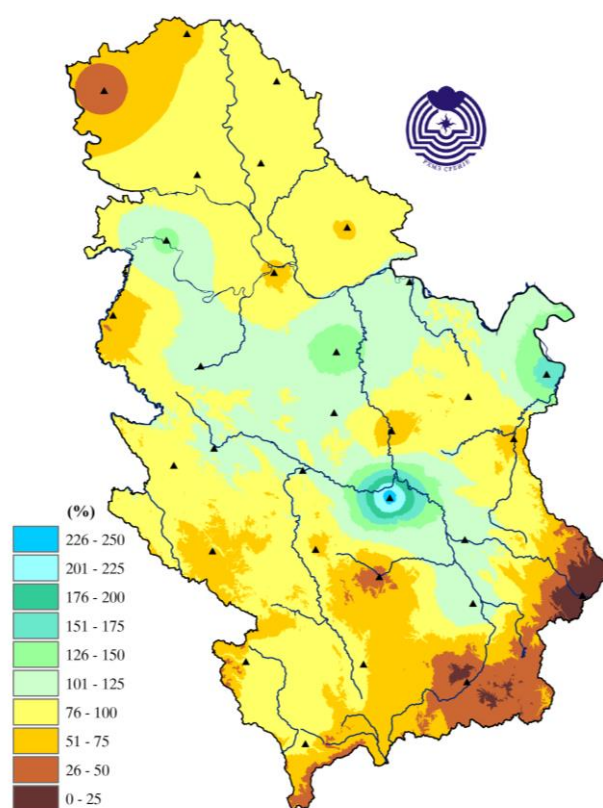


Figure 10. Spatial distribution of the monthly precipitation sums in the percentages of normal for the 1991–2020 base period

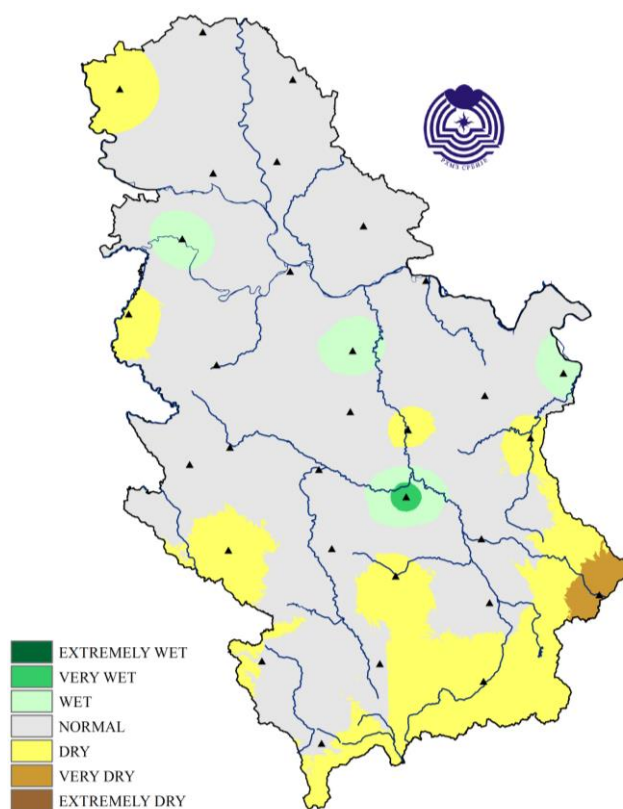


Figure 11. Monthly precipitation sums according to the percentile method

July 2023 ranks as the **8th driest** for Dimitrovgrad with precipitation sum of 7,3 mm for the period from 1926 to 2023 (Figure 12).

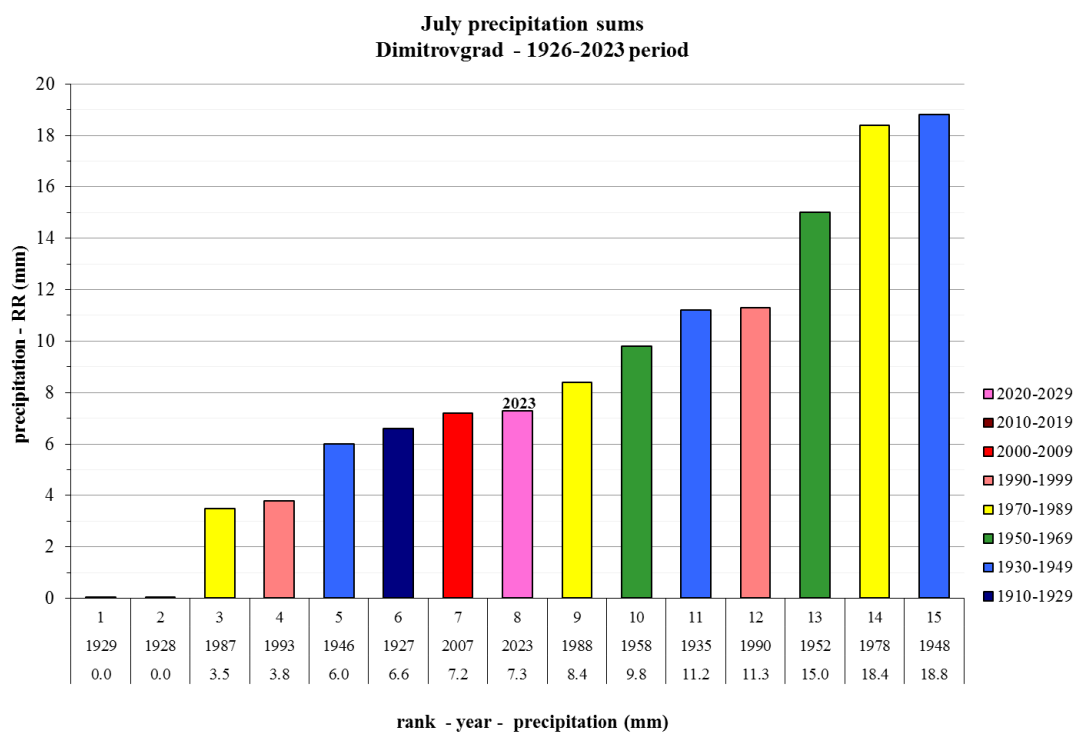


Figure 12. The lowest precipitation in Dimitrovgrad

The highest daily precipitation sum of 47,3 mm was recorded in Krusevac on July 6. On July 23, Belgrade observed the highest daily precipitation sum of 20,0 mm.

Number of days with precipitation ranged from 5 in Dimitrovgrad to 12 in Smederevska Palanka, Veliko Gradiste and Cuprija (*Figure 13*). The observed number of days with precipitation was 3 days below the July average in most of the country (*Figure 14*).

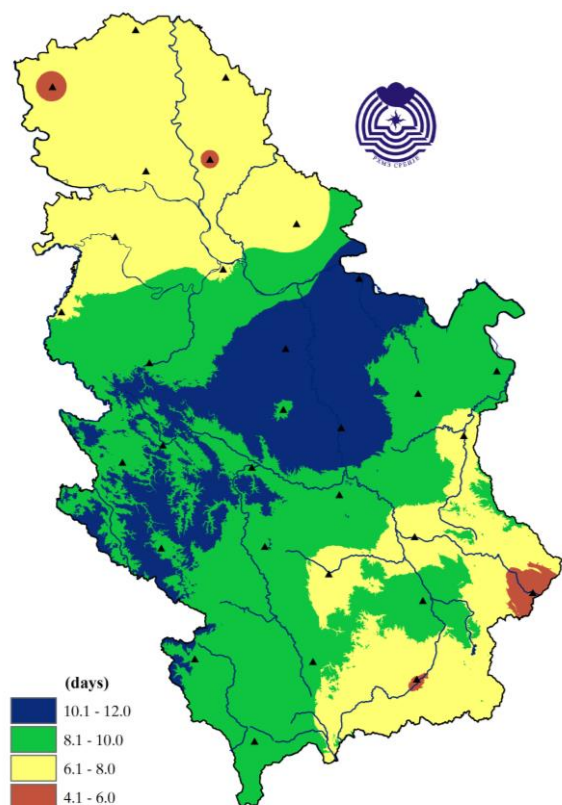


Figure 13. Spatial distribution of number of days with precipitation

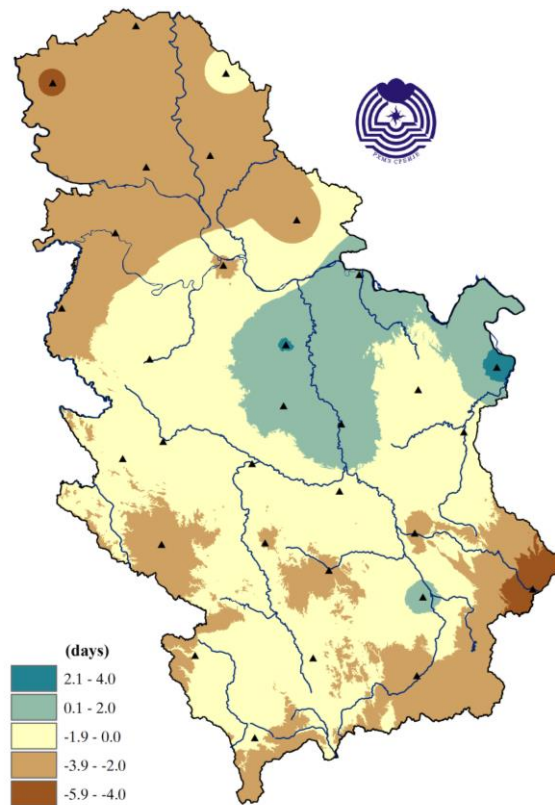


Figure 14. Spatial distribution of deviation of number of days with precipitation

Figure 15 shows assessment of air temperature and precipitation sums for Serbia for July based on the tercile distribution relative to the 1991 – 2020 base period. It can be noted that July 2023 was marked by air temperature significantly above the upper tercile boundary and precipitation sums within the average.

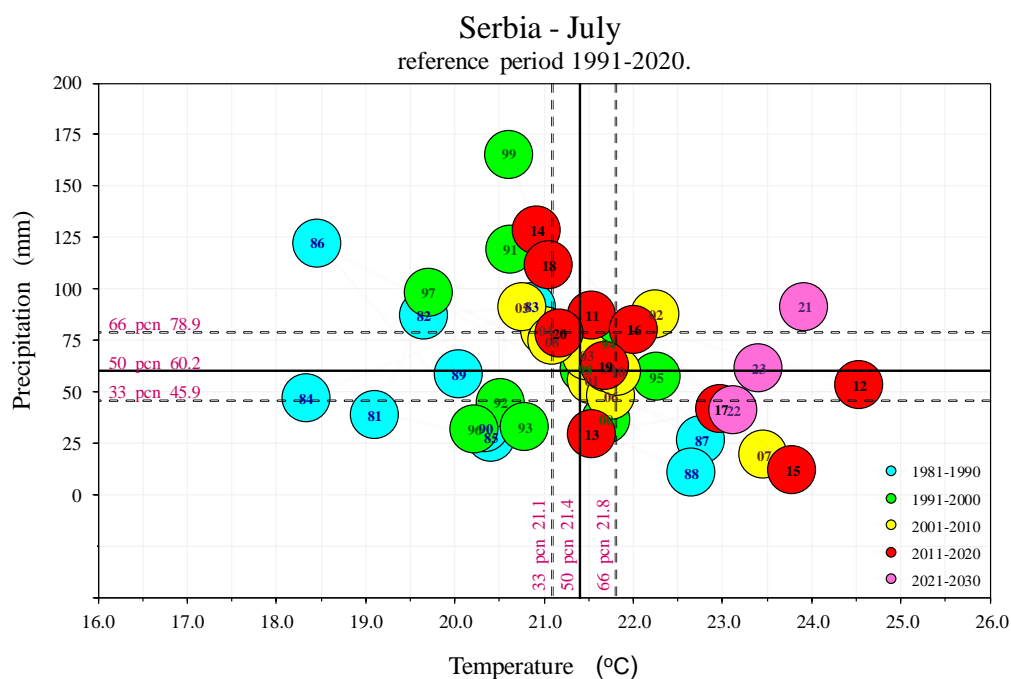


Figure 15. Assessment of air temperature and precipitation for Serbia with the accompanying terciles in relation to the 1991-2020 base period

Figure 16 show daily and cumulative precipitations sums with averaged normal 1991-2020 for July in Belgrade, and for the stations Sombor, Novi Sad, Loznica, Negotin, Kragujevac, Zlatibor, Nis and Vranje precipitation sums are given in [Appendix](#).

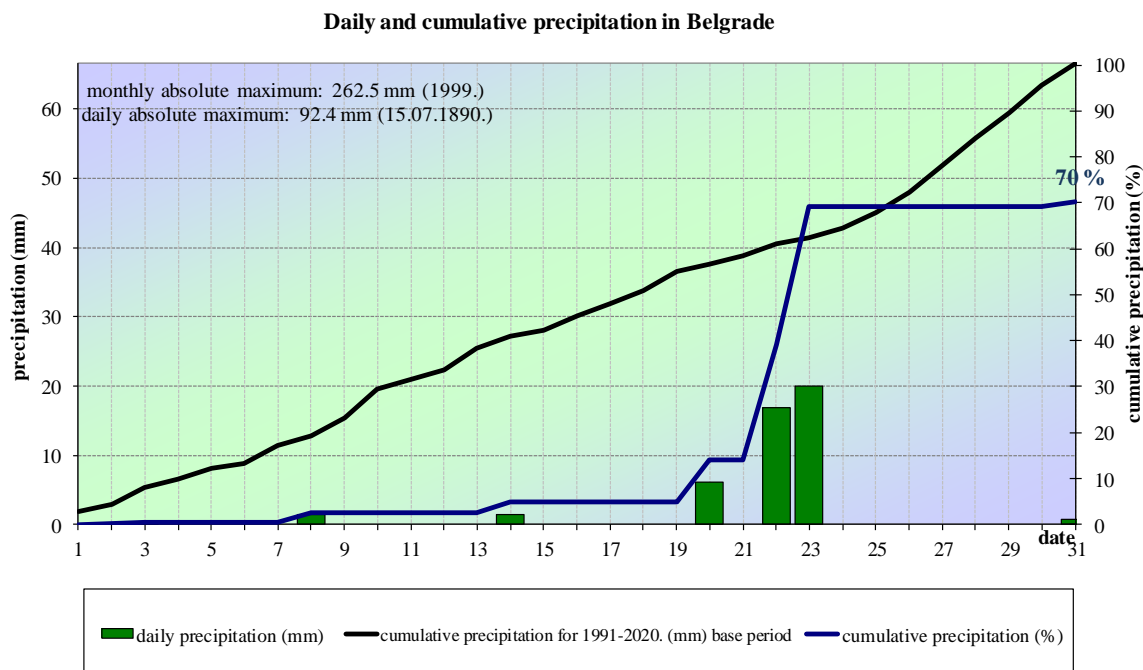


Figure 16. Daily and cumulative precipitation in Belgrade

WIND

Stormy wind, with gusts $\geq 17,2$ m/s, was recorded in most of Serbia during July, most frequently affecting Crni Vrh (total of 7 days during July). In the lowland, most days with stormy wind was recorded in Smederevska Palanka and Zrenjanin.

