Republic Hydrometeorological Service of Serbia
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Republic of Serbia

MONTHLY BULLETIN FOR SERBIA

NOVEMBER 2023

Belgrade, the 5th of December 2023

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- ***Record snow depth of 38 cm was measured in Vranje on November 26***

AIR TEMPERATURE

Mean monthly air temperature

Mean November air temperature ranged from 6,3ºC in Pozega to 9,5ºC in Belgrade, and on the mountains from 0,9ºC at Kopaonik to 5,1ºC at Zlatibor (*Figure 1).*

Departure of the mean monthly air temperature from the normal[1] for the 1991–2020 base period ranged from -0,2ºC at Kopaonik to +2,2ºC in Kuršumlija (Figure 2).

Mean November air temperature, based on the percentile method[2], was in the categories of normal and warm *(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

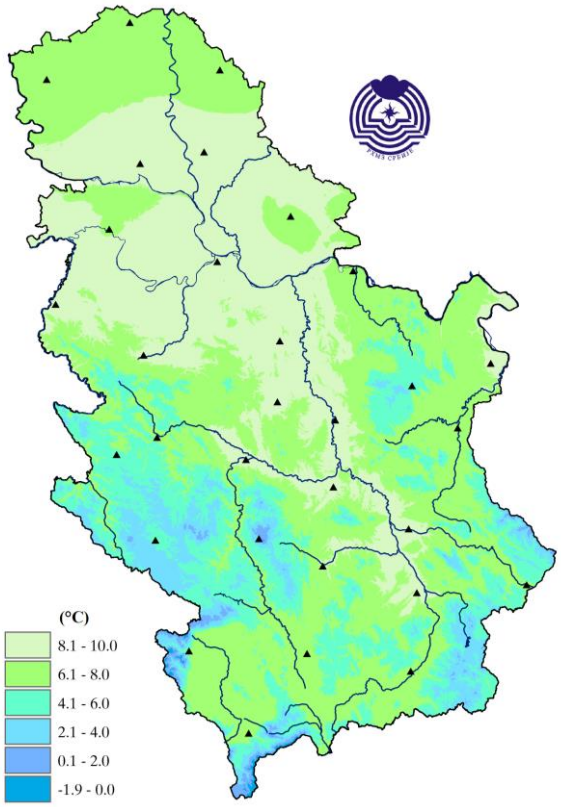


Figure 1. Spatial distribution of mean monthly air temperature (ºC)

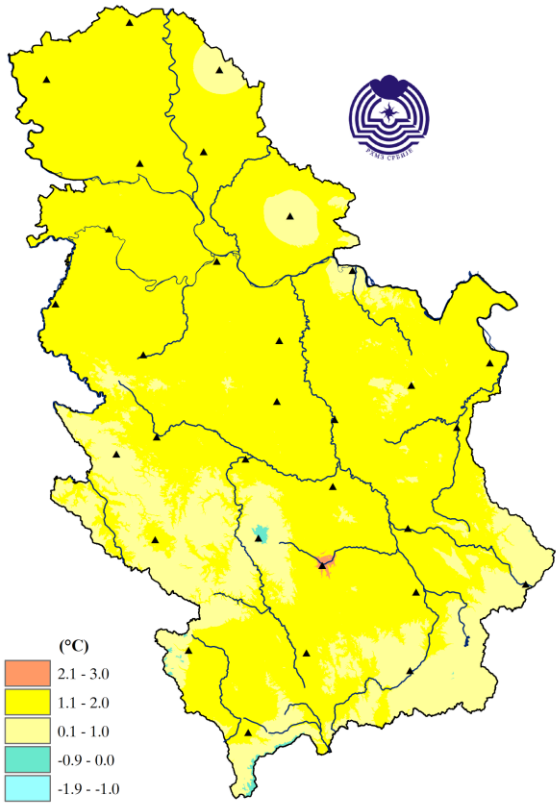


Figure 2. Spatial distribution of mean monthly air temperature anomaly (ºC)

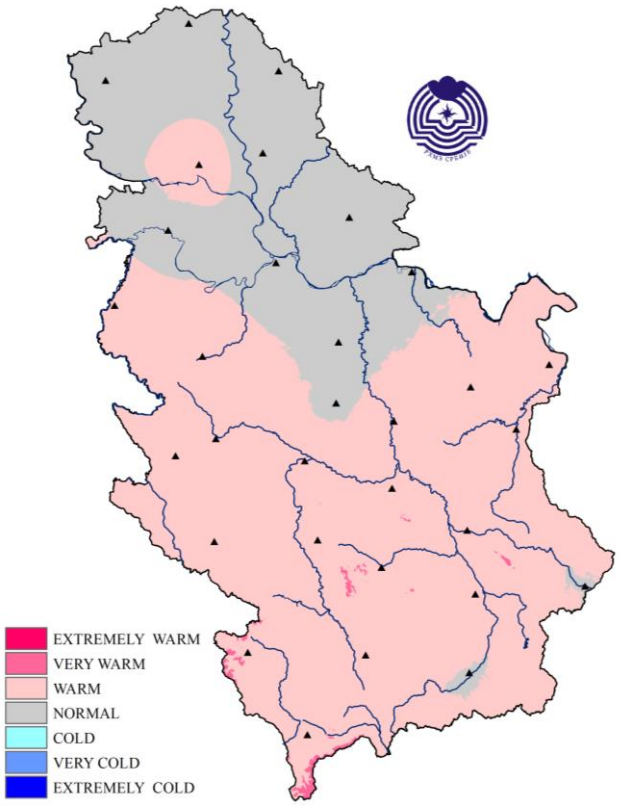


Figure 3. Spatial distribution of the mean monthly air temperature using percentile method

Mean daily air temperature in Belgrade, based on the percentile method, was in the warm category most of the first and middle of the second decade, and normal category in the rest of the month (*Figure 4*). 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.

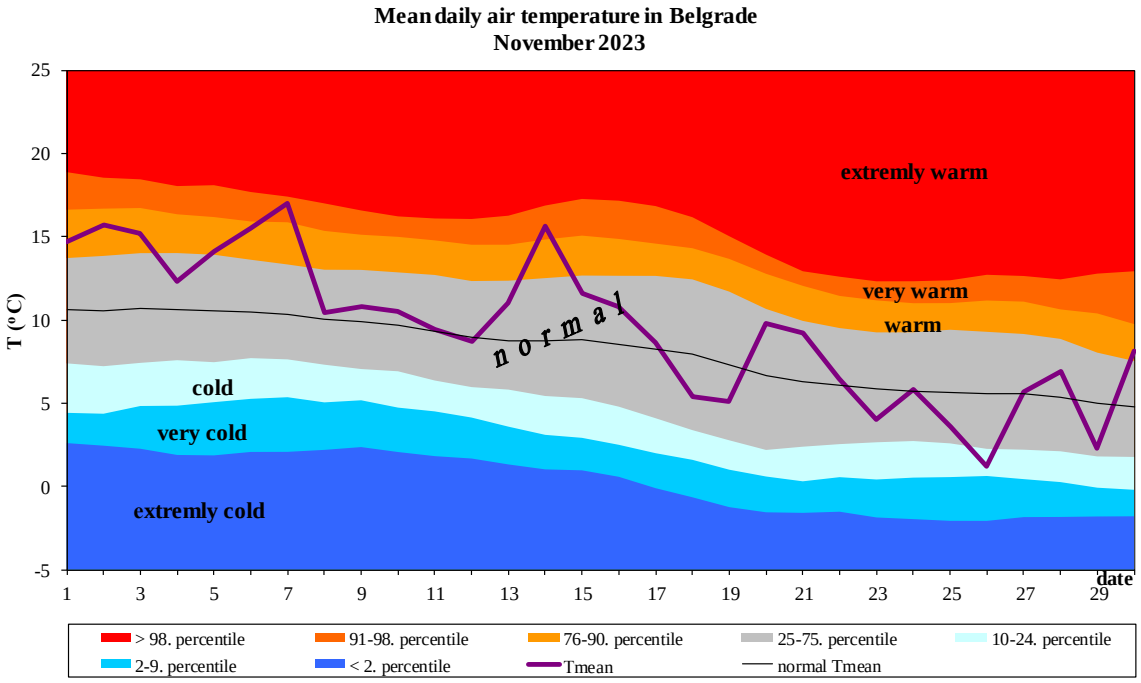


Figure 4. Daily course of the mean daily air temperature and accompanying percentiles for Belgrade

Maximum air temperature

The mean maximum air temperature in November ranged from 11,3ºC on Palic to 14,9ºC in Loznica while Belgrade observed 14,2°C. On the mountains, mean maximum November air temperature ranged from 4,2ºC at Kopaonik to 10,0ºC in Sjenica.

Based on the percentile method, mean maximum air temperature was in the following categories: normal category in most of the country, warm category in Belgrade, Negotin and Crni Vrh, and very warm in Zajecar.
The highest maximum daily air temperature of 27,2ºC was measured in Loznica on November 3. On November 5, Belgrade observed 23,8ºC.

There were 2 summer days[3] in Valjevo, and one in Loznica, Sremska Mitrovicia, Požega and Kraljevo.

The recorded number of ice days[4] was the following: 6 days - Kopaonik, 4 days - Crni Vrh, 1 day - Sjenica and Zlatibor.

[3] Summer day refers to a day with maximum daily air temperature 25°C and above
[4] Ice day is defined as the day with maximum air temperature lower than 0°C

Figure 5 shows daily course of the maximum daily air temperature and the accompanying percentiles for Belgrade in November 2023 and for the stations Sombor, Novi Sad, Loznica, Negotin, Kragujevac, Zlatibor, Nis and Vranje are given in the Appendix.

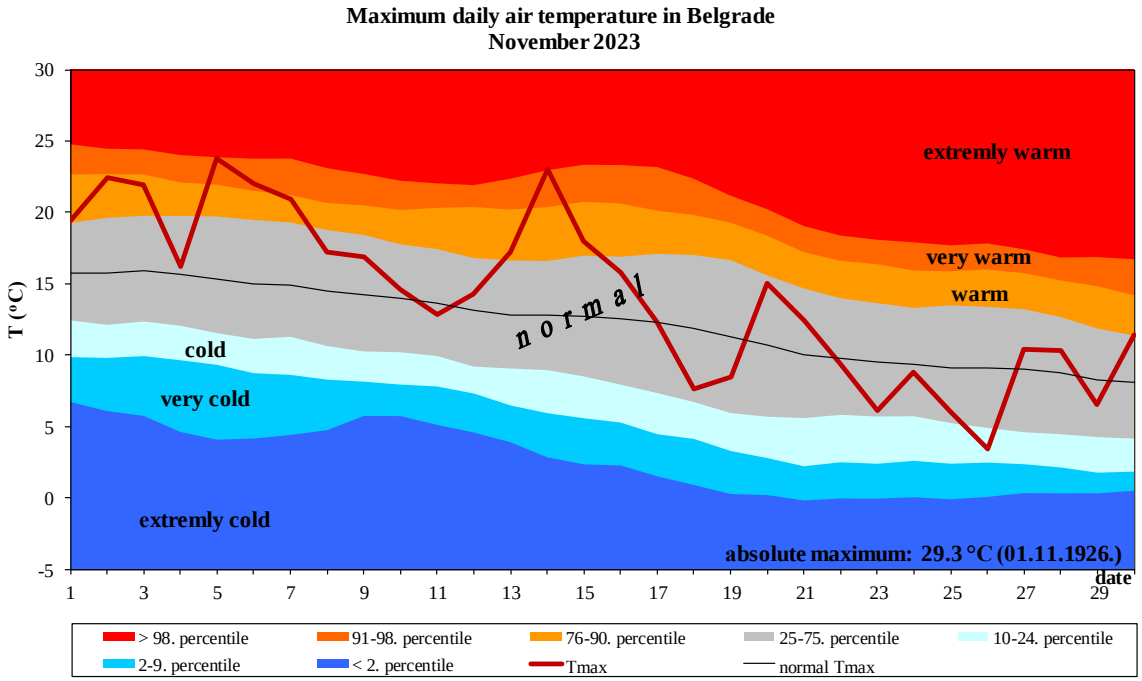


Figure 5. Daily course of the maximum daily air temperature and accompanying percentiles for Belgrade

Minimum air temperature

Mean minimum air temperature in November ranged from 2,5ºC in Pozega to 6,2ºC in Belgrade. On the mountains, mean minimum air temperature ranged from -1,8ºC at Kopaonik to 1,7ºC at Zlatibor.

Based on the percentile method, mean minimum monthly air temperature was in the categories of normal and warm in most of the country, and very warm in Kursumlija.

The lowest minimum daily air temperature of -12,9ºC was measured in Sjenica on November 27. In the lowland, the lowest daily air temperature of -5,9ºC was measured in Vranje on November 27. On the same day, Belgrade observed the lowest monhtly air temperature of -0,5ºC.

Number of frost days[5] ranged from 2 to 7 days in the lowland, and from 8 at Zlatibor to 17 days at Kopaonik. The recorded number of frost days was 2 to 7 days below the November average.

There were 2 days with severe frost[6] at Kopaonik, while Sjenica recorded 1 day.

Figure 6 shows assessment of the minimum and maximum air temperature in Serbia for November based on the tercile distribution relative to the 1991-2020 base period. It can be noted that the minimum and mean maximum air temperature were around the upper tercile threshold.

[5] Frost day is defined as the day with minimum air temperature lower than 0°C
[6] Day with severe frost is defined as the day with the minimum air temperature -10°C and below

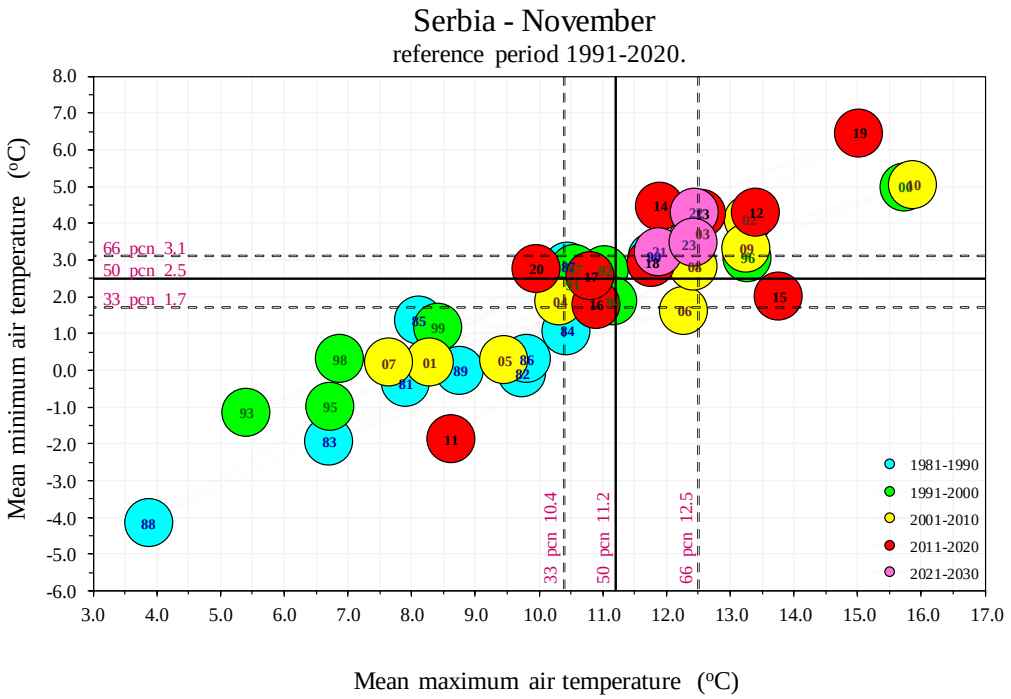


Figure 6. Assessment of minimum and maximum air temperature for Serbia with the accompanying terciles in relation to the 1991-2020 base period

Figure 7 shows daily course of the minimum daily air temperature and the accompanying percentiles for Belgrade in November 2023, and for the stations Sombor, Novi Sad, Loznica, Negotin, Kragujevac, Zlatibor, Nis and Vranje are given in the Appendix.

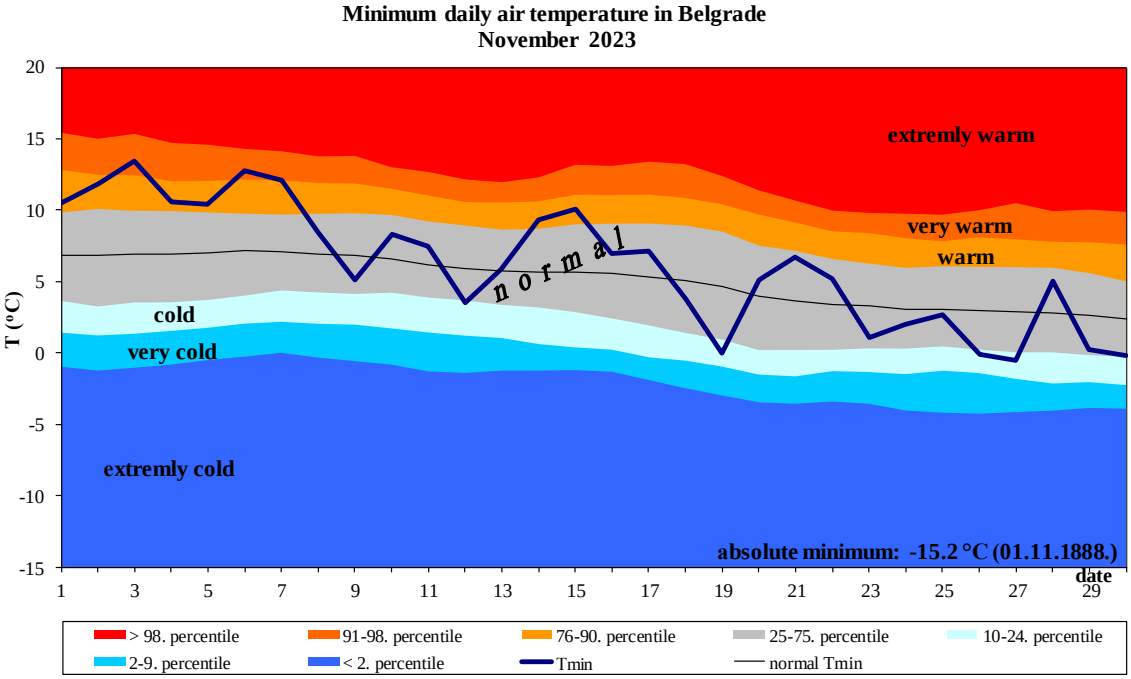


Figure 7. Daily course of the minimum daily air temperature and accompanying percentiles for Belgrade

PRECIPITATION

November 2023 ranks as **the wettest** for Serbia in the period since 1951 (*Figure 8*). For a number of stations, this November was either the wettest or 2nd wettest since the record-keeping began *(Table 1)*. The graphical representation for the stations Kopaonik, Zlatibor, Crni Vrh, Zajecar, Cuprija, Kraljevo and Dimitrovgrad are given in Appendix.

