Republic Hydrometeorological Service of Serbia
Kneza Viseslava 66
11000 Belgrade
Republic of Serbia

MONTHLY BULLETIN FOR SERBIA

SEPTEMBER 2024

Belgrade, the 5th of October 2024

Division for Climate Monitoring and Climate Forecast
Department of National Center for Climate Change, Climate Model Development and Disaster Risk Assessment
web: http://www.hidmet.gov.rs
mail: office@hidmet.gov.rs

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- ***Heat wave was recorded in the first half of September***
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- ***3rd wettest September for Novi Sad, 4th at Crni Vrh and Kursumlija***
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- ***Zrenjanin observed the highest number of days with precipitation of 20 mm and above***

AIR TEMPERATURE

Mean monthly air temperature

September 2024 was warm with mean air temperature ranging from 16,7ºC in Pozega to 20,3ºC in Belgrade, and on the mountains from 10,3ºC at Kopaonik to 14,7ºC at Zlatibor (*Figure 1*).

Departure of the mean monthly air temperature from the normal[1] for the 1991–2020 base period ranged from +0,8ºC in Sjenica and Vranje to +2,5ºC in Ćuprija (*Figure 2*).

Mean September air temperature, based on the percentile method [2], was in the warm category in most of the country, very warm in Cuprija, Loznica and Novi Sad, and normal in Negotin (*Figure 3*).

[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

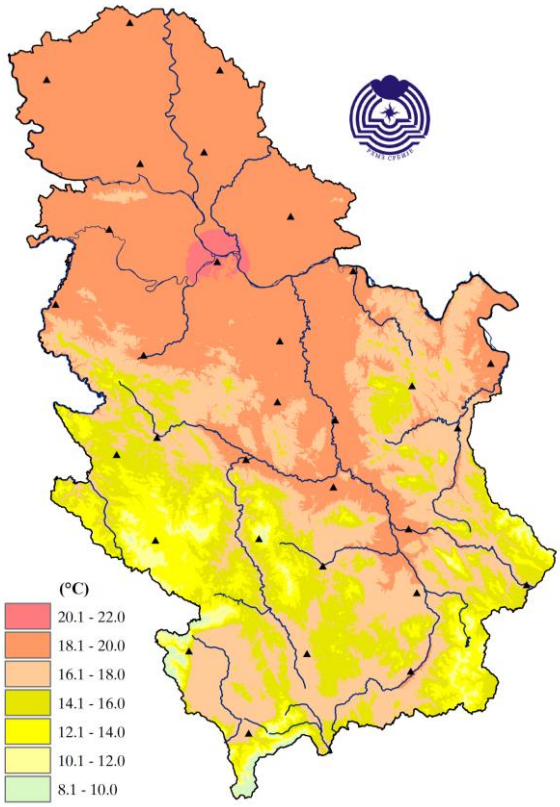


Figure 1. Spatial distribution of mean monthly air temperature (ºC)

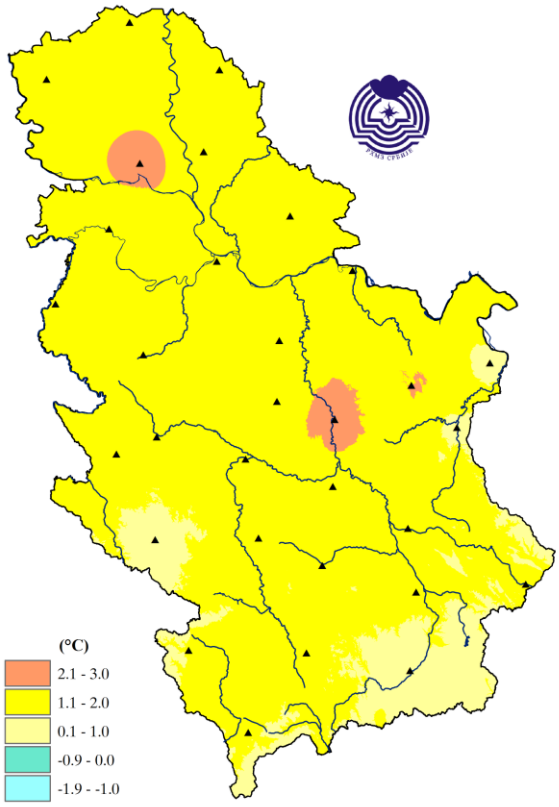


Figure 2. Spatial distribution of mean monthly air temperature anomaly (ºC)

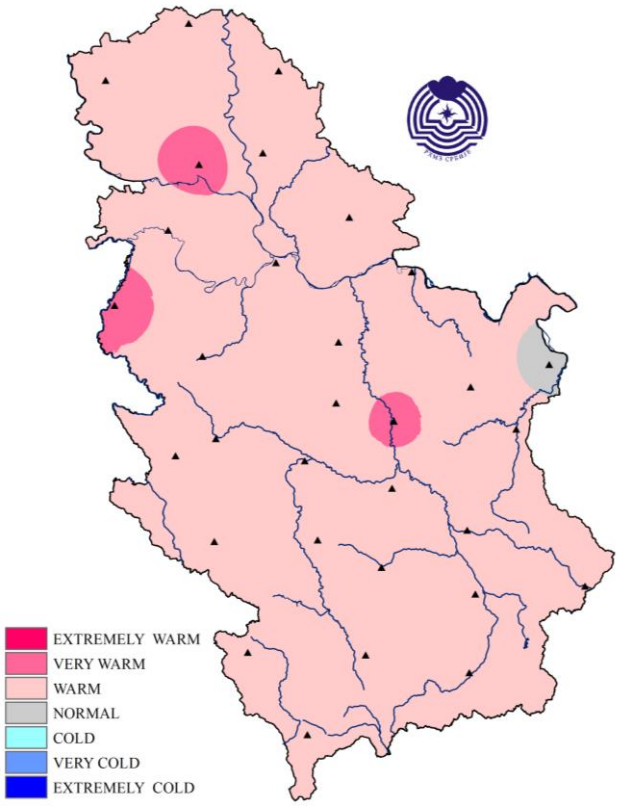


Figure 3. Spatial distribution of the mean monthly air temperature using percentile method

September 2024 was 6th warmest for Cuprija since the record-keeping began at this station (*Figure 4)*, and 10th warmest for the 1951-2024 period (*Figure 5).*

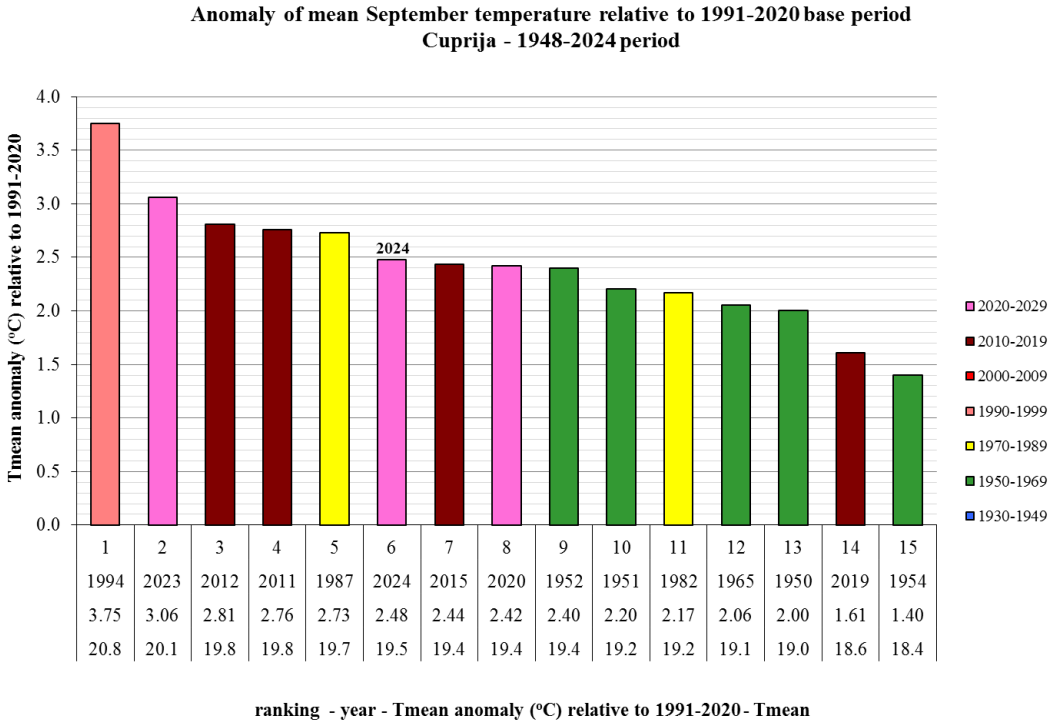


Figure 4. Rank of the warmest September in Cuprija for the period from 1948 to 2024

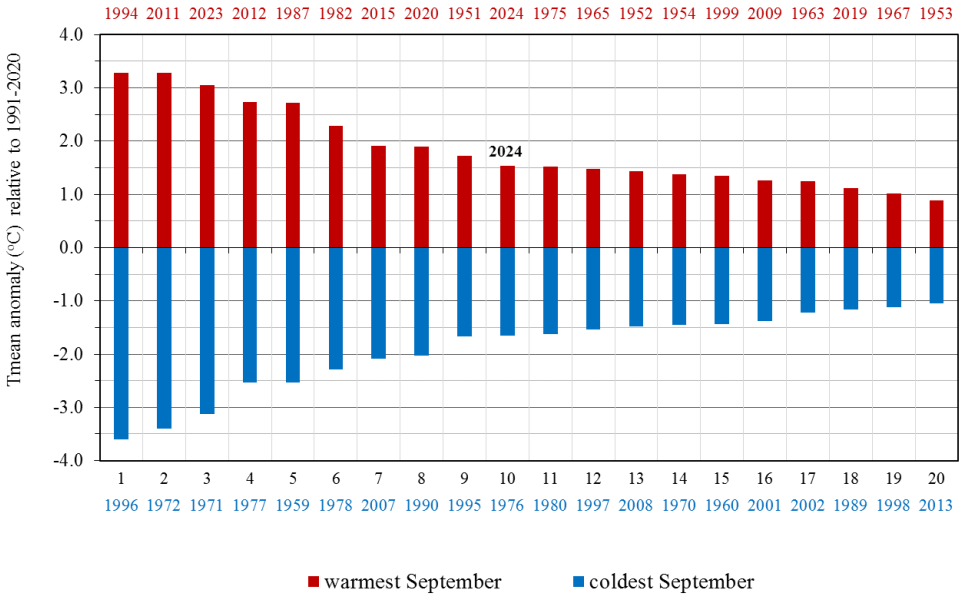


Figure 5. Rank of the warmest and coldest September in Serbia for the period from 1951 to 2024

Mean daily air temperature in Belgrade, based on the percentile method, was in the categories of very and extremely warm during most of the first decade and at the end of the third decade. In the middle of September, mean daily air temperature was in the categories of very and extremely cold (*Figure 6*). 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.

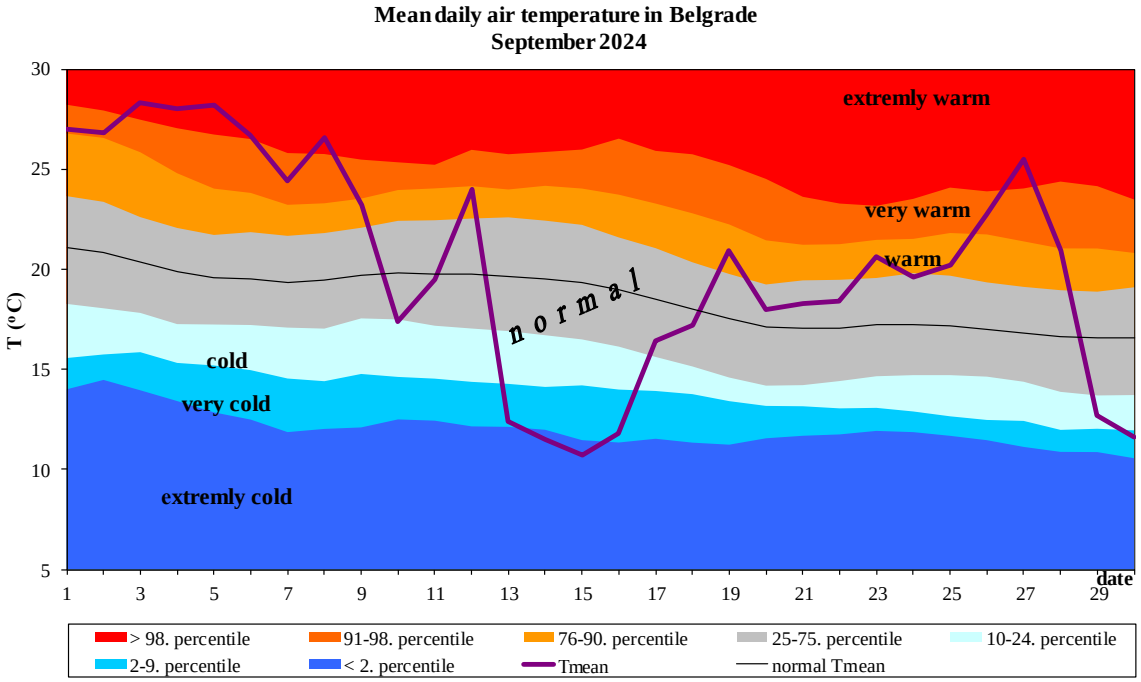


Figure 6. Daily course of the mean daily air temperature and accompanying percentiles for Belgrade

Maximum air temperature

Mean maximum air temperature in September ranged from 25,0ºC in Pozega to 27,7ºC in Cuprija, whilst 26,6°C was measured in Belgrade. On the mountains, mean maximum air temperature ranged from 14,5ºC at Kopaonik to 20,7ºC in Sjenica.

Based on the percentile method, mean maximum monthly air temperature was in the warm category in most of the country, very warm at Crni Vrh, and normal at Zlatibor and Sjenica.

The highest maximum daily air temperature of 38,3ºC was measured in Cuprija on September 3 thereby equaling the previous September record set on September 1, 2015. Sombor observed the maximum air temperature of 36,6ºC thereby **breaking previous September record** of 36,5ºC set on September 18, 2015.

On September 3, Belgrade recorded air temperature of 36,5ºC which was the highest air temperature during September.

Summer days[3] recorded in the entire country, ranging from 14 days in Pozega to 22 days in Nis, while Belgrade registered 19 summer days. On the mountains, summer days were not recorded at Kopaonik, while Zlatibor and Sjenica observed the highest number of summer

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

days, total of 10 days. The observed number of summer days was 3 to 6 days above September average in most of the country.

Number of tropical days[4] ranged from 9 to 11 days. On the mountains, there was 1 tropical day at Crni Vrh. At most places, the observed number of tropical days was from 5 to 7 days above September average.

Most of Serbia recorded 2 to 5 days with the air temperature of 35ºC and above which is the highest ever recorded number during September (*Table 1).*

Table 1. Record-breaking number of days with air temperature of 35ºC and above

MMS	number of days Tmax≥35ºC September 2024	previous record Tmax≥35ºC	year of Tmax≥35ºC
PALIC	**2**	1	2008/2015
SOMBOR	**4**	2	2008/2015
NOVI SAD	**4**	3	2015
ZRENjANIN	**4**	3	2015
KIKINDA	**4**	3	2015
B.KARLOVAC	**4**	3	2015
LOZNICA	**5**	3	1987/2015
S.MITROVICA	**4**	3	2015

In most of the country, heat wave [5] began at the end of August and lasted until 8 September at most stations (*Table 2)*, with the longest duration (17 days) in Sombor, from August 23 to September 8, and 16 days on Palic, from August 24 to September 8.

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

[5] Heat wave is, 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 consecutive days or longer

Table 2. Heat waves in Serbia

HEAT WAVES IN SERBIA - SEPTEMBER 2024

(relative to the 1991-2020 base period)

SEPTEMBER

station/day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PALIC	EW	EW	EW	EW	EW	VW	VW	VW	EW																					
SOMBOR	EW	EW	EW	EW	EW	VW	VW	VW	EW																					
KIKINDA	EW	EW	EW	EW	EW	VW	VW	VW	EW																					
ZRENJANIN	EW	EW	EW	EW	EW	VW	VW	VW	EW																					
NOVI SAD	EW	EW	EW	EW	EW	EW	EW	VW	EW																					
SR.MITROVICA	EW	EW	EW	EW	EW	EW	VW	VW	EW																					
BELGRADE	EW	EW	EW	EW	EW	EW	VW	VW	EW																					
LOZNICA	EW	EW	EW	EW	EW	EW	EW	EW	EW																					
VALJEVO	VW	EW	EW	EW	EW	EW	VW	VW	EW																					
V.GRADISTE	EW	EW	EW	EW	EW	VW																								
SM.PALANKA	EW	EW	EW	EW	EW	EW	VW	VW	VW																					
KRAGUJEVAC		VW	EW	EW	EW	VW	VW	VW	VW																					
KRALJEVO	VW	EW	EW	EW	EW	EW	EW	VW	EW																					
POZEGA	VW	EW	EW	EW	EW	EW	EW	VW	EW																					
ZLATIBOR		VW	VW	EW	VW	VW	VW	VW	EW																					
CUPRIJA	EW	VW	EW	EW	EW	VW	VW	VW	VW																					
KRUSEVAC	VW	VW	EW	EW	EW	VW	VW	VW	VW	VW																				
NEGOTIN	EW	EW	EW	EW	EW																									
ZAJECAR																														
CRNI VRH	VW	EW	EW	EW	EW	VW																								
KOPAONIK			VW	EW	EW	EW	EW	VW	VW																					
SJENICA		VW	VW	EW	VW	VW	VW	EW	EW																					
NIS		VW	EW	EW	EW	VW	VW	VW	VW	VW																				
VRANJE		VW	VW	VW	EW	VW	VW	VW	VW																					
DIMITROVGRAD																														
LESKOVAC		VW	VW	EW	EW	VW	VW	VW	VW	VW																				
KURSUMLIJA		VW	EW	EW	EW	VW	VW	VW	VW	VW																				
B.KARLOVAC	EW	EW	EW	EW	EW	VW	VW	VW	VW																					

EW	EXTREMELY WARM
VW	VERY WARM

Figure 7 shows daily course of the maximum daily air temperature and the accompanying percentiles for Belgrade in September 2024 and for the stations Sombor, Novi Sad, Loznica, Negotin, Kragujevac, Zlatibor, Nis and Vranje are given in the Appendix.