In July 2023, **exceptionally strong wind gusts** were recorded, with speed exceeding 25 m/s at places. The strongest wind gust was registered in the period from 19 to 22 July. Maximum wind gusts for the main meteorological stations during July 2023 are given in the table.

Station	wind gust (m/s)	direction		time
Crni Vrh	30.2	30	WNW	19. jul 20:48
Krusevac	29.9	34	NNW	5. jul 17:26
S.Mitrovica	28.3	30	WNW	19.jul 18:21
Zrenjanin	27.7	35	N	13.jul 19:41
Kragujevac	27.5	33	NNW	19.jul 19:52
S.Palanka	25.2	28	W	21.jul 20:54
Vranje	22.4	01	N	19.jul 22:17
Loznica	22.1	34	NNW	19.jul 18:13
Negotin	21.1	25	WSW	19.jul 21:24
Zajecar	21.0	33	NNW	22.jul 20:47
Palic	20.8	16	SSE	21.jul 18:25
Leskovac	20.8	36	N	19.jul 21:37
Sjenica	20.0	21	SSW	19.jul 2:18
Sombor*	19.6	28	W	21.jul 17:50
V.Gradiste	19.3	32	NW	21.jul 20:57
Nis	19.2	23	SW	19.jul 21:19
Kraljevo	19.1	30	WNW	19.jul 20:10
Beograd	18.5	27	W	19.jul 19:04
Cuprija*	18.5	33	NNW	21.jul 21:31
Valjevo	18.2	28	W	19.jul 19:10

* Missing data:

Sombor: 5 July

Ćuprija: 31 July

Novi Sad: from 14 to 26 July

Banatski Karlovac: 19 and 21 July

Kikinda: 2, 12, 15, 16, 19, 21, 25, 28, 30 and 31 July

CLOUD COVER, BRIGHT AND CLOUDY DAYS

Mean July cloud cover in Serbia was around or slightly below the average, ranging from 2/10 to 4/10. Figures 17, 18 and 19 show average daily cloud cover in July for Belgrade, Pozega and Leskovac.

The least number of bright days⁷ was recorded in Sombor and Pozega, total of 7 days, while the highest number of bright days, total of 18 days, was observed in Nis and Dimitrovgrad. Belgrade observed 13 bright days. The observed number of bright days was up to 5 days above the July average.

Cloudy days⁸ were not registered in Novi Sad, Banatski Karlovac, Loznica, Sremska Mitrovica, Belgrade and Kursumlija. The highest number of cloudy days, total of 3 days, was recorded in Sombor and Cuprija. Number of cloudy days was up to 4 days below the July average in most of the country.

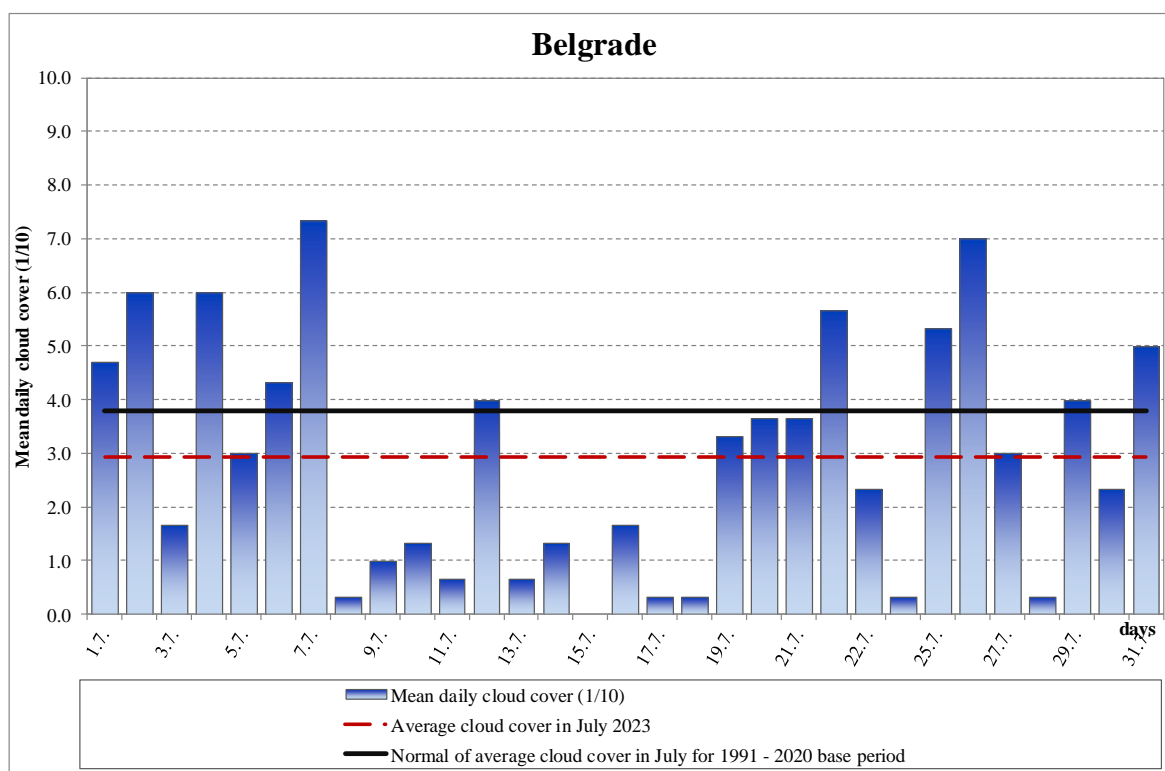


Figure 17. Mean daily cloud cover in Belgrade

⁷ Bright day refers to a day with cloud cover less than 2/10

⁸ Cloudy day refers to a day with cloud cover over 8/10

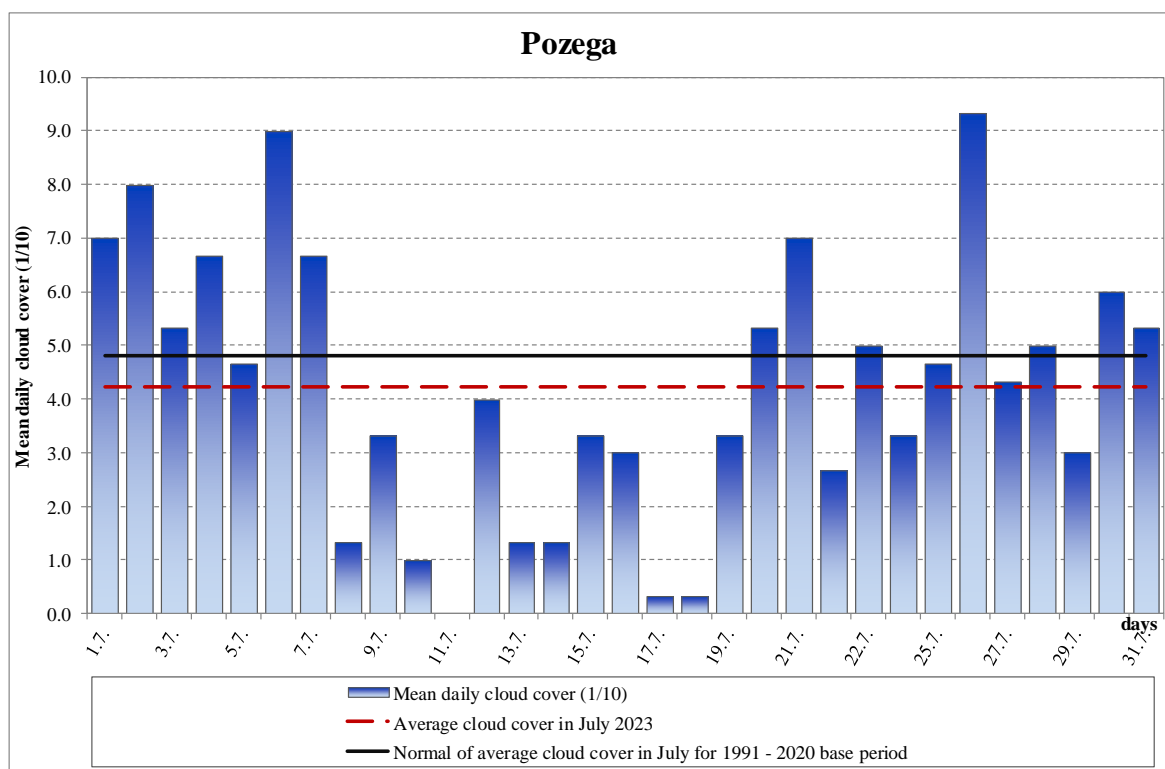


Figure 18. Mean daily cloud cover in Pozega

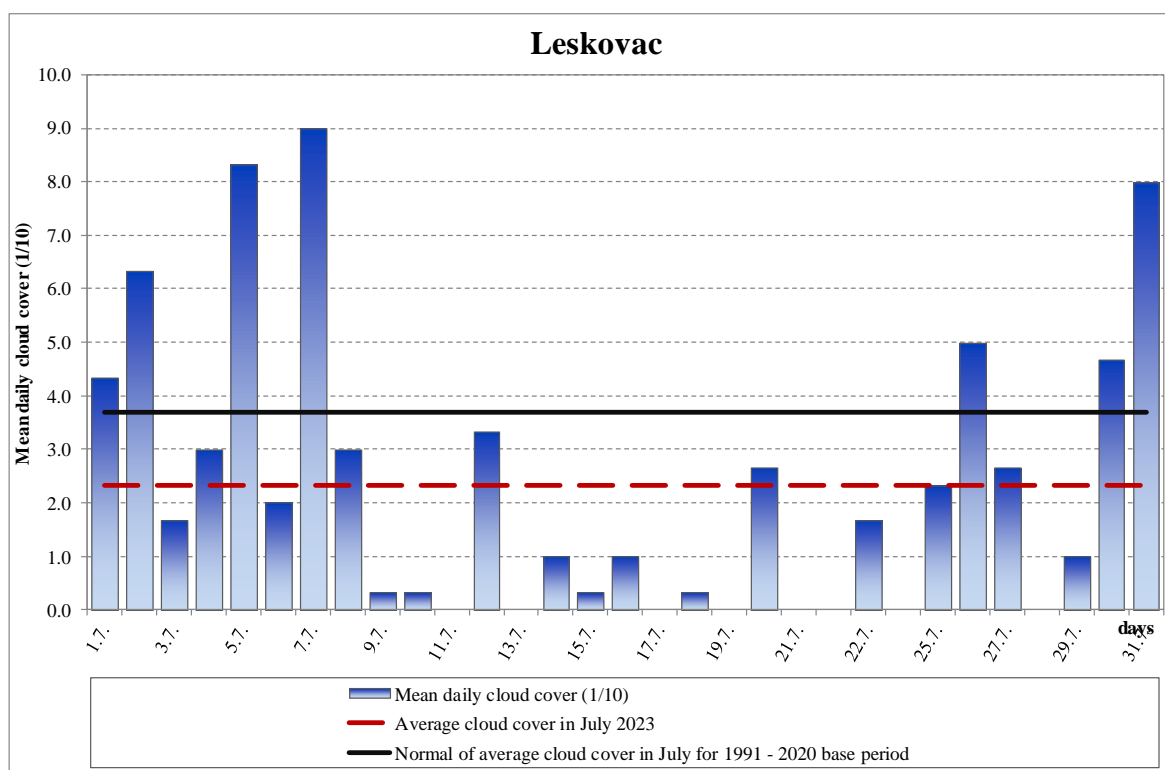


Figure 19. Mean daily cloud cover in Leskovac

SUNSHINE DURATION (INSOLATION)

Sunshine duration in July ranged from 280,3 hours in Pozega to 383,4 hours in Vranje (*Figure 20*).

July insolation ranged from 102% at Crni Vrh to 122% at Kopaonik relative to the normal for the 1991-2020 base period (*Figure 21*).

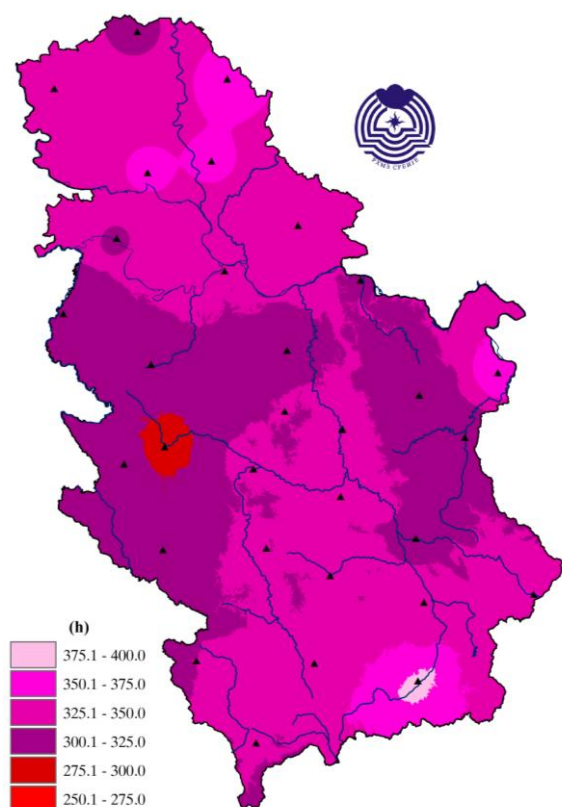


Figure 20. Insolation, expressed in hours

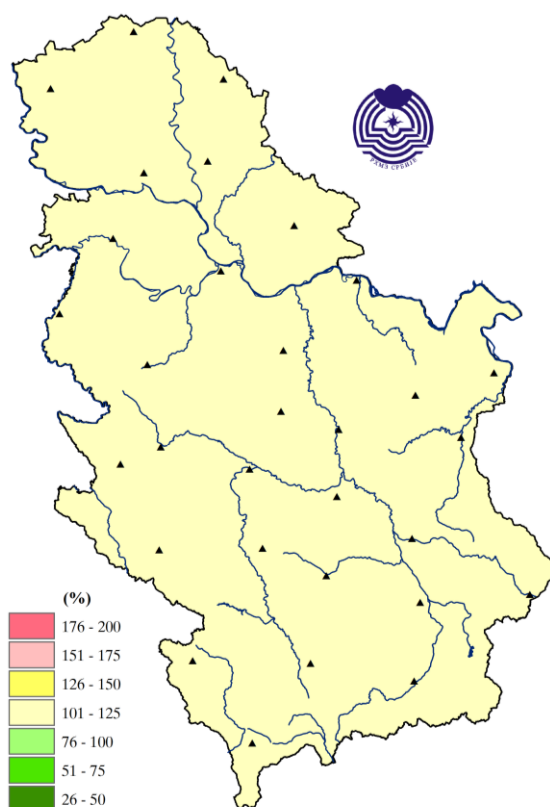


Figure 21. Insolation expressed in the percentages of normal

* **Note:** Climate analysis of meteorological elements was done based on the preliminary data obtained from 28 main meteorological stations

OVERVIEW OF THE SYNOPTIC SITUATION*

Influence of the low pressure from the west and northwest, ridge and warm air mass from the south and north of Africa, periods of very warm weather as well as pronounced processes, locally severe weather events, heavy rain, hail and strong wind in the warm and unstable air mass; considerably colder conditions in the middle of the third decade

Due to low pressure activities, the first week of July was characterized by frontal waves of wet air from the Alps and western Mediterranean within the upper air depression causing changeable weather with intermittent rain and isolated showers and thunderstorms, affecting mostly western and southwestern parts of the country.