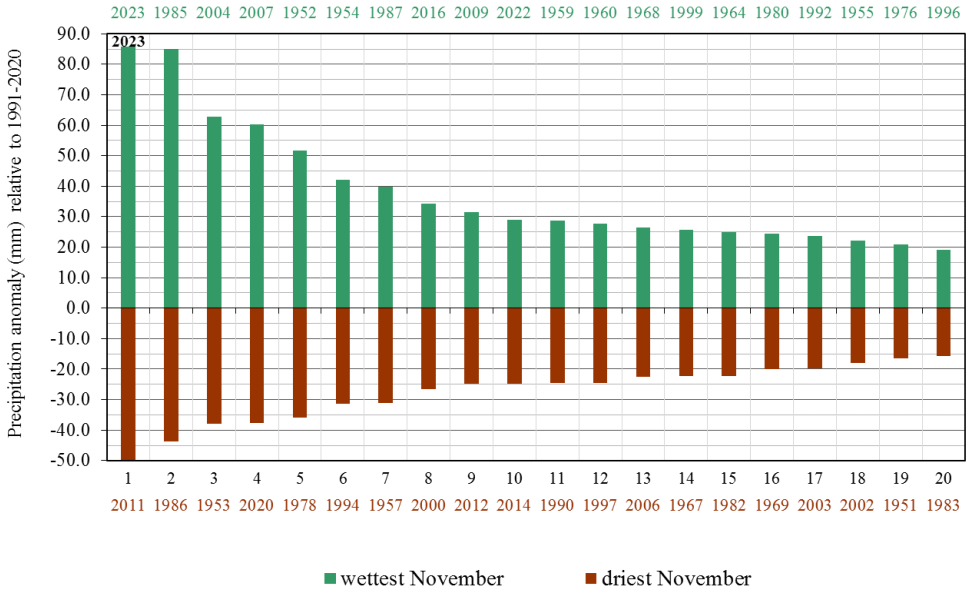


Figure 8. Rank of the wettest and driest November for Serbia for the period from 1951 to 2023

Table 1. The ranking of November 2023 in terms of precipitation, average, and percentage of the 1991-2020 normal

STATION	historical period	∑RR for November 2023 (mm)	normal for November 1991-2020	percentage (%) from normal	ranking for November 2023 (descending RR)
KOPAONIK	1949-2022	229.1	75.1	305	1
ZLATIBOR	1950-2022	197.3	80.4	245	1
CRNI VRH	1966-2022	184.8	60.9	303	1
ZAJECAR	1925-2022	177.4	47.6	373	1
CUPRIJA	1926-2022	159.1	49.1	324	1
KRALJEVO	1926-2022	152.7	49.0	312	1
DIMITROVGRAD	1926-2022	149.3	48.2	309	1
SJENICA	1925-2022	207.6	67.9	306	2
NIS	1925-2022	167.6	49.0	342	2
KRUSEVAC	1925-2022	166.5	49.3	338	2
VALJEVO	1926-2022	152.4	54.5	280	2
VRANJE	1926-2022	144.1	54.3	265	2
KRAGUJEVAC	1925-2022	136.5	44.6	306	2
V.GRADISTE	1926-2022	128.0	45.4	282	2
POZEGA	1925-2022	138.6	54.3	255	3
LOZNICA	1925-2022	146.1	69.0	212	4
LESKOVAC	1925-2022	130.5	55.5	235	4
NEGOTIN	1941-2022	146.3	56.0	261	5
PALIC	1936-2022	110.8	43.6	254	5
S.PALANKA	1926-2022	106.6	44.5	239	5
KURSUMLIJA	1925-2022	120.4	51.7	233	7
BELGRADE	1887-2022	110.3	49.6	222	9
SOMBOR	1931-2022	96.1	49.5	194	9
S.MITROVICA	1925-2022	93.6	48.8	192	10
KIKINDA	1925-2022	83.5	41.6	201	10
NOVI SAD	1945-2022	83.8	51.5	163	12
ZRENJANIN	1925-2022	82.3	43.6	189	13
B.KARLOVAC	1946-2022	72.1	42.0	172	15

November precipitation sums ranged from 72,1 mm in Banatski Karlovac to 229,1 mm at Kopaonik, while Belgrade recorded 110,3 mm (*Figure 9*).

Precipitation totals compared to the normal for the 1991-2020 base period ranged from 163% in Novi Sad to 373% in Zajecar (*Figure 10*).

Based on the percentile method, precipitation sums were in the categories of extremely rainy and very rainy in most of the country, and rainy in Novi Sad, Zrenjanin and Banatski Karlovac *(Figure 11).*

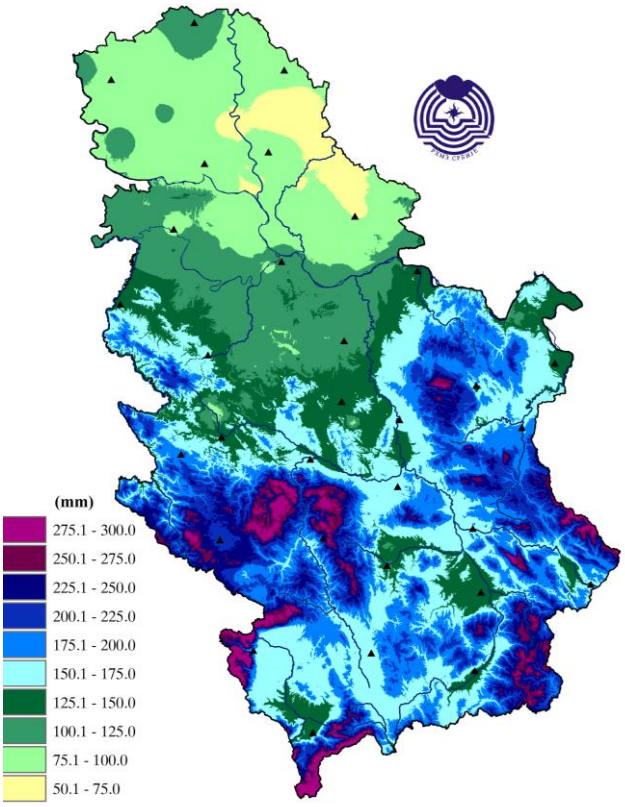


Figure 9. Spatial distribution of the monthly precipitation sums (mm) according to data from 28 major meteorological, 22 climatological and 75 rain gauge stations

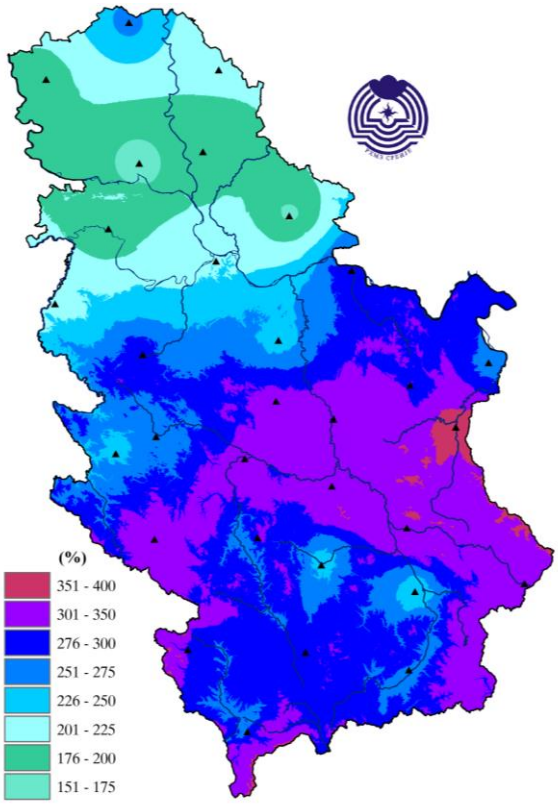


Figure 10. Spatial distribution of the monthly precipitation sums in the percentages of normal for the 1991–2020 base period

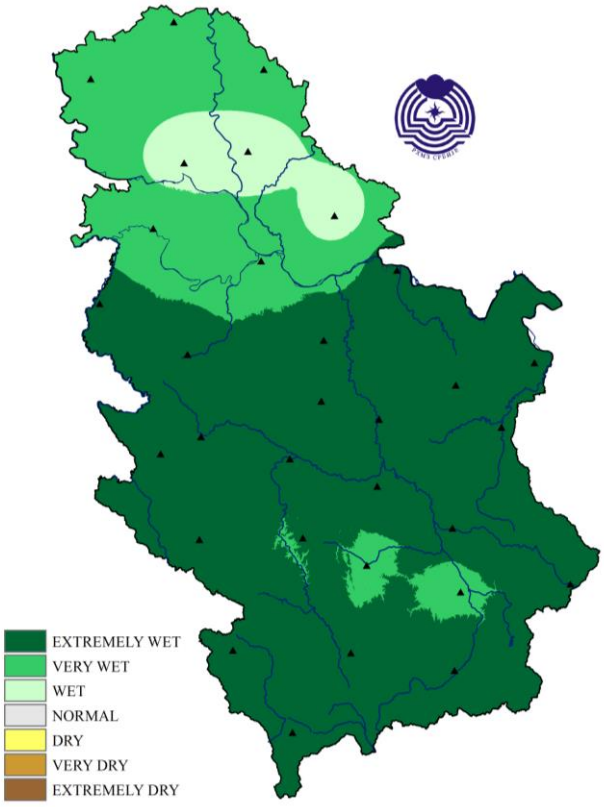


Figure 11. Monthly precipitation sums according to the percentile method

The highest daily precipitation sum of 44,0 mm was measured in Palic on November 15. On November 22, Belgrade observed the highest daily precipitation sum of 19,3 mm.

Number of days with precipitation in November ranged from 13 in Novi Sad to 23 in Leskovac *(Figure 12*). The observed number of days with precipitation was 5 to 10 days above the November average in most of the country (*Figure 13*). At 5 main meteorological stations the **maximum number of days with precipitation** for November has been registered since the record-keeping began, at two stations this number is equal (*Table 2).*

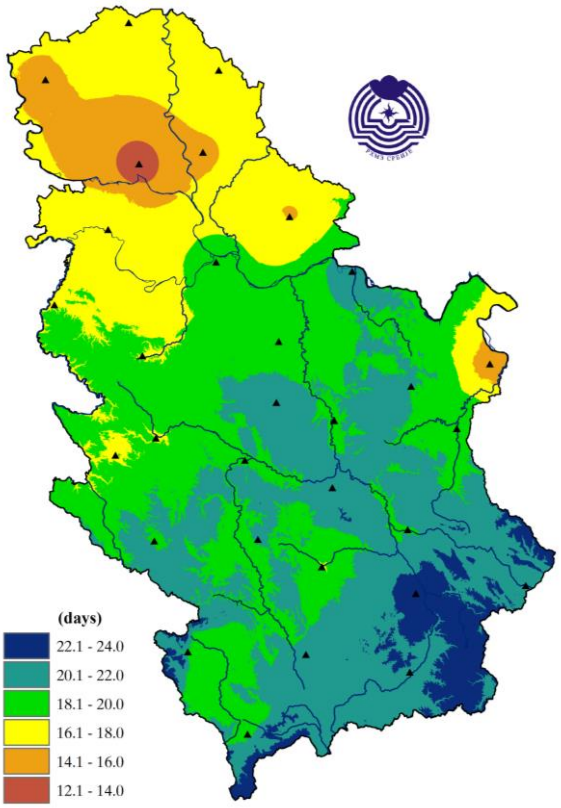


Figure 12. Spatial distribution of number of days with precipitation

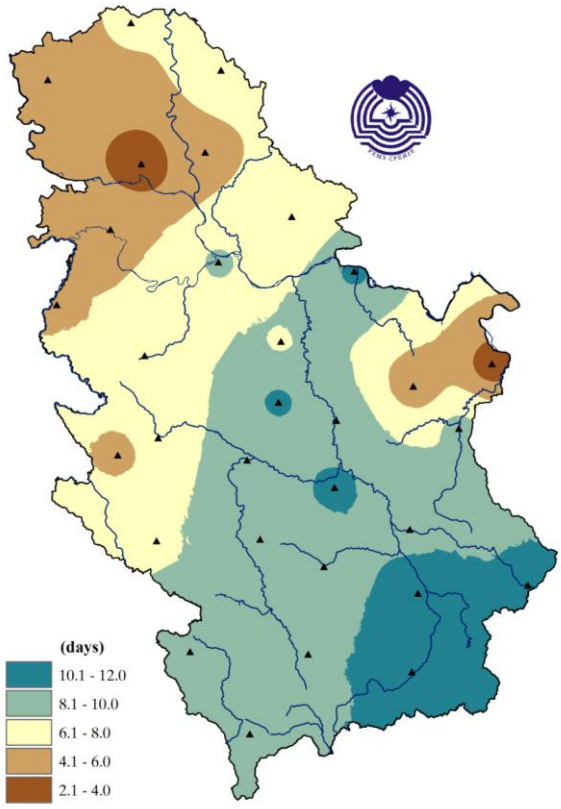


Figure 13. Spatial distribution of deviation of number of days with precipitation

Table 2. The exceeded and equal number of days with precipitation

MMS	Number of days with precipitation November 2023	Average number of days for November	Exceeded maximum number of days	Year of the maximum number of days with precipitation
LESKOVAC	23	10.1	21	1985
DIMITROVGRAD	21	10.2	20	1956
VRANjE	21	11.1	20	1966
KRAGUJEVAC	21	10.7	19	1937/1956/1979/1985
V.GRADISTE	21	11.6	19	1937/1952/1985
KRUSEVAC	21	10.6	izj.	1985
B.KARLOVAC	16	10.1	izj.	1985/2007

Snow cover was recorded in the southwest, south and southeast of the country. The highest number of days with snow cover, total of 14 days, was recorded at Kopaonik. As for the lowland, the highest number of days with snow cover, total of 3 days, was recorded in Leskovac, Dimitrovgrad and Vranje.

The highest snow depth of 43 cm was measured at Kopaonik on November 30. As for the lowland, the highest snow depth of 38 cm was measured in Vranje on November 26. The recorded snow depth was **the highest ever recorded at this station** since the record-keeping began. The previous record of 30 cm was set on November 8, 1995.

The highest snow depth was recorded on November 26. Figure 14 shows the spatial distribution for that day based on the data obtained from the 28 main, 33 climatological and 144 precipitation meteorological stations.

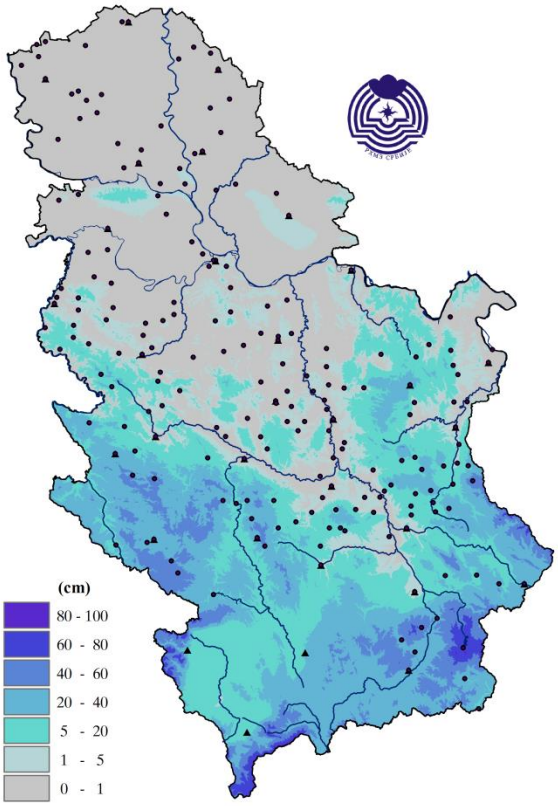


Figure 14. Spatial distribution of the highest snow depth on November 26

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

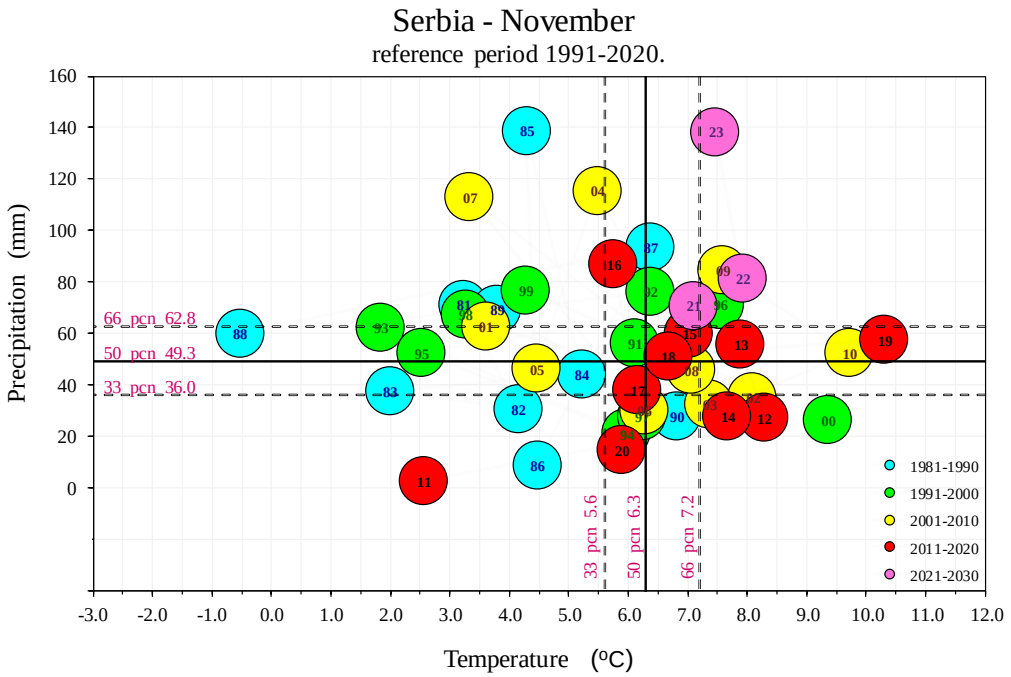


Figure 15. Assessment of air temperature and precipitation for Serbia with the accompanying terciles in relation to the 1991-2020 base period

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

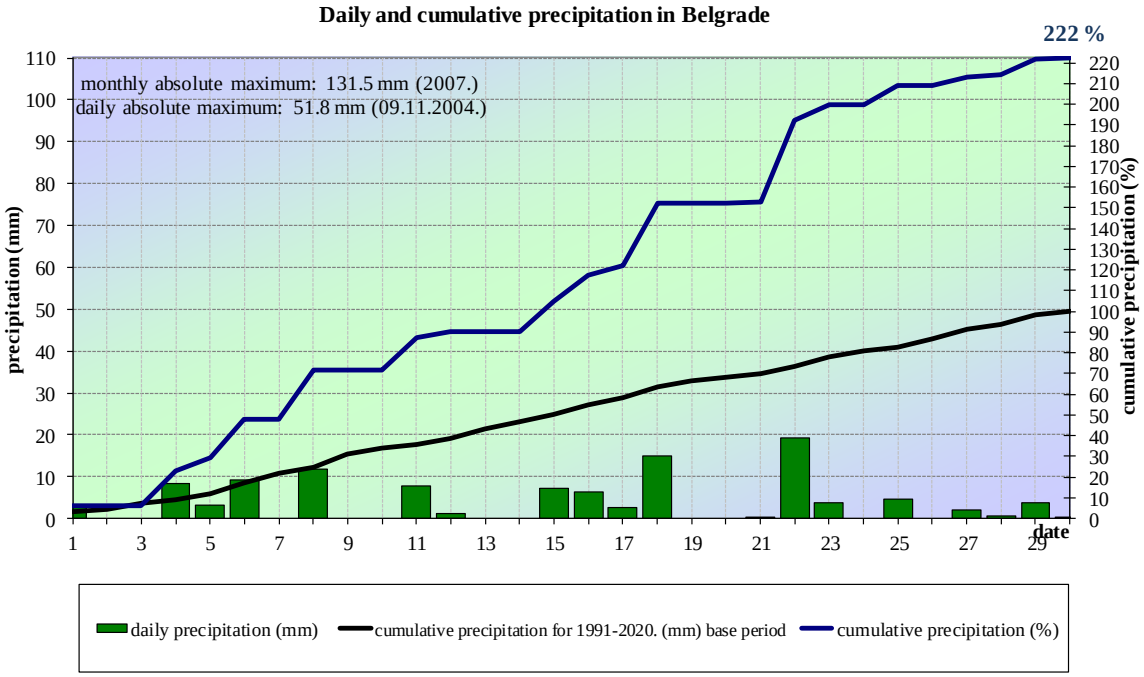


Figure 16. Daily and cumulative precipitation in Belgrade

CLOUD COVER, BRIGHT AND CLOUDY DAYS

Mean November cloud cover in Serbia was around the average, ranging from 6/10 to 8/10. Figures 17, 18 and 19 show the average daily November cloud cover for Belgrade, Kopaonik and Sombor.