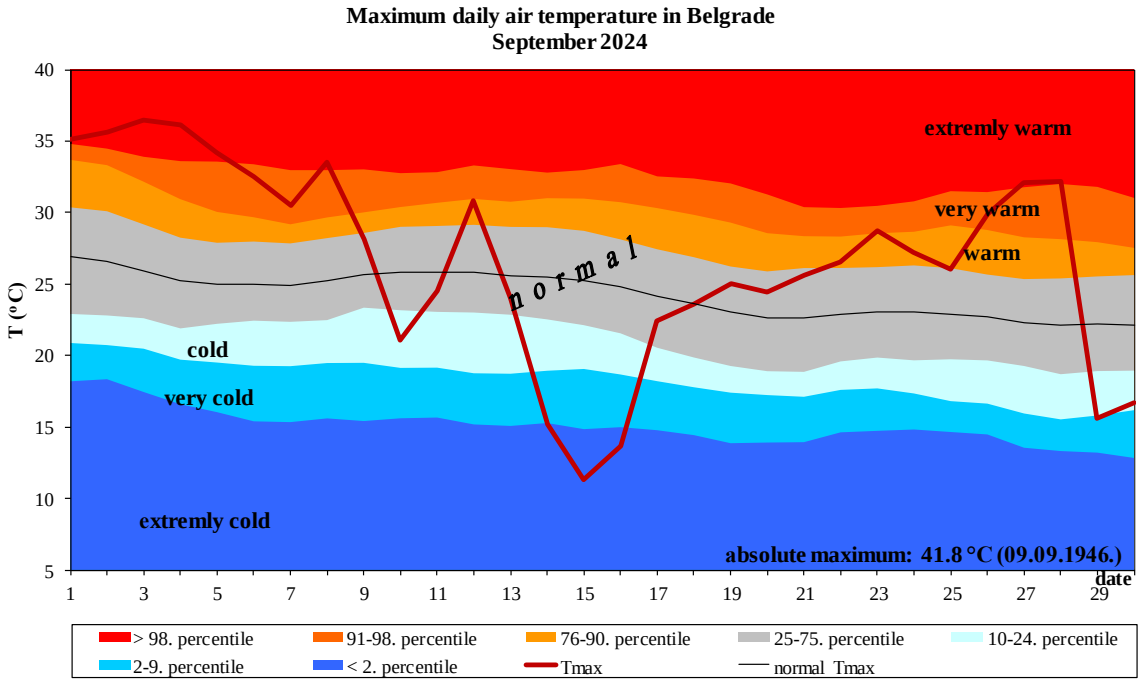


Figure 7. Daily course of the maximum daily air temperature and accompanying percentiles for Belgrade

Minimum air temperature

Mean minimum air temperature in September ranged from 10,4ºC in Pozega to 15,4ºC in Belgrade. On the mountains, mean minimum air temperature ranged from 6,9ºC in Sjenica and Kopaonik to 10,9ºC at Crni Vrh.

Based on the percentile method, mean minimum monthly air temperature was in the following categories: warm in most of the country, very warm in Banatski Karlovac and Cuprija, normal in Sremska Mitorvica, Valjevo, Negotin, Sjenica, Pozega, Kraljevo, Zajecar and Vranje.

The lowest minimum daily air temperature of -1,4ºC was measured on September 30 at Kopaonik. In the lowland, the lowest daily air temperature of 3,4ºC was measured in Zajecar and Dimitrovgrad on September 22. On the same day, Belgrade observed the lowest monhtly air temperature of 7,0ºC.

Seven tropical nights[6] was recorded in Belgrade, 4 in Veliko Gradiste and Nis, 3 in Novi Sad, Smederevska Palanka and Cuprija, 2 on Palic, Zrenjanin, Kikinda and Kraljevo, and 1 in Banatski Karlovac and Kragujevac. At five meteorological stations, **the maximum number of tropical nights for September was exceeded** (*Table 3).*

Table 3. Record-breaking number of tropical nights for September

MMS stations	Number of tropical nights September 2024	The previous record of tropical nights	Year of the previous record
NOVI SAD	**3**	1	2009/2011
S. PALANKA	**3**	1	1952/2011/2012/2015
KRALjEVO	**2**	1	1994/2012
CUPRIJA	**3**	2	1952/1994
NIS	**4**	3	1994

Figure 8 shows assessment of the minimum and maximum air temperature in Serbia for September based on the tercile distribution relative to the 1991-2020 base period. It can be noted that the mean maximum and minimum air temperature were above the upper tercile.

[6] Tropical night refers to a day with minimum daily air temperature 20°C and above

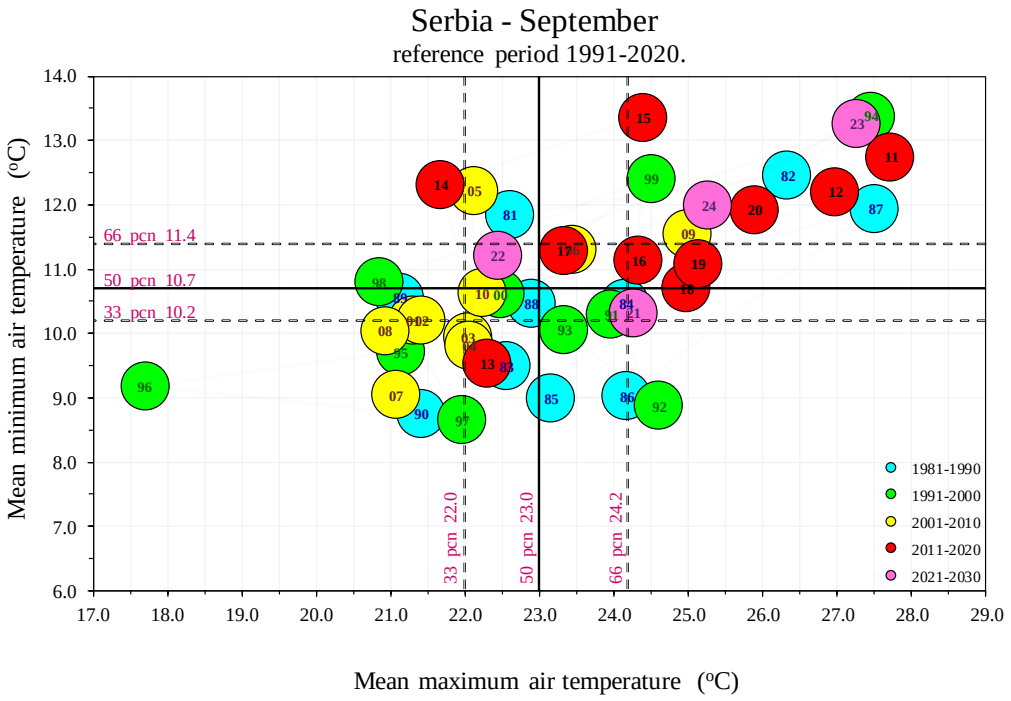


Figure 8. Assessment of minimum and maximum air temperature for Serbia with the accompanying terciles in relation to the 1991-2020 base period

Figure 9 shows daily course of the minimum daily air temperature and the accompanying percentiles for Belgrade in September 2024, and for the stations Sombor, Novi Sad, Loznica, Negotin, Kragujevac, Zlatibor, Nis and Vranje are given in the Appendix.

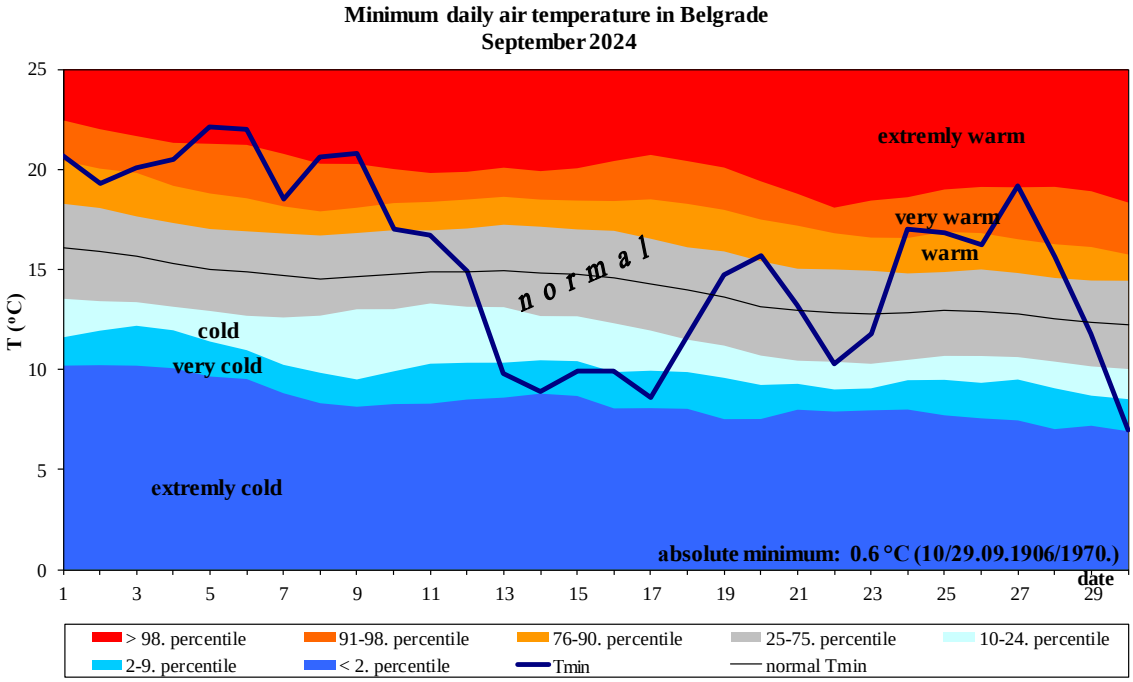


Figure 9. Daily course of the minimum daily air temperature and accompanying percentiles for Belgrade

PRECIPITATION

September was rainy in most of Serbia. September 2024 was 3rd wettest for Novi Sad (*Figure 10)* and 4th wettest for Kursumlija (*Figure 11)* and Kopaonik since the record-keeping began. This September ranks as **the 8th** wettest for Serbia for the 1951-2024 period (*Figure 12*).

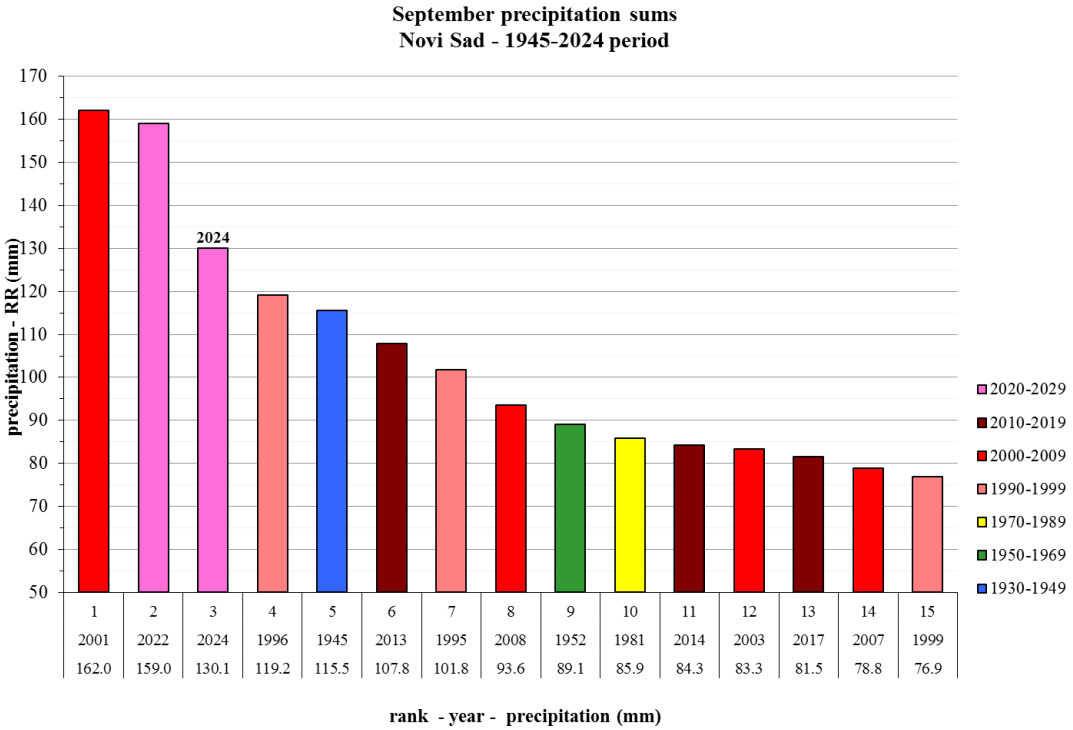


Figure 10. Rank of the highest precipitation in Novi Sad

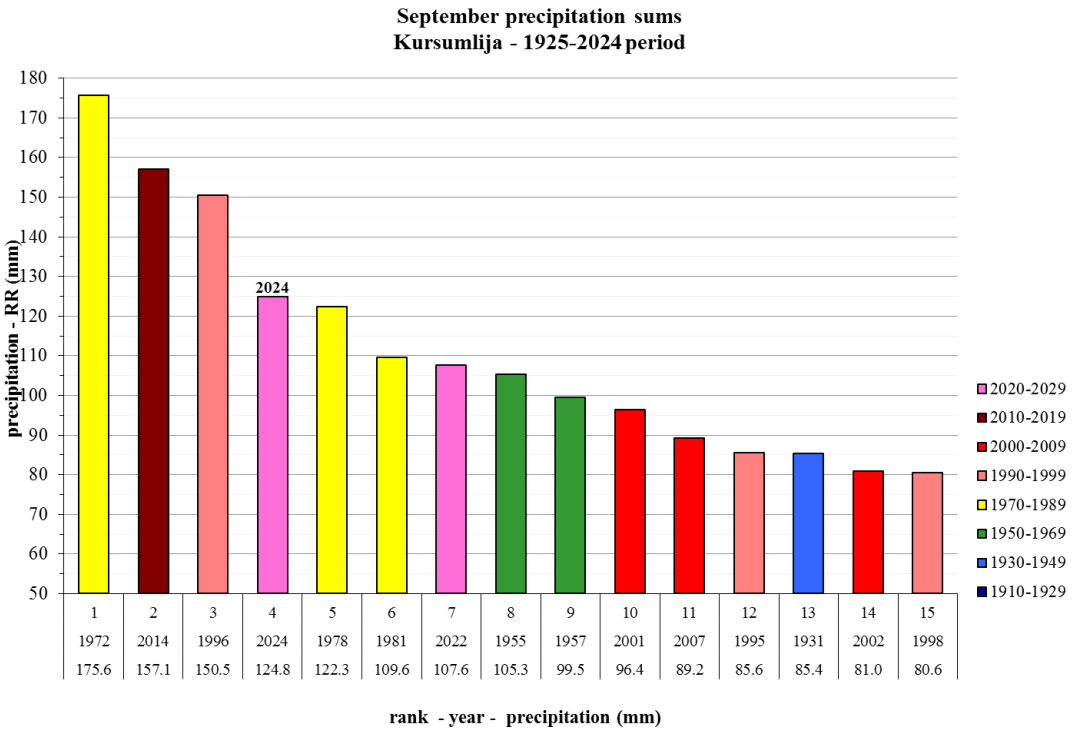


Figure 11. Rank of the highest precipitation in Kursumlija

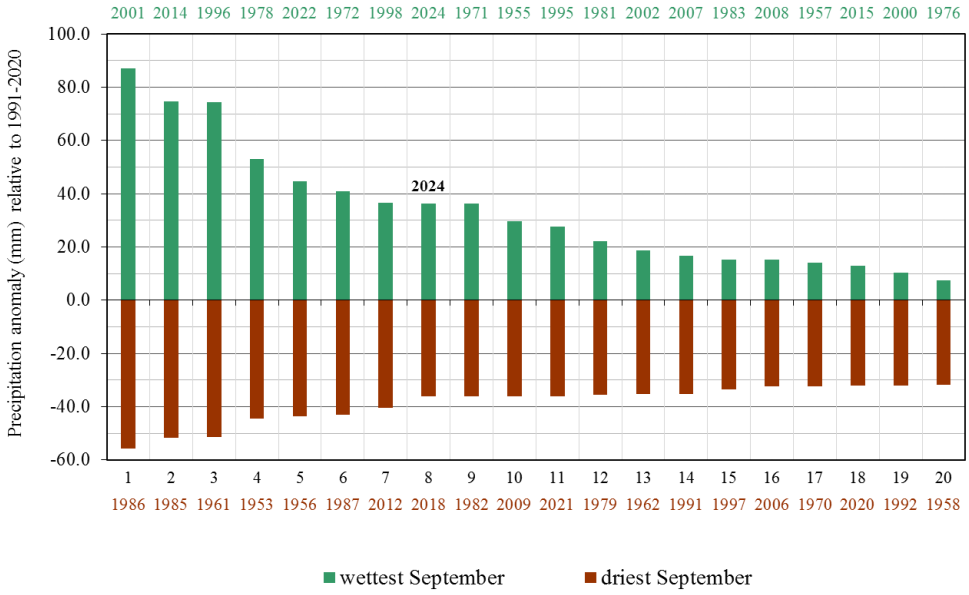


Figure 12. Rank of the wettest and driest September in Serbia for the period from 1951 to 2024

September precipitation sums ranged from 32,1 mm in Negotin to 168,5 mm at Kopaonik, while Belgrade observed 98,0 mm (*Figure 13*).

Precipitation totals compared to the normal for the 1991-2020 base period ranged from 59% in Negotin to 228% in Kursumlija (*Figure 14*).

Based on the percentile method, precipitation sums were in the categories of rainy and very rainy in most of the country, normal in Veliko Gradiste, Negotin, Sjenica, Zajecar, Dimitrovgrad, Crni Vrh and Zlatibor (*Figure 15*).