Period of dry and gradually warmer weather set in due to formation of the ridge in the central Mediterranean and advection of the warm, tropical air mass from the North Africa.

The beginning of the second decade, after few hot days was marked by labialization of the air mass in the northern regions due to low pressure development in the north and northwest concurrently further advection of warm air from the south of the continent was registered. Collision zone of two air masses caused formation of strong and supercell storm that transferred throughout the day from the west toward east, from the Alps across the Pannonia plain, Slavonia and Vojvodina toward the Carpathian and Black Sea. Episodes of isolated severe weather were observed in the north of the country accompanied by heavy rainfall, hail and strong wind from the northwest of the country toward central Banat. Until the end of the second decade, anticyclone on the ground and warm air mass were observed in the spatial ridge across the central Mediterranean with very warm weather.

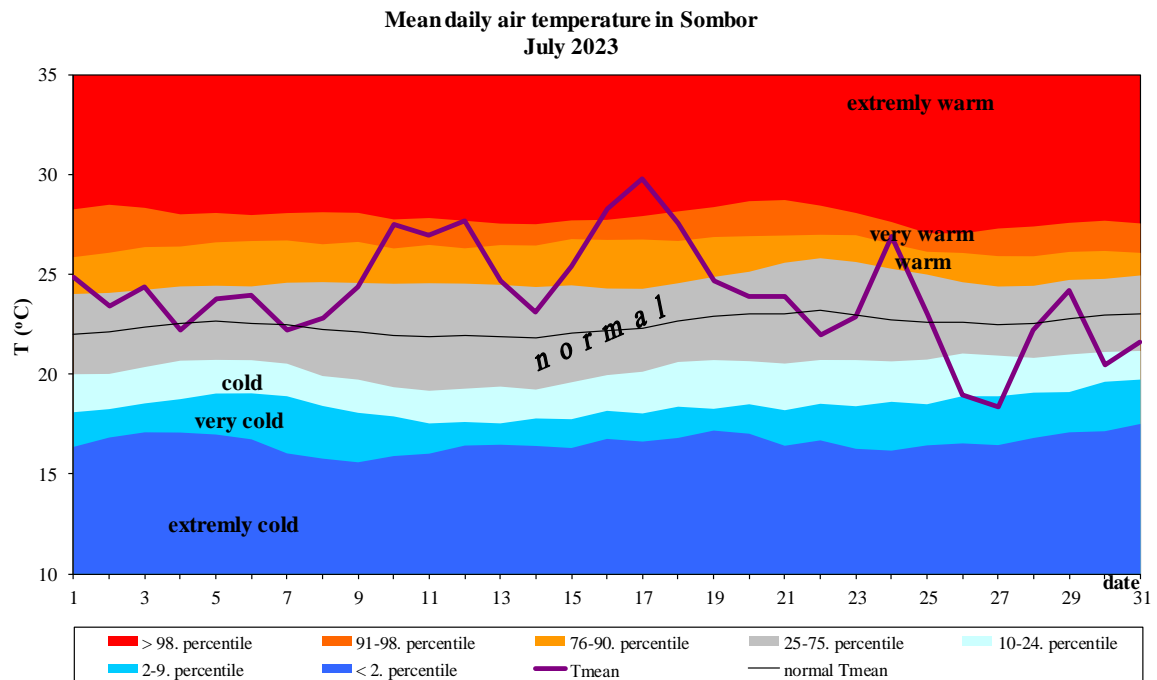
At the end of the second decade, after development and low pressure transfer from the northwest and British Isles and Northern Sea toward southeast and central Europe, influx of moisture took place within the Alps and the Pannonia Plain along with another incursion of cold front across Srem, Macva and southern Backa toward east and storm front predominantly in the zonal upper air circulation. Rain and heavy showers with stormy wind gusts were recorded. Elsewhere, in central and eastern areas, isolated showers with thunderstorms were observed affecting most southwest of Serbia with hail.

Changeable weather at the beginning of the third decade, and few warm days in the middle of the decade was followed by isolated episodes of strong cloud formation accompanied by thunderstorm processes with heavy rain, hail and strong wind influenced by passage of cold front emanating from the northwest. The strongest development was registered in central Serbia, Sumadija and Pomoravlje, the weather was considerably colder. In a subsequent period, it was dry and warm until the end of the month, while another incursion from the west and northwest, cloud cover with intermittent rain and isolated thundershowers was observed at the end of the month, affecting north and east of the country.

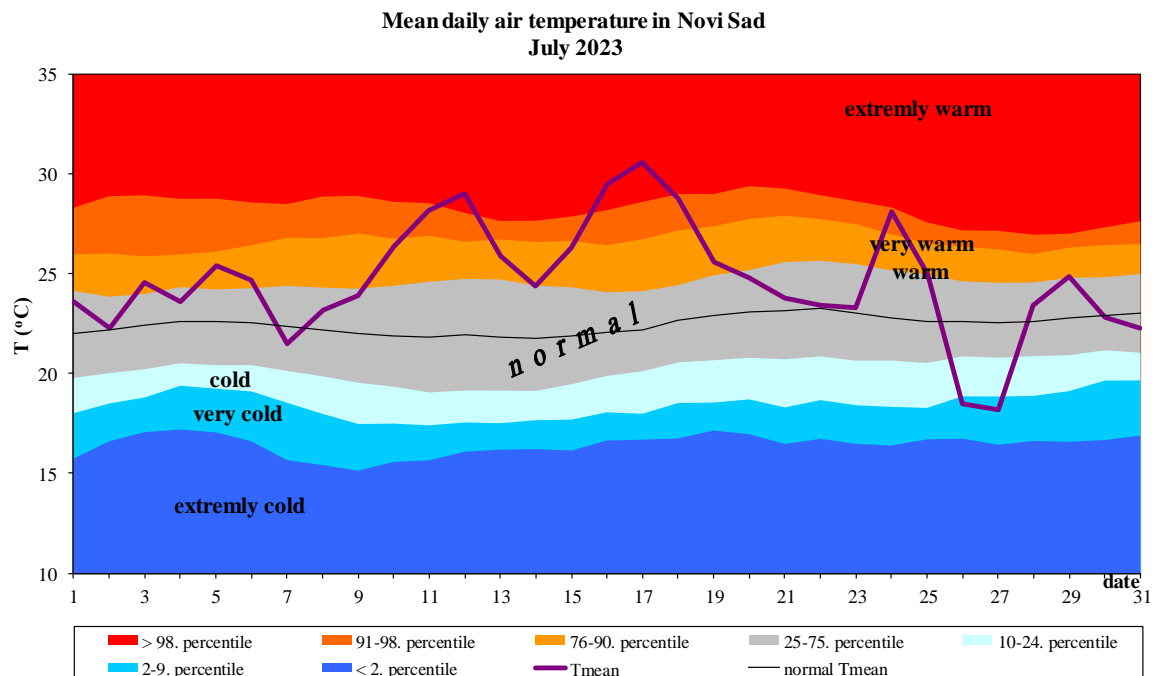
* National Center for Hydrometeorological Early Warning System

APPENDIX

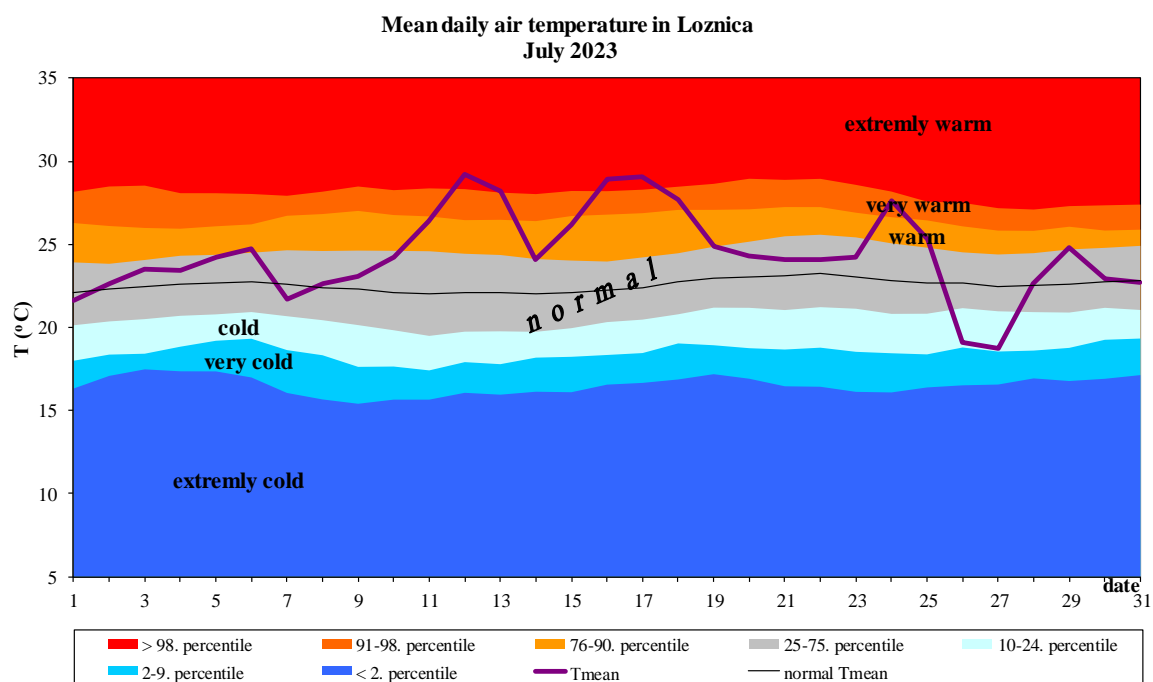
Mean air temperature



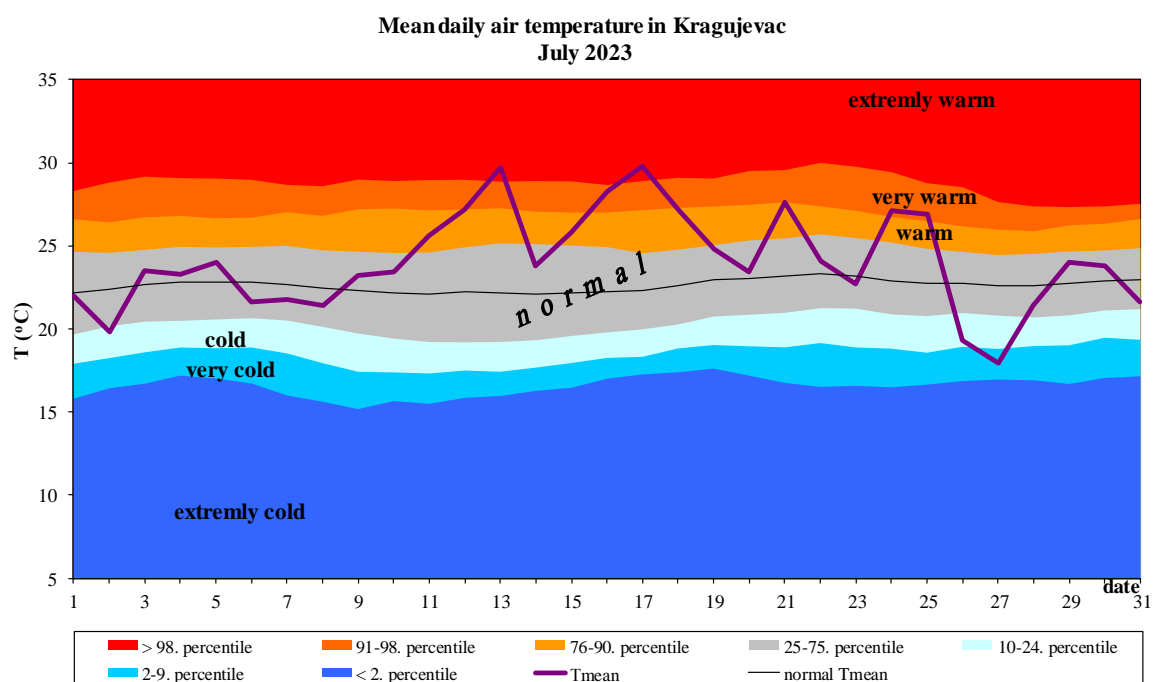
Appendix 1. Daily course of the mean daily air temperature and accompanying percentile for Sombor