Bright days[7] were not registered in Loznica and Kraljevo. The highest number of bright days, total of 4 days, was recorded in Banatski Karlovac. Belgrade observed one bright day. The observed number of bright days was around 3 days below the November average.

The minimum number of cloudy days[8] was recorded in Sremska Mitrovica, total of 6 days, and the maximum number of cloudy days, total of 17 days, was registered at Kopaonik. Belgrade observed 11 cloudy days. Number of cloudy days in the north and the east was up to 5 days below the November average, elsewhere, it was up to 4 days above the November average.

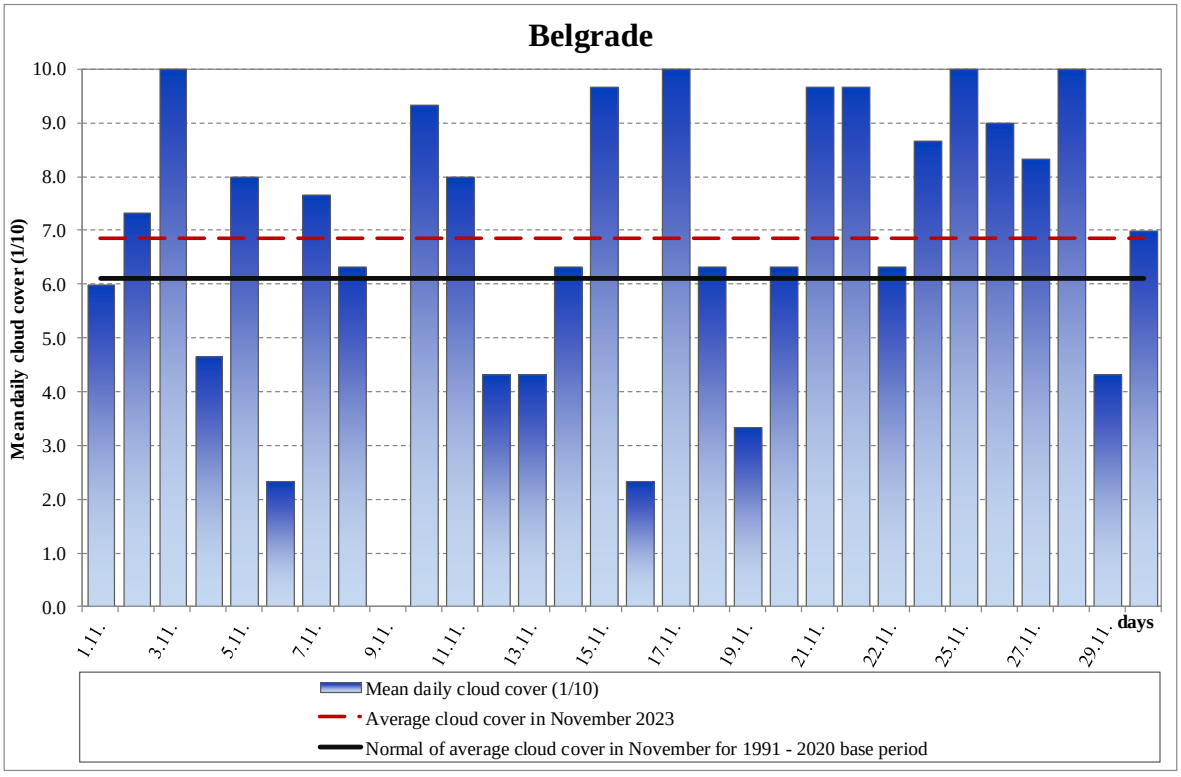


Figure 17. Mean daily cloud cover in Belgrade

[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

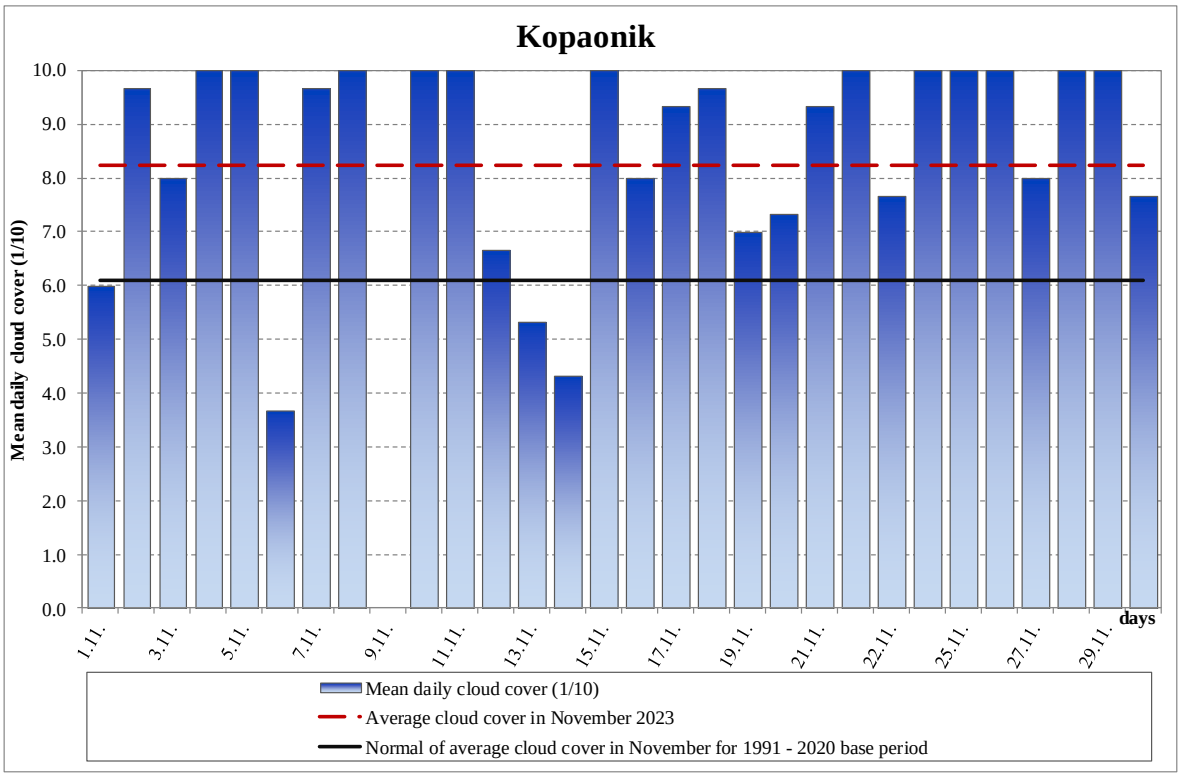


Figure 18. Mean daily cloud cover on Kopaonik

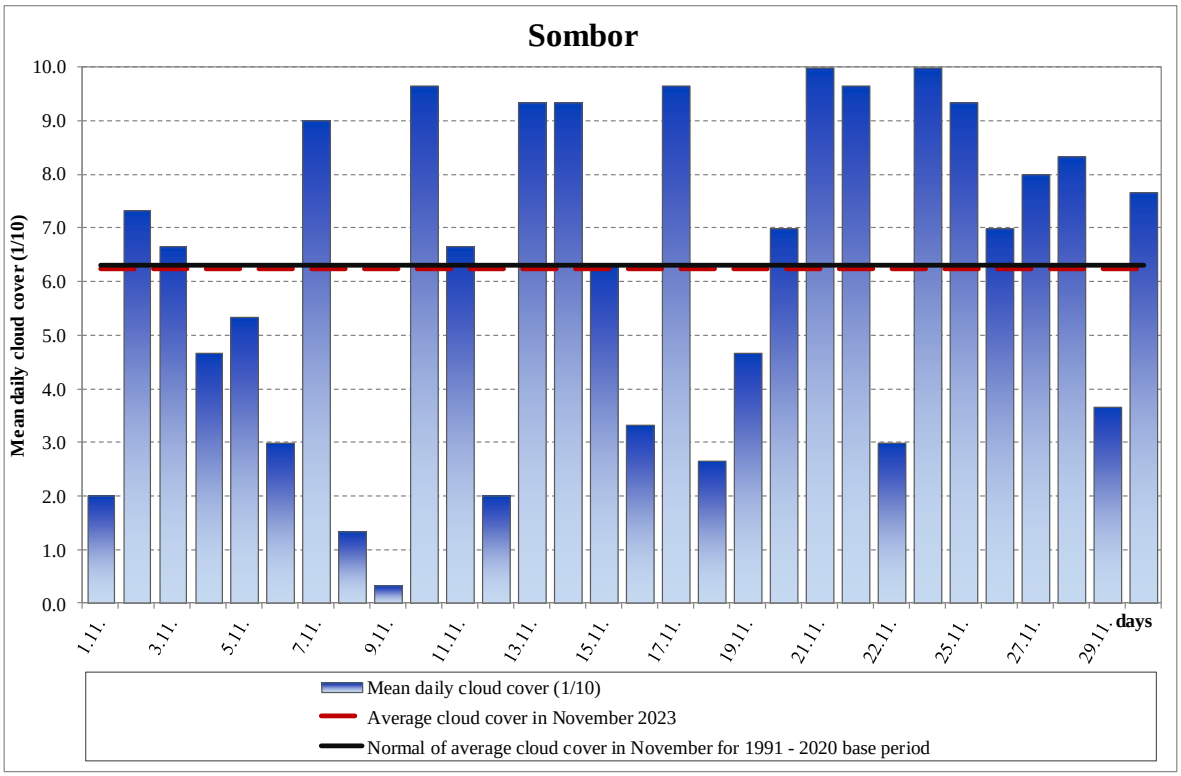


Figure 19. Mean daily cloud cover in Sombor

SUNSHINE DURATION (INSOLATION)

Sunshine duration in November ranged from 54,1 hours in Leskovac to 103,4 hours in Negotin (*Figure 20*).

November insolation ranged from 64% in Leskovac to 142% in Negotin compared to the normal for the 1991-2020 base period (*Figure 21*).

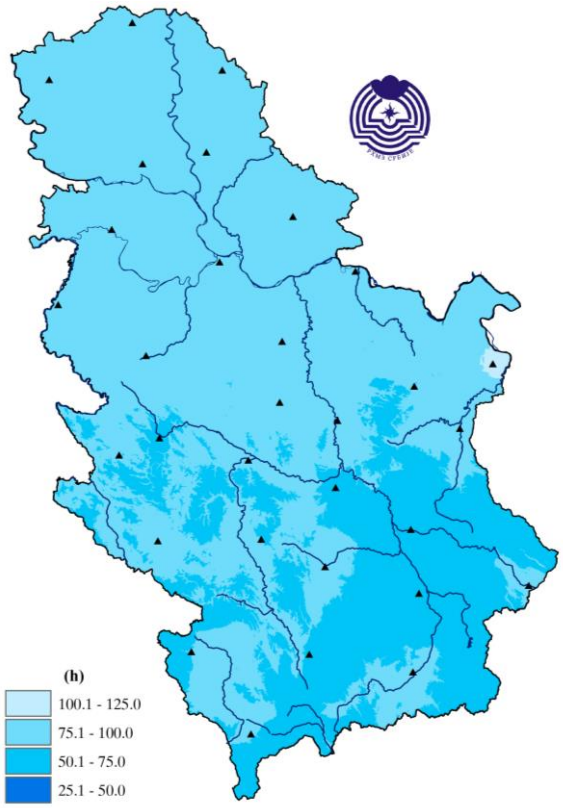


Figure 20. Insolation, expressed in hours

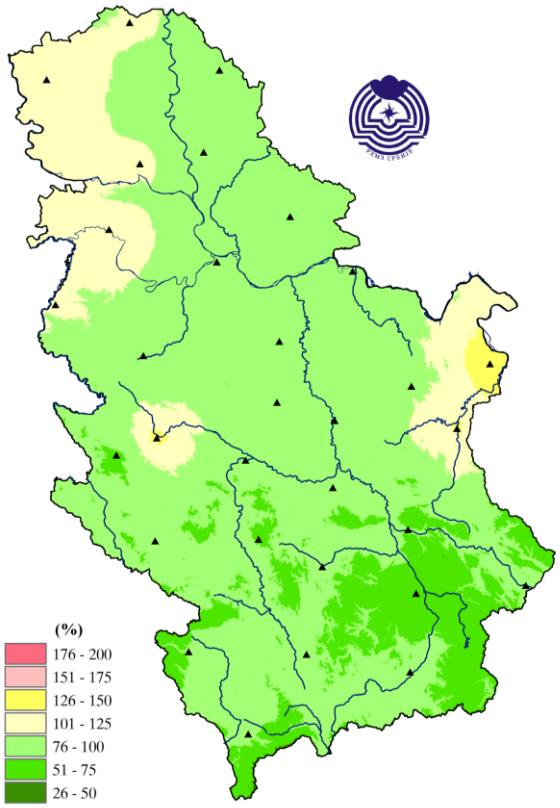


Figure 21. Insolation expressed in the percentages of normal

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

OVERVIEW OF THE SYNOPTIC SITUATION*

Extremely warm and windy weather accompanied by rainfall due to a series of moist air masses emanating from the north and northwest and frequent cyclonic activities in the area of Iceland and the Arctic, as well as in the Mediterranean Sea, influence of strong upper-level circulations; in the third decade, colder, with snow in the hilly-mountainous areas.

First half of the month was marked by extremely warm weather with frequent influences of fast-moving moist air masses emanating from the northwest along with warm and humid waves from the Mediterranean. Frequent and heavy precipitation, rain and showers were recorded in central, eastern, and southeastern Serbia.

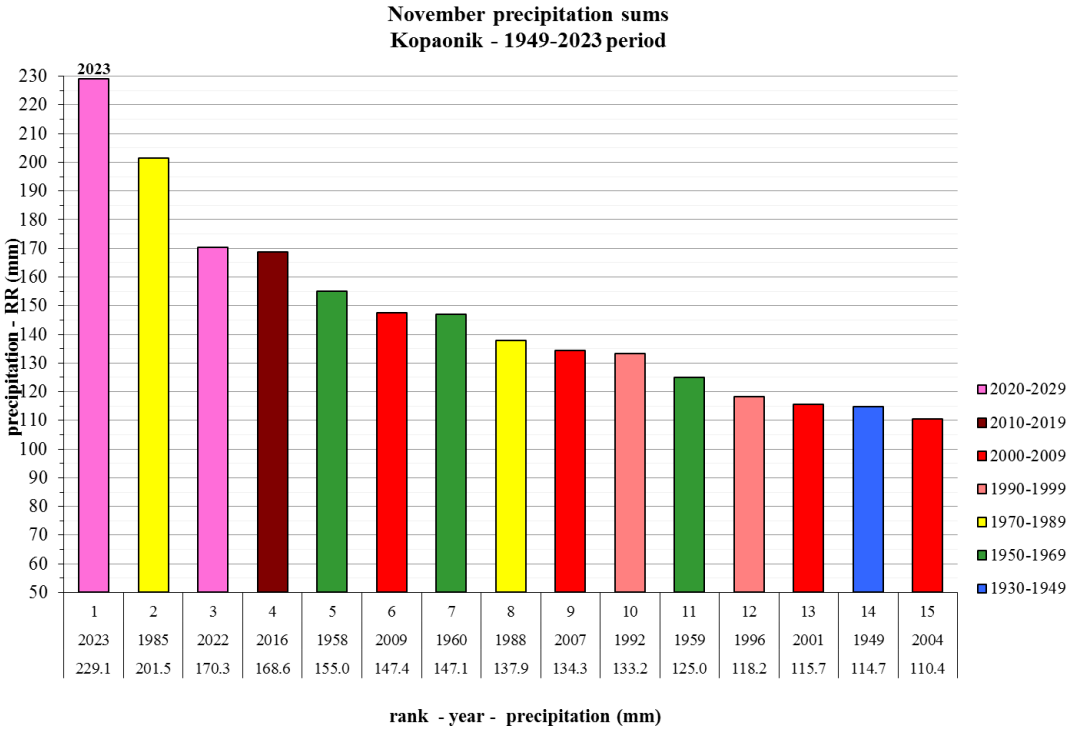
In a subsequent period, as of the mid-month, low pressure field developed in the Alps region and the northern Adriatic shifting across the Balkan Peninsula and the Adriatic Sea towards the southeast and the Black Sea within a strong northwesterly upper-air circulation. Beginning of the third decade was marked by cyclone cutoff in the area of the western Mediterranean.The mentioned cyclone moved from the north of Africa towards Eastern Europe, with simultaneous formation of an upper-level low pressure system in the north of the continent, its strengthening, and transfer across Central Europe towards the north of the Apennine and Balkan Peninsula. These developments maintained changeable weather conditions, occasionally with rain, and by the end of the second decade, snow was recorded in mountainous areas.

The third decade was marked by a very warm weather pertaining for a few days on the front side of the cyclone from the west of the Balkans. It was followed by a significant temperature drop, strong winds, and snow in the hilly-mountainous regions of the country. This was due to a cold air mass within the cyclone that moved across our regions towards the Aegean and Black Seas. Period at the end of the month was characterized by the establishment of the high pressure system over the Pannonian Plain and the Balkan Peninsula producing stable and dry weather.

