Republic Hydrometeorological Service of Serbia
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Republic of Serbia

MONTHLY BULLETIN FOR SERBIA

MARCH 2024

Belgrade, the 5th of April 2024

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AIR TEMPERATURE

Mean monthly air temperature

March 2024 ranks as **the warmest** for Serbia, with the mean monthly air temperature of **3,7°C** for the 1951-2024 period (*Figure 1)*. Since the meteorological measurments commenced, March 2024 was **the warmest March for the majority of the main meteorological stations** (*Table 1*).

In appendix are graphs depicting 15 warmest years since the measurements for the stations began: Novi Sad, Valjevo, Loznica, Ćuprija, Sremska Mitrovica, Sombor, Palić, Kikinda, Zrenjanin, Beograd, Smederevska Palanka and Veliko Gradište.

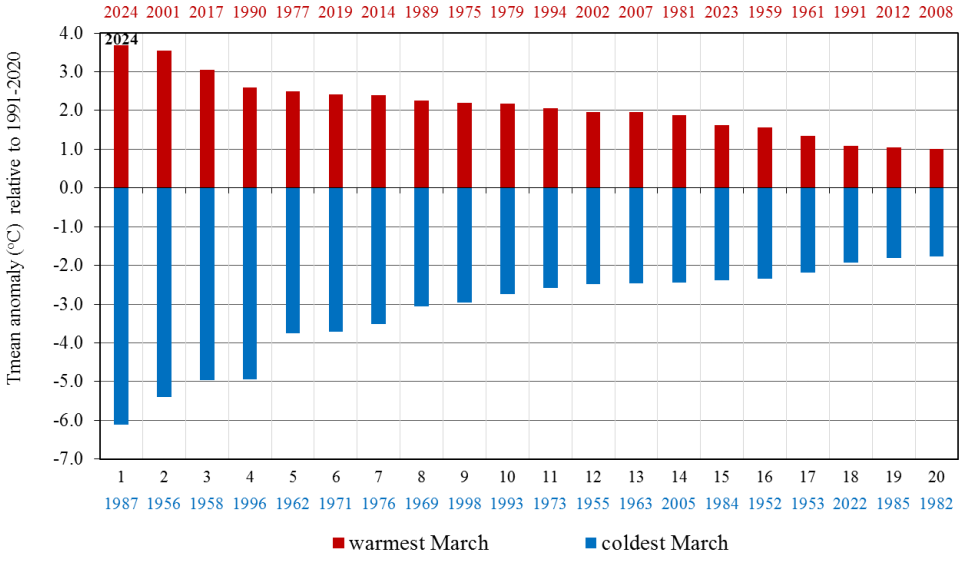


Figure 1. Rank of the warmest and coldest March in Serbia for the period from 1951 to 2024

Table 1. Ranking of March 2024 with mean air temperature, average and departure from the normal 1991-2020

STATION	historical period	Tmean (°C) - March 2024	1991-2020 base period for March	temperature anomaly (°C)	ranking for March 2024
NOVI SAD	1948-2023	11.5	7.0	4.6	**1**
VALJEVO	1927-2023	11.6	7.2	4.4	**1**
LOZNICA	1952-2023	11.9	7.5	4.3	**1**
CUPRIJA	1948-2023	11.0	6.7	4.3	**1**
S.MITROVICA	1925-2023	11.0	6.9	4.2	**1**
SOMBOR	1942-2023	10.7	6.7	4.0	**1**
PALIC	1945-2023	10.6	6.6	4.0	**1**
KIKINDA	1948-2023	10.7	6.8	4.0	**1**
ZRENJANIN	1944-2023	10.9	7.0	3.9	**1**
BELGRADE	1888-2023	**12.1**	8.3	3.8	**1**
S.PALANKA	1939-2023	10.9	7.1	3.8	**1**
B.KARLOVAC	1986-2023	10.6	6.8	3.8	**1**
V.GRADISTE	1926-2023	10.3	6.8	3.5	**1**
KRALJEVO	1926-2023	11.3	7.2	4.1	2
KRAGUJEVAC	1925-2023	11.0	7.1	3.9	2
ZLATIBOR	1951-2023	6.7	2.9	3.9	2
KURSUMLIJA	1952-2023	9.7	6.0	3.7	2
POZEGA	1952-2023	9.3	5.7	3.7	2
KOPAONIK	1950-2023	**1.5**	-1.8	3.4	2
KRUSEVAC	1927-2023	10.8	7.1	3.7	3
SJENICA	1947-2023	5.8	2.2	3.6	3
LESKOVAC	1948-2023	9.7	6.8	2.8	3
NIS	1925-2023	11.1	7.5	3.6	4
DIMITROVGRAD	1945-2023	8.6	5.4	3.1	4
VRANJE	1926-2023	9.8	6.7	3.1	5
NEGOTIN	1927-2023	10.1	7.3	2.8	5
ZAJECAR	1927-2023	9.1	6.4	2.8	6
CRNI VRH	1967-2023	4.5	1.4	3.0	7