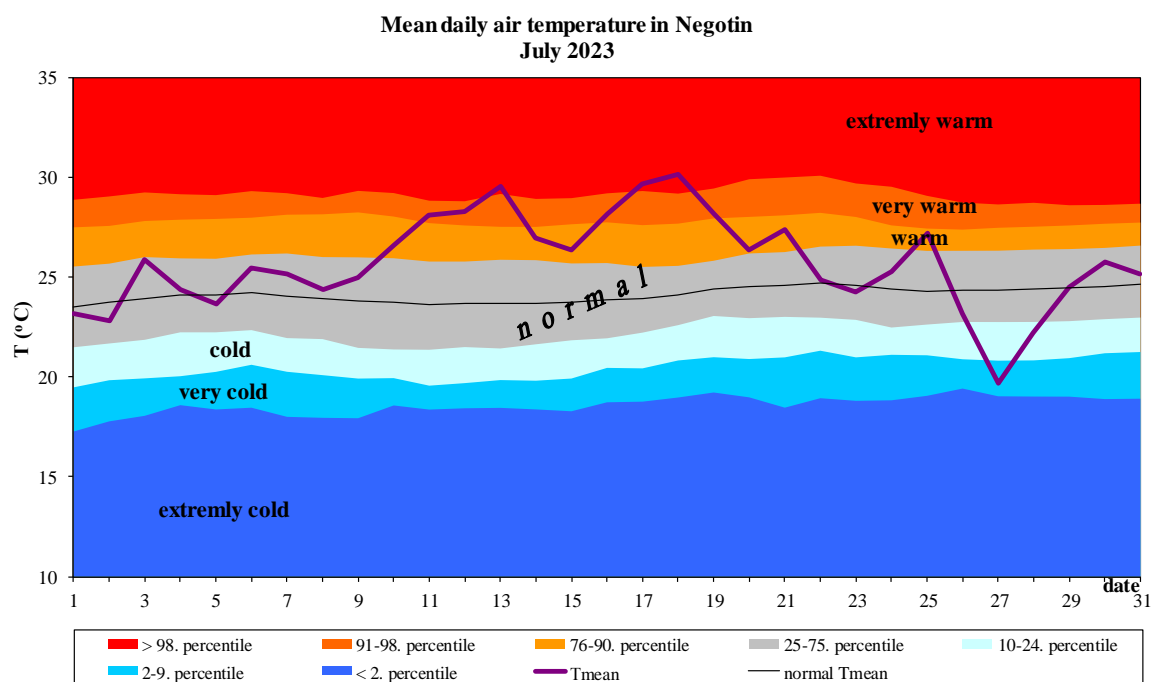
Appendix2. Daily course of the mean daily air temperature and accompanying percentile for Novi Sad



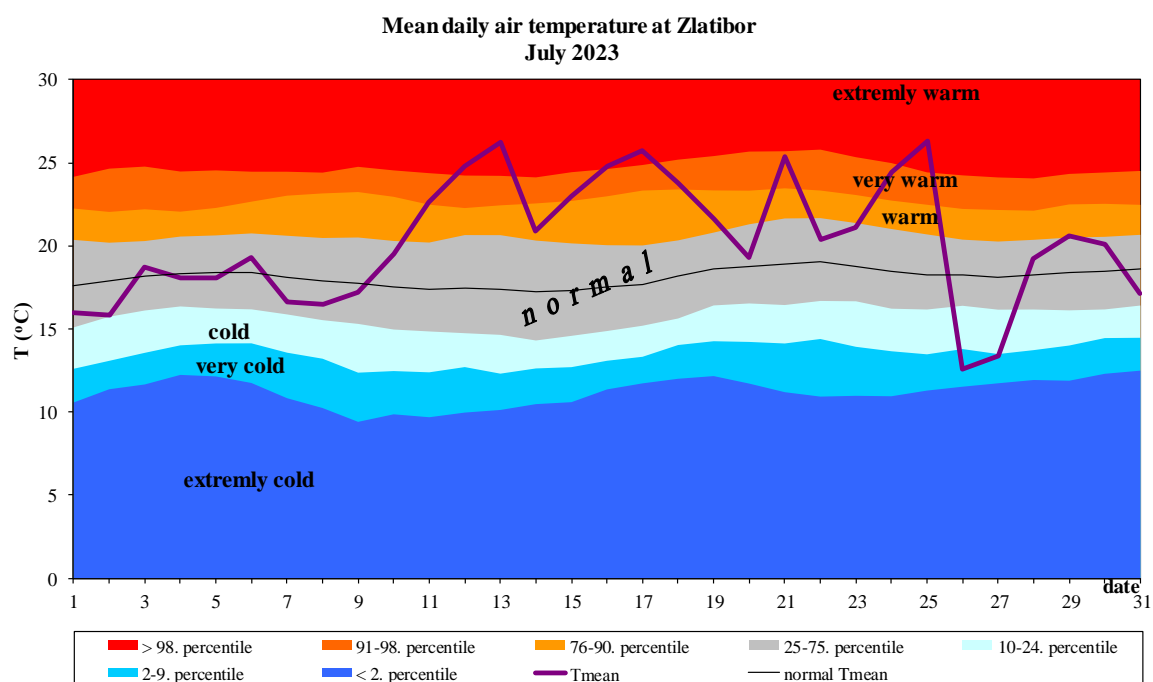
Appendix 3. Daily course of the mean daily air temperature and accompanying percentile for Loznica



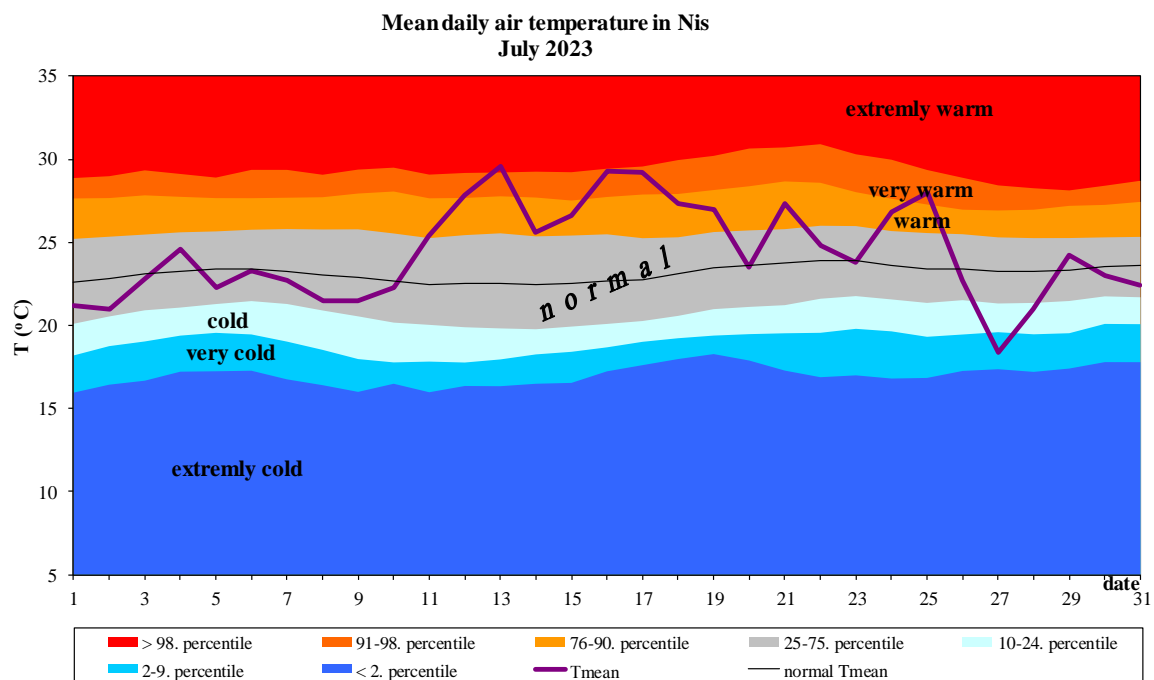
Appendix 4. Daily course of the mean daily air temperature and accompanying percentile for Kragujevac



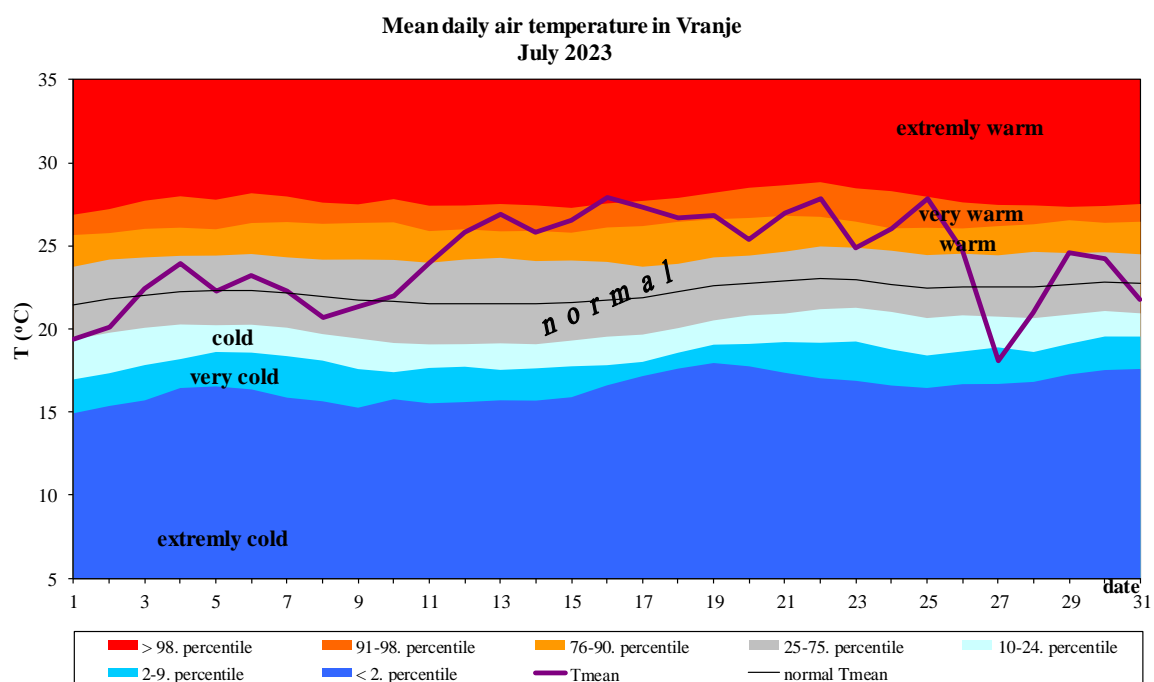
Appendix 5. Daily course of the mean daily air temperature and accompanying percentile for Negotin



Appendix 6. Daily course of the mean daily air temperature and accompanying percentile on Zlatiboru

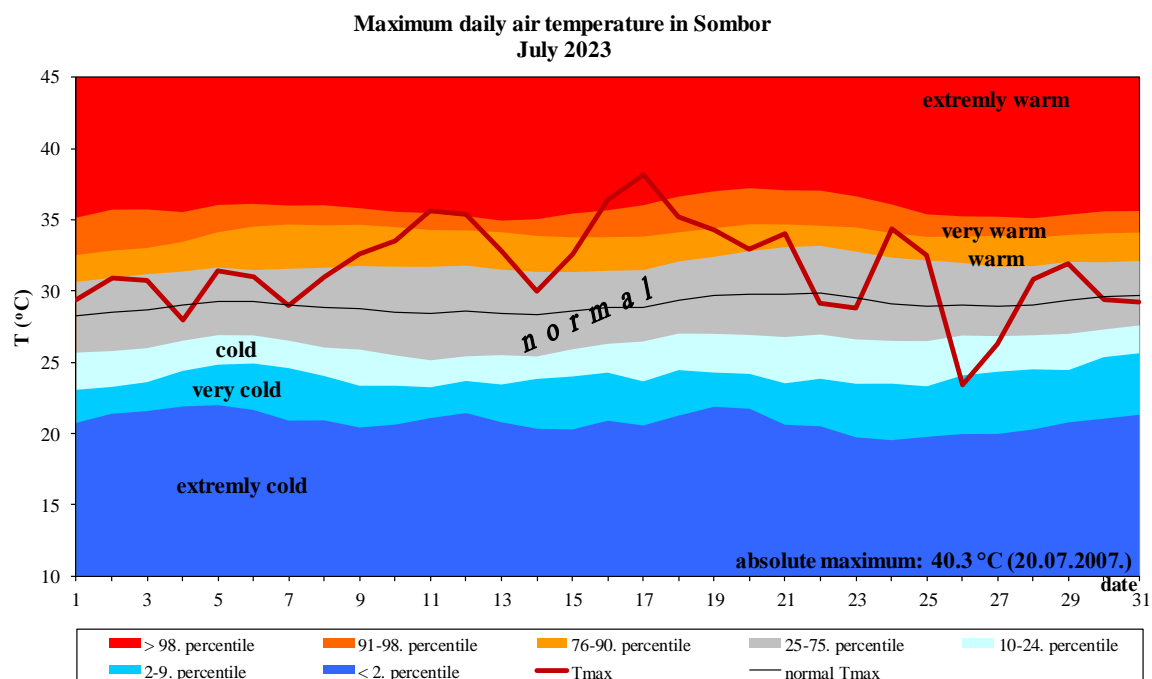


Appendix 7. Daily course of the mean daily air temperature and accompanying percentile for Nis

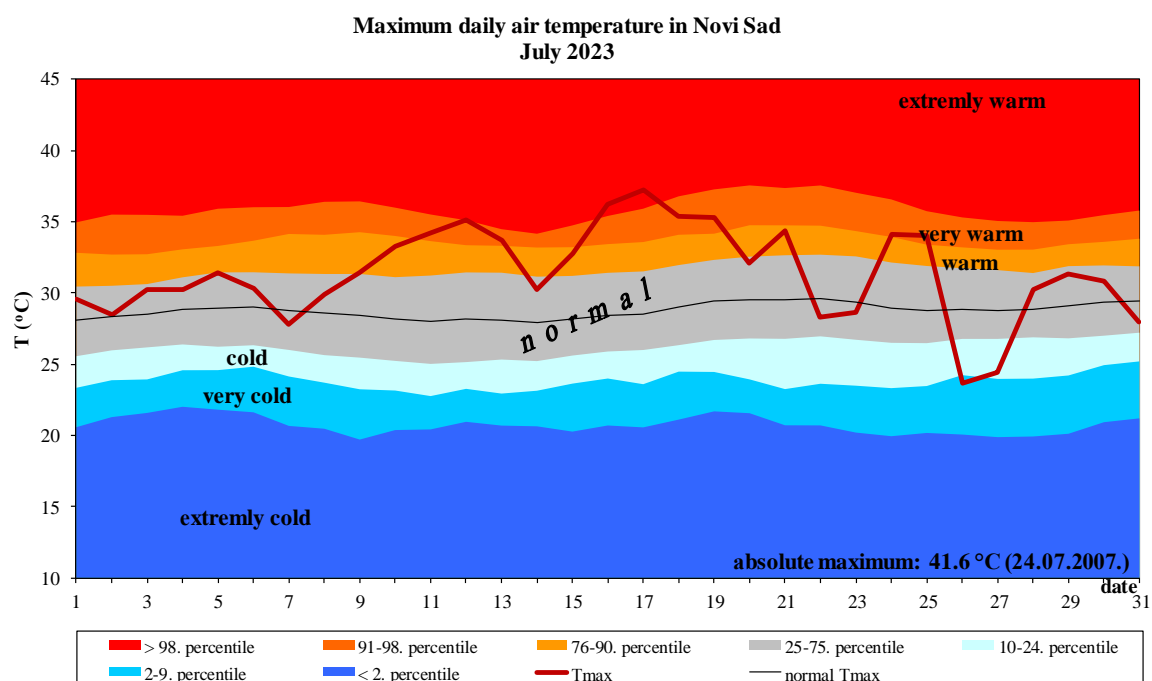


Appendix 8. Daily course of the mean daily air temperature and accompanying percentile for Vranje