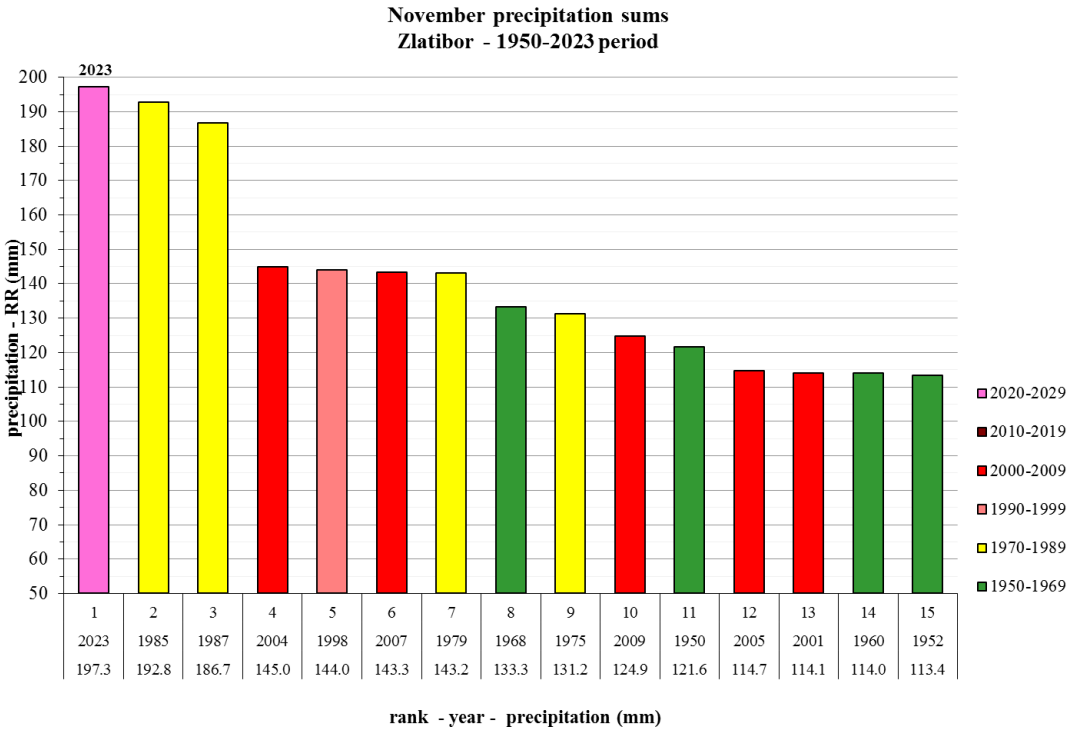
* National Center for Hydrometeorlogical Early Warning System

APPENDIX

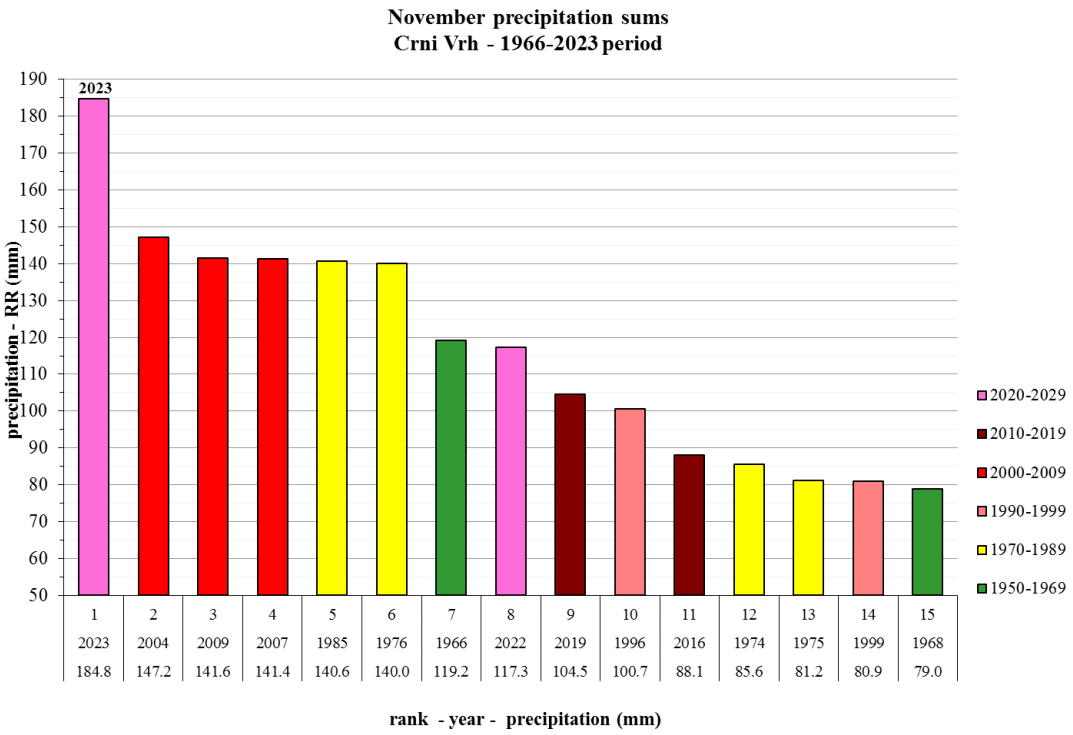
Ranks of the highest precipitation in November



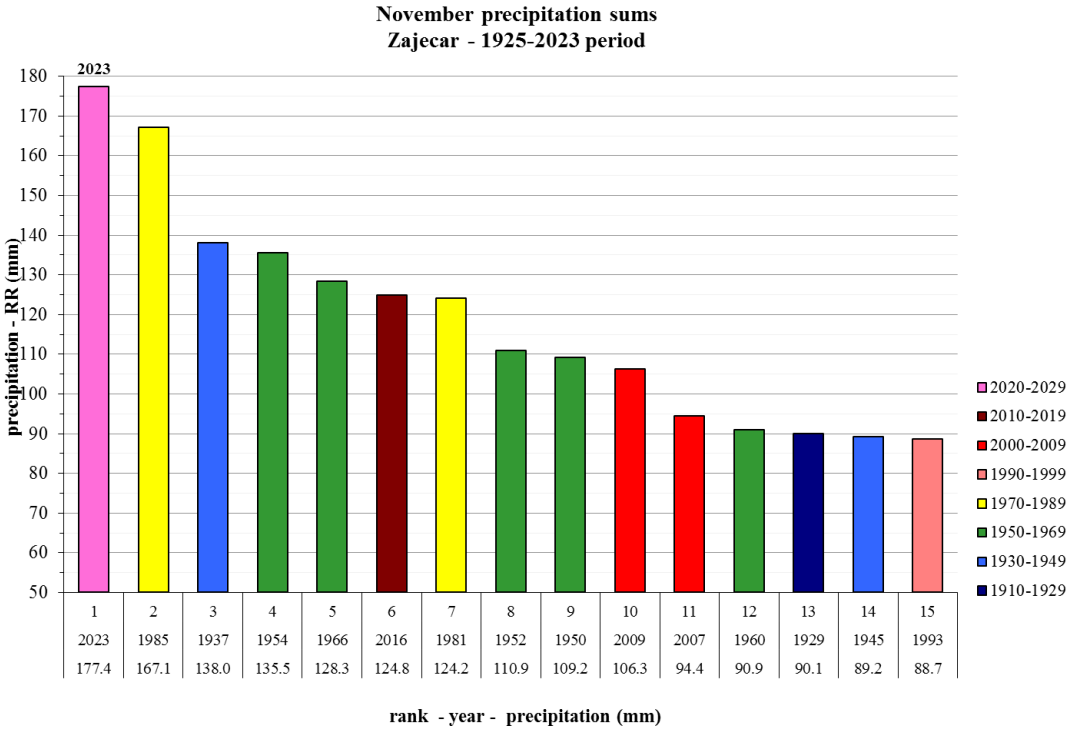
Appendix 1. Rank of the highest precipitation on Kopaonik



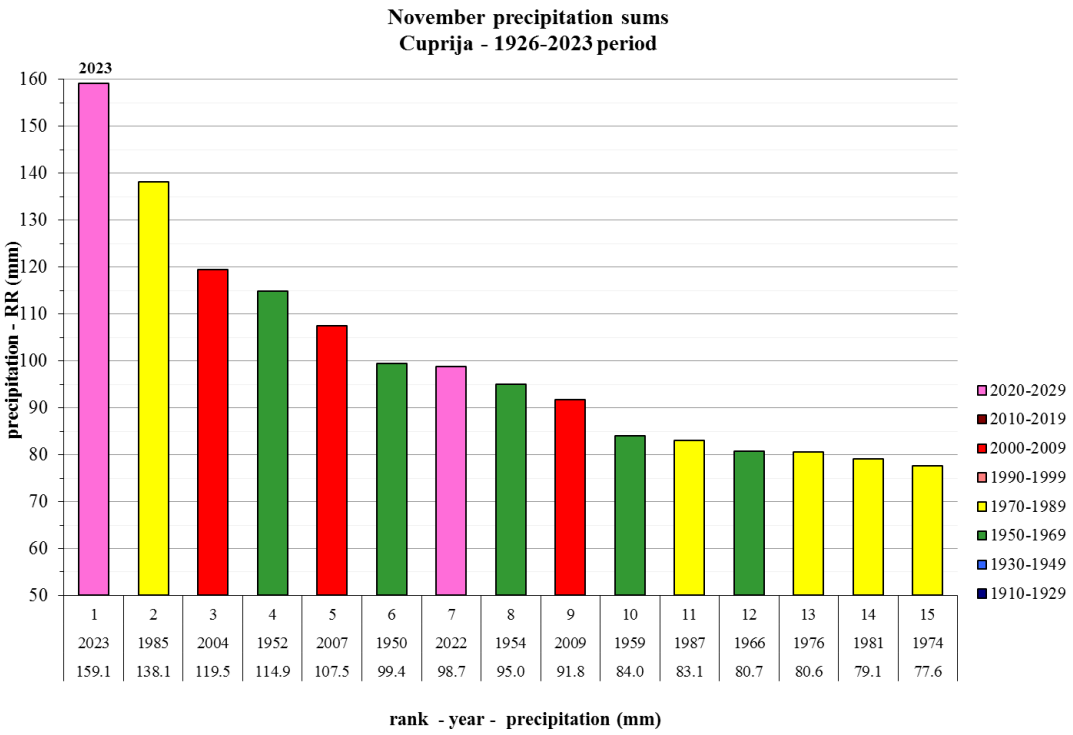
Appendix 2. Rank of the highest precipitation on Zlatibor



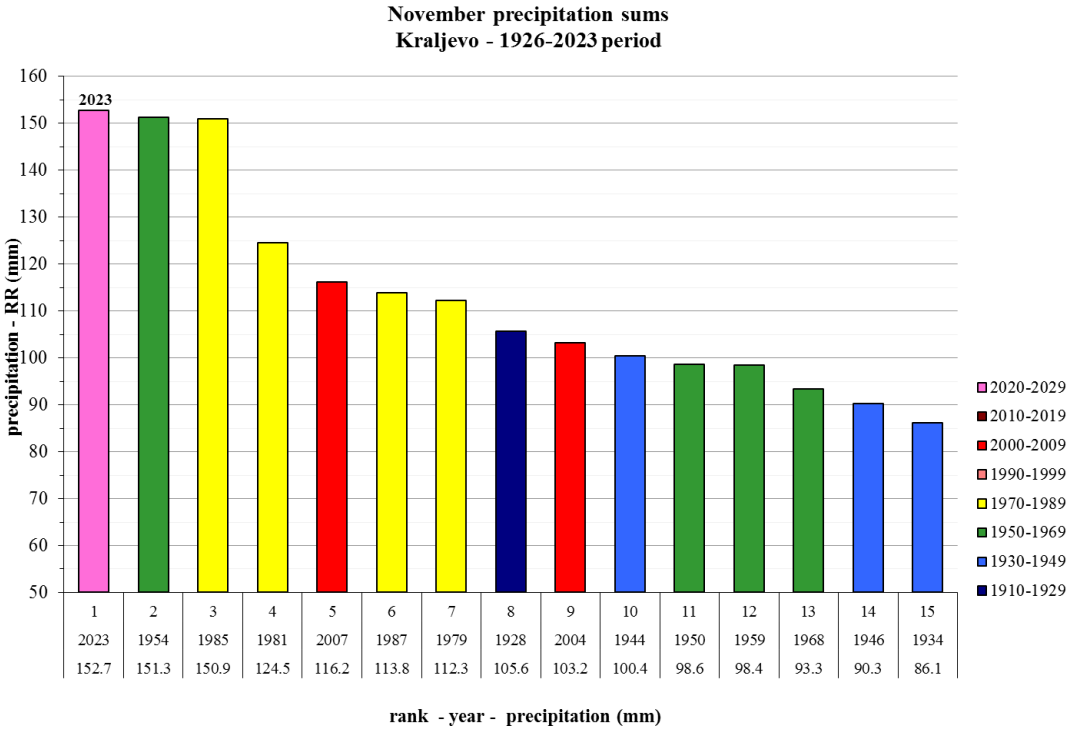
Appendix 3. Rank of the highest precipitation on Crni Vrh



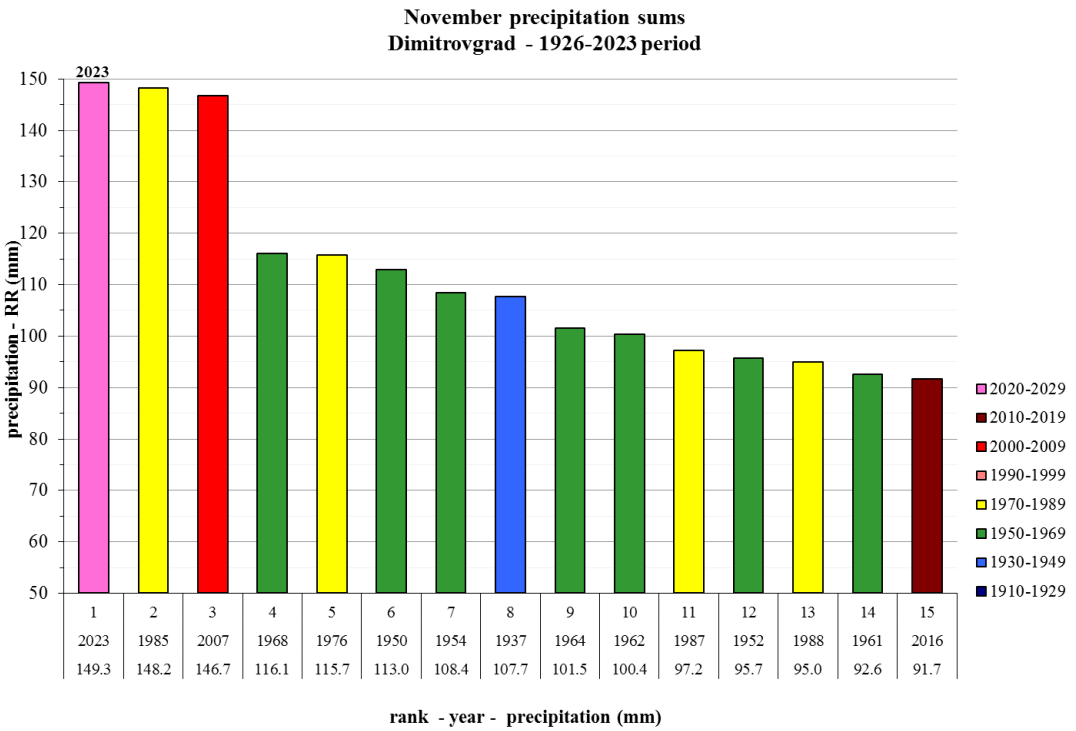
Appendix 4. Rank of the highest precipitation in Zajecar