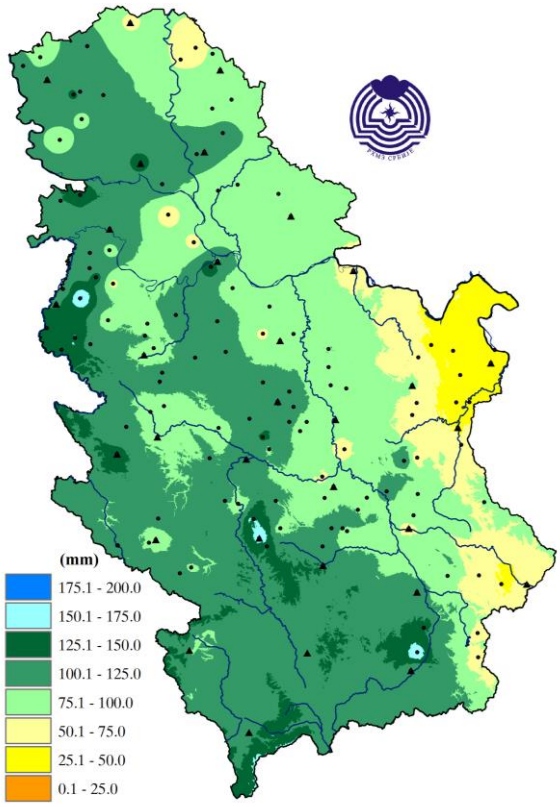


Figure 13. Spatial distribution of the monthly precipitation sums (mm) according to data from 28 major meteorological, 25 climatological and 87 rain gauge stations

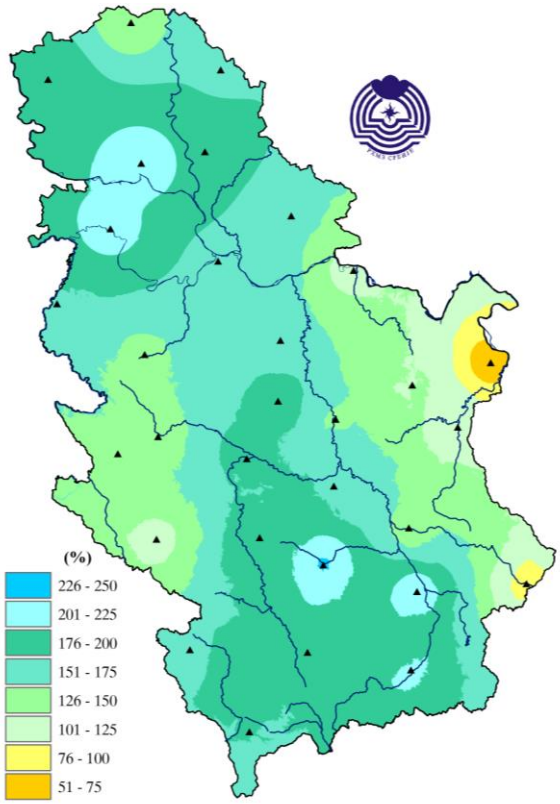


Figure 14. Spatial distribution of the monthly precipitation sums in the percentages of normal for the 1991–2020 base period

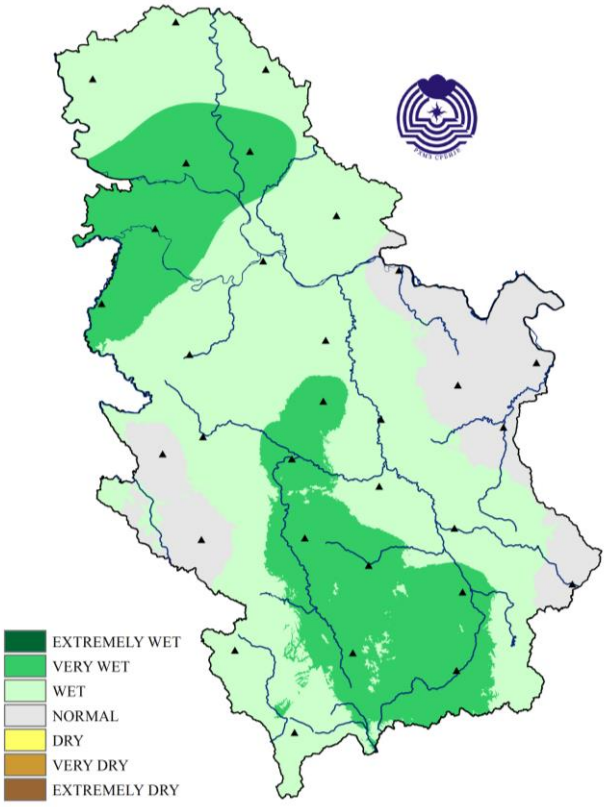


Figure 15. Monthly precipitation sums according to the percentile method

The highest daily precipitation sum of 59,6 mm was measured in Kursumlija on September 11 thereby **breaking the previous record** for this station of 54,6 mm set on September 1, 1978. On September 29, Belgrade observed the highest daily precipitation sum of 18,9 mm.

Number of days with precipitation ranged from 6 in Zajecar to 17 at Kopaonik (*Figure 16).* The observed number of days with precipitation was 2 to 4 days above the average in the southern Serbia and 6 days above September average in Vranje (*Figure 17*).

Zrenjanin observed 3 days with daily precipitation sum of 20 mm and above, which is the **highest ever** September value for this station (the previous record was 2 days).

One day with precipitation of 50 mm and above was registered in Kraljevo, Kursumlija, Krusevac and Kopaonik.

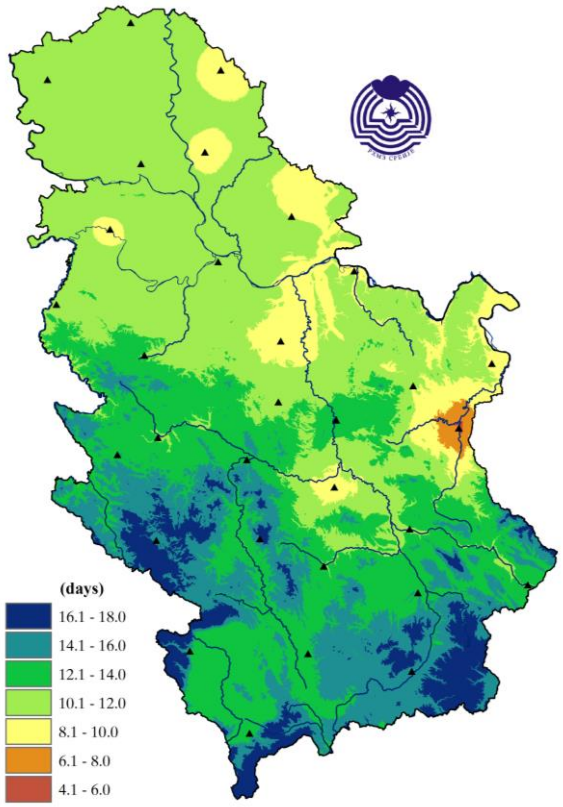


Figure 16. Spatial distribution of number of days with precipitation

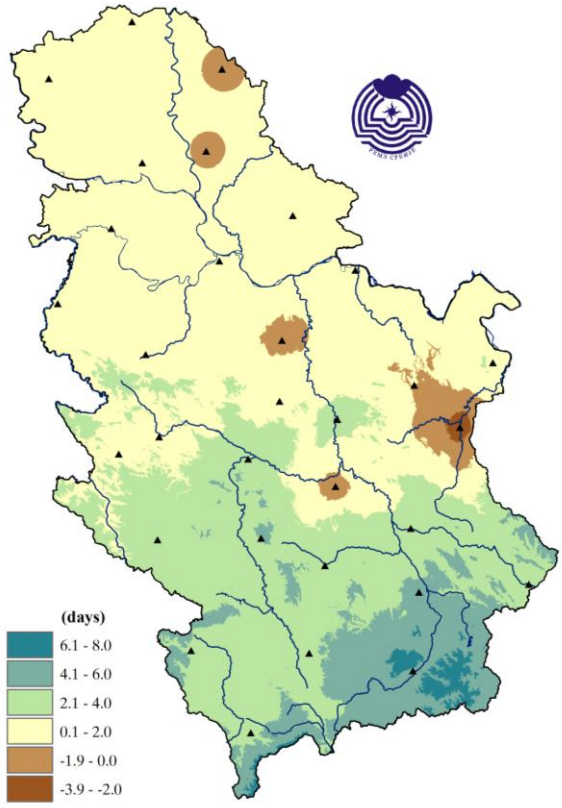


Figure 17. Spatial distribution of deviation of number of days with precipitation

Figure 18 shows assessment of air temperature and precipitation sums for Serbia for September based on the tercile distribution relative to the 1991 – 2020 base period. It can be noted that September 2024 was marked by air temperature and precipitation sums above the upper tercile threshold.

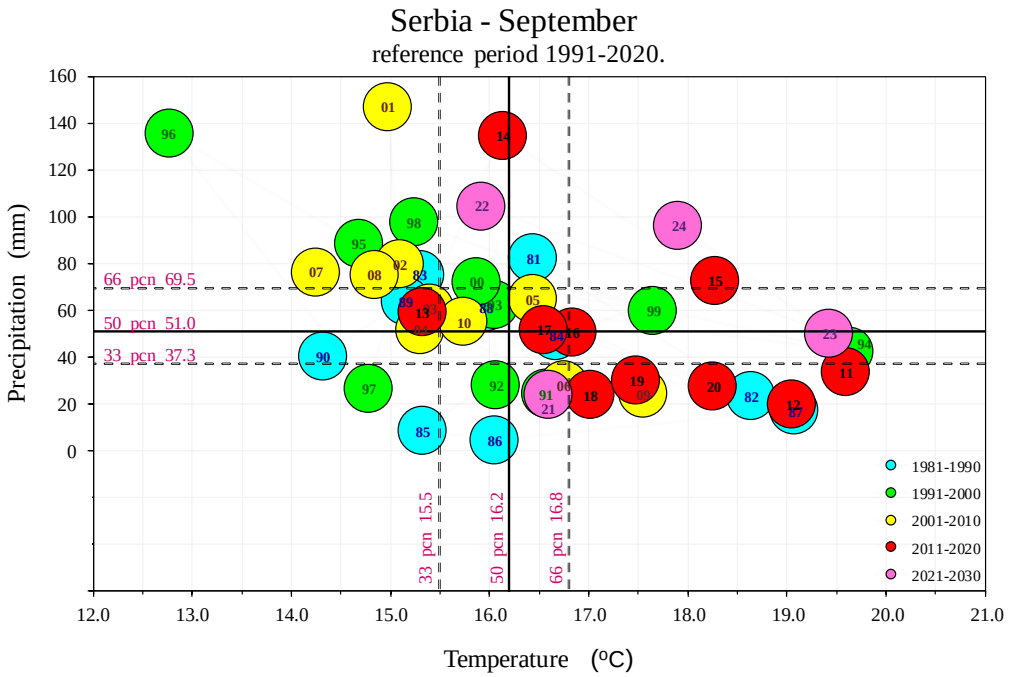


Figure 18. Assessment of air temperature and precipitation for Serbia with the accompanying terciles in relation to the 1991-2020 base period

Figure 19 show daily and cumulative precipitations sums with averaged normal 1991-2020 for September in Belgrade, and for the stations Sombor, Novi Sad, Loznica, Negotin, Kragujevac, Zlatibor, Nis and Vranje precipitation sums are given in Appendix.

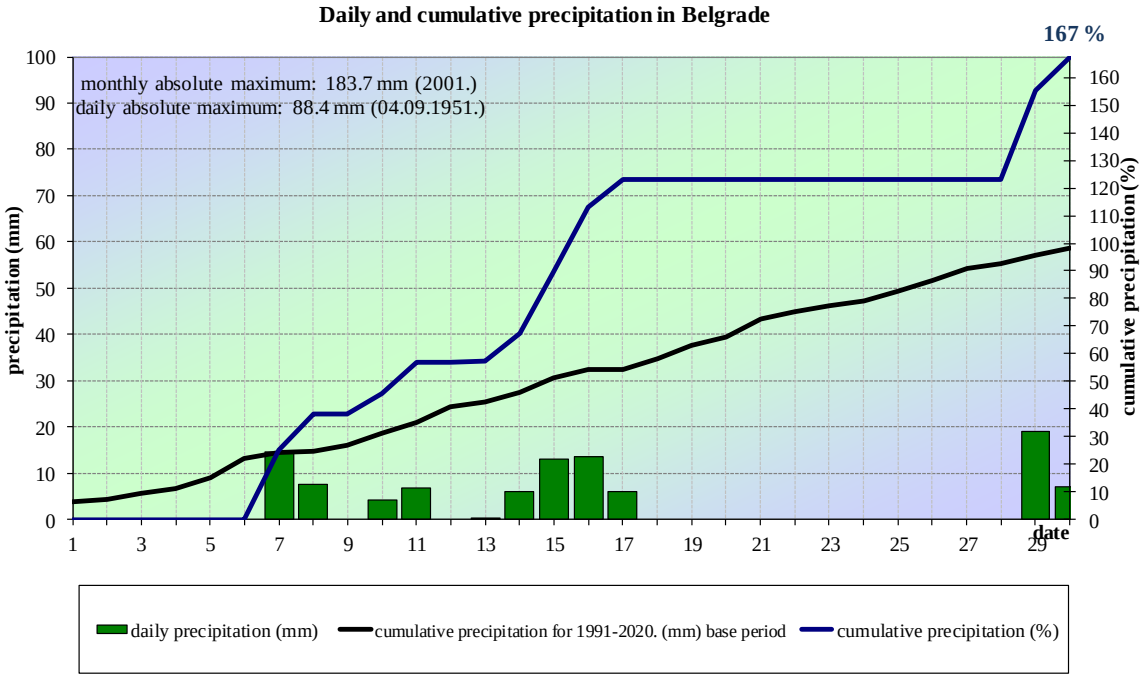


Figure 19. Daily and cumulative precipitation in Belgrade

CLOUD COVER, BRIGHT AND CLOUDY DAYS

Mean September cloud cover in Serbia was around the average, ranging from 4/10 to 6/10. Average daily cloud cover in September for Belgrade, Kopaonik and Nis is shown in Figures 20, 21 and 22.

Number of bright days[7] ranged from 4 in Pozega and Kopaonik to 11 in Banatski Karlovac and Crni Vrh. Belgrade observed 10 bright days. The observed number of bright days was around the average in most of the country.

Number of cloudy days[8] was in a range from 6 in Novi Sad, Veliko Gradiste and Crni Vrh, to 11 at Zlatibor, whilst Belgrade observed 8 days. Number of cloudy days was around September average in most of the country.