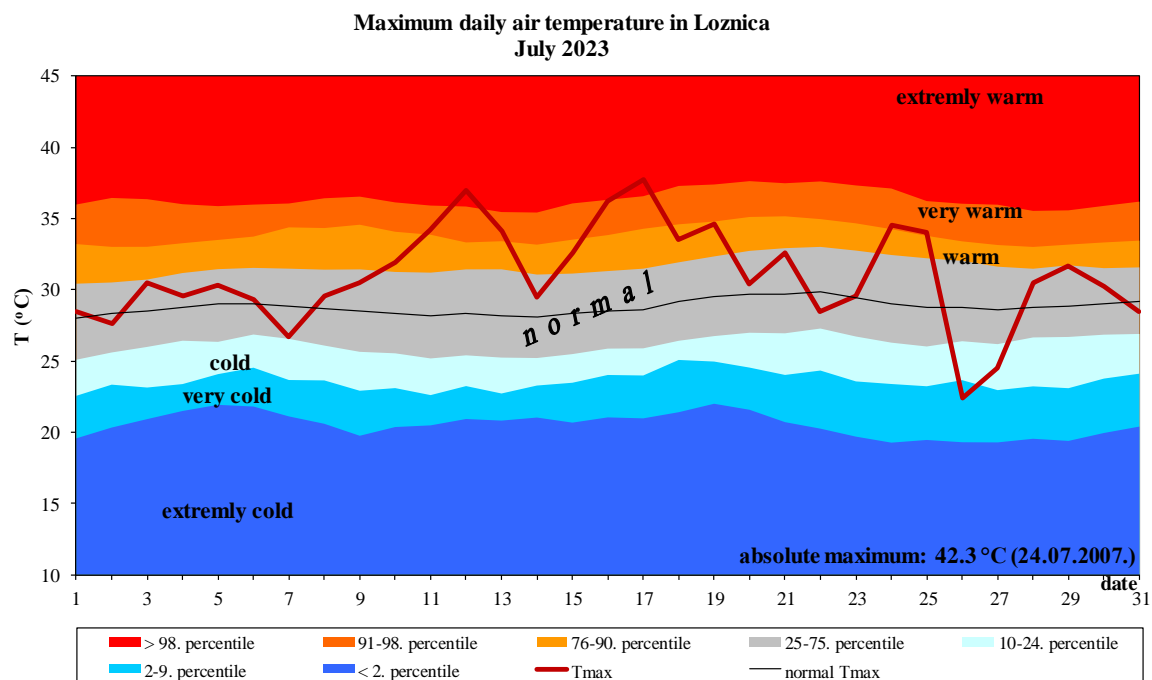
Maximum air temperature



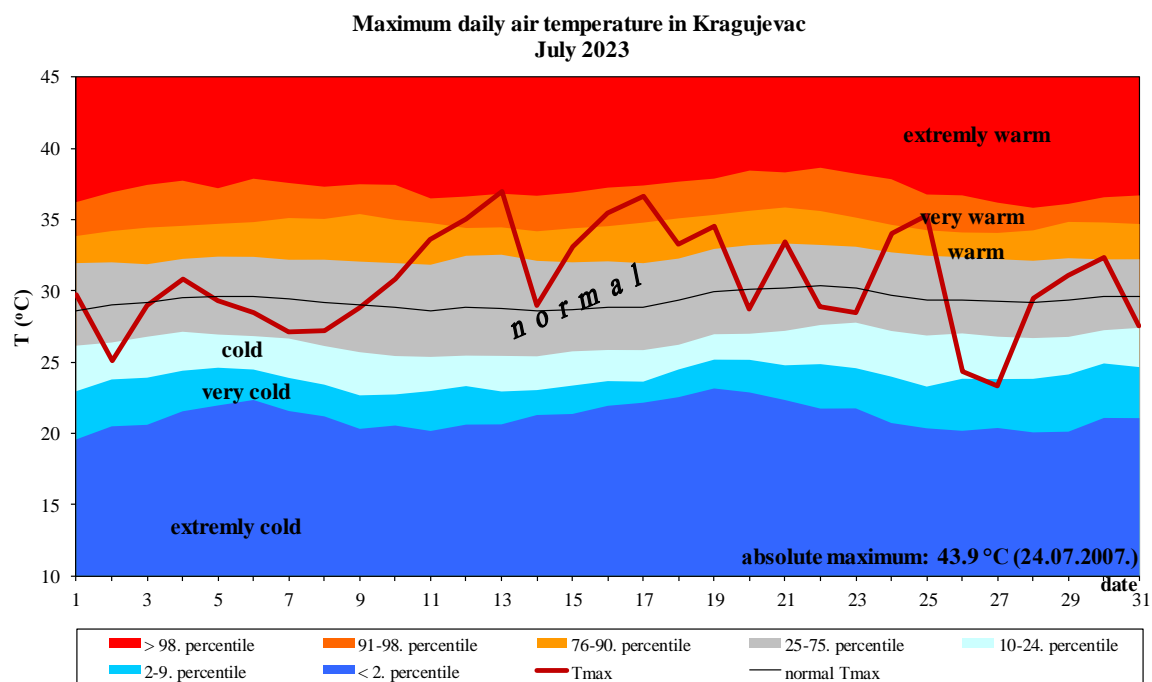
Appendix 9. Daily course of the maximum daily air temperature and the accompanying percentile for Sombor



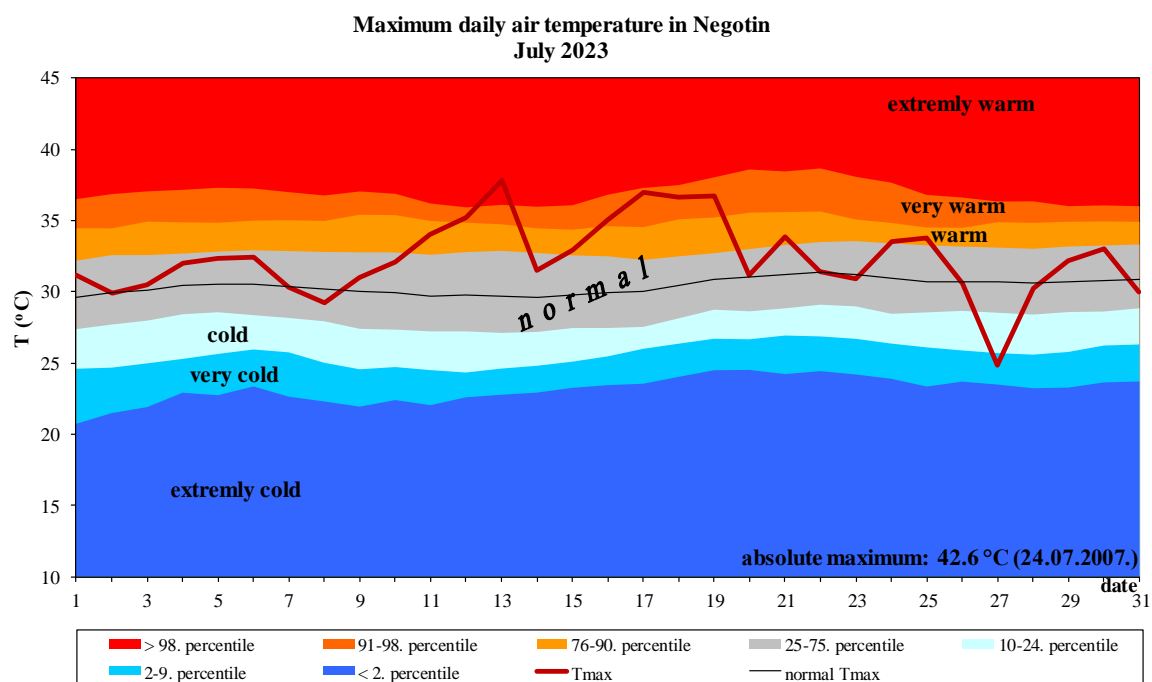
Appendix 10. Daily course of the maximum daily air temperature and the accompanying percentile for Novi Sad



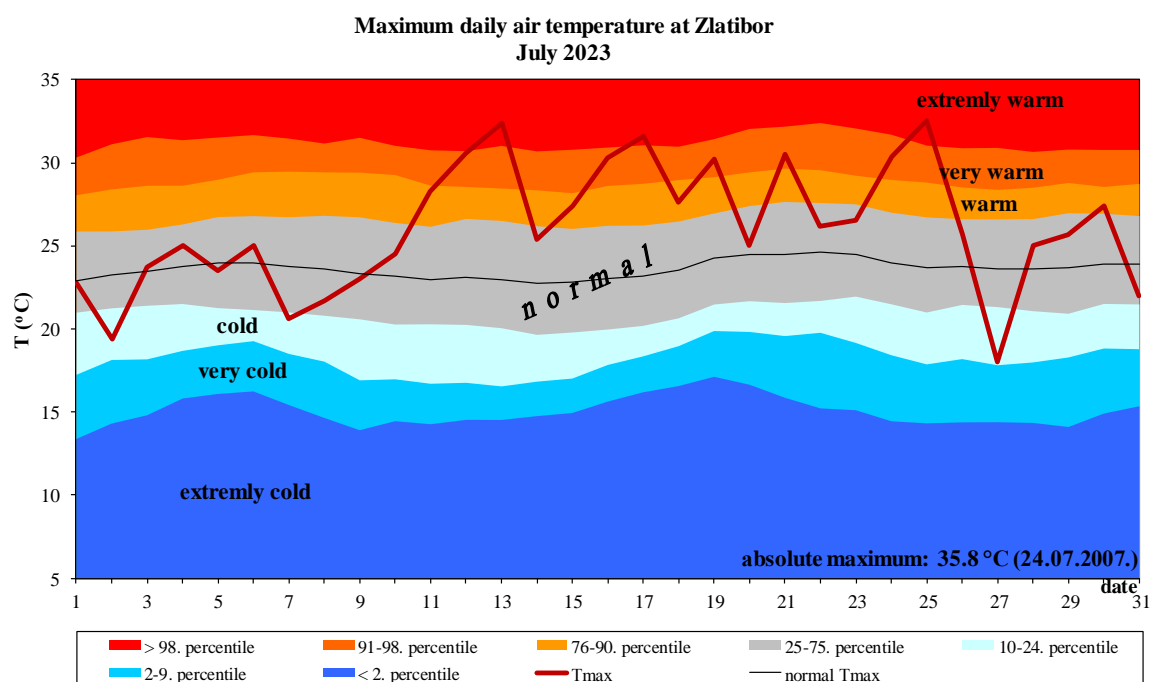
Appendix 11. Daily course of the maximum daily air temperature and the accompanying percentile for Loznica



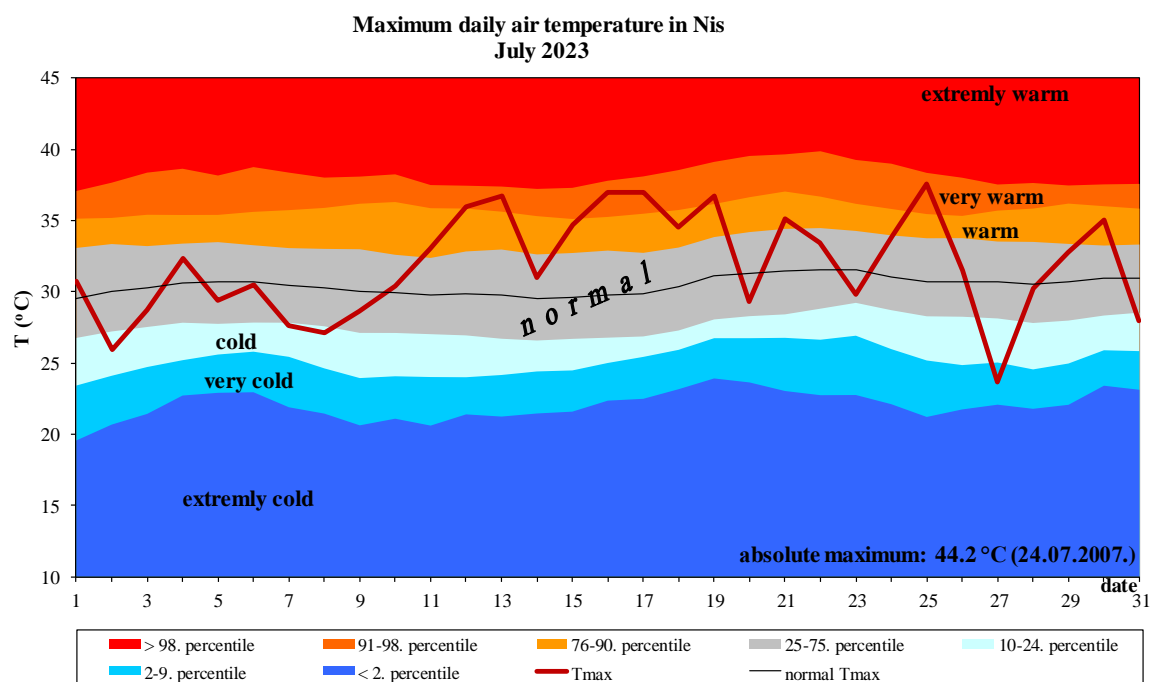
Appendix 12. Daily course of the maximum daily air temperature and the accompanying percentile for Kragujevac