Appendix 5. Rank of the highest precipitation in Cuprija

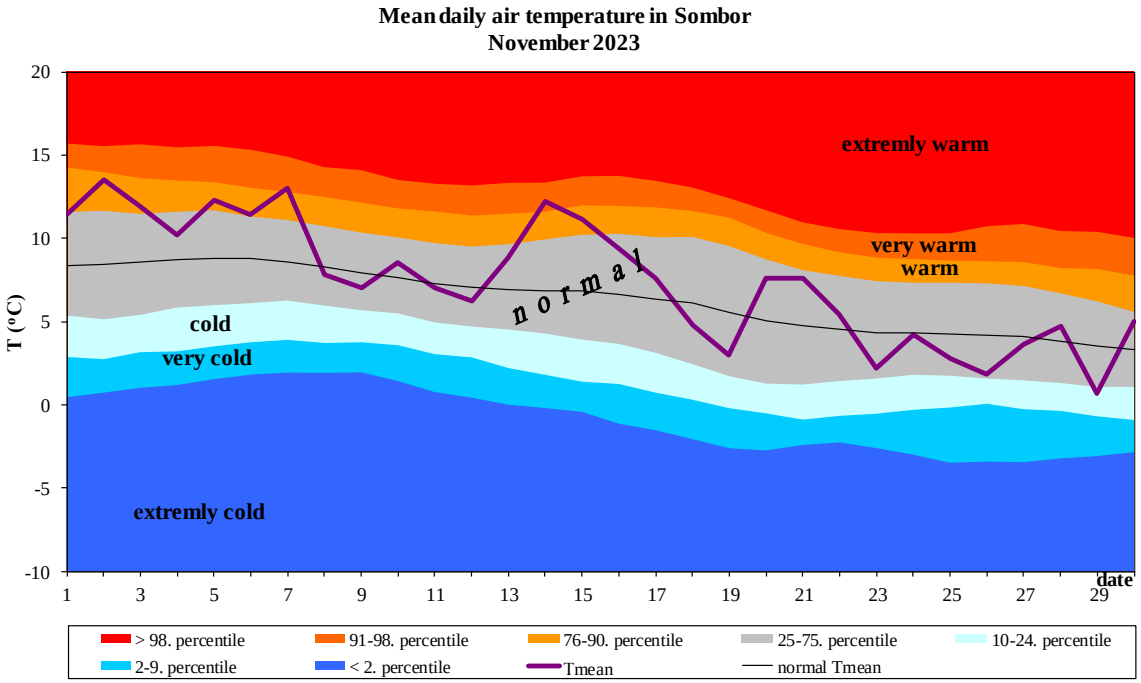


Appendix 6. Rank of the highest precipitation in Kraljevo

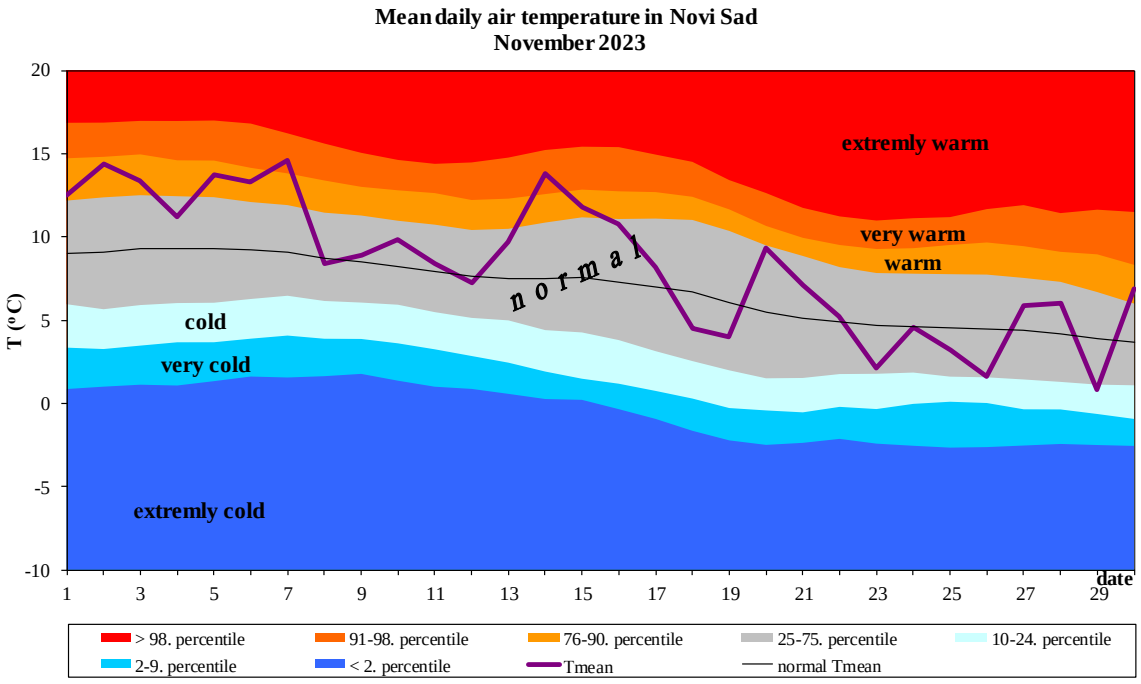


Appendix 7. Rank of the highest precipitation in Dimitrovgrad

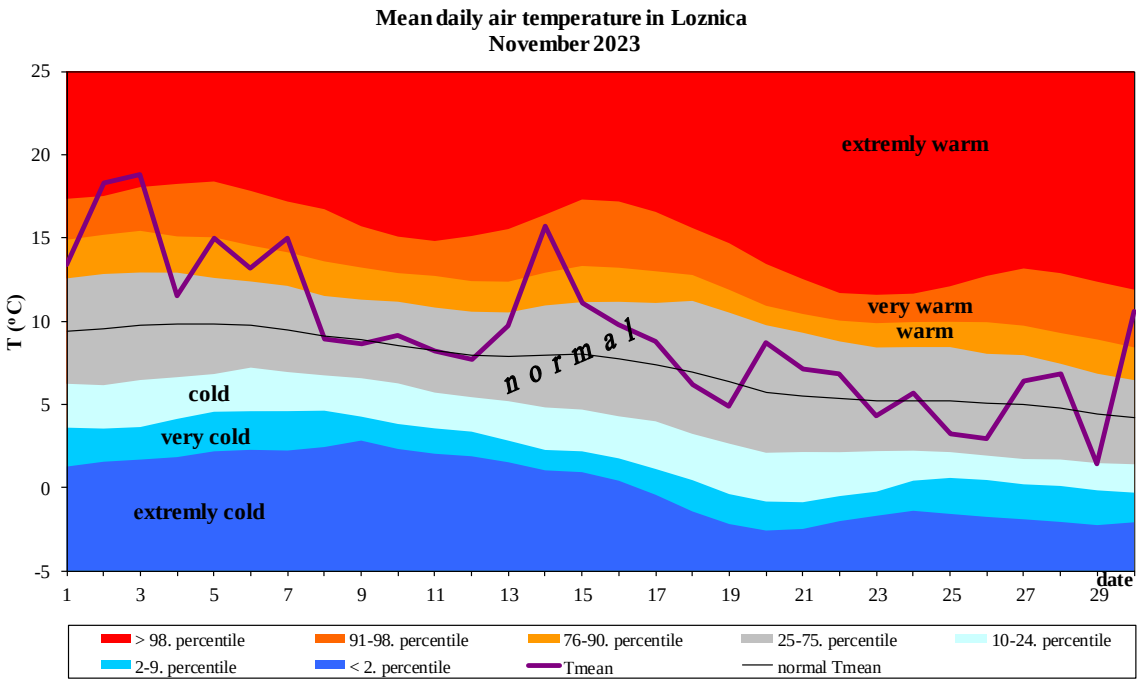
Mean air temperature



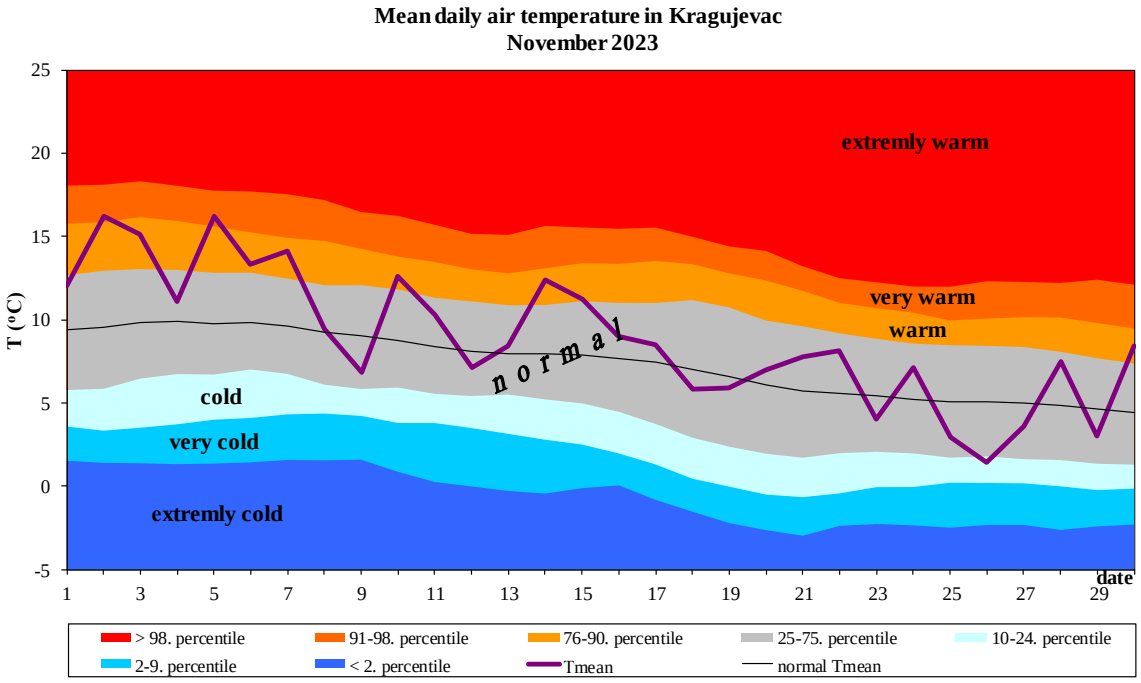
Appendix 8. Daily course of the mean daily air temperature and accompanying percentile for Sombor



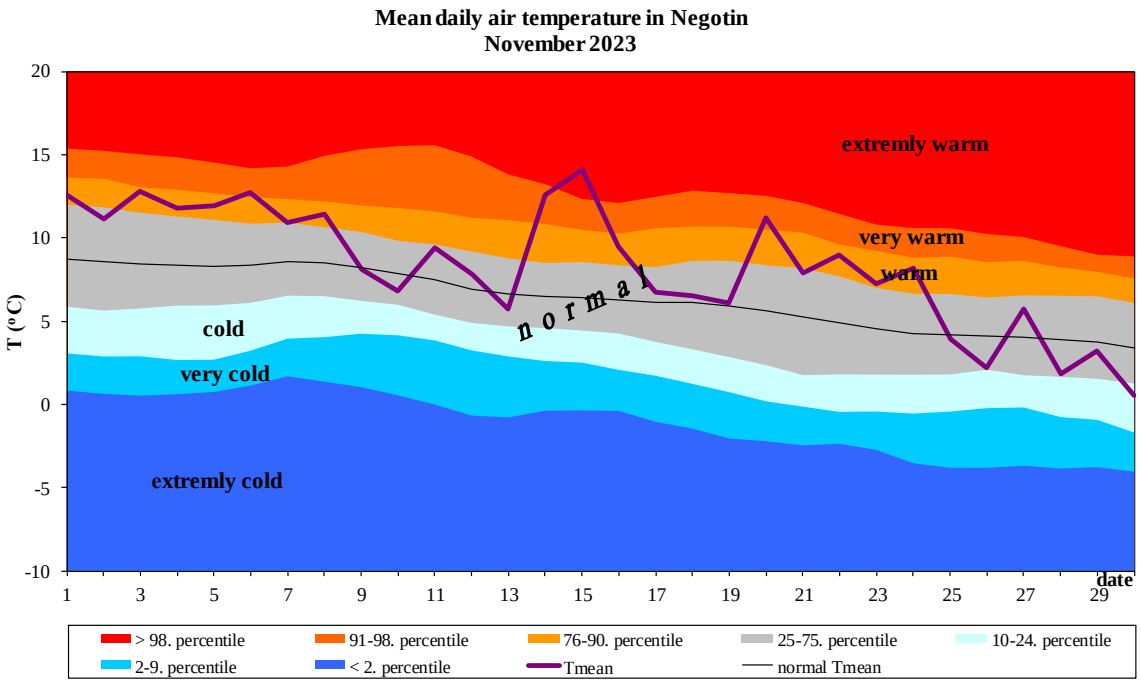
Appendix 9. Daily course of the mean daily air temperature and accompanying percentile for Novi Sad



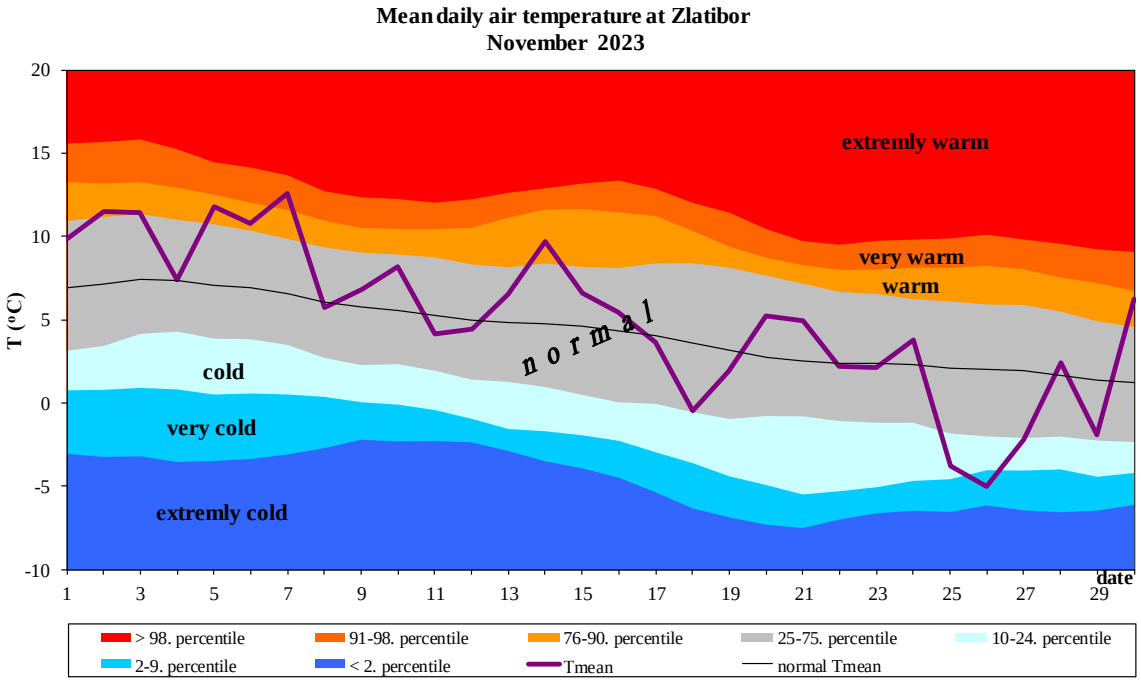
Appendix 10. Daily course of the mean daily air temperature and accompanying percentile for Loznica



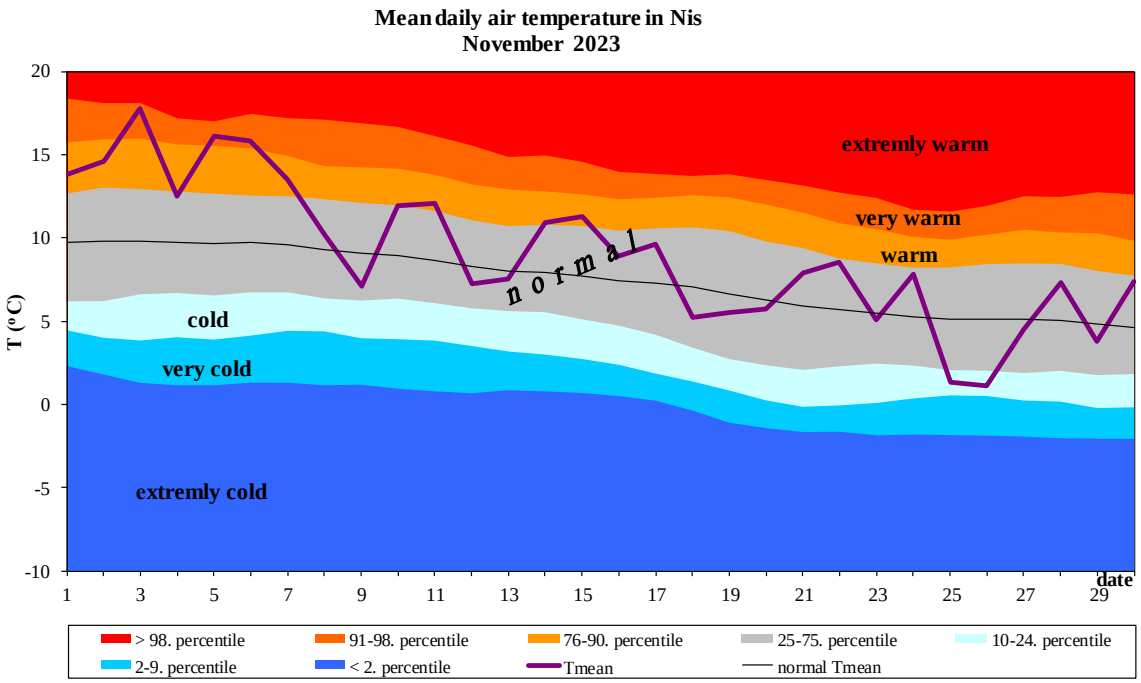
Appendix 11. Daily course of the mean daily air temperature and accompanying percentile for Kragujevac



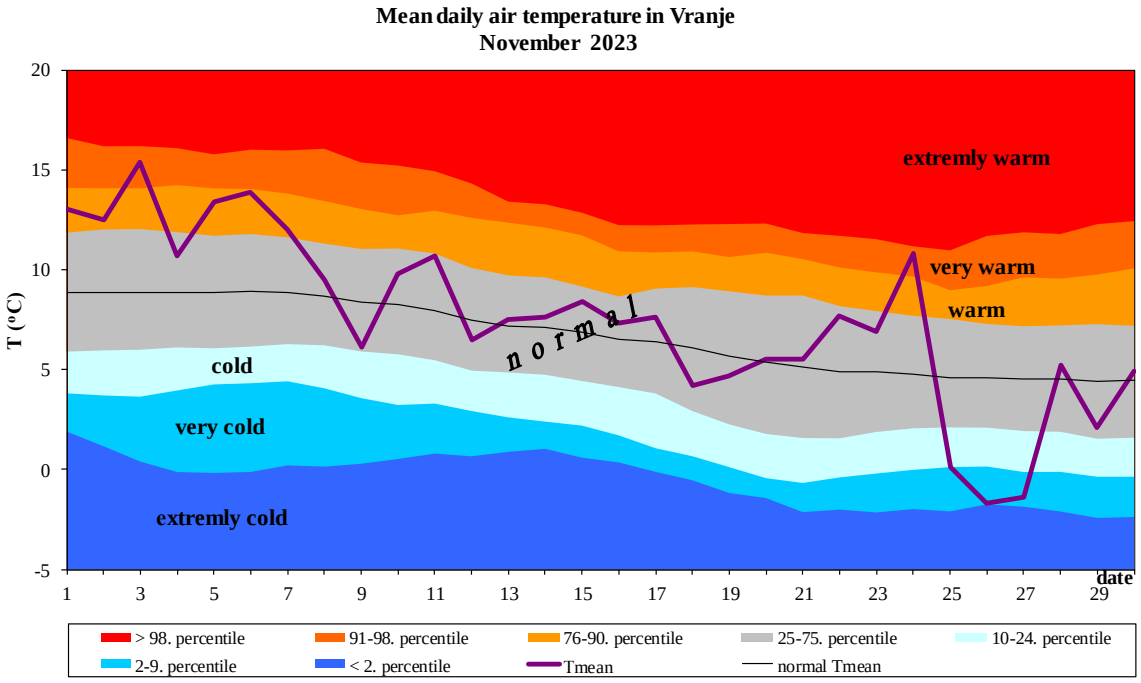
Appendix 12. Daily course of the mean daily air temperature and accompanying percentile for Negotin



Appendix 13. Daily course of the mean daily air temperature and accompanying percentile on Zlatiboru

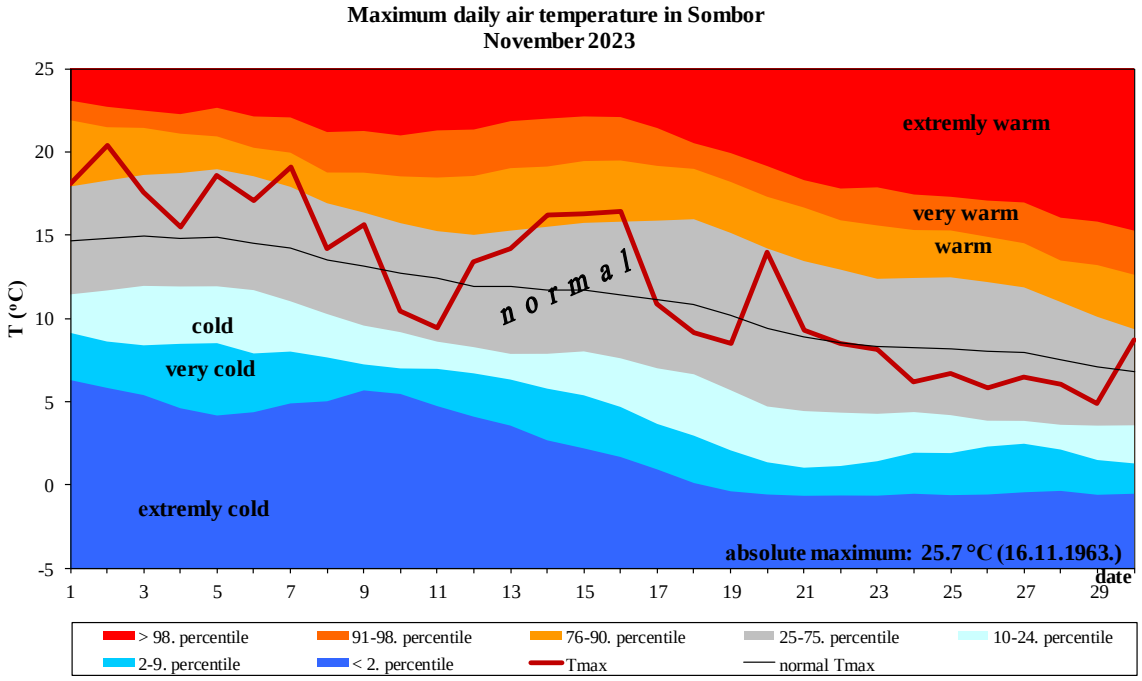


Appendix 14. Daily course of the mean daily air temperature and accompanying percentile for Nis