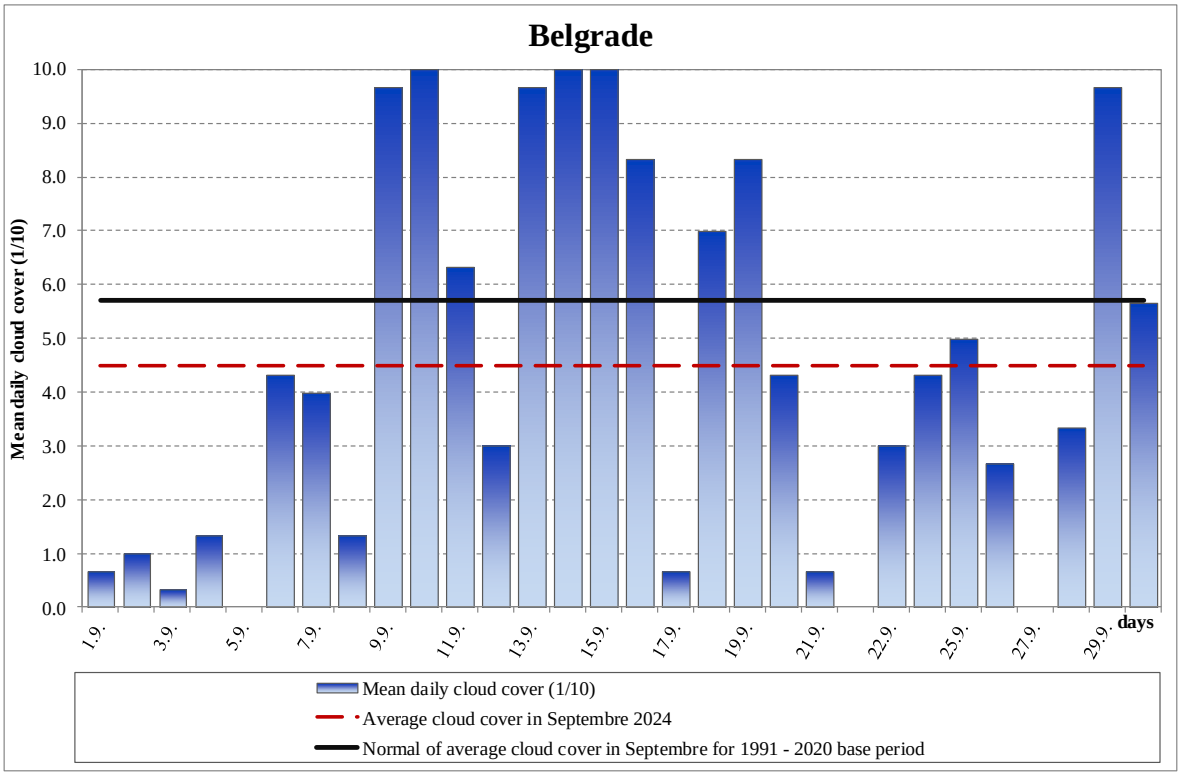


Figure 20. Mean daily cloud cover in Belgrade

[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

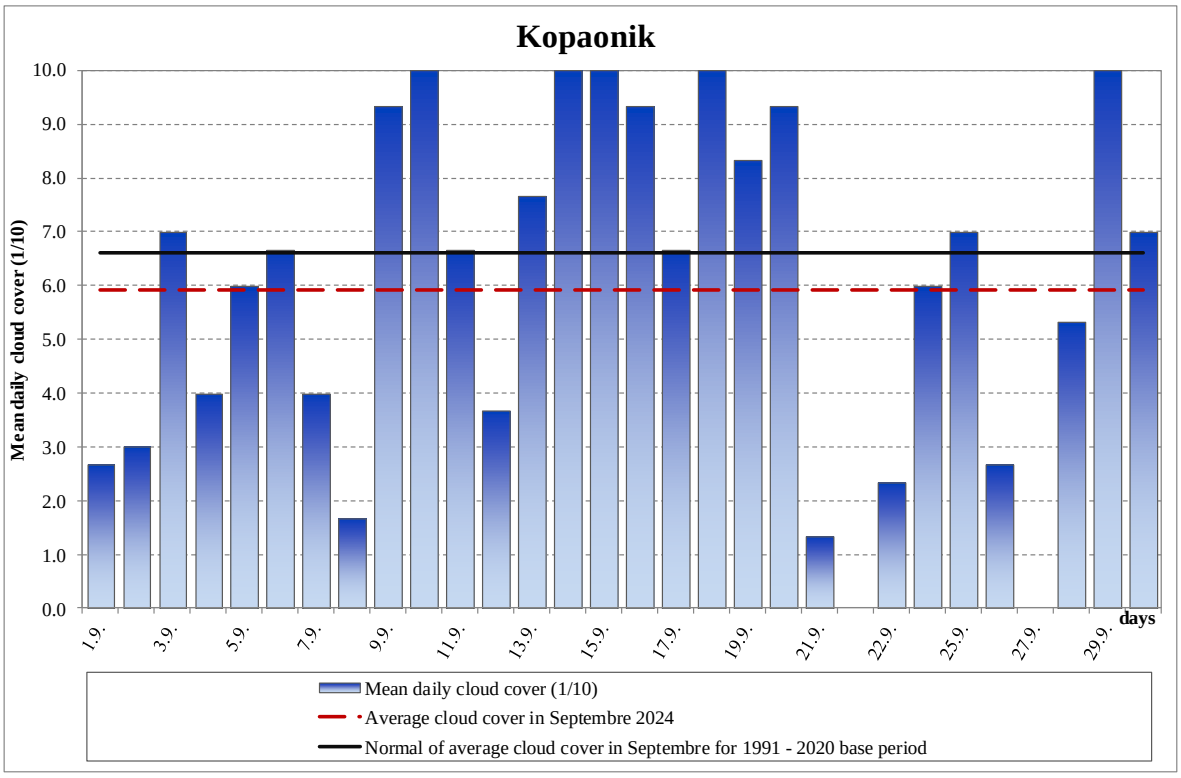


Figure 21. Mean daily cloud cover on Kopaonik

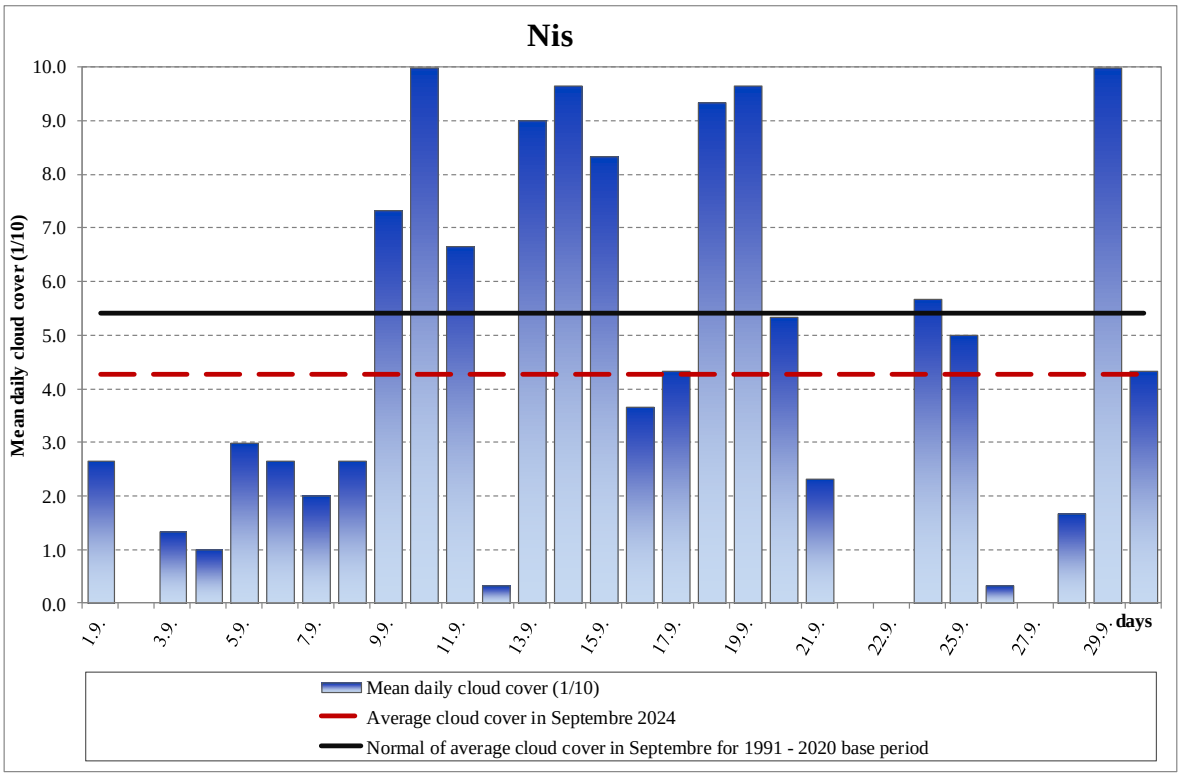


Figure 22. Mean daily cloud cover in Nis

SUNSHINE DURATION (INSOLATION)

September insolation ranged from 141,5 časova at Kopaonik to 219,6 hours in Novi Sad (*Figure 23*).

September insolation ranged from 76% at Kopaonik to 110% in Požegi compared to the normal for the 1991-2020 base period (*Figure 24).*

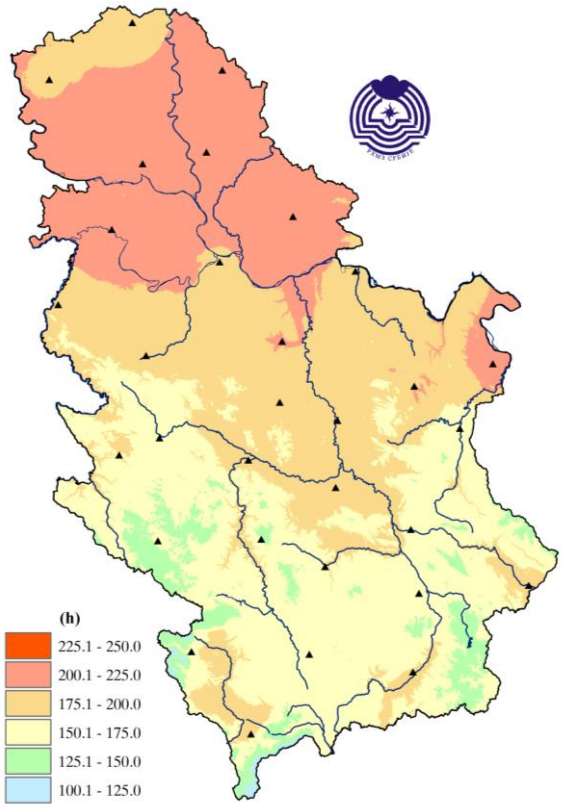


Figure 23. Insolation, expressed in hours

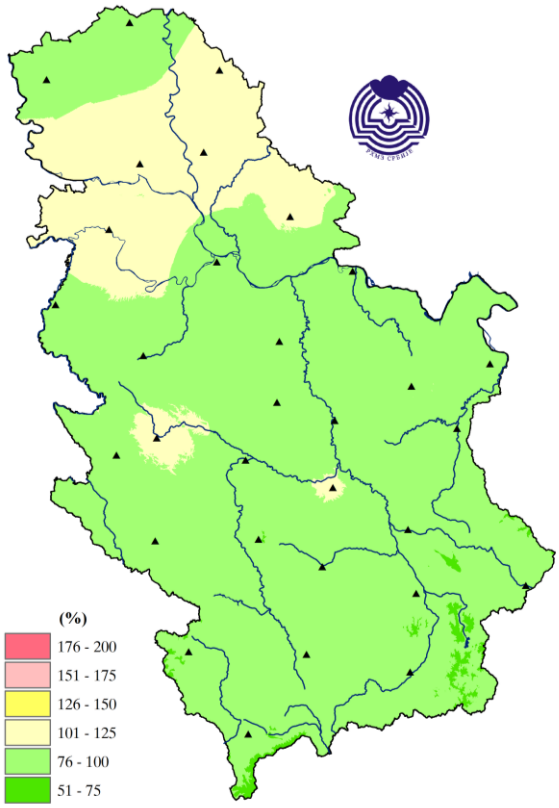


Figure 24. Insolation expressed in the percentages of normal

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

OVERVIEW OF THE SYNOPTIC SITUATION*

Cyclonal circulation in the northwest and north of the continent, a weak gradient of geopotential above the Balkans, changeable weather with rain and showers, and noticeably colder; then pronounced southwest upper-air circulation and development of surface low pressure; relatively warm and changeable weather, locally with rain and thunderstorms. By the end of the month, a cold atmospheric front and significant cooling.

Period until the middle of the first decade was characterized by very warm, dry, and mostly sunny weather due to the influence of the periphery of an anticyclone from the north and northeast of the continent, along with a mild ridge within a spatial upper-air depression centered in the North Sea. Period as of the middle of the first decade was marked by unsettled weather. Initially, it remained very warm but humid, with local showers and thunderstorms, more frequent in the western and northern regions, due to the passage of a low pressure and waves of moist air from the western Mediterranean, across the northern Adriatic toward the Pannonian Plain. Specifically, the mentioned upper-air low pressure moved toward the Bay of Biscay, simultaneously deepening, which caused the development of surface low pressures and accompanying waves of moist air in the western Mediterranean and Central Europe.

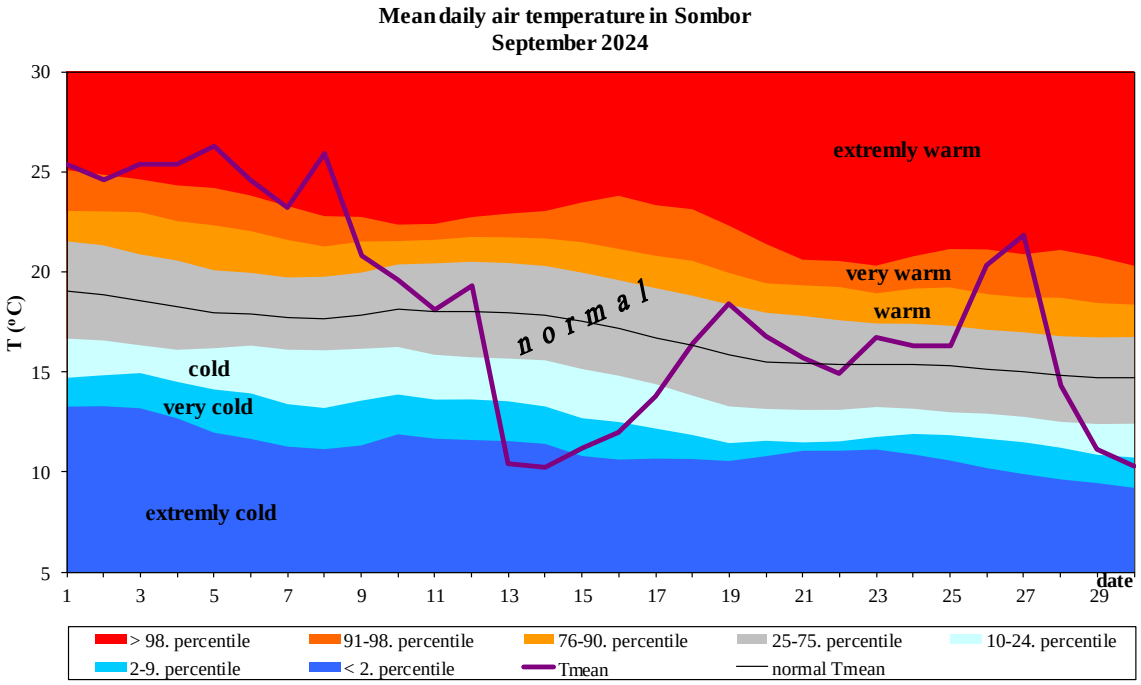
In a subsequent period, at the end of the first and the beginning of the second decade, there was a short-lived noticeable cooling, with heavy rain and showers, due to the passage of a low pressure and a cold front, alongside a pronounced meridional disturbance within the spatial North Atlantic circulation. Consequently, the following period, most of the second decade, weather was influenced by upper air low pressure. Initially, through the strengthening of the southwest upper-air circulation across our region, accompanied by development in western Europe and the western Mediterranean, followed by further deepening and its transfer from the Adriatic toward the Pannonian Plain and the Carpathians. The weather was changeable and noticeably colder, with scattered rain, showers, and thunderstorms. In the middle of the month, a significant amount of precipitation was observed in the north, and then in the west, southwest, and south of the country. By the end of the second decade, the upper-air low pressure from the Central Europe was in retrograde movement over the Alps and the northern Adriatic toward the western Mediterranean.

During most of the third decade, the weather was relatively stable across much of the country owing to the weak gradient of low air pressure and a mild ridge from the central Mediterranean, along with a temporary establishment of an omega pattern over the western and central Balkans. Subsequently, a southwest upper-air circulation developed due to the formation and deepening of an upper-air depression in the north and northwest of the continent, bringing warm weather. This period was marked by unstable conditions with short-lived showers in the west, southwest, and south, and occasionally in the north as well. By the end of the month, a cold front passed from the northwest, along with a ridge of low pressure moving across Serbia toward the east. The weather was cloudy and cold, with rain, local showers, and thunderstorms.

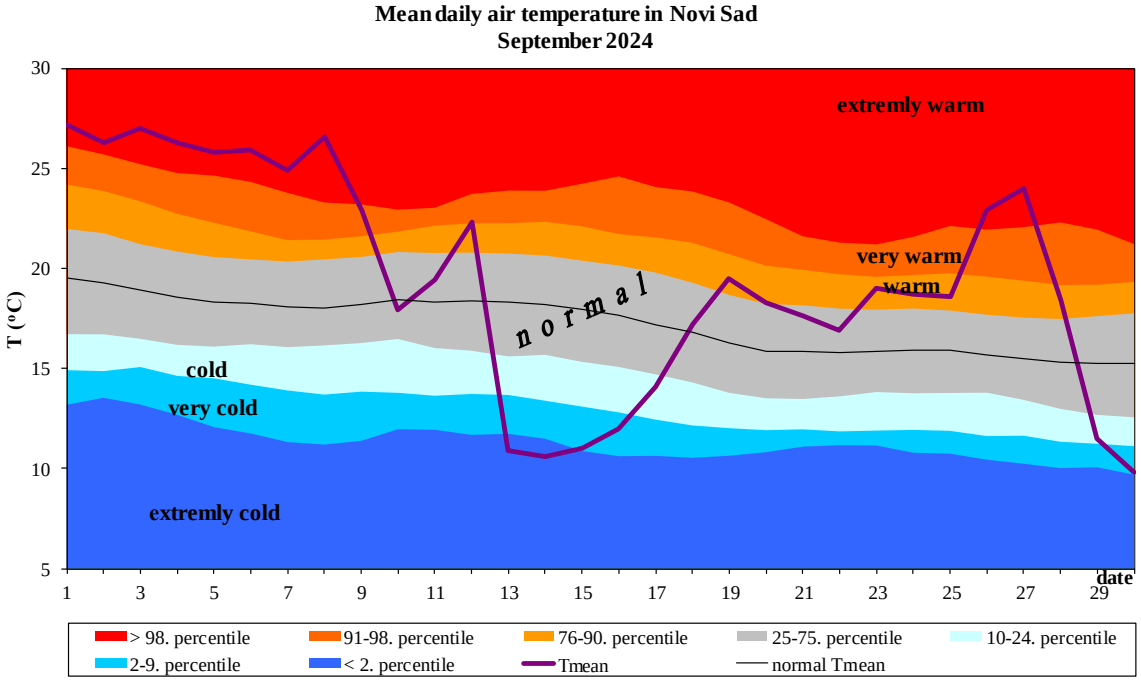
* National Center for Hydrometeorlogical Early Warning System

APPENDIX

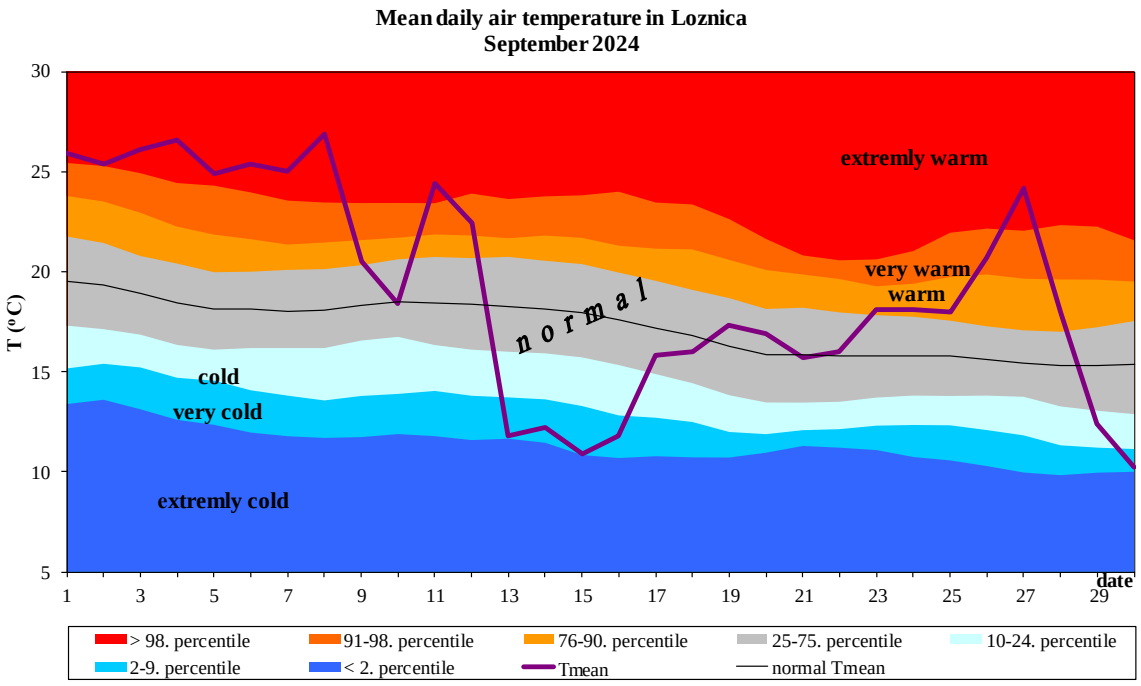
Mean air temperature



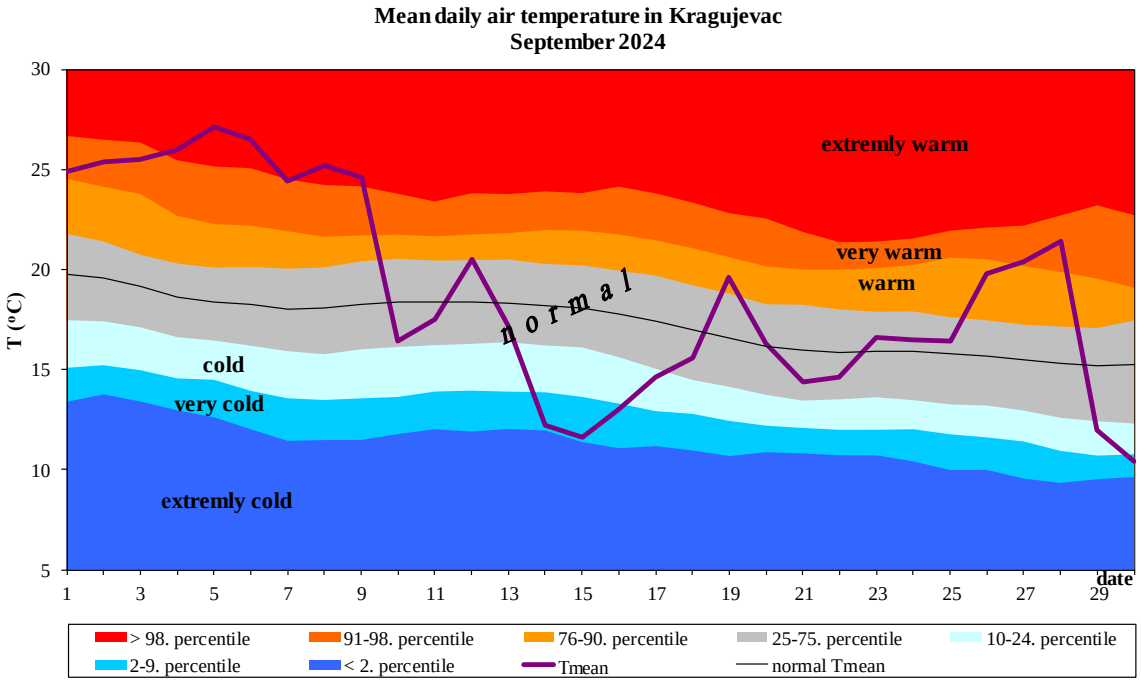
Appendix 1. Daily course of the mean daily air temperature and accompanying percentile for Sombor