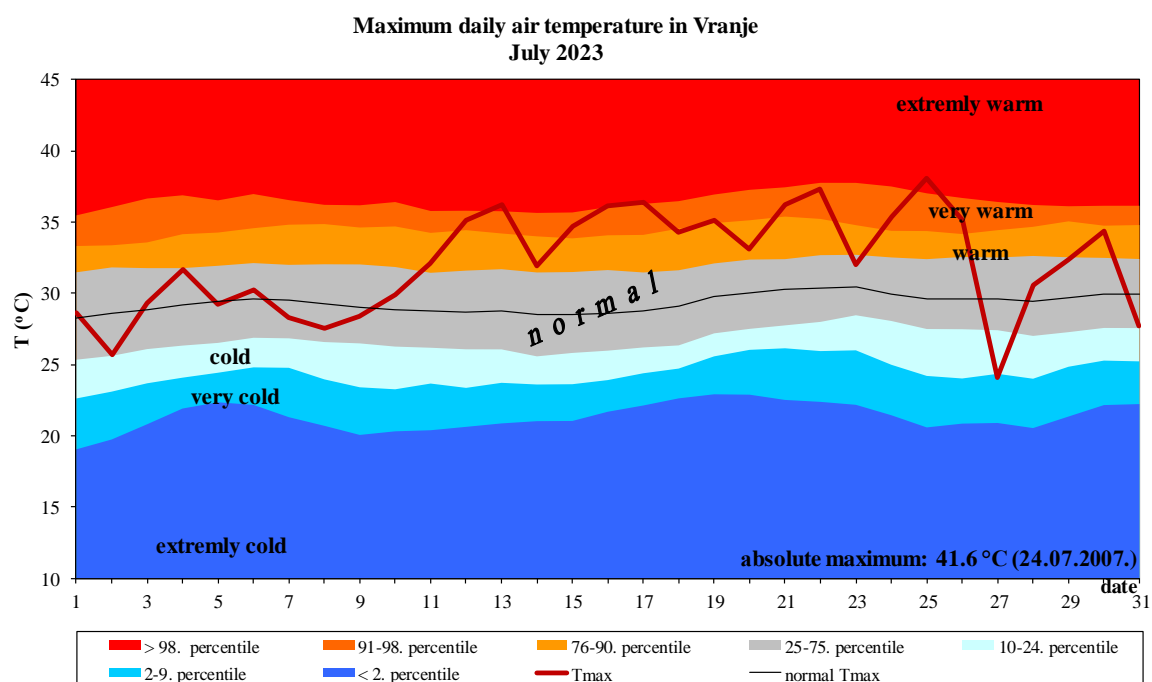
Appendix 13. Daily course of the maximum daily air temperature and the accompanying percentile for Negotin



Appendix 14. Daily course of the maximum daily air temperature and the accompanying percentile on Zlatibor

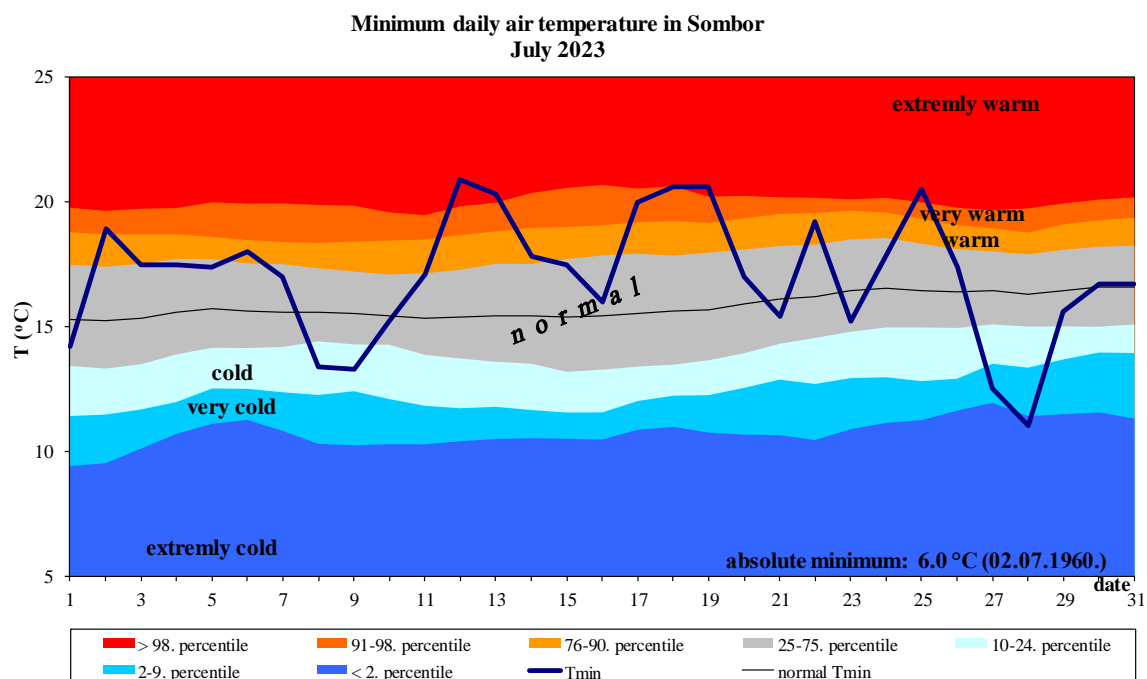


Appendix 15. Daily course of the maximum daily air temperature and the accompanying percentile for Nis

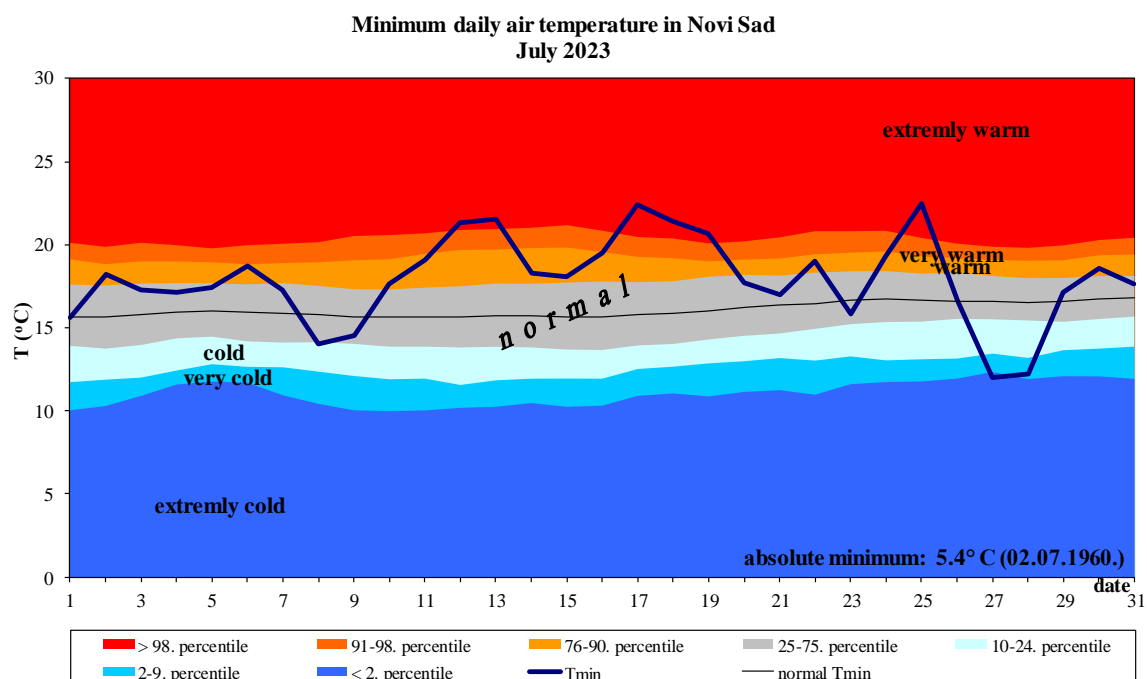


Appendix 16. Daily course of the maximum daily air temperature and the accompanying percentile for Vranje

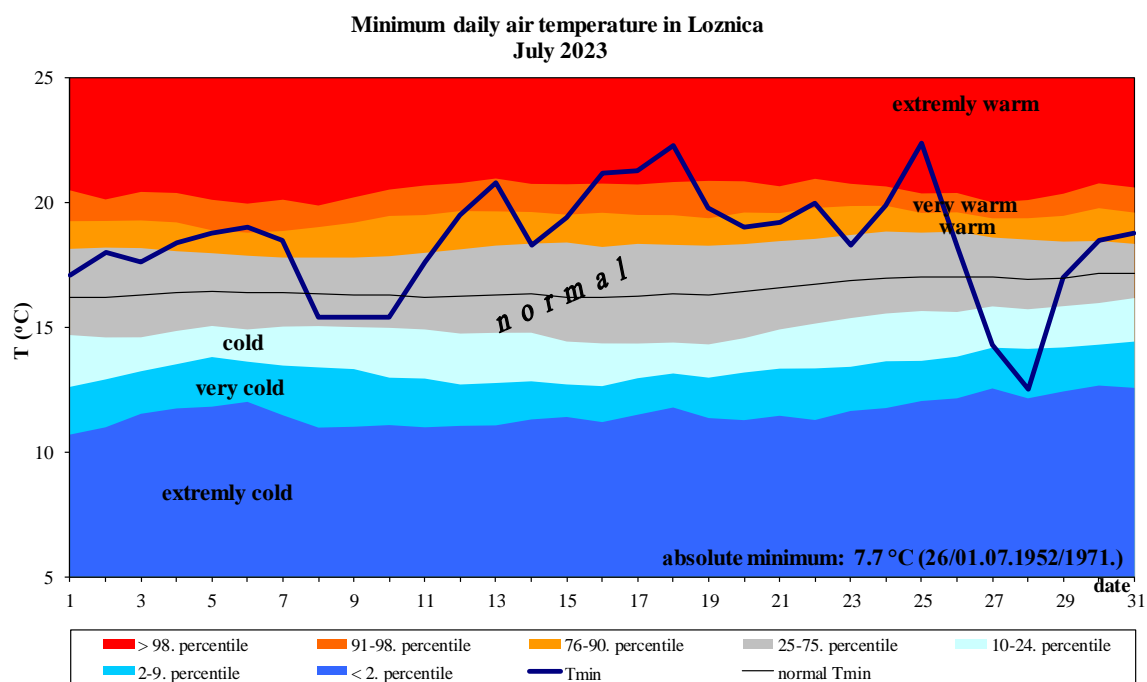
Minimum air temperature



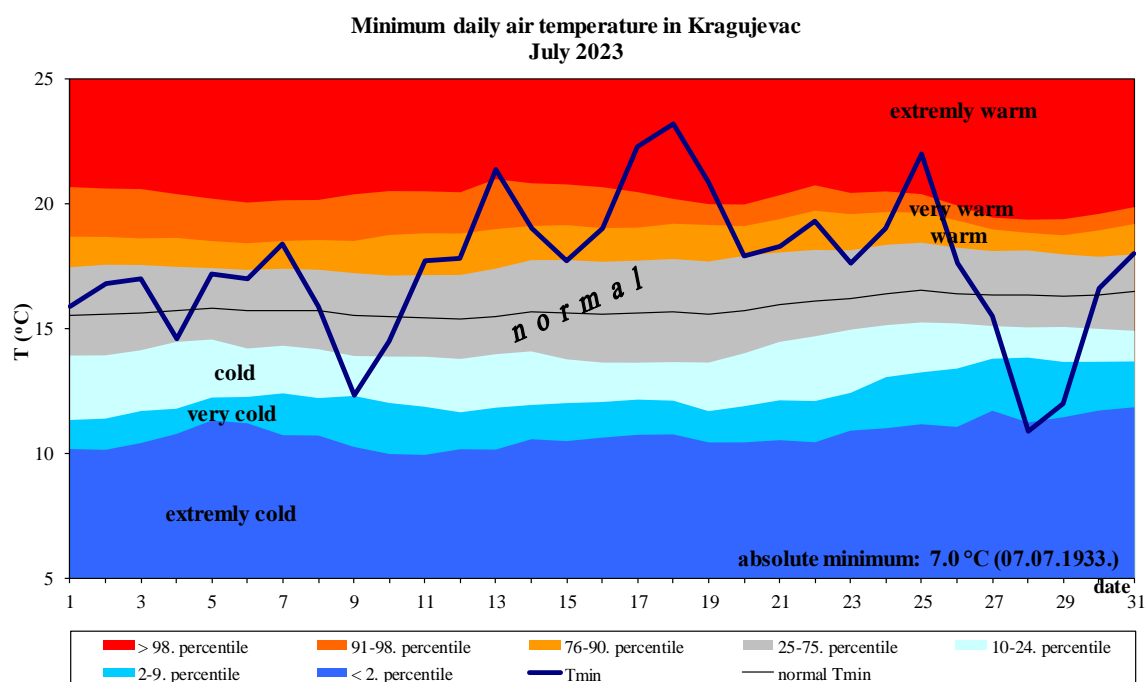
Appendix 17. Daily course of the minimum daily air temperature and the accompanying percentile for Sombor



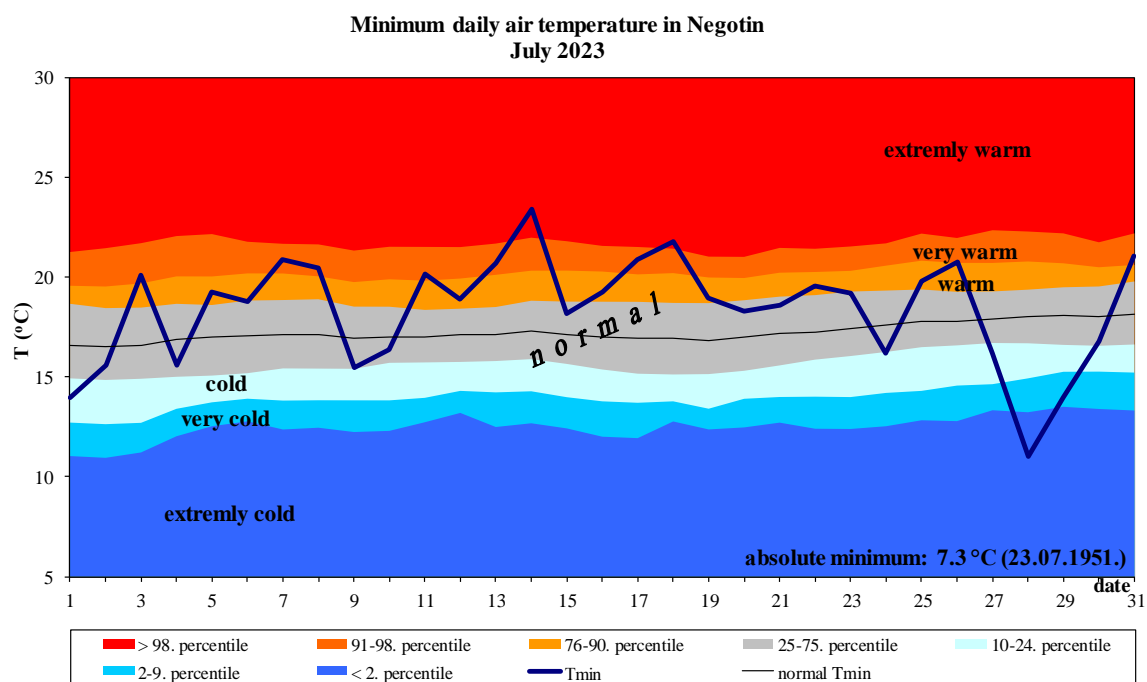
Appendix 18. Daily course of the minimum daily air temperature and the accompanying percentile for Novi Sad