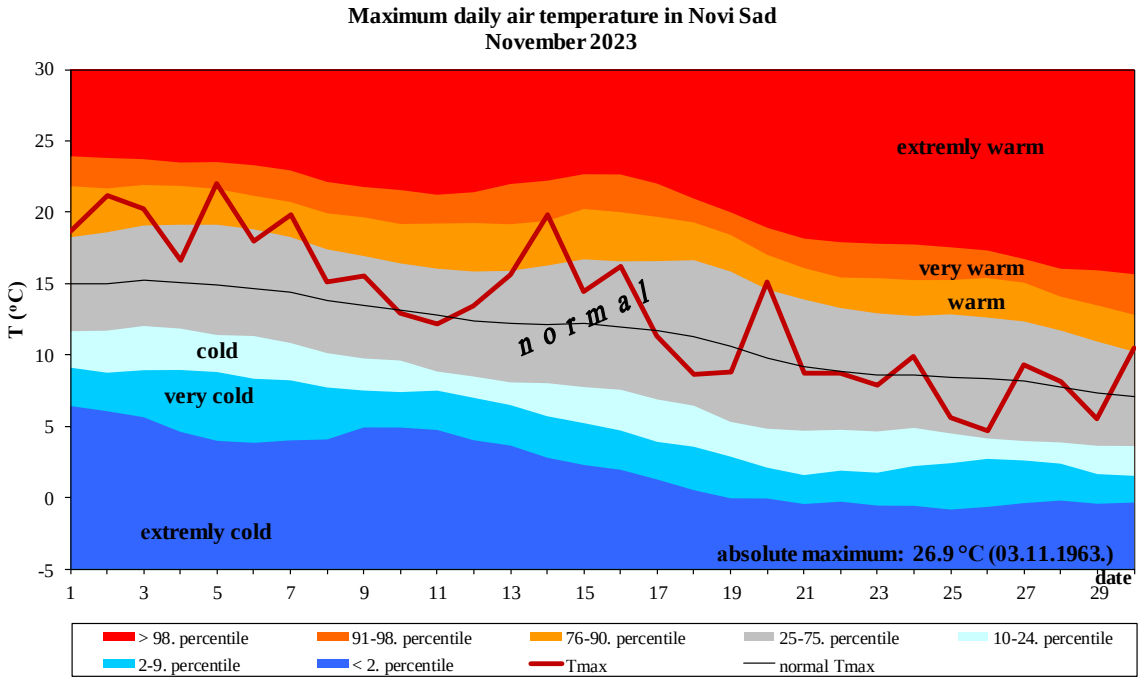


Appendix 15. Daily course of the mean daily air temperature and accompanying percentile for Vranje

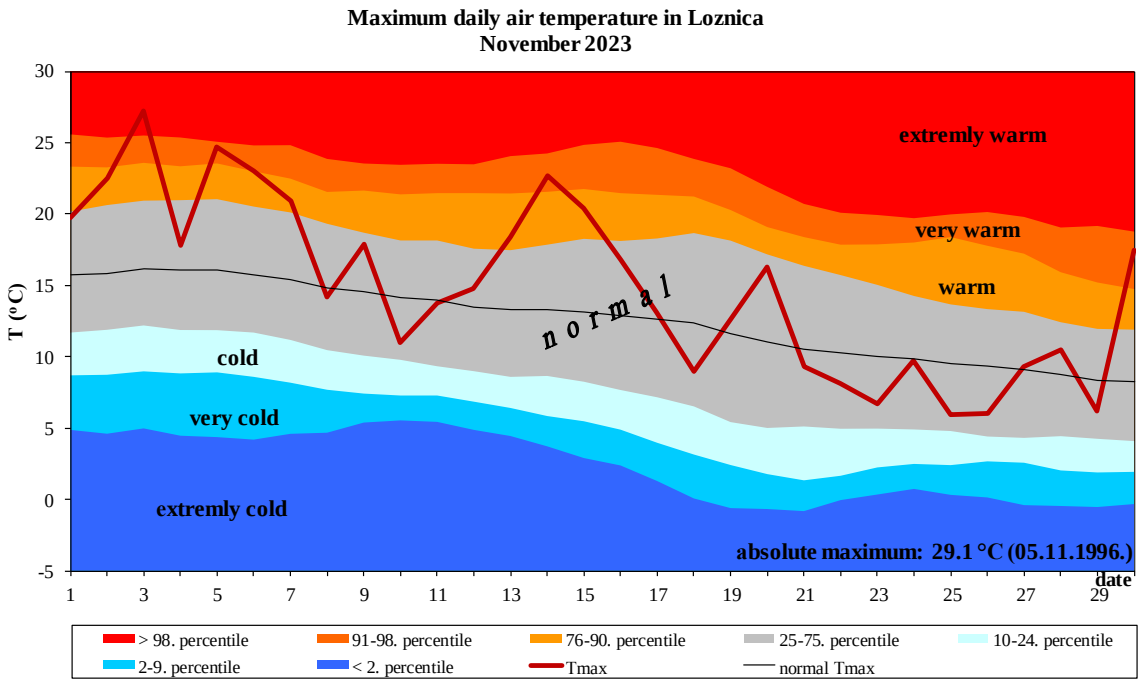
Maximum air temperature



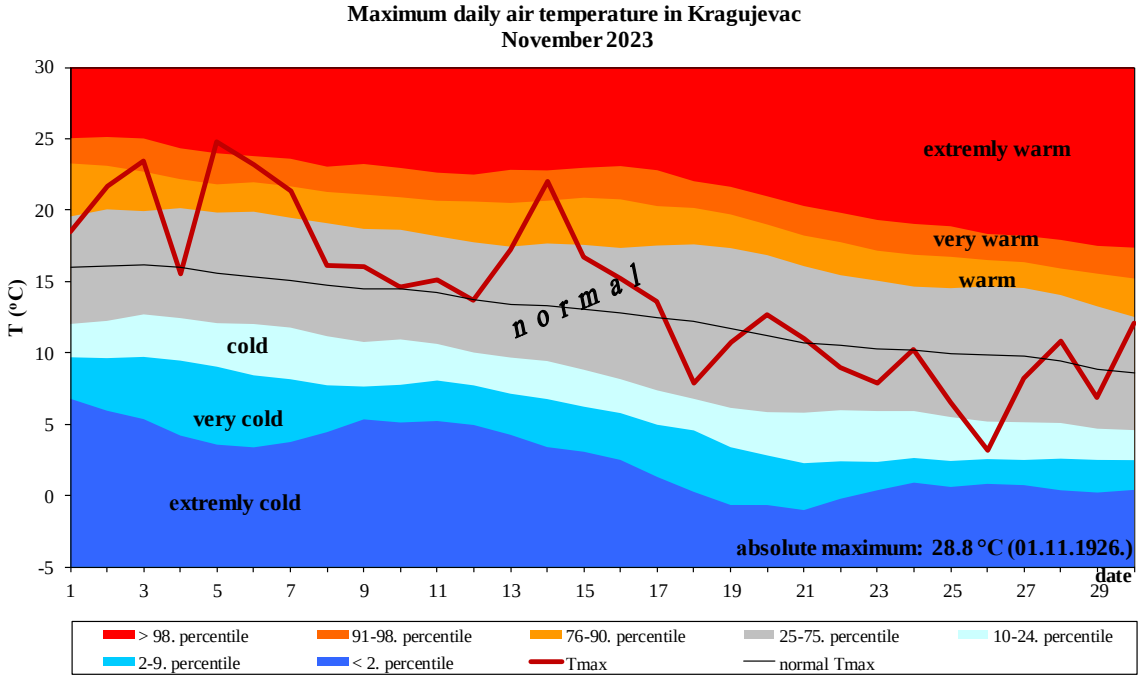
Appendix 16. Daily course of the maximum daily air temeperature and the accompanying percentile for Sombor



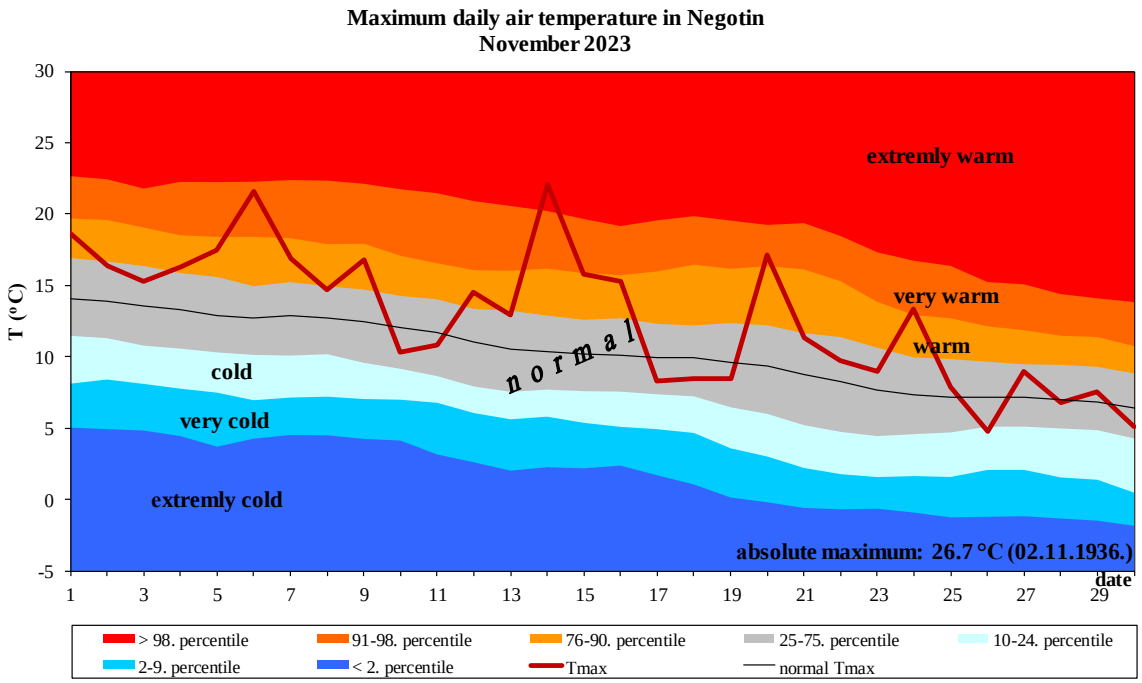
Appendix 17. Daily course of the maximum daily air temeperature and the accompanying percentile for Novi Sad



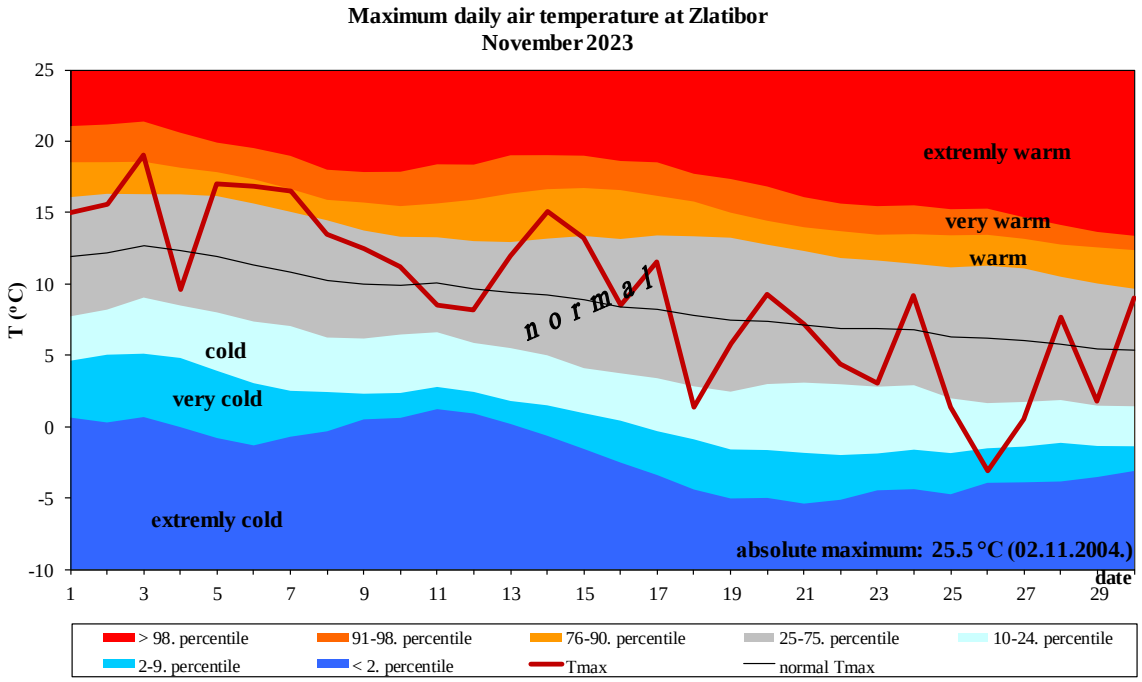
Appendix 18. Daily course of the maximum daily air temeperature and the accompanying percentile for Loznica



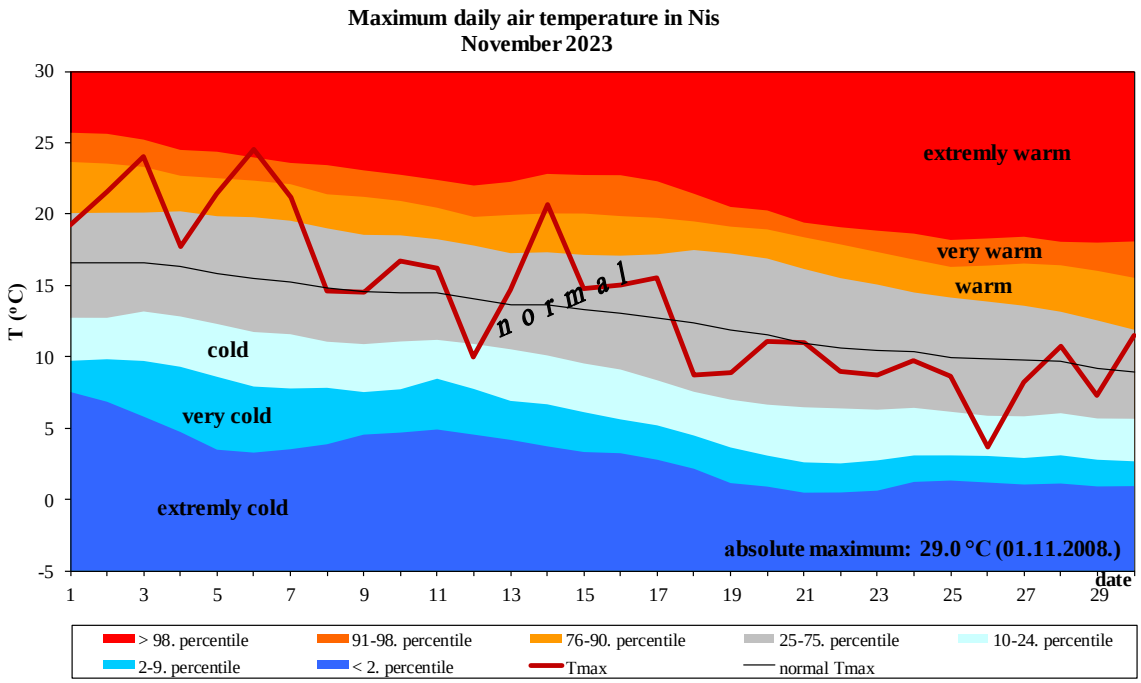
Appendix 19. Daily course of the maximum daily air temeperature and the accompanying percentile for Kragujevac



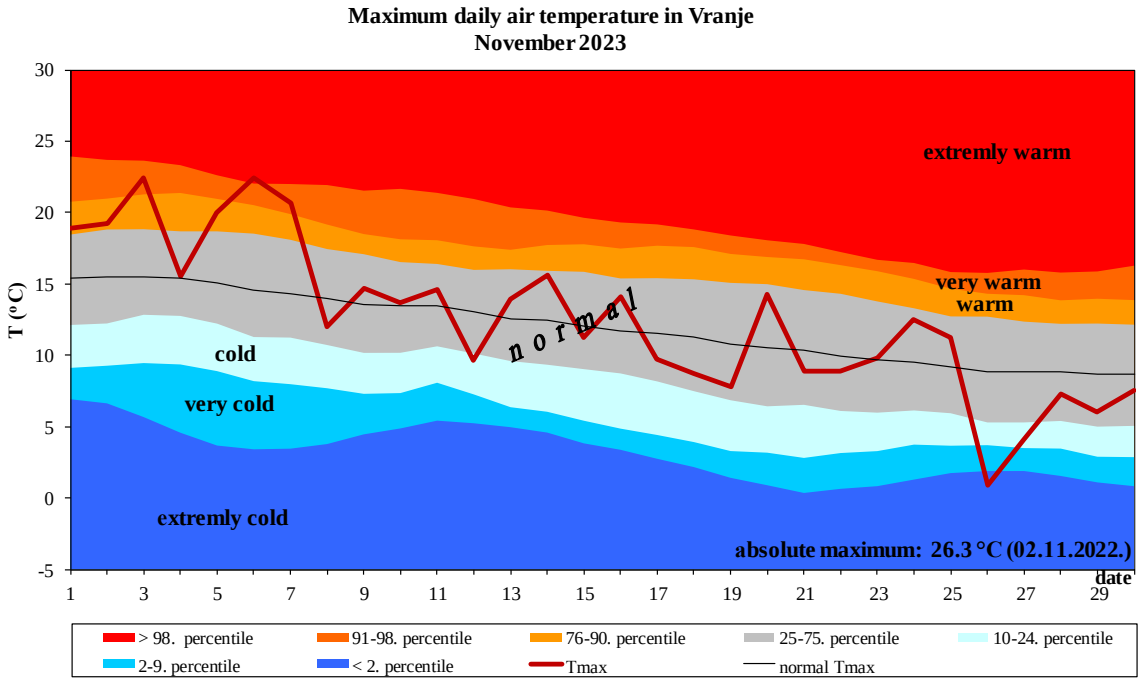
Appendix 20. Daily course of the maximum daily air temeperature and the accompanying percentile for Negotin



Appendix 21. Daily course of the maximum daily air temeperature and the accompanying percentile on Zlatibor

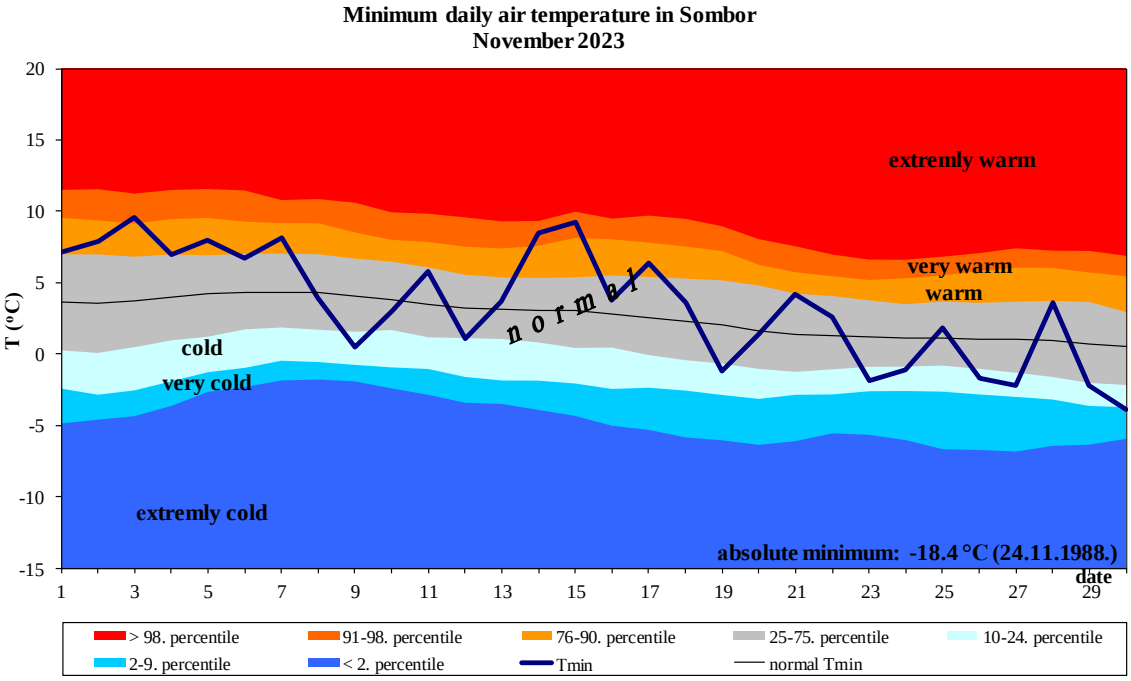


Appendix 22. Daily course of the maximum daily air temeperature and the accompanying percentile for Nis