Mean air temperature in March ranged from 8,6ºC in Dimitrovgrad to 12,1ºC in Belgrade, and on the mountains from 1,5ºC at Kopaonik to 6,7ºC at Zlatibor (*Figure 2*).

Departure of the mean monthly air temperature from the normal[1] for the 1991–2020 base period ranged from +2,8ºC in Negotin, Leskovac and Zajecar to +4,6ºC in Novi Sad (*Figure 3*).

Mean air temperature, based on the percentile method [2], was in the extremely warm category in most of the country, very warm in Negotin, Nis, Leskovac, Zajecar, Dimitrovgrad, Vranje and Kopaonik, and warm category at Crni Vrh (*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

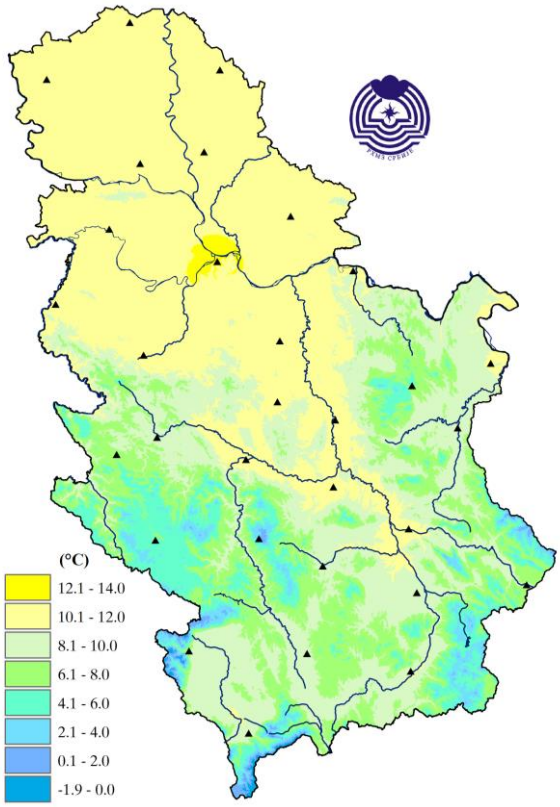


Figure 2. Spatial distribution of mean monthly air temperature (ºC)