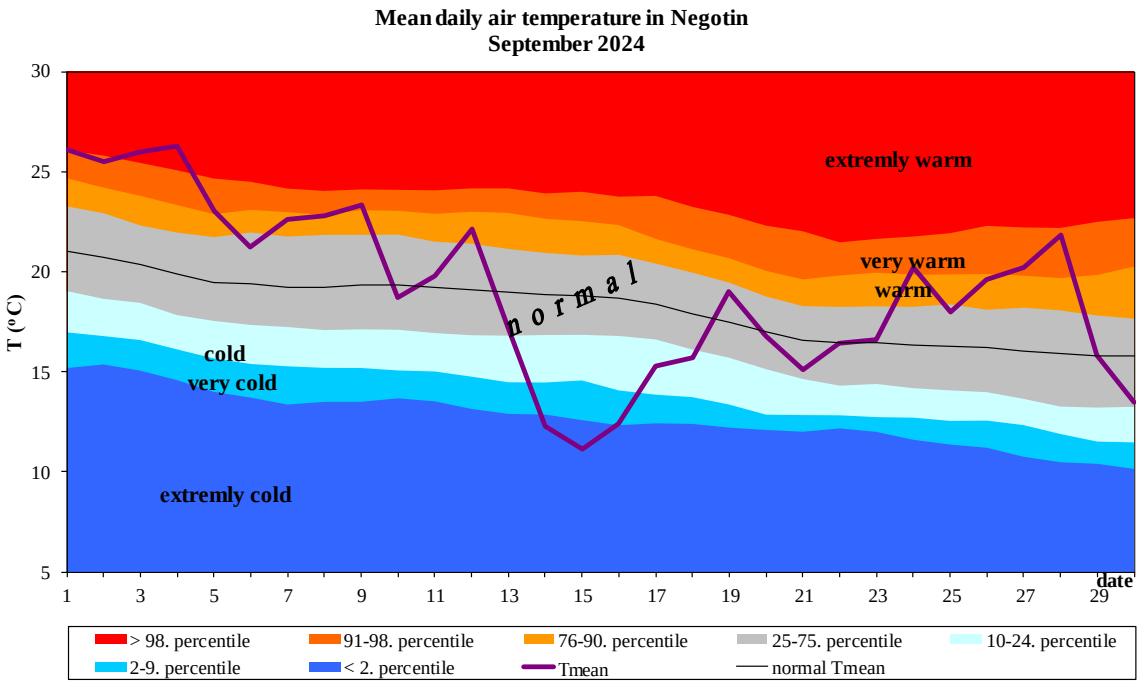
Appendix 2. Daily course of the mean daily air temperature and accompanying percentile for Novi Sad



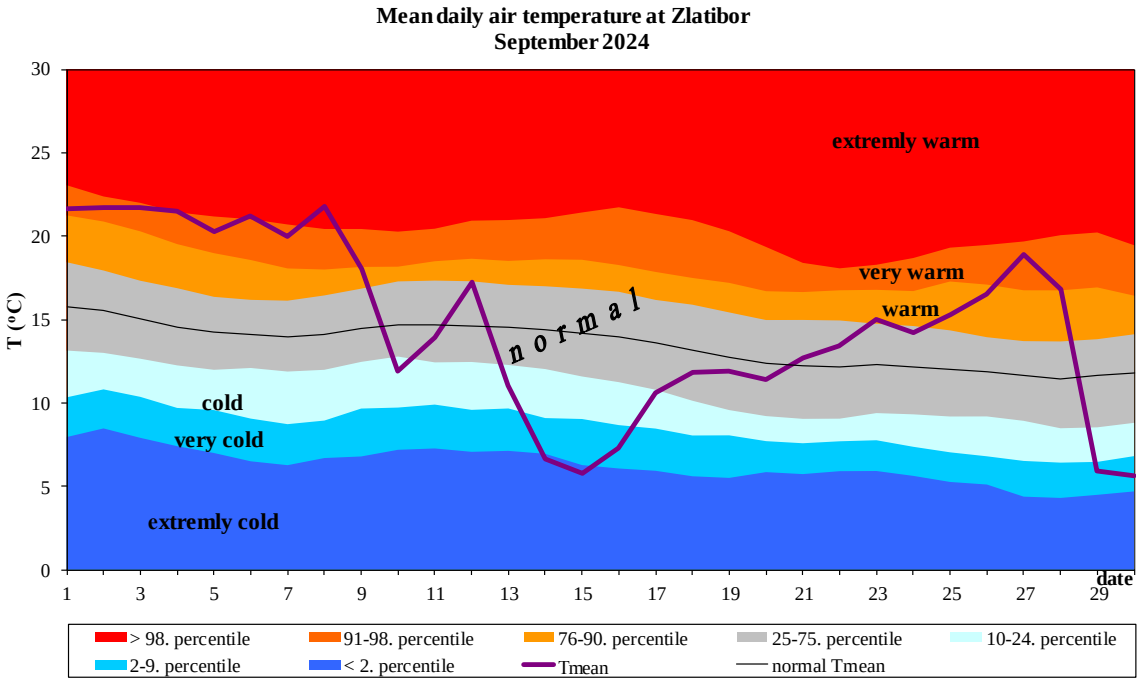
Appendix 3. Daily course of the mean daily air temperature and accompanying percentile for Loznica



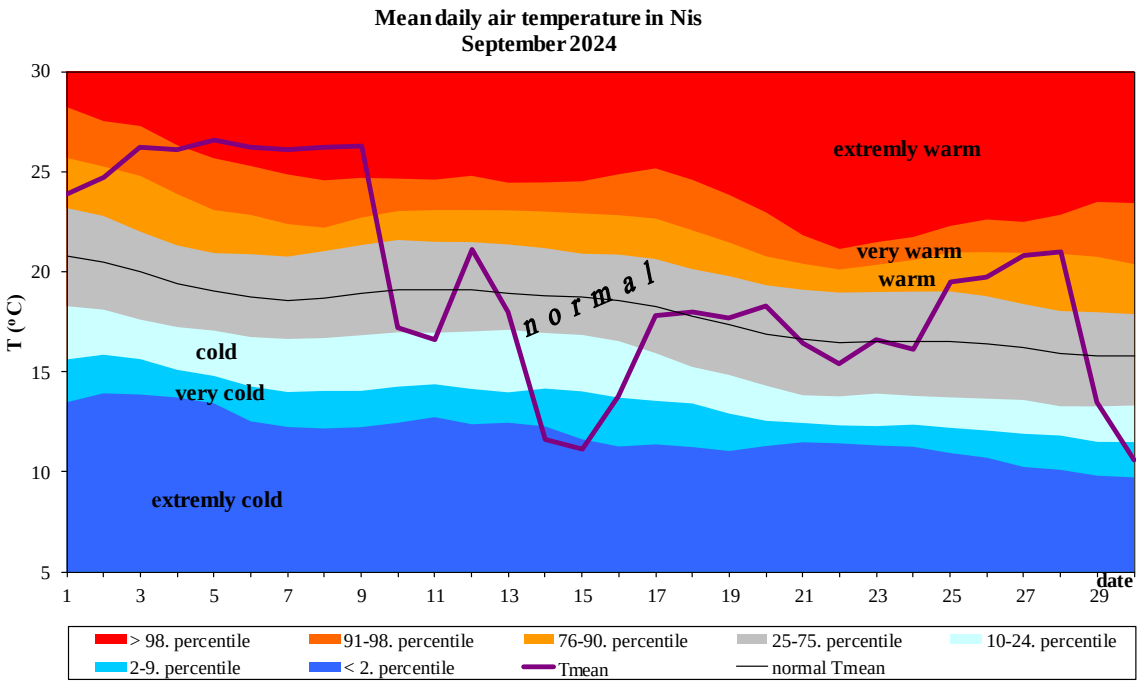
Appendix 4. Daily course of the mean daily air temperature and accompanying percentile for Kragujevac



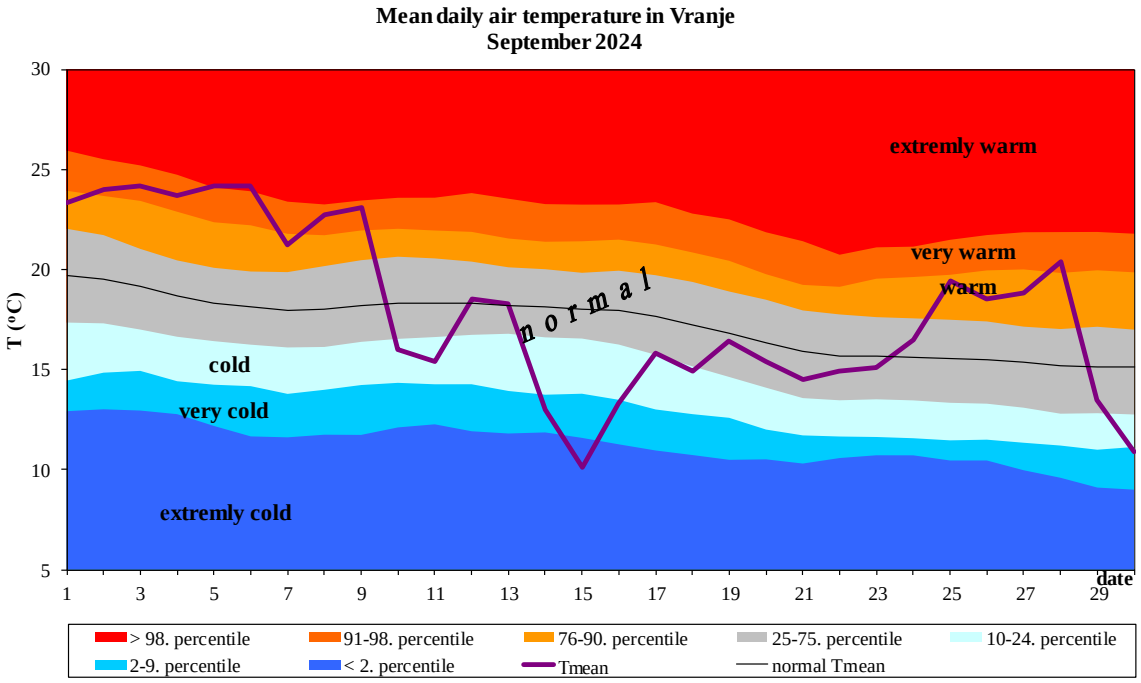
Appendix 5. Daily course of the mean daily air temperature and accompanying percentile for Negotin



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

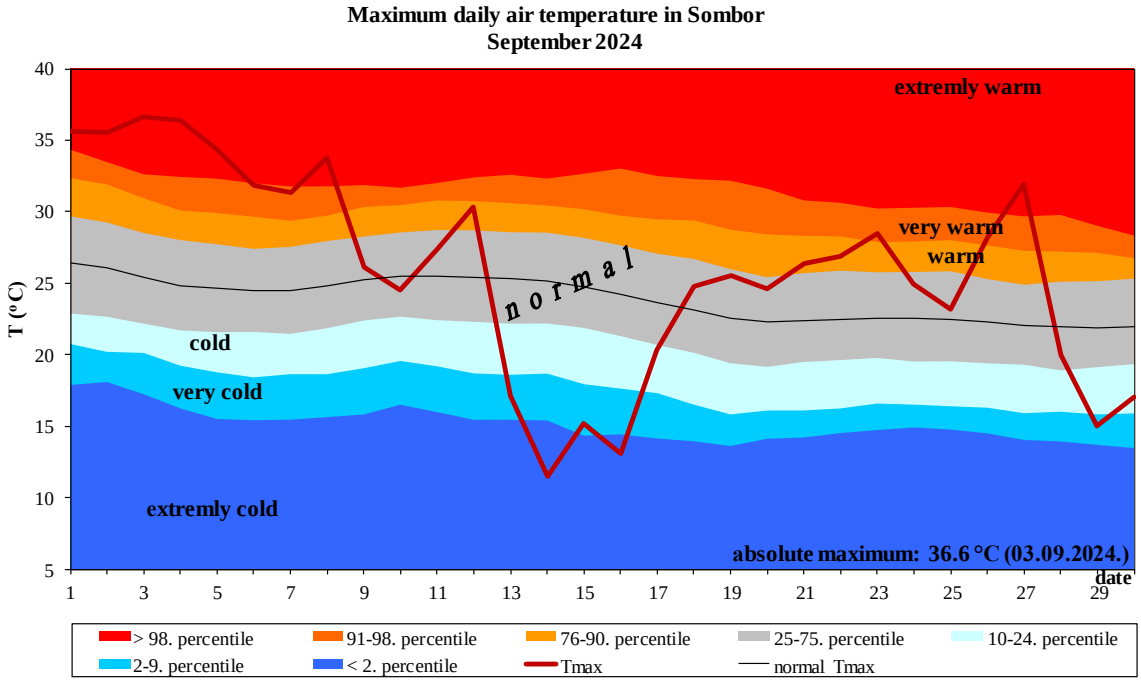


Appendix 7. Daily course of the mean daily air temperature and accompanying percentile for Nis

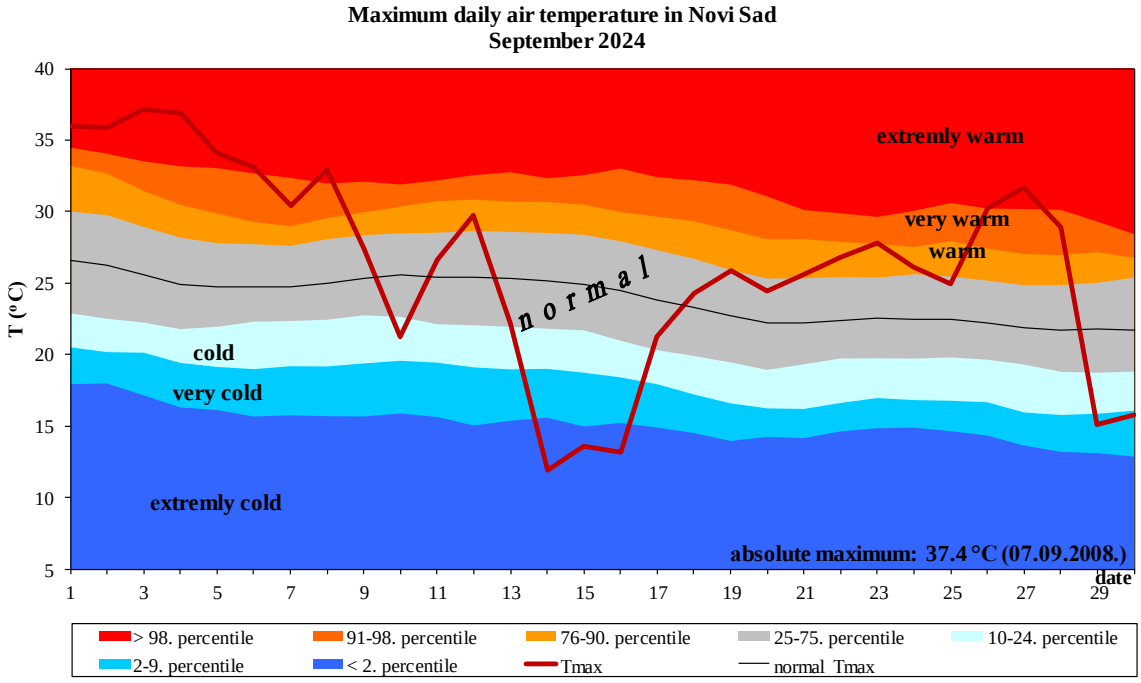


Appendix 8. Daily course of the mean daily air temperature and accompanying percentile for Vranje