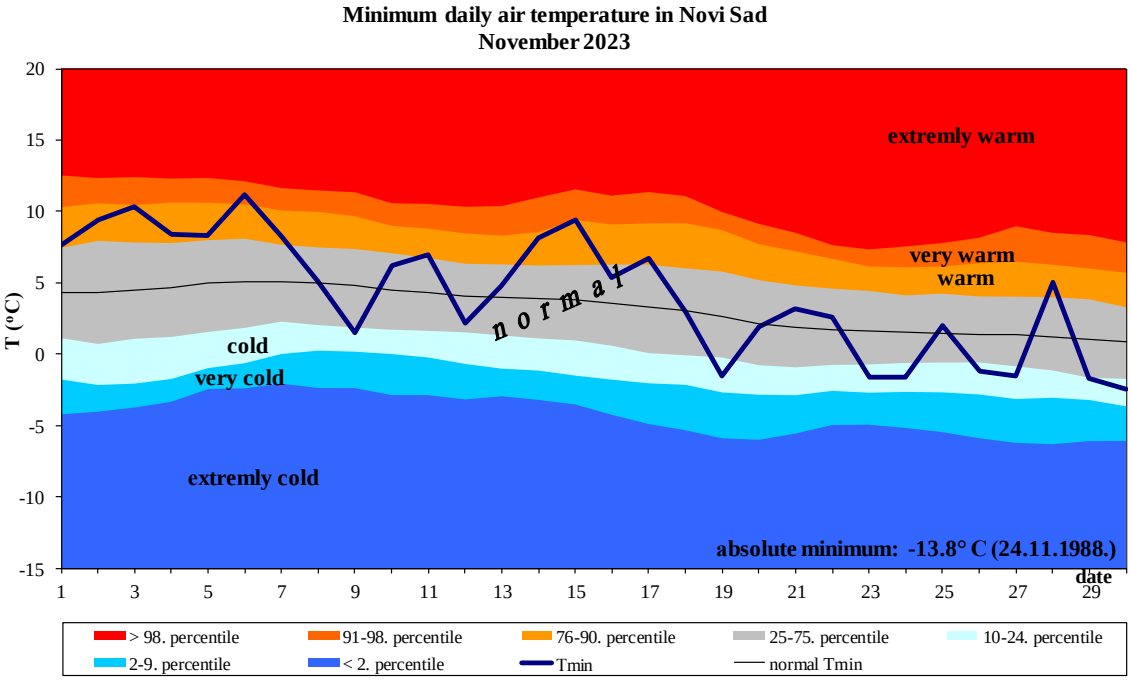


Appendix 23. Daily course of the maximum daily air temeperature and the accompanying percentile for Vranje

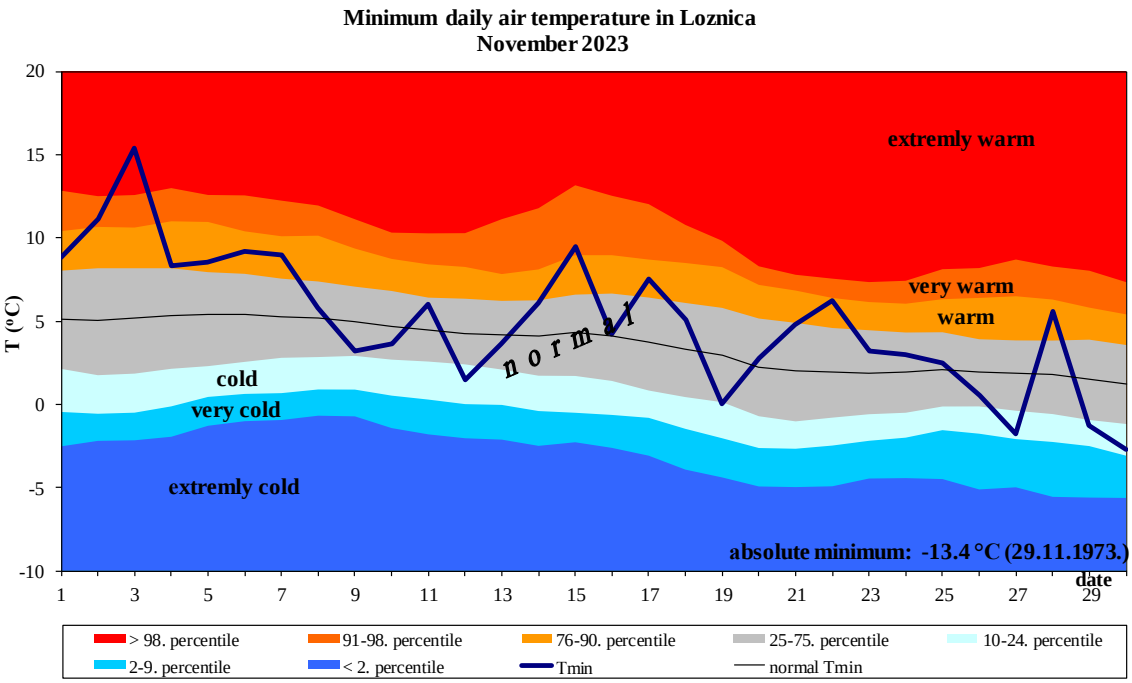
Minimum air temperature



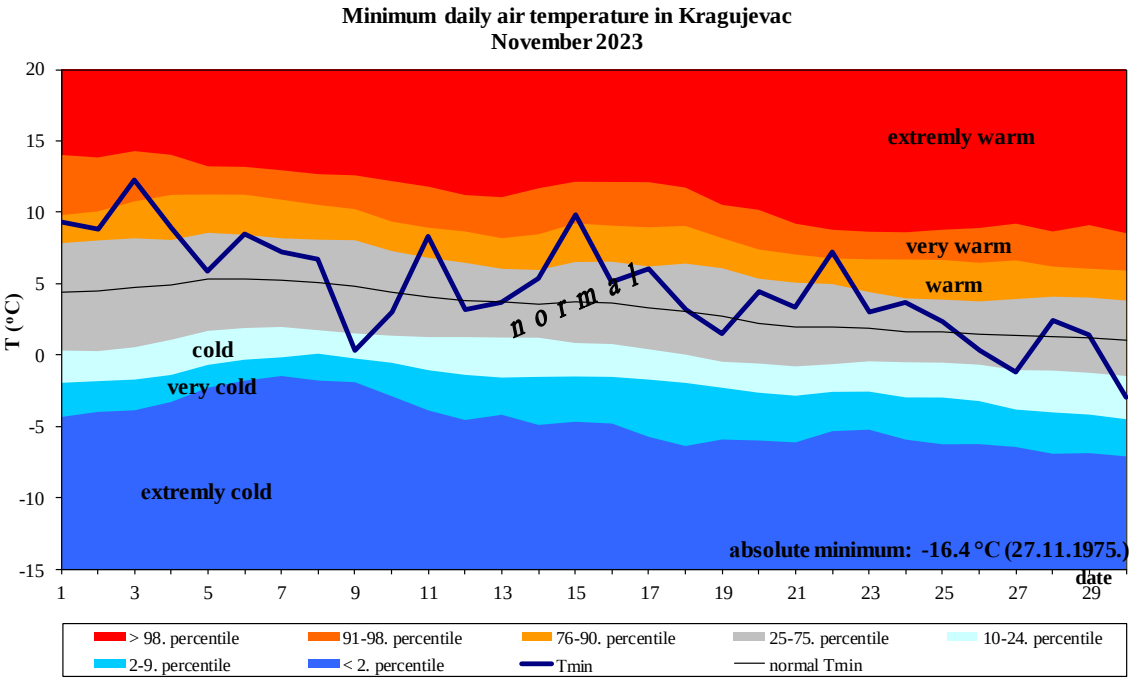
Appendix 24. Daily course of the minimum daily air temperature and the accompanying percentile for Sombor



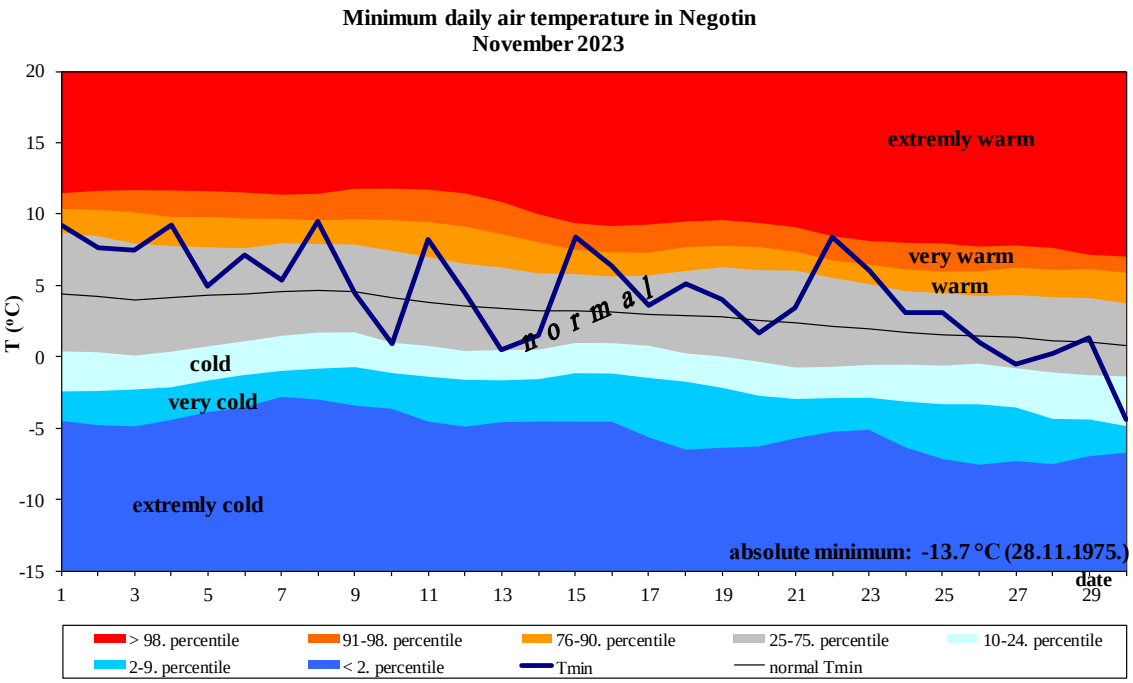
Appendix 25. Daily course of the minimum daily air temperature and the accompanying percentile for Novi Sad



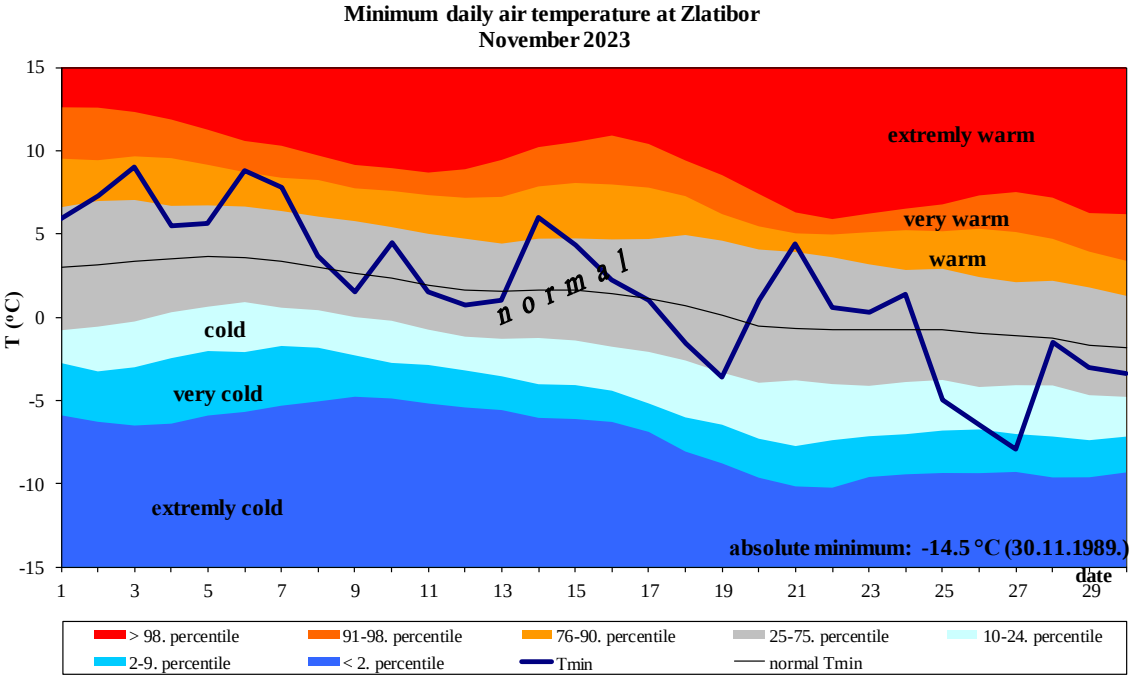
Appendix 26. Daily course of the minimum daily air temperature and the accompanying percentile for Loznica



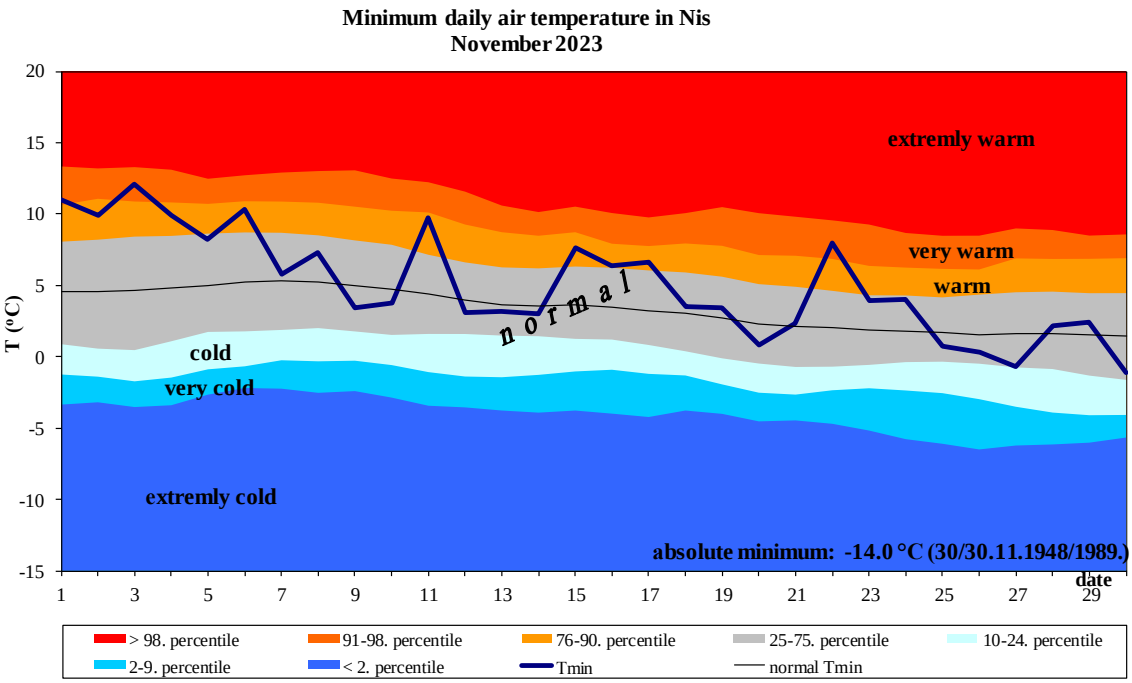
Appendix 27. Daily course of the minimum daily air temperature and the accompanying percentile for Kragujevac



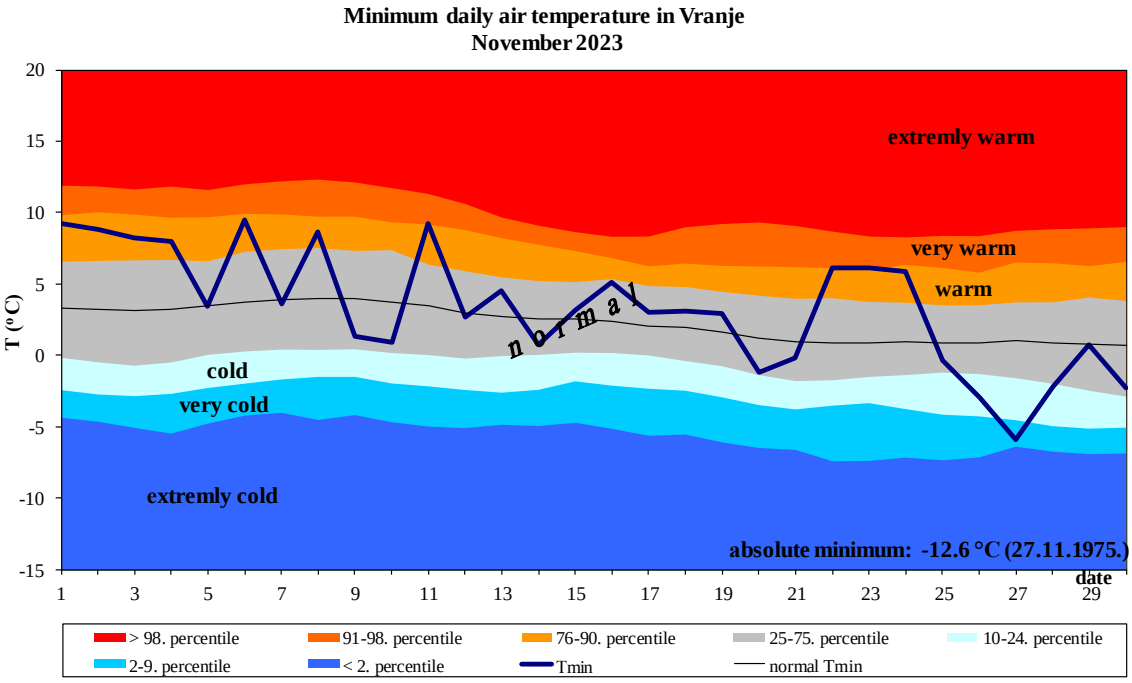
Appendix 28. Daily course of the minimum daily air temperature and the accompanying percentile for Negotin



Appendix 29. Daily course of the minimum daily air temperature and the accompanying percentile on Zlatibor