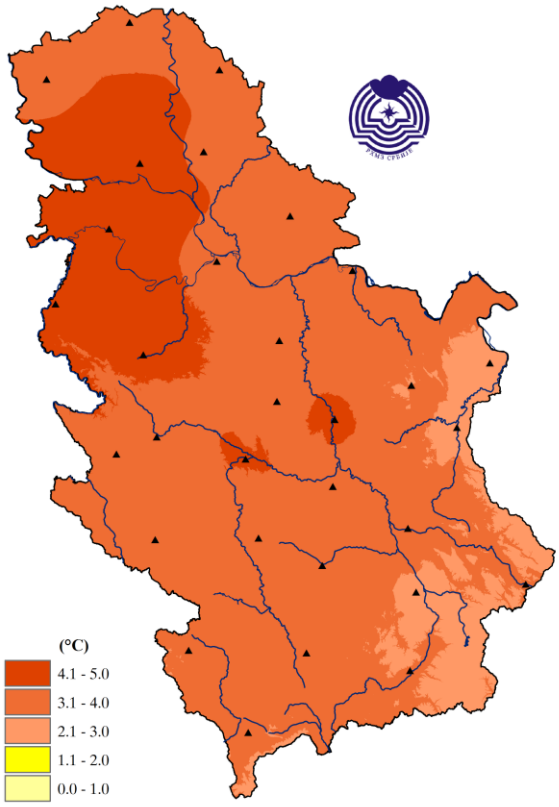


Figure 3. Spatial distribution of mean monthly air temperature anomaly (ºC)

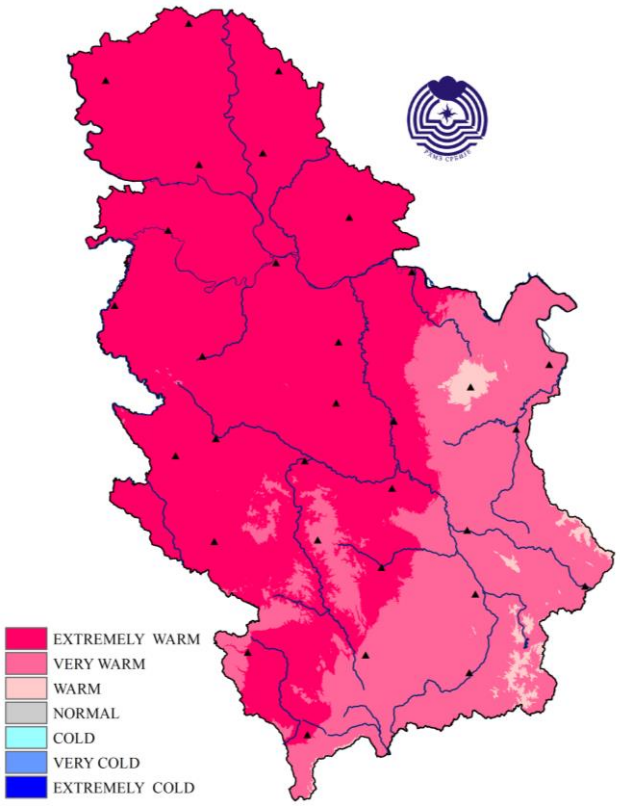


Figure 4. Spatial distribution of the mean monthly air temperature using percentile method

Mean daily air temperature in Belgrade, based on the percentile method, was in the categories of warm and very warm during most of the month, and extremely warm at the end of the month. At the end of the first decade, it was within the normal values, as well as at the end of the second and middle of the third decade (*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.