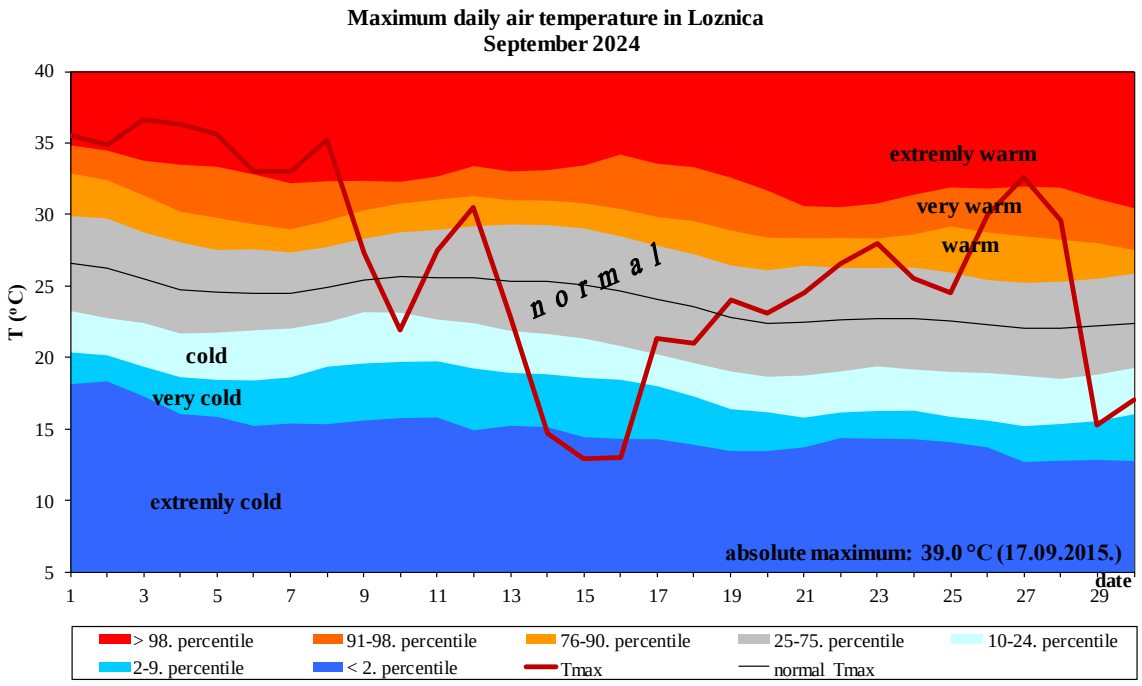
Maximum air temperature



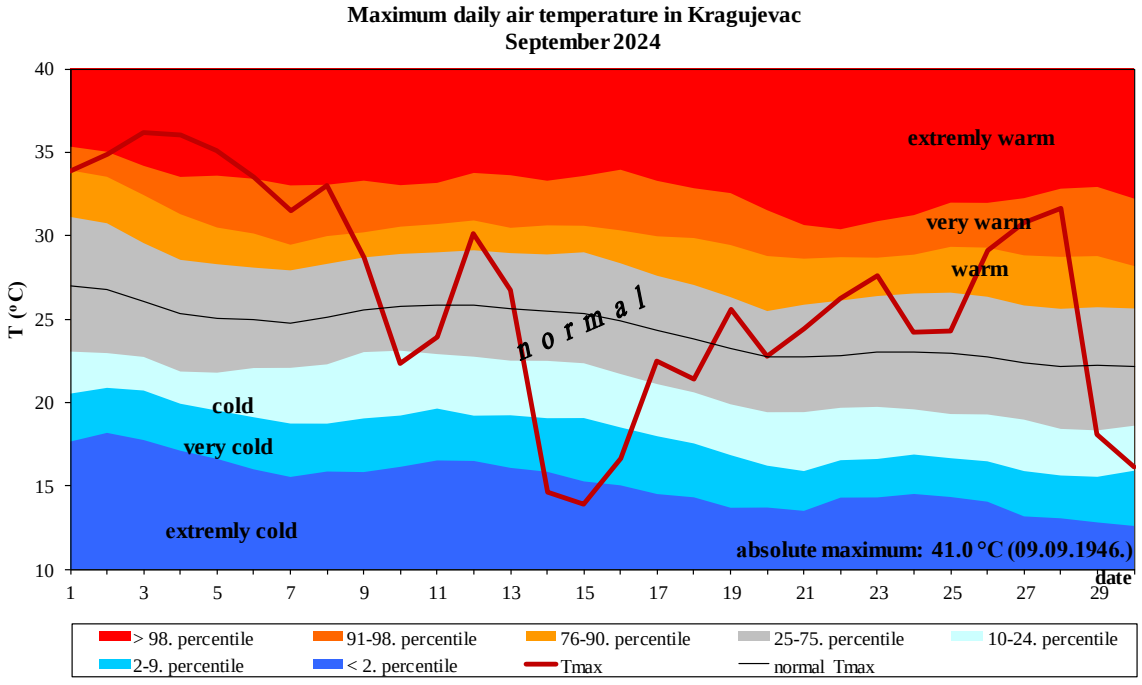
Appendix 9. Daily course of the maximum daily air temeperature and the accompanying percentile for Sombor



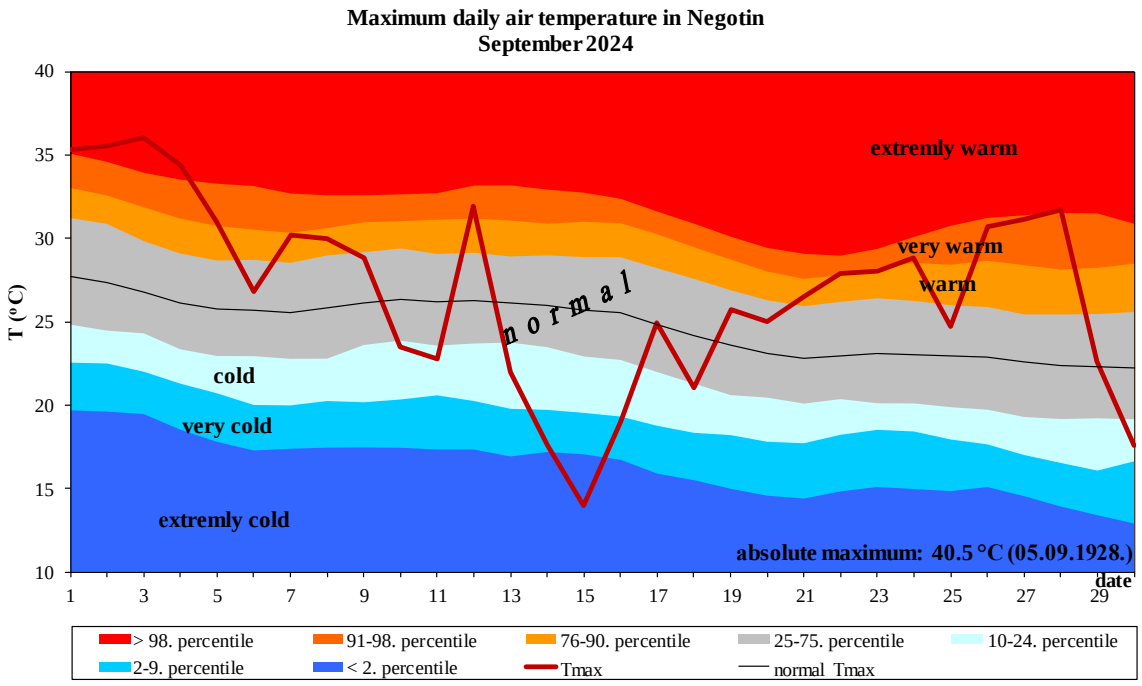
Appendix 10. Daily course of the maximum daily air temeperature and the accompanying percentile for Novi Sad



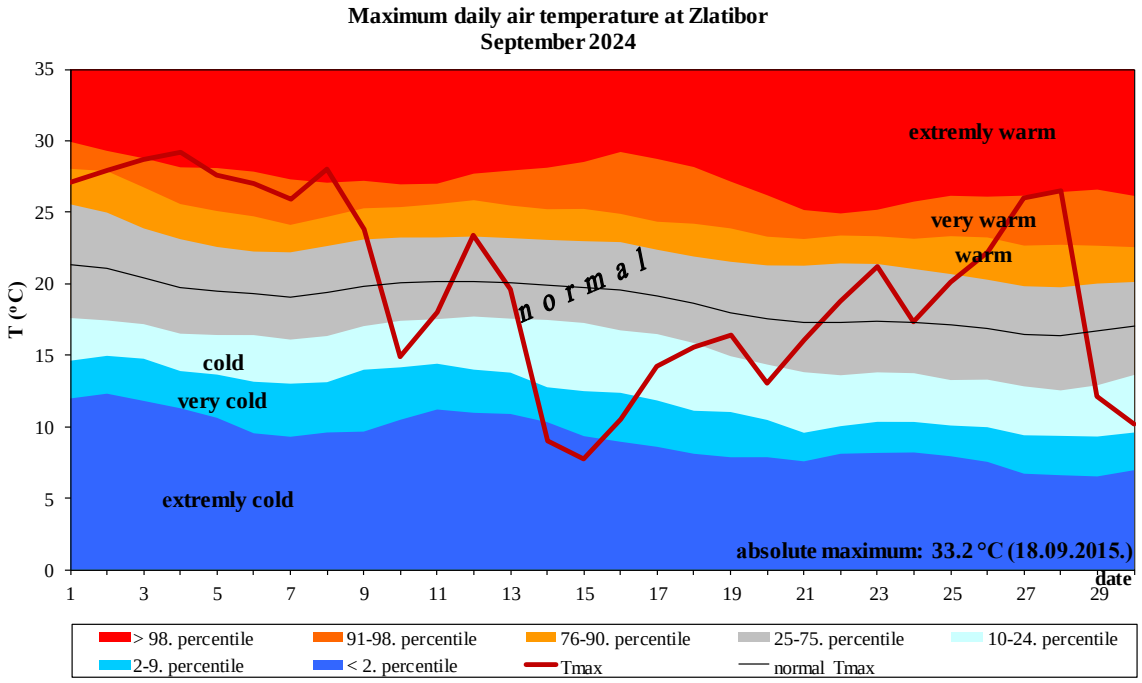
Appendix 11. Daily course of the maximum daily air temeperature and the accompanying percentile for Loznica



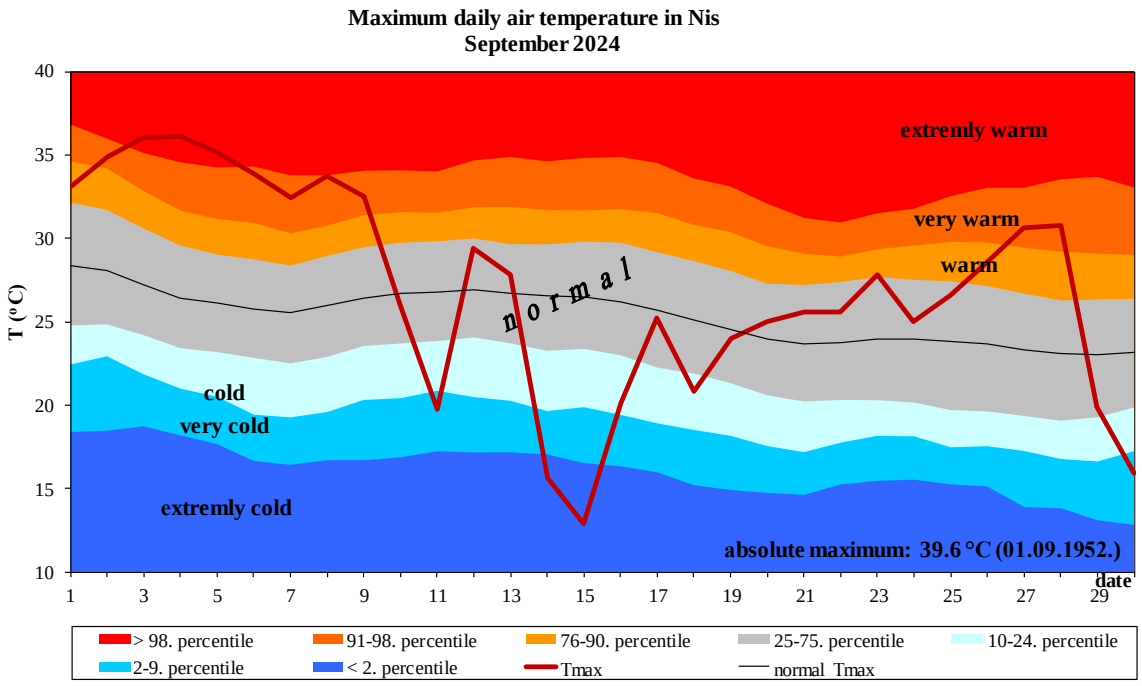
Appendix 12. Daily course of the maximum daily air temeperature and the accompanying percentile for Kragujevac



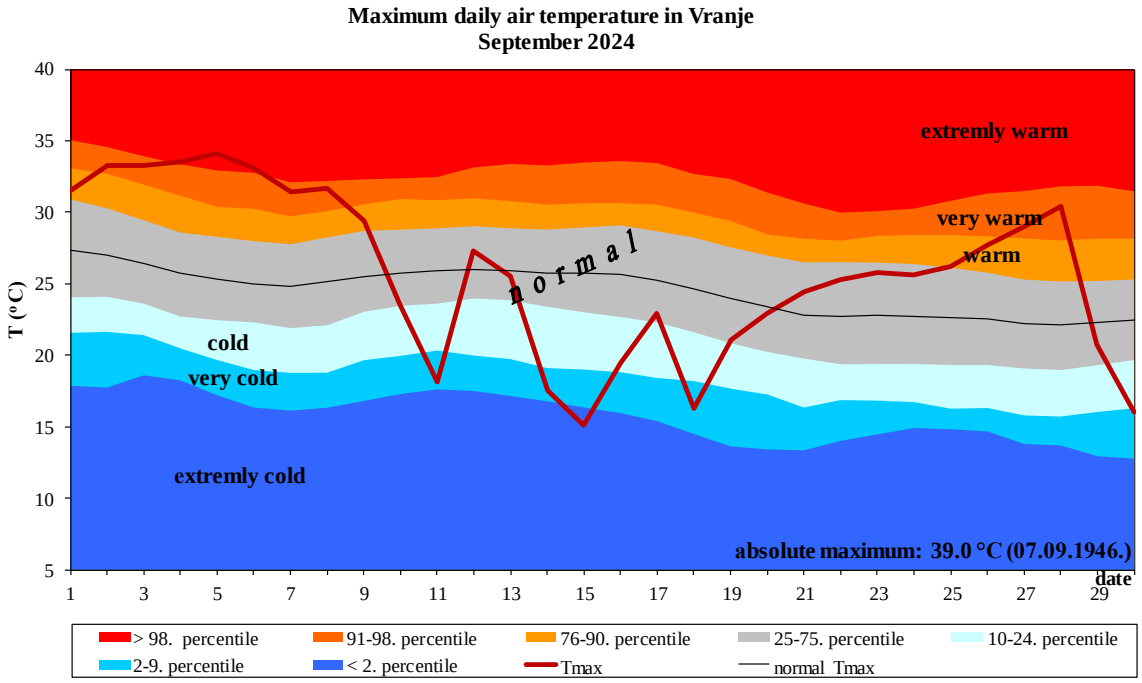
Appendix 13. Daily course of the maximum daily air temeperature and the accompanying percentile for Negotin



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

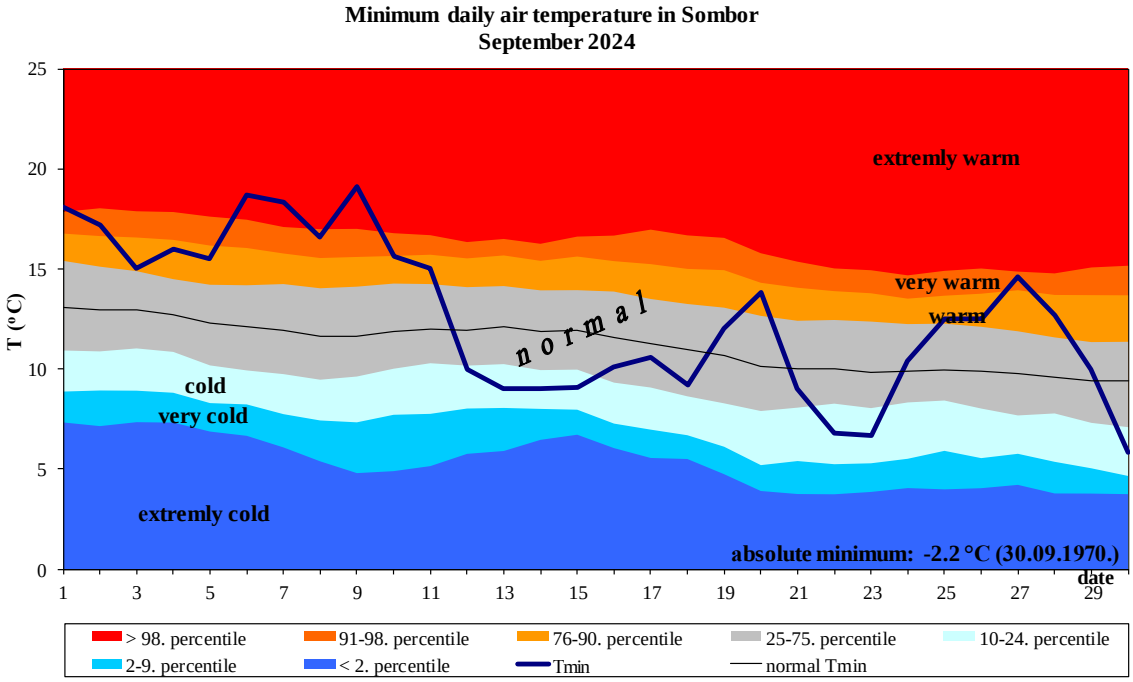


Appendix 15. Daily course of the maximum daily air temeperature and the accompanying percentile for Nis

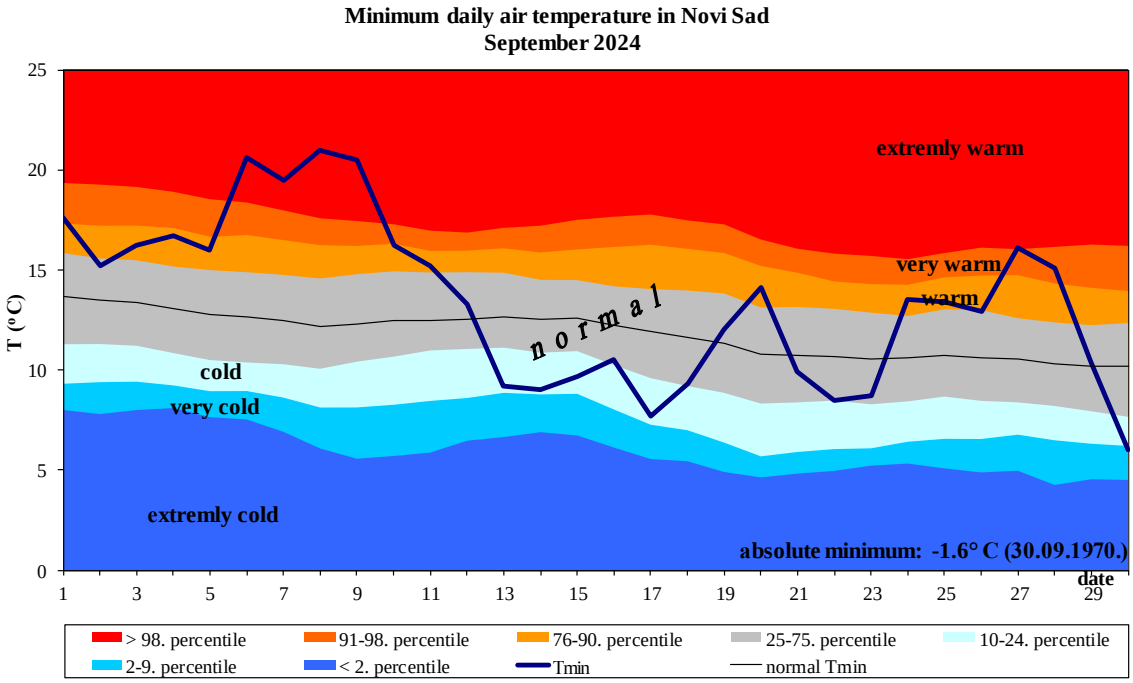


Appendix 16. Daily course of the maximum daily air temeperature and the accompanying percentile for Vranje