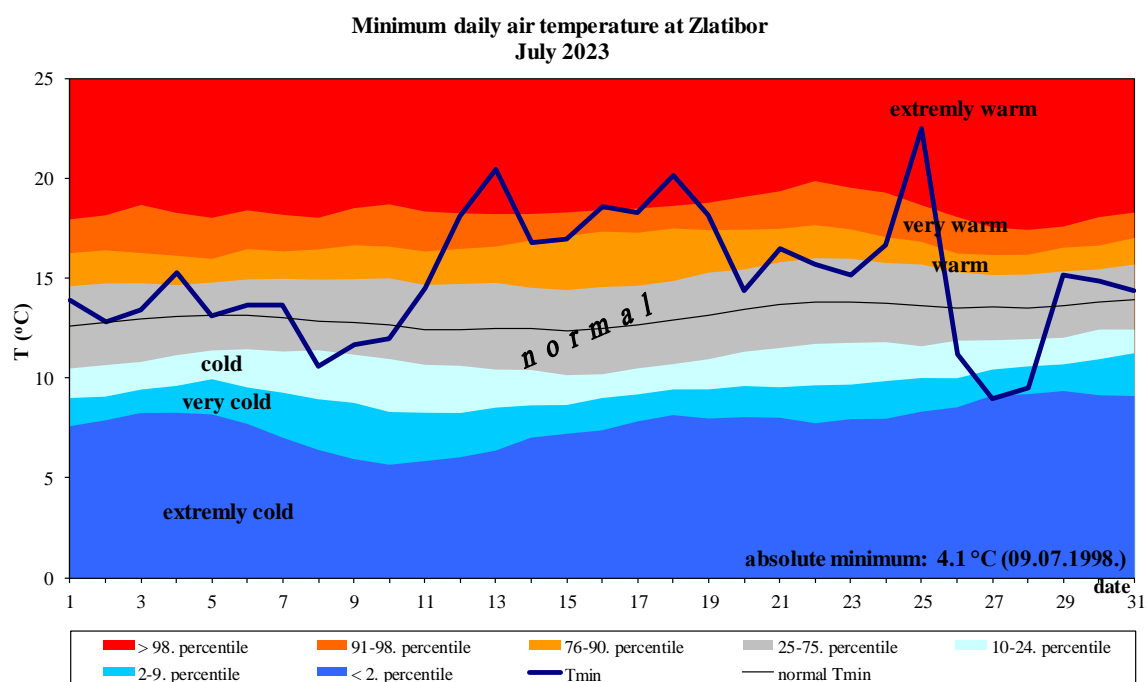
Appendix 19. Daily course of the minimum daily air temperature and the accompanying percentile for Loznica



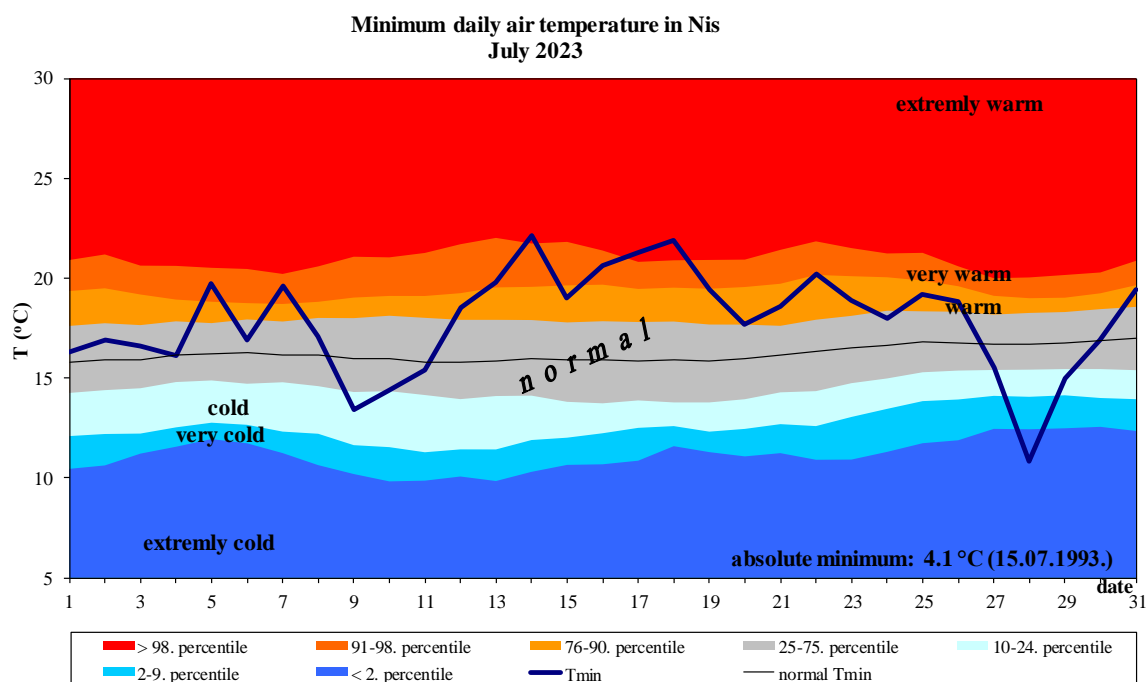
Appendix 20. Daily course of the minimum daily air temperature and the accompanying percentile for Kragujevac



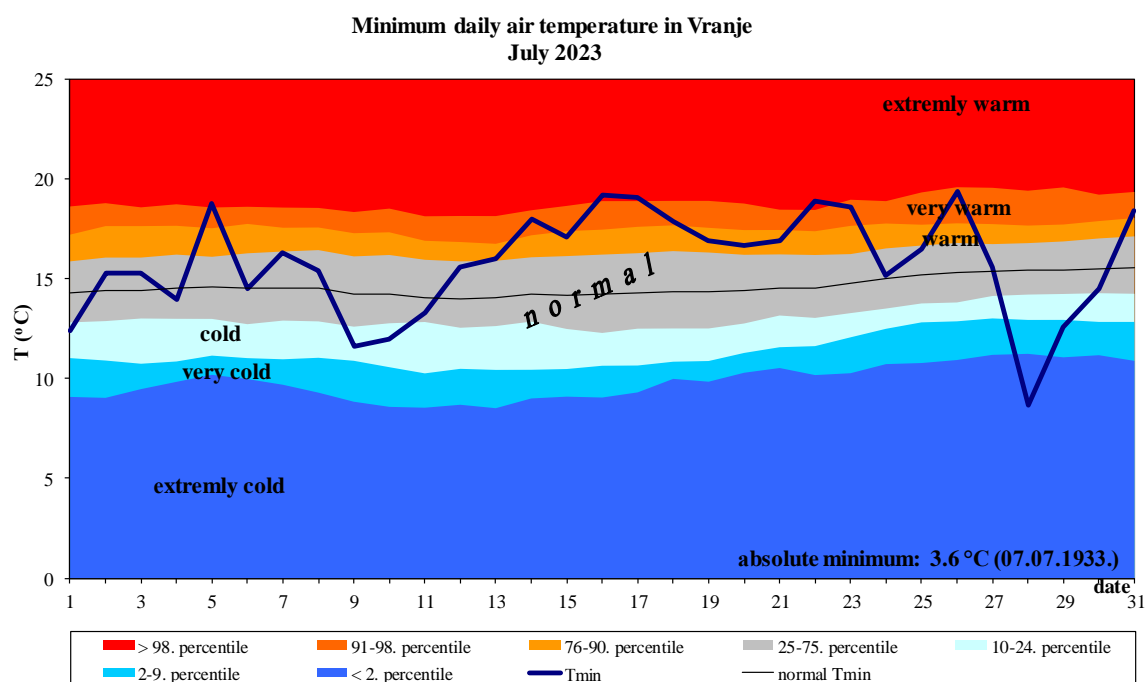
Appendix 21. Daily course of the minimum daily air temperature and the accompanying percentile for Negotin



Appendix 22. Daily course of the minimum daily air temperature and the accompanying percentile on Zlatibor



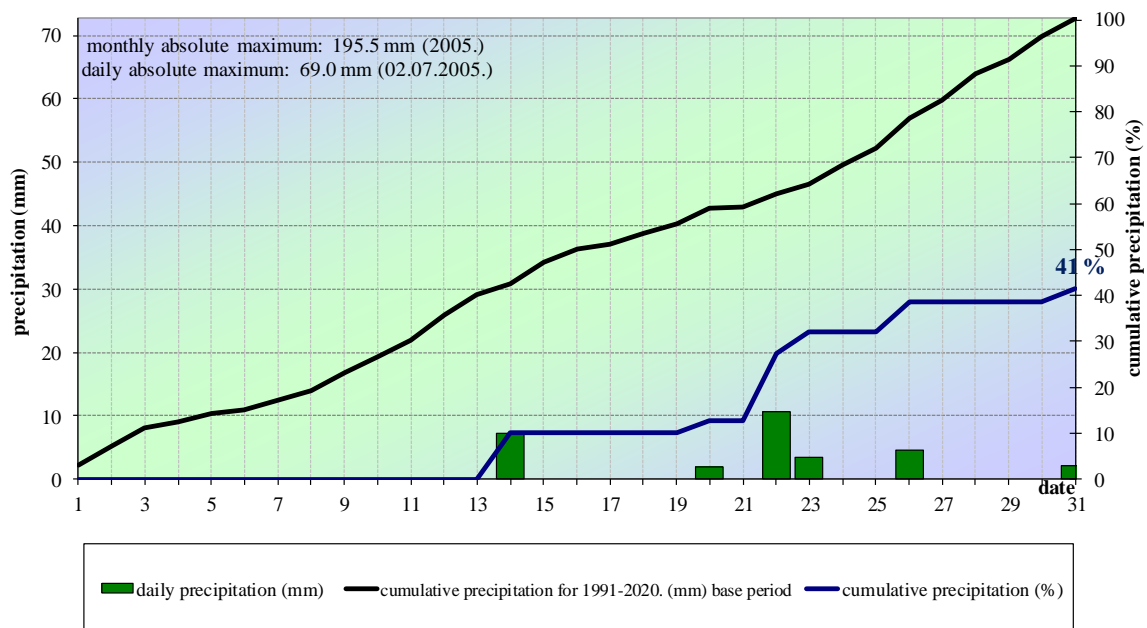
Appendix 23. Daily course of the minimum daily air temperature and the accompanying percentile for Nis



Appendix 24. Daily course of the minimum daily air temperature and the accompanying percentile for Vranje