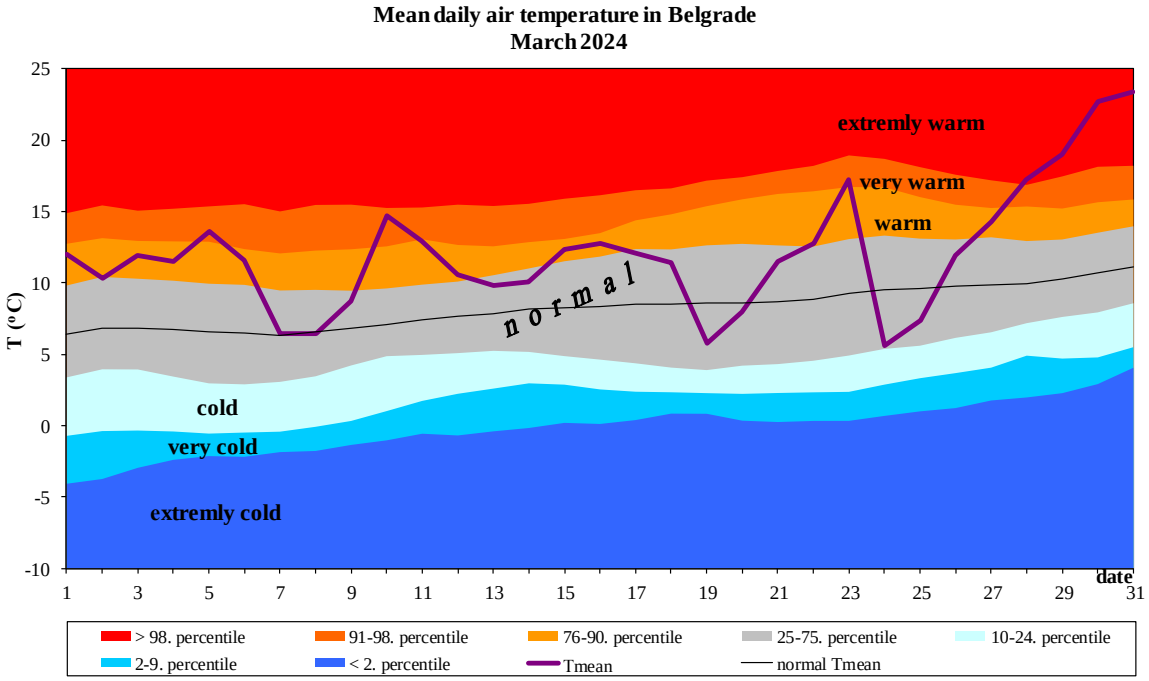


Figure 5. Daily course of the mean daily air temperature and accompanying percentiles for Belgrade

Maximum air temperature

Mean maximum air temperature in March ranged from 15,0ºC in Zajecar to 18,6ºC in Loznica, whilst Belgrade observed air temperature of 17,5°C.
On the mountains, mean maximum March air temperature ranged from 5,3ºC at Kopaonik to 12,0ºC in Sjenica.

Based on the percentile method, mean maximum monthly air temperature was in the following categories: extremely warm in most of the country, very warm in the east and south of the country, warm in Negotin and Crni Vrh, and normal in Zajecar.

The highest maximum daily air temperature of 30,0ºC was measured in Cuprija on March 30, whereas Belgrade observed 29,3ºC.

The absolute maximum daily air temperature was exceeded in Sombor, Banatski Karlovac, Negotin and Crni Vrh (*Table 2).*

Table 2. Daily absolute Tmax exceeded

MMS station	Tmax March 2024	date Tmax March 2024	exceeded absolute Tmax	Date Absolute Tmax
SOMBOR	**27.8**	30	27.6	24. III 1977.
B.KARLOVAC	**29.5**	30	28	25. III 2001.
CRNI VRH	**22.7**	30	23	24. III 1977.
NEGOTIN	**27.2**	31	27	23. III 1977.

One ice day [3] was recorded at Crni Vrh and Kopaonik. **Never before have there been fewer icy days in March on Kopaonik.** The least number of days, total of 2 ice days, was registered in March 1959.

Apart from the mountains, entire country saw 2 to 3 summer days[4]. The hitherto record of the maximum number of summer days was equaled on Palic, Zrenjanin, Kikinda, Banatski Karlovac, Negotin, Kraljevo and Vranje.

One tropical day[5] was recorded in Cuprija, which was previously recorded only in March 1952.

Heat wave[6] was registered in Loznica and Pozega in the period from 27 to 31 March.

Figure 6 shows daily course of the maximum daily air temperature and the accompanying percentiles for Belgrade in March 2024 and for the stations Sombor, Novi Sad, Loznica, Negotin, Kragujevac, Zlatibor, Nis and Vranje are given in the Appendix.