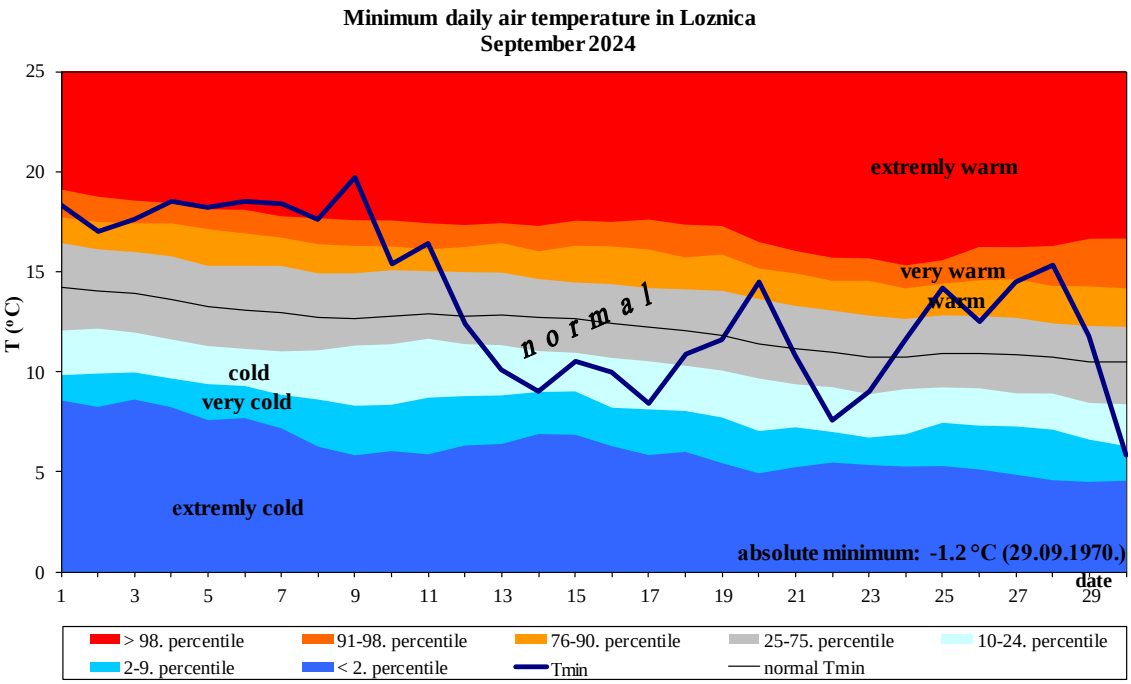
Minimum air temperature



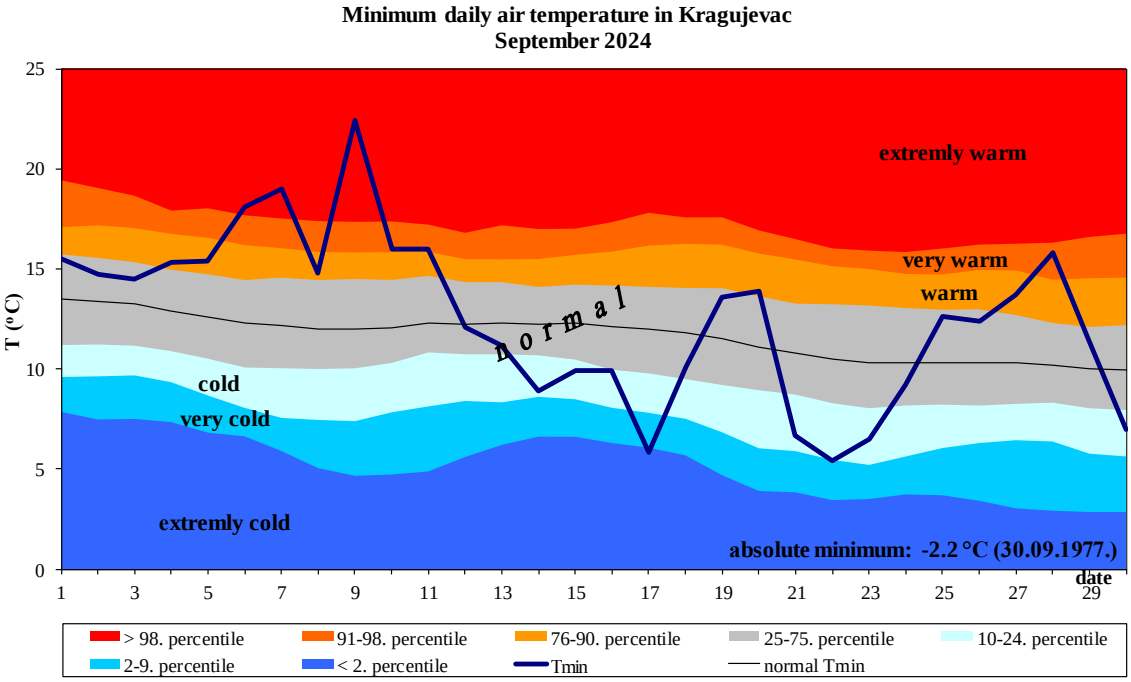
Appendix 17. Daily course of the minimum daily air temperature and the accompanying percentile for Sombor



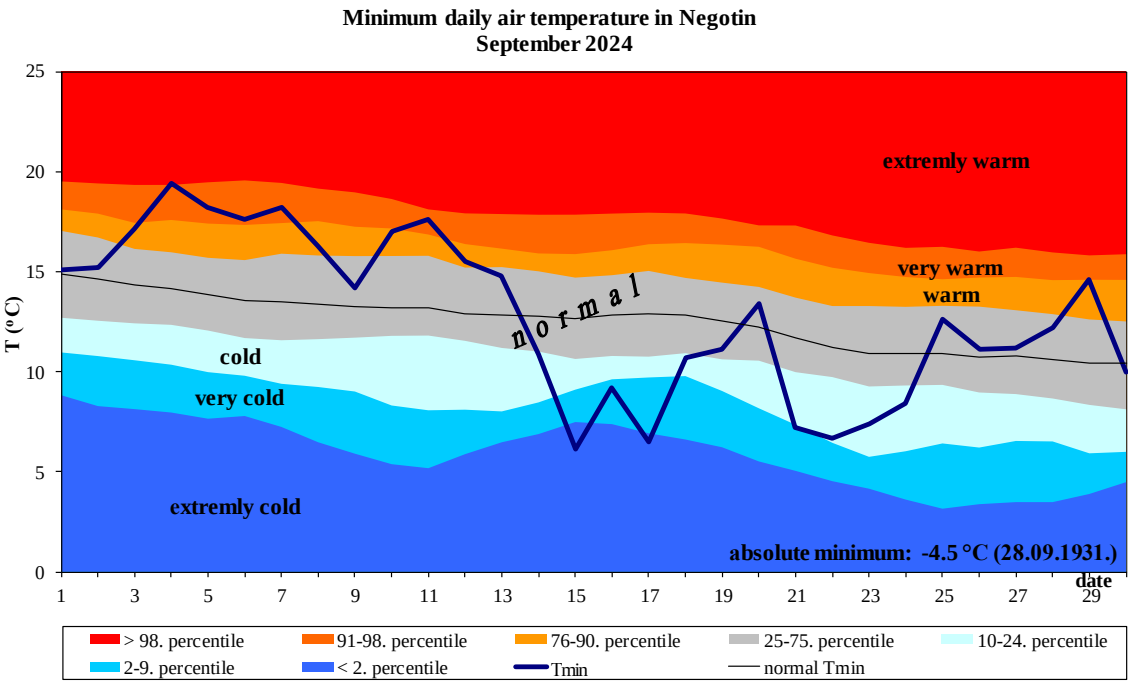
Appendix 18. Daily course of the minimum daily air temperature and the accompanying percentile for Novi Sad



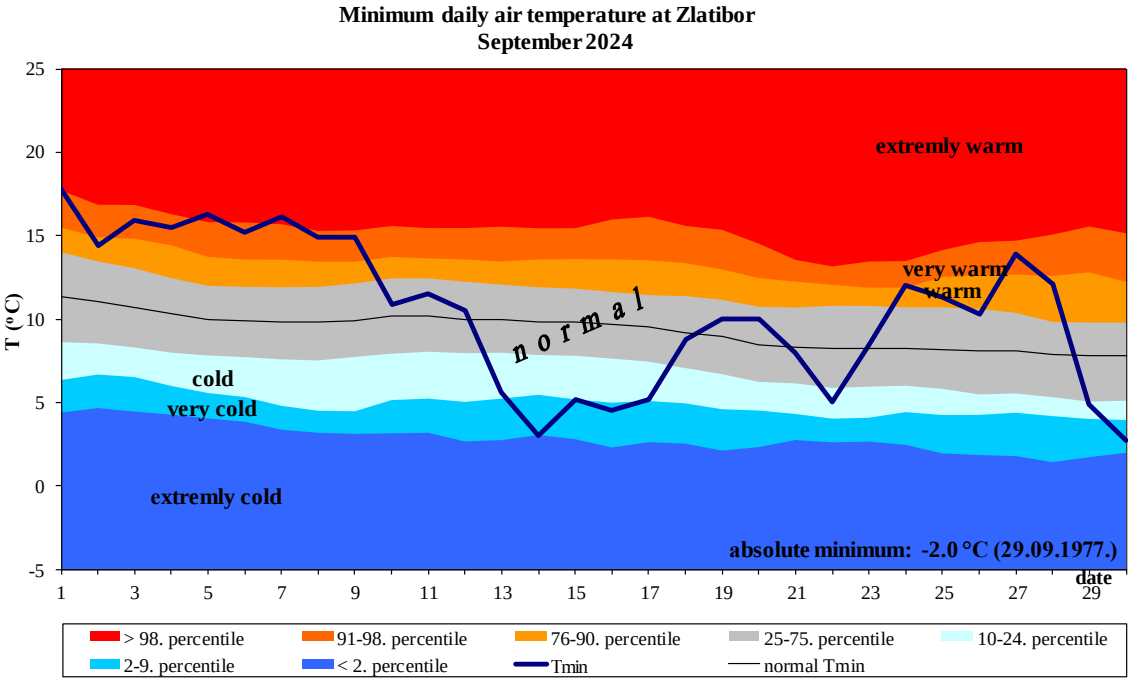
Appendix 19. Daily course of the minimum daily air temperature and the accompanying percentile for Loznica



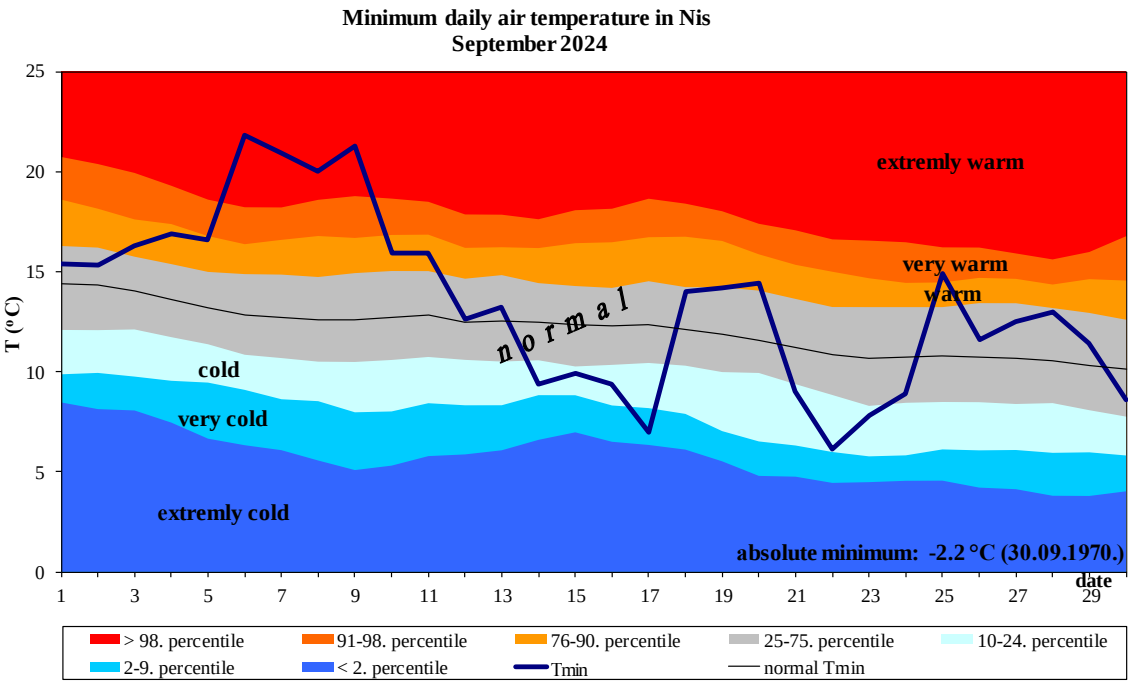
Appendix 20. Daily course of the minimum daily air temperature and the accompanying percentile for Kragujevac



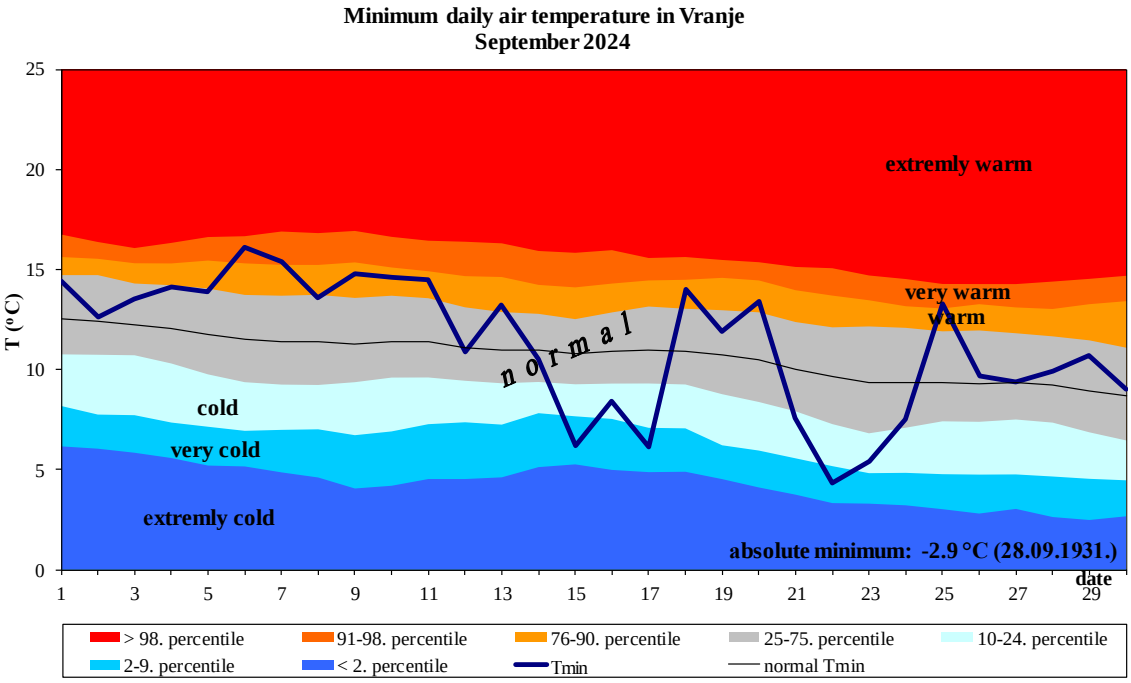
Appendix 21. Daily course of the minimum daily air temperature and the accompanying percentile for Negotin



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

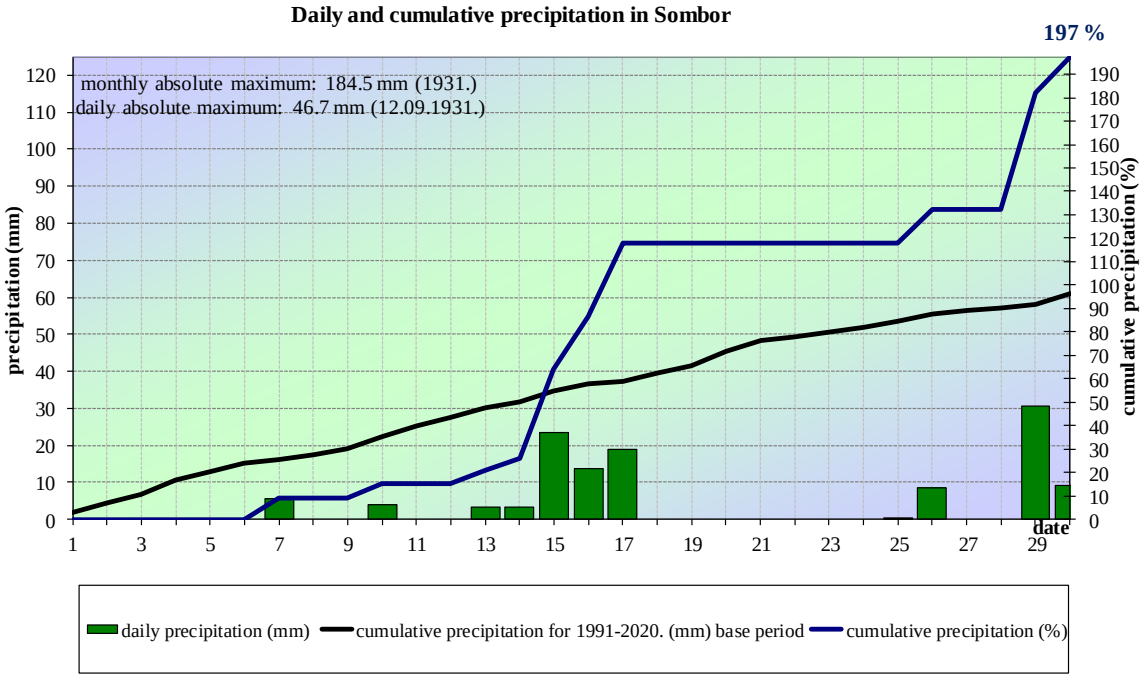


Appendix 23. Daily course of the minimum daily air temperature and the accompanying percentile for Nis