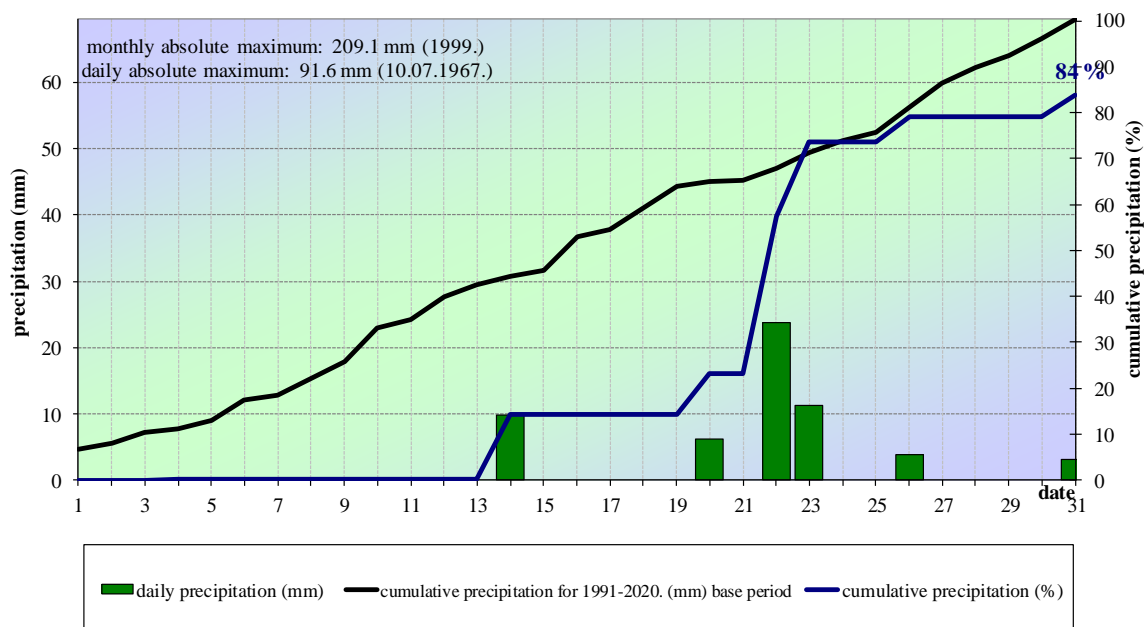
Precipitation

Daily and cumulative precipitation in Sombor

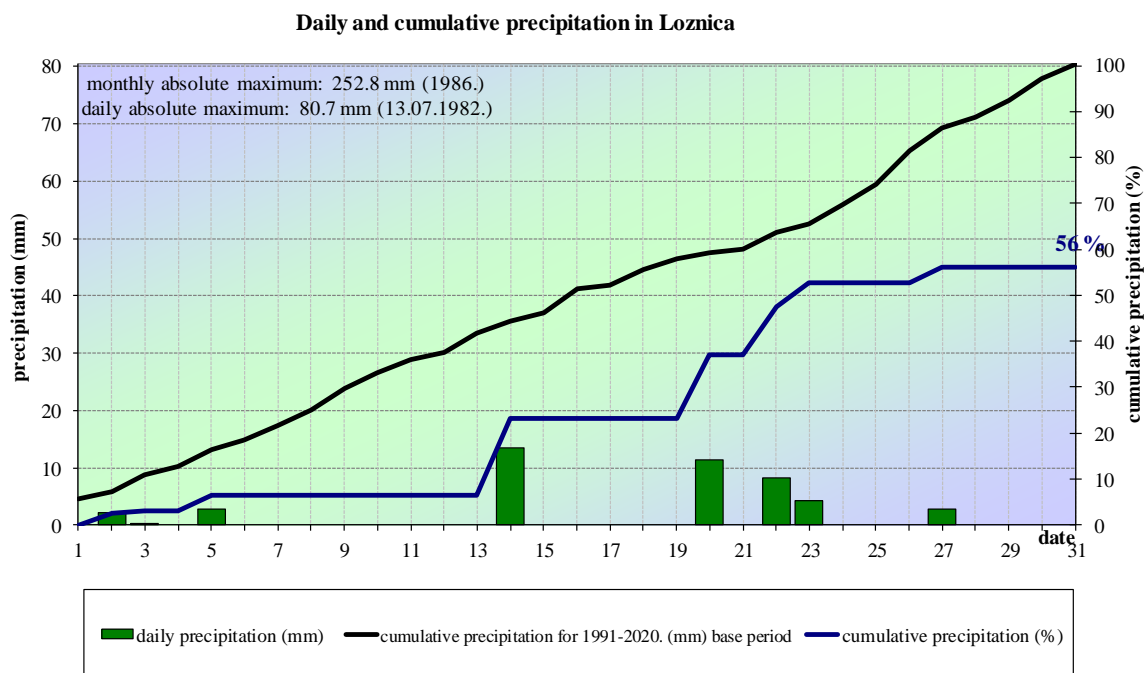


Appendix 25. Daily and cumulative precipitation sums for Sombor

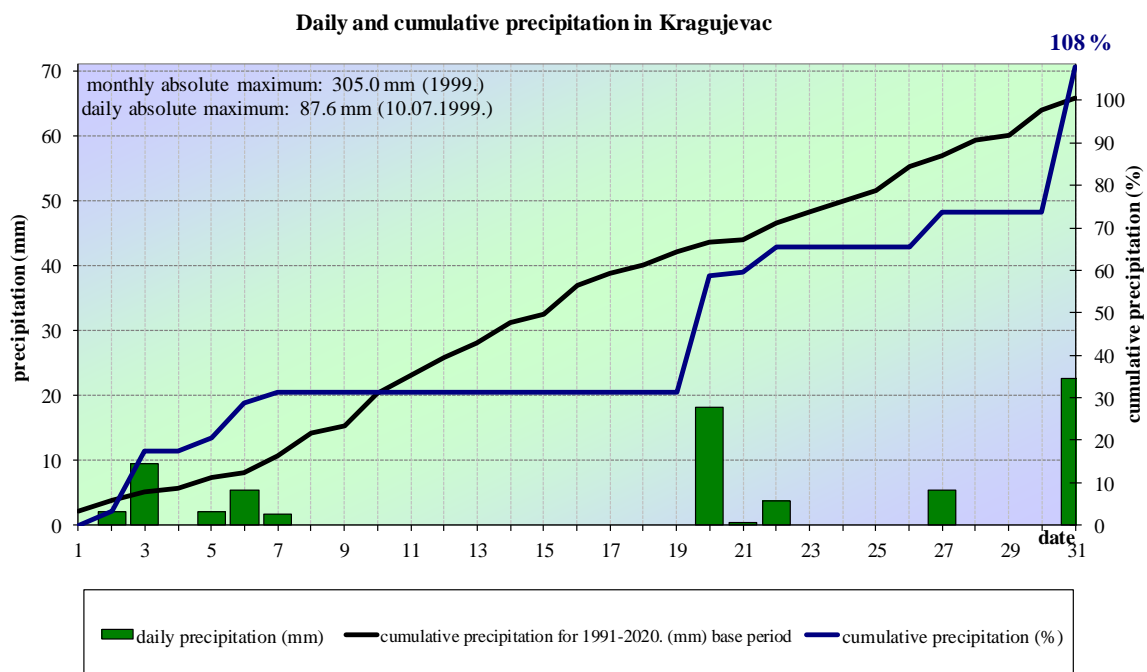
Daily and cumulative precipitation in Novi Sad



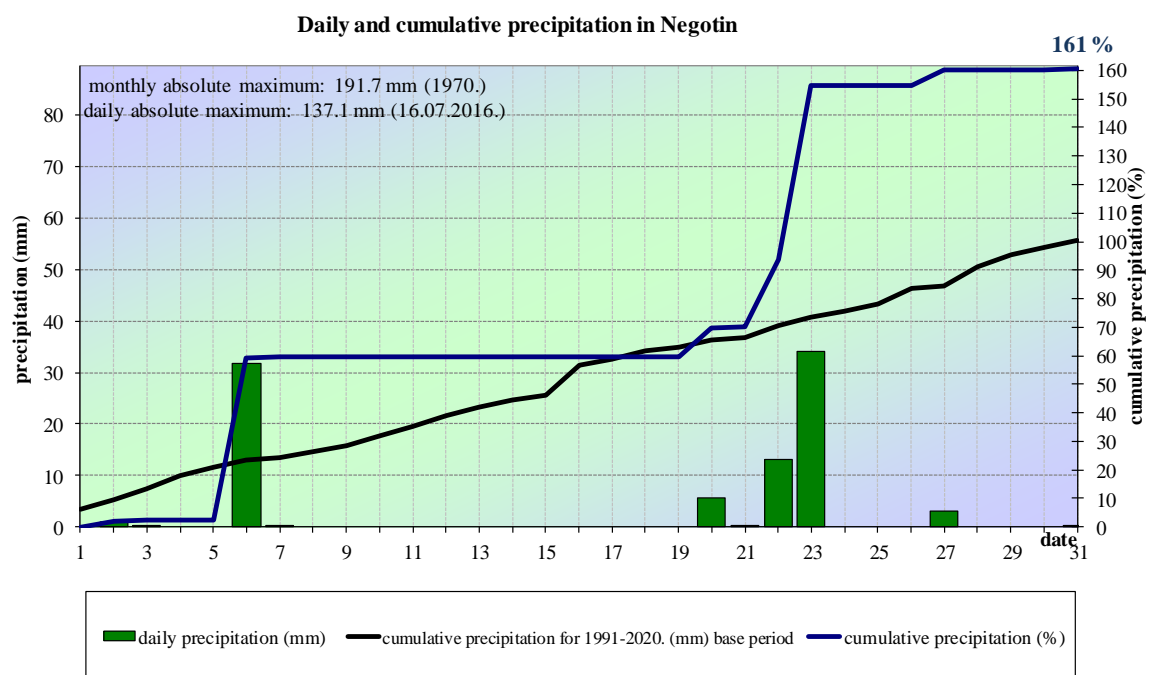
Appendix 26. Daily and cumulative precipitation sums for Novi Sad



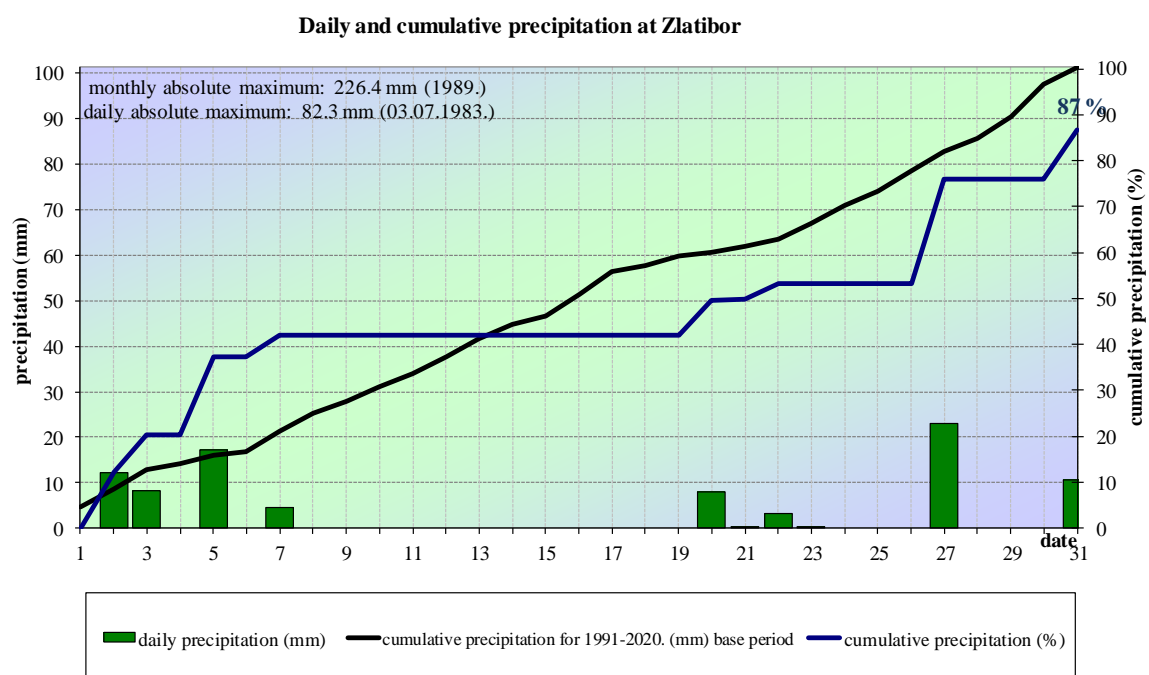
Appendix 27. Daily and cumulative precipitation sums for Loznica



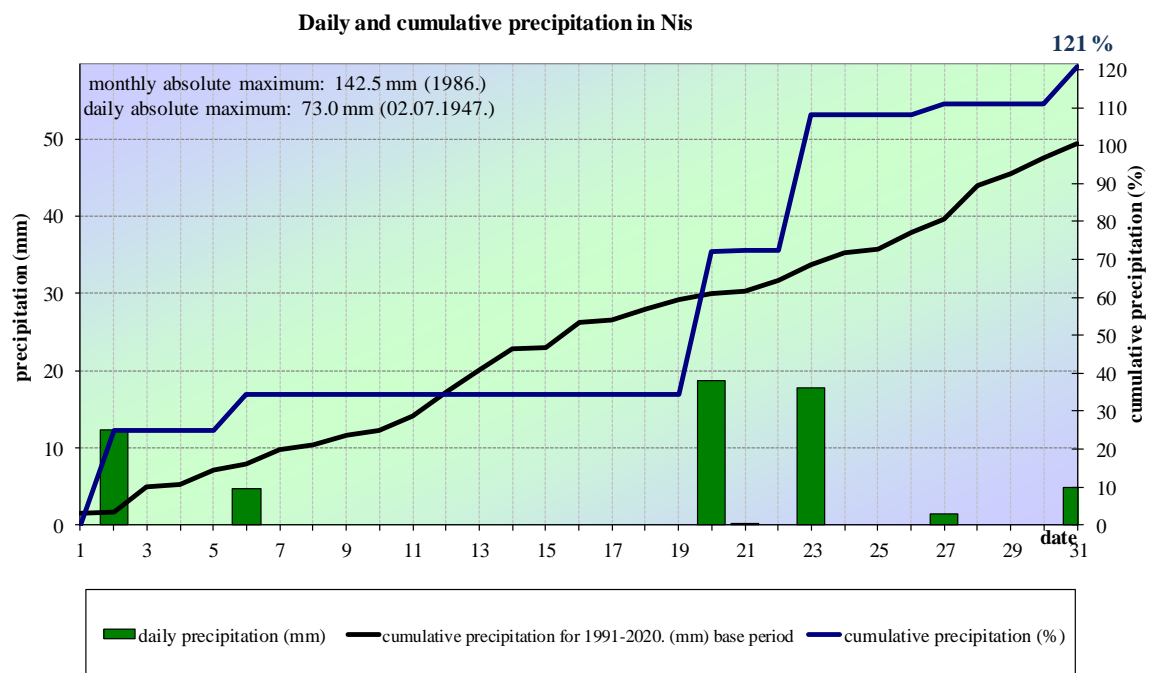
Appendix 28. Daily and cumulative precipitation sums for Kragujevac



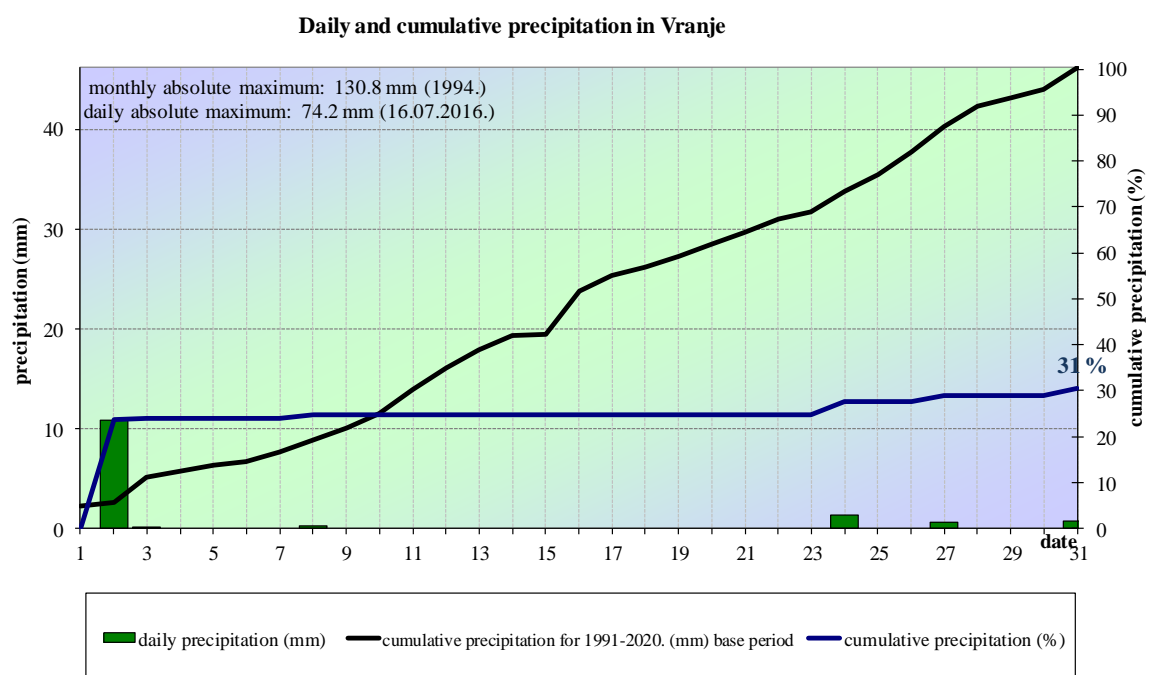
Appendix 29. Daily and cumulative precipitation sums for Negotin



Appendix 30. Daily and cumulative precipitation sums on Zlatibor



Appendix 31. Daily and cumulative precipitation sums for Nis



Appendix 32. Daily and cumulative precipitation sums for Vranje