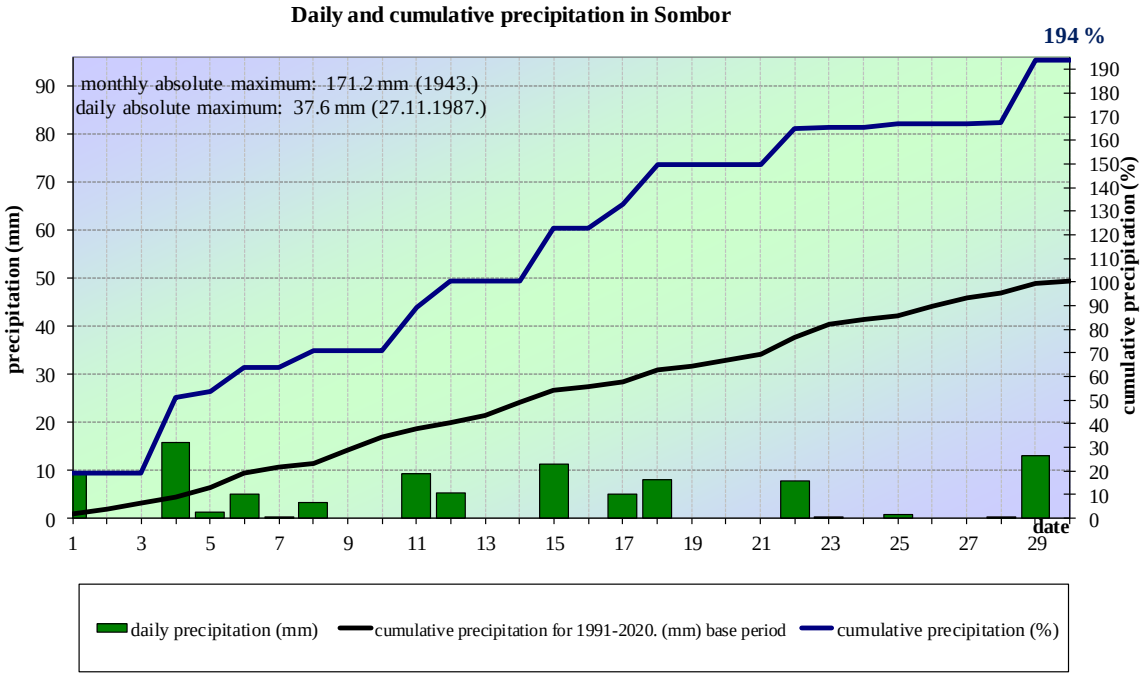


Appendix 30. Daily course of the minimum daily air temperature and the accompanying percentile for Nis

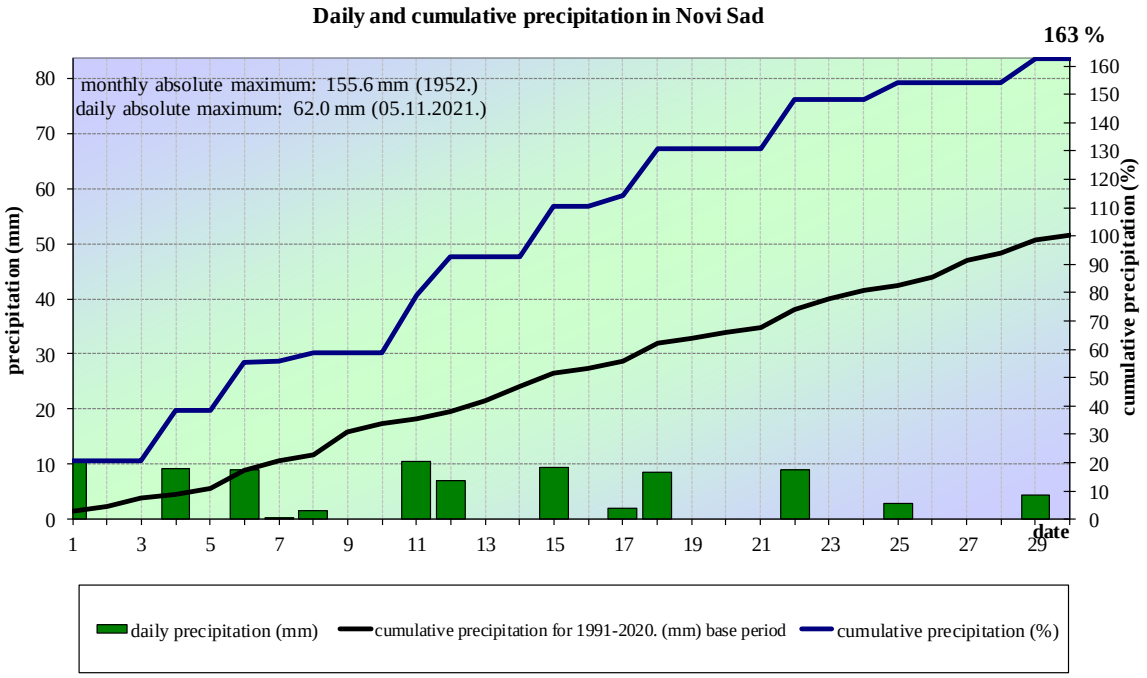


Appendix 31. Daily course of the minimum daily air temperature and the accompanying percentile for Vranje

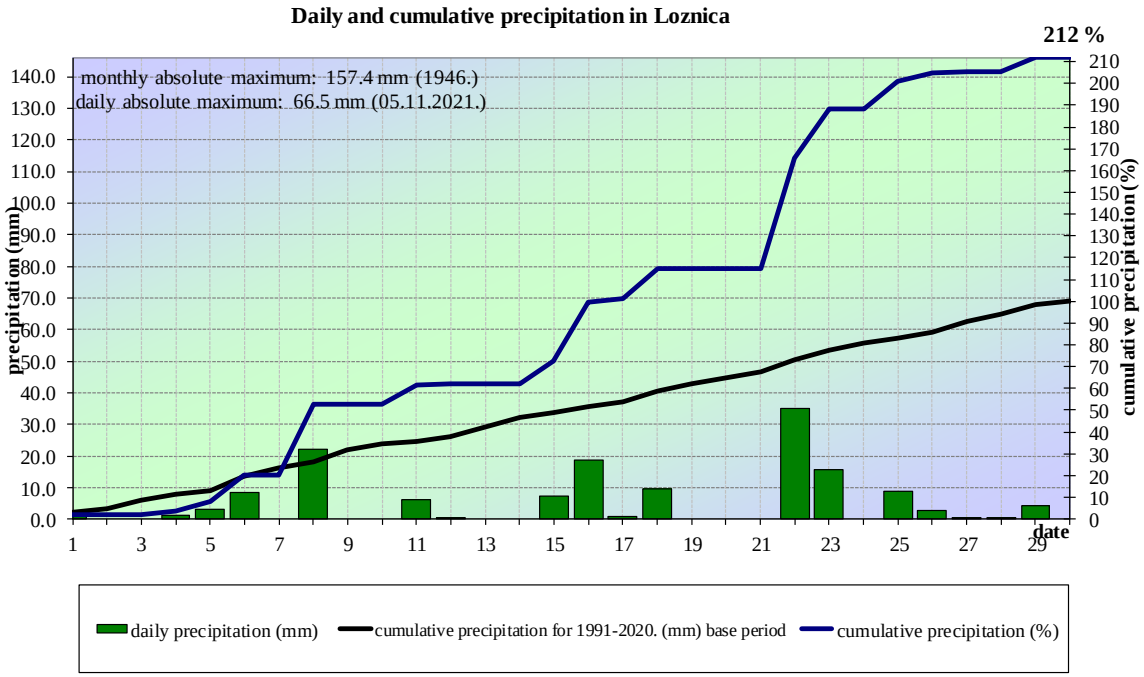
Precipitation



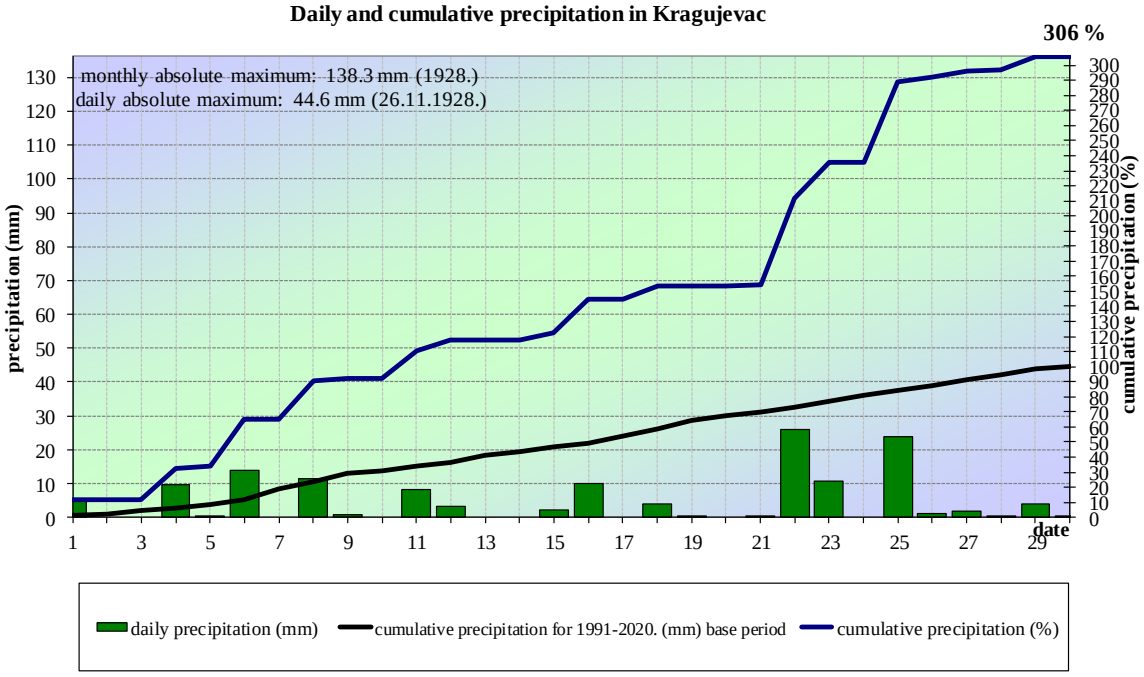
Appendix 32. Daily and cumulative precipitation sums for Sombor



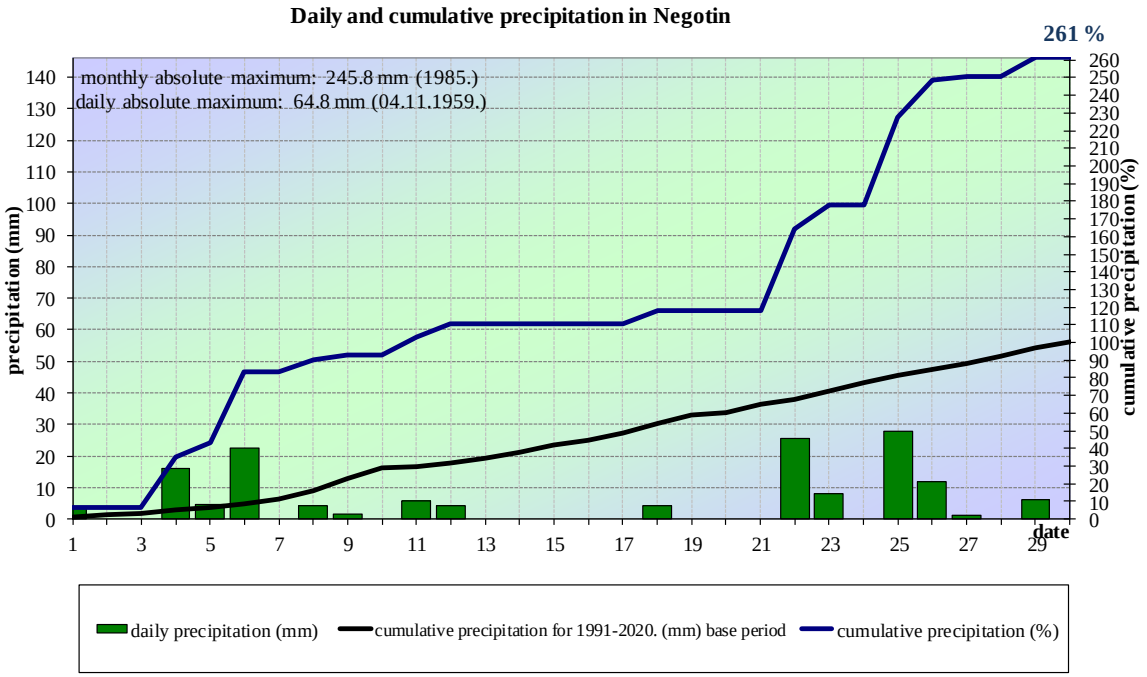
Appendix 33. Daily and cumulative precipitation sums for Novi Sad



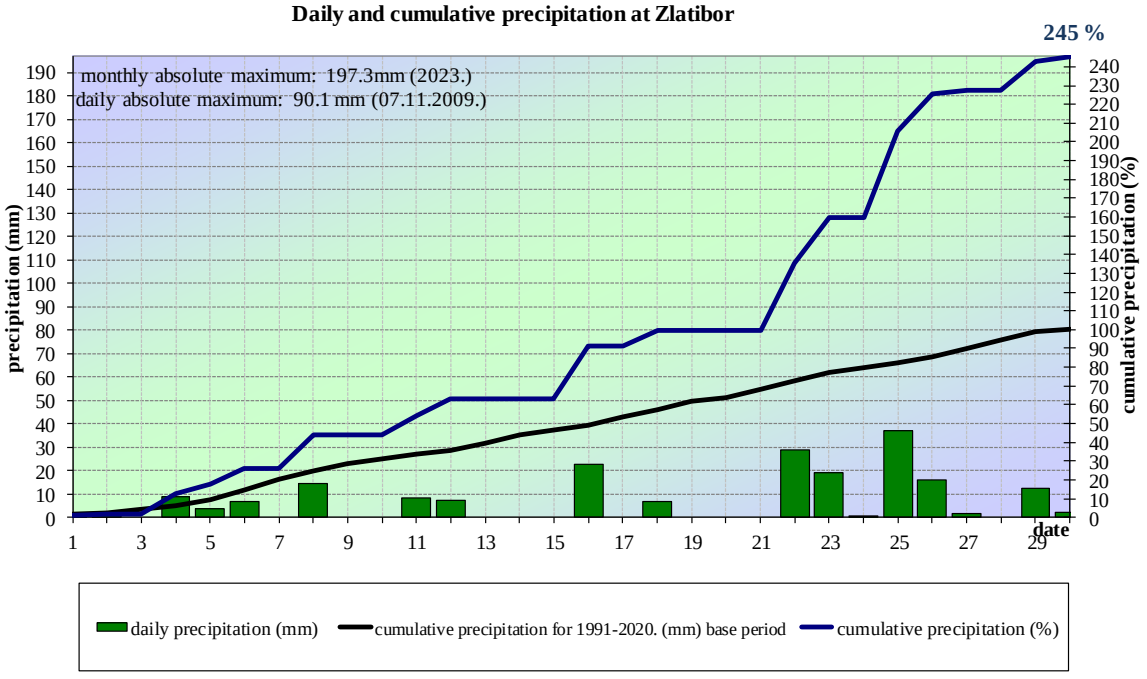
Appendix 34. Daily and cumulative precipitation sums for Loznica



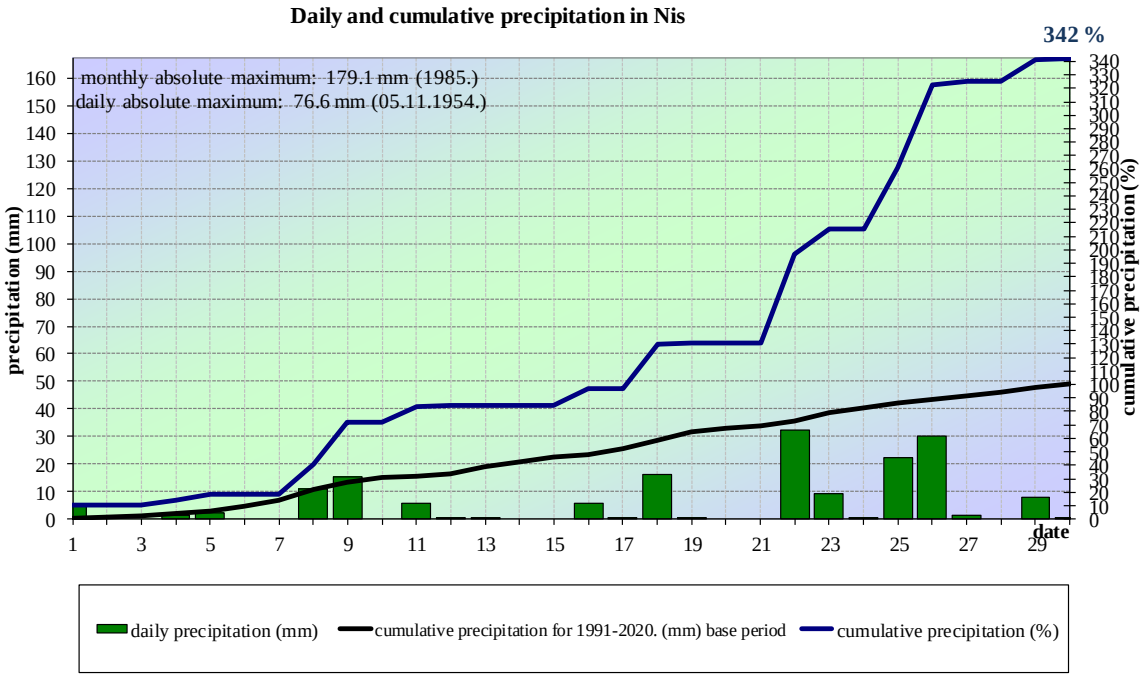
Appendix 35. Daily and cumulative precipitation sums for Kragujevac



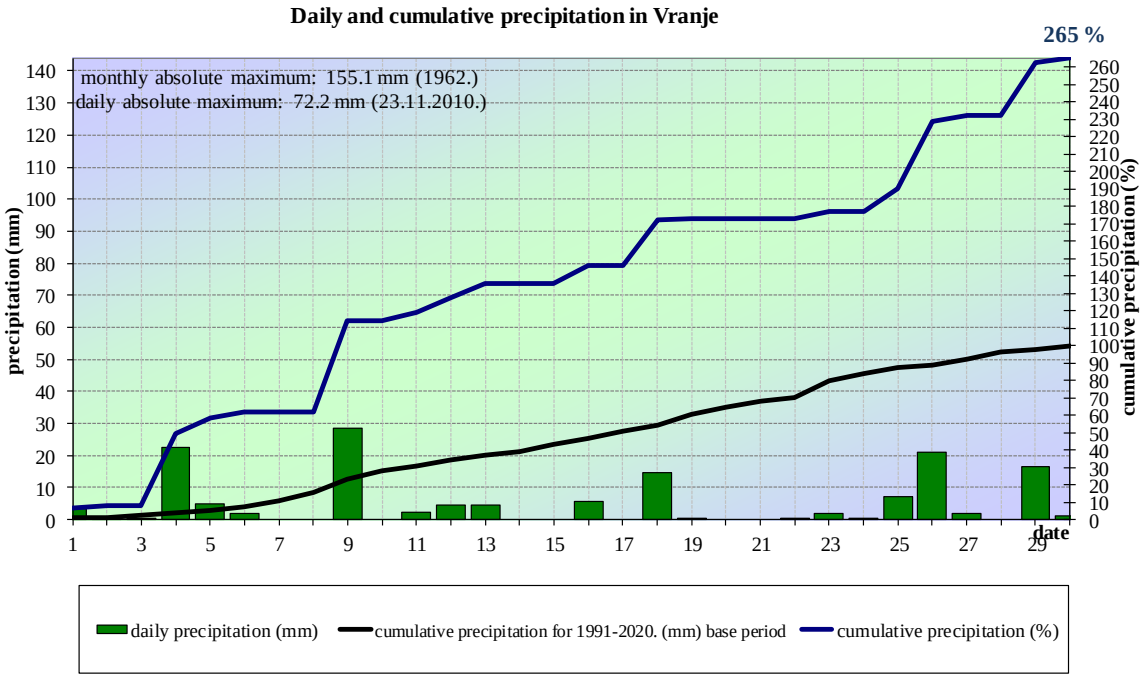
Appendix 36. Daily and cumulative precipitation sums for Negotin



Appendix 37. Daily and cumulative precipitation sums on Zlatibor



Appendix 38. Daily and cumulative precipitation sums for Nis



Appendix 39. Daily and cumulative precipitation sums for Vranje