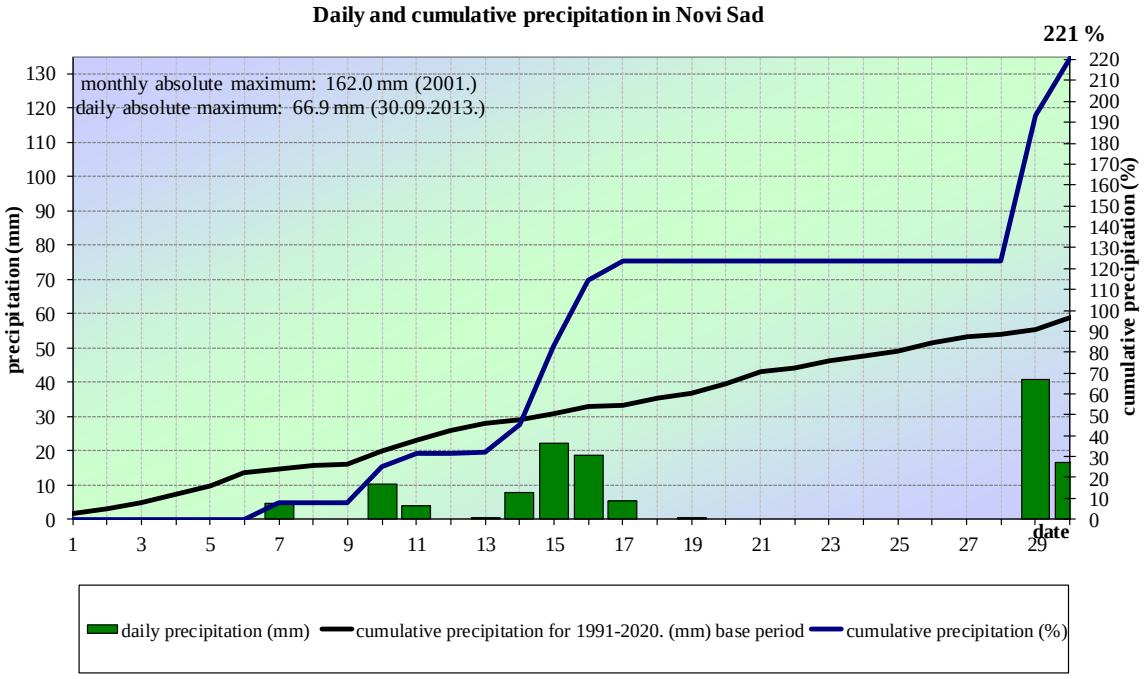


Appendix 24. Daily course of the minimum daily air temperature and the accompanying percentile for Vranje

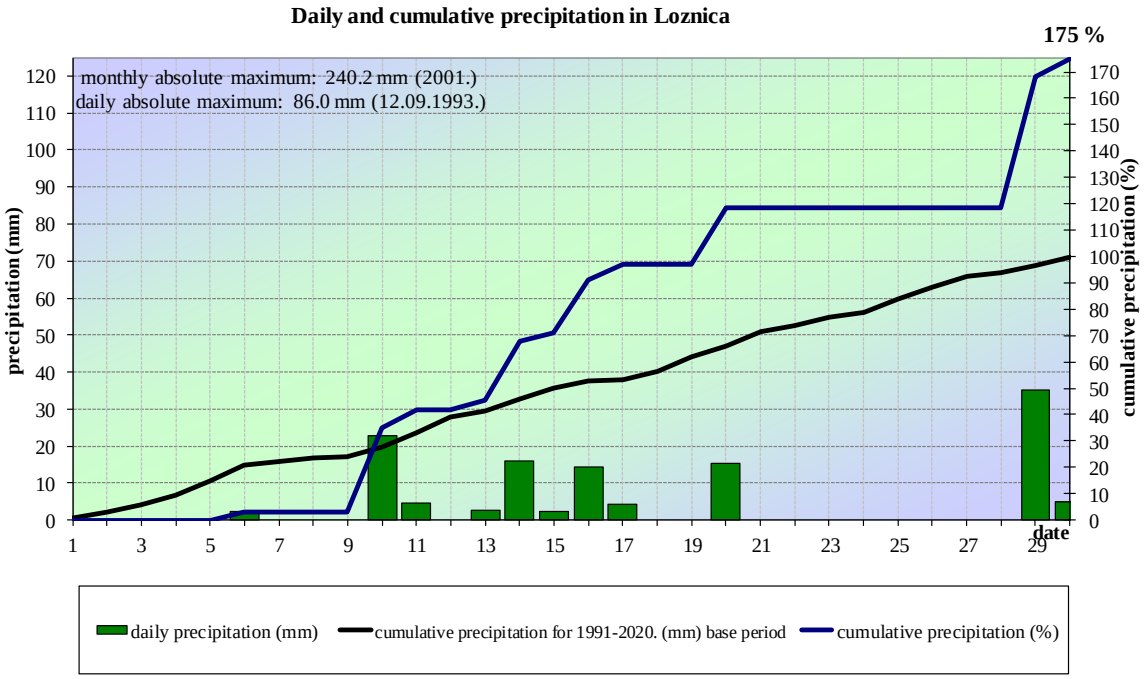
Precipitation



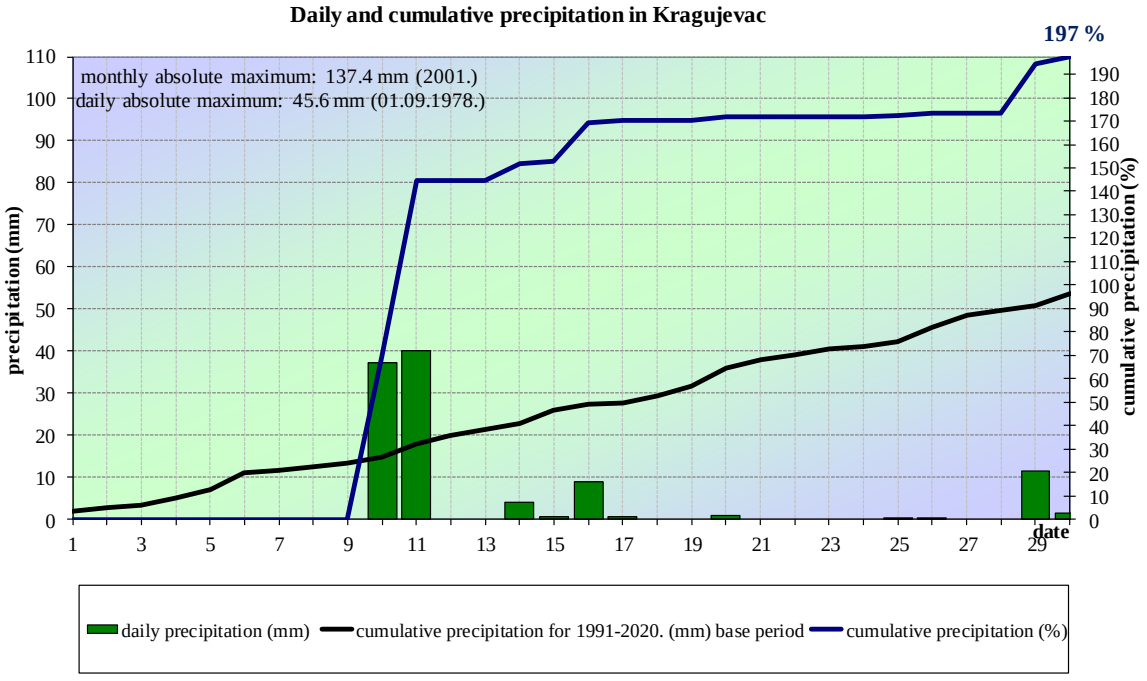
Appendix 25. Daily and cumulative precipitation sums for Sombor



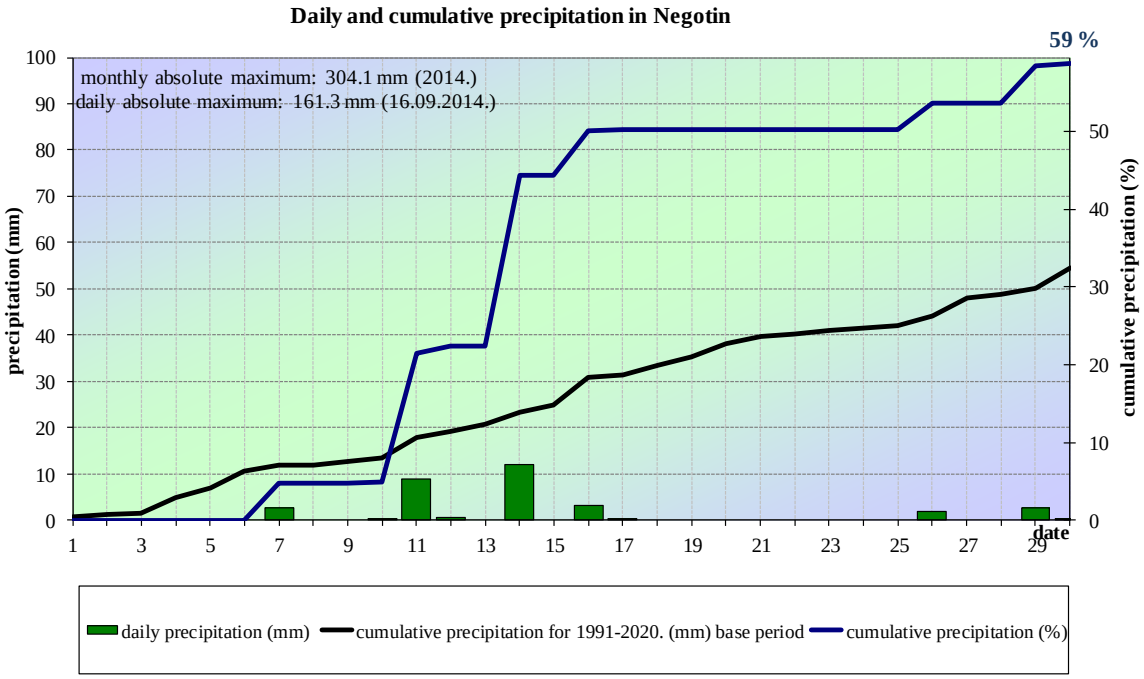
Appendix 26. Daily and cumulative precipitation sums for Novi Sad



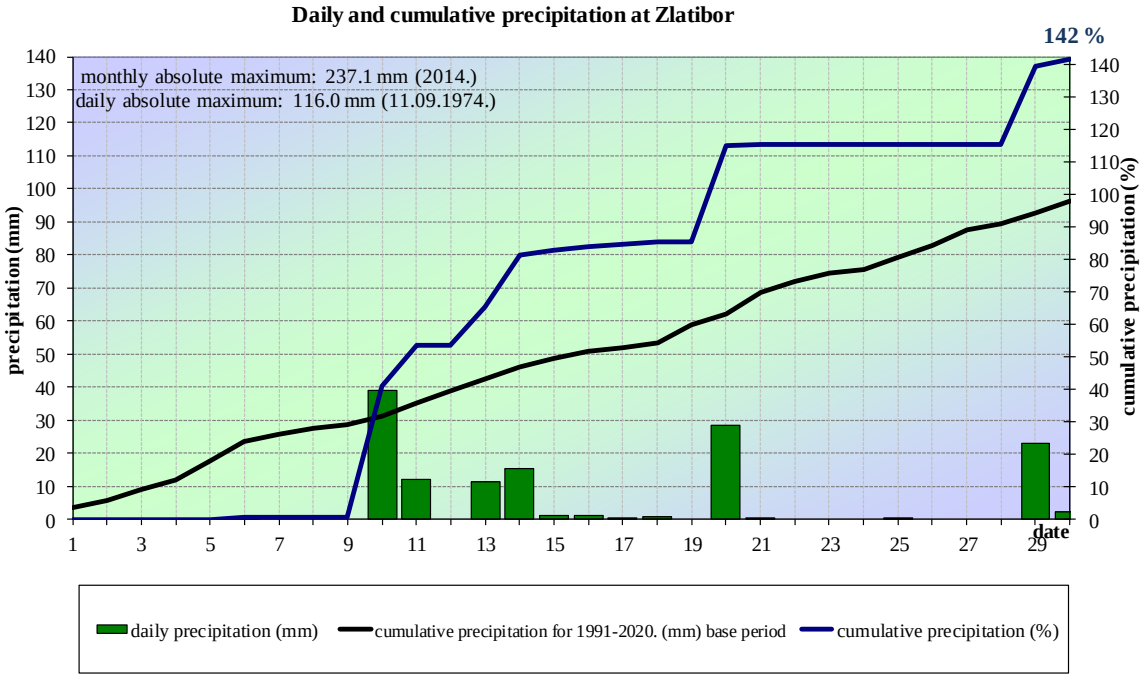
Appendix 27. Daily and cumulative precipitation sums for Loznica



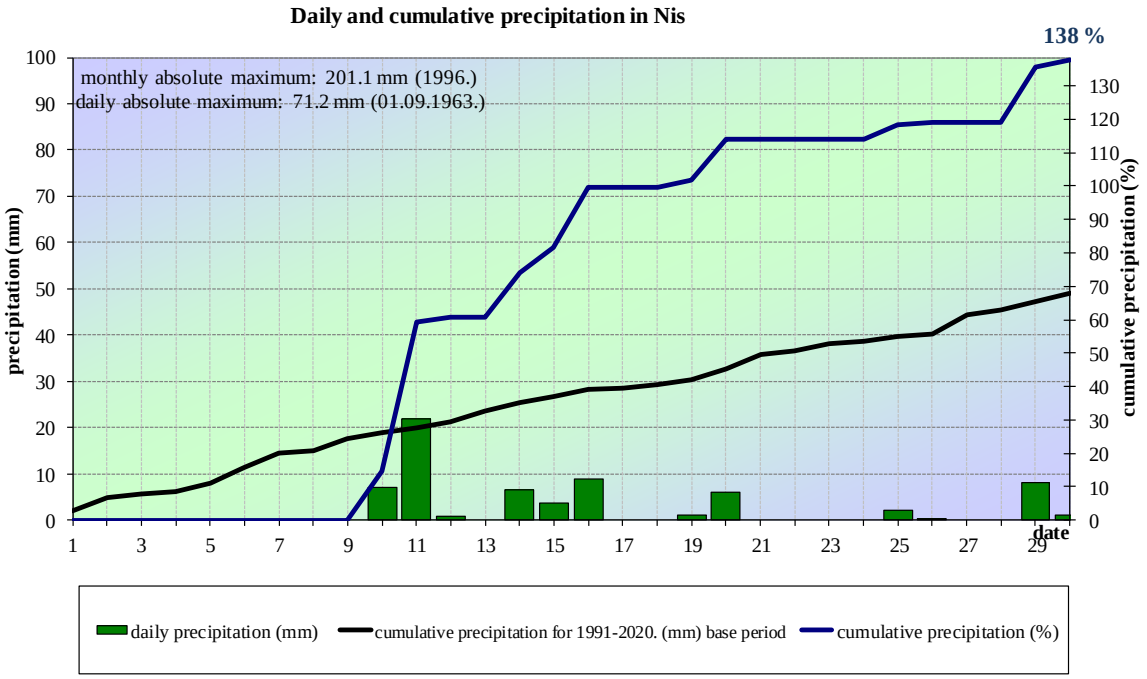
Appendix 28. Daily and cumulative precipitation sums for Kragujevac



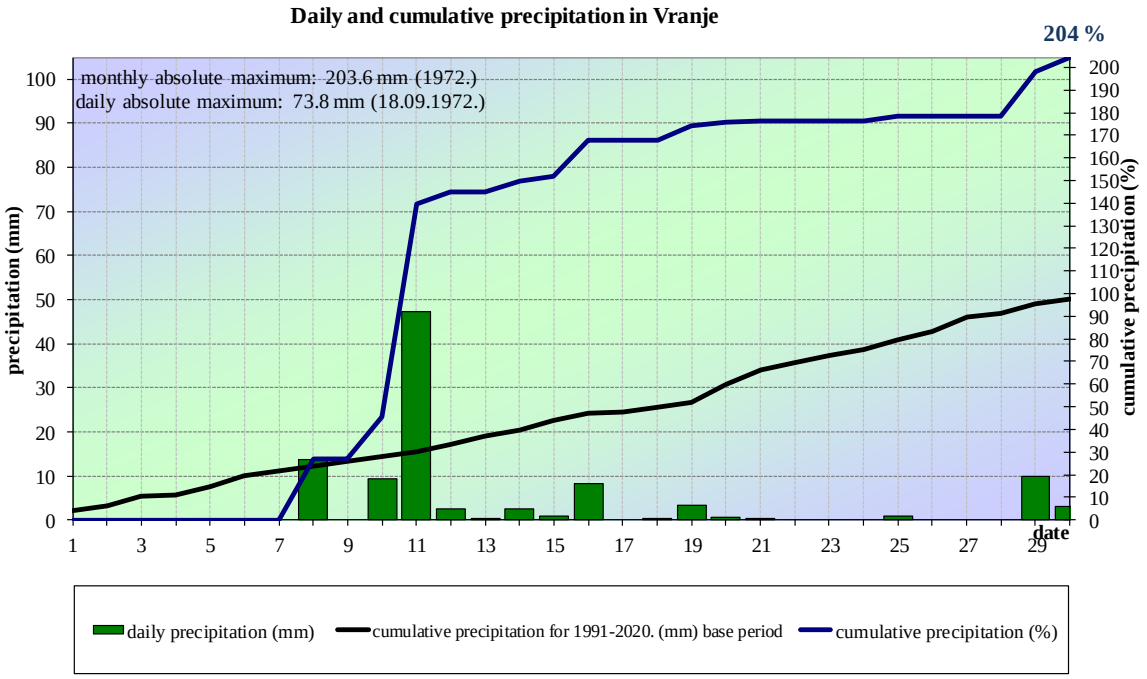
Appendix 29. Daily and cumulative precipitation sums for Negotin



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