[3] Ice day is defined as the day with maximum air temperature lower than 0°C
[4] Summer day refers to a day with maximum daily air temperature 25°C and above
[5] Tropical day refers to a day with maximum daily air temperature 30°C and above
[6] 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

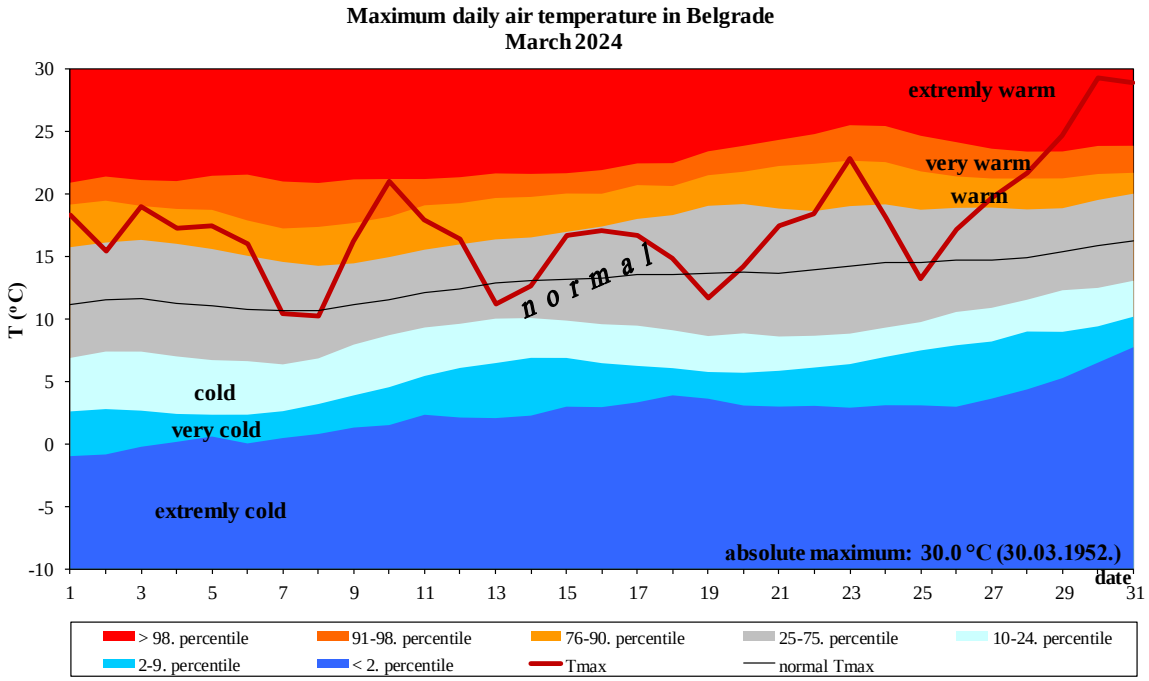


Figure 6. Daily course of the maximum daily air temperature and accompanying percentiles for Belgrade

Minimum air temperature

Mean minimum air temperature in March ranged from 3,0ºC in Pozega to 7,8ºC in Belgrade. On the mountains, mean minimum air temperature ranged from -1,4ºC at Kopaonik to 3,0ºC at Zlatibor.

Based on the percentile method, mean minimum monthly air temperature was in the following categories: extremely warm in most of the country, very warm in Sjenica, Leskovac, Vranje, Crni Vrh and Kopaonik.

The lowest minimum daily air temperature of -8,1ºC was measured at Kopaonik on March 20. In the lowland, the lowest daily air temperature of -4,0ºC was measured in Veliko Gradiste on March 21. On March 20, Belgrade observed the lowest monthly air temperature 1,8ºC.

Belgrade didn't observe any frost days[7] whereas Dimitrovgrad recorded the highest number of frost days, total of 7. In the upland, number of frost days ranged from 6 at Zlatibor to 23 at Kopaonik. The recorded number of frost days was 6 to 10 days below March average in most of the country.

The least number of frost days since the record-keeping began was observed at Zlatibor, total of 6 days compared to the previous record of 7 days which was set in March 2001 and 2007. The minimum number of frost days was equaled in Cuprija, total of 4 days, (1950, 2001, 2024) and in Smederevska Palanka, total of 2 days (2001, 2007, 2017, 2024). It is common for Belgrade not to observe any frost days.

Figure 7 shows assessment of the minimum and maximum air temperature in Serbia for March 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 are significantly above the upper

[7] Frost day is defined as the day with minimum air temperature lower than 0°C

tercile and that mean minimum air temperature values are the highest in the data series since 1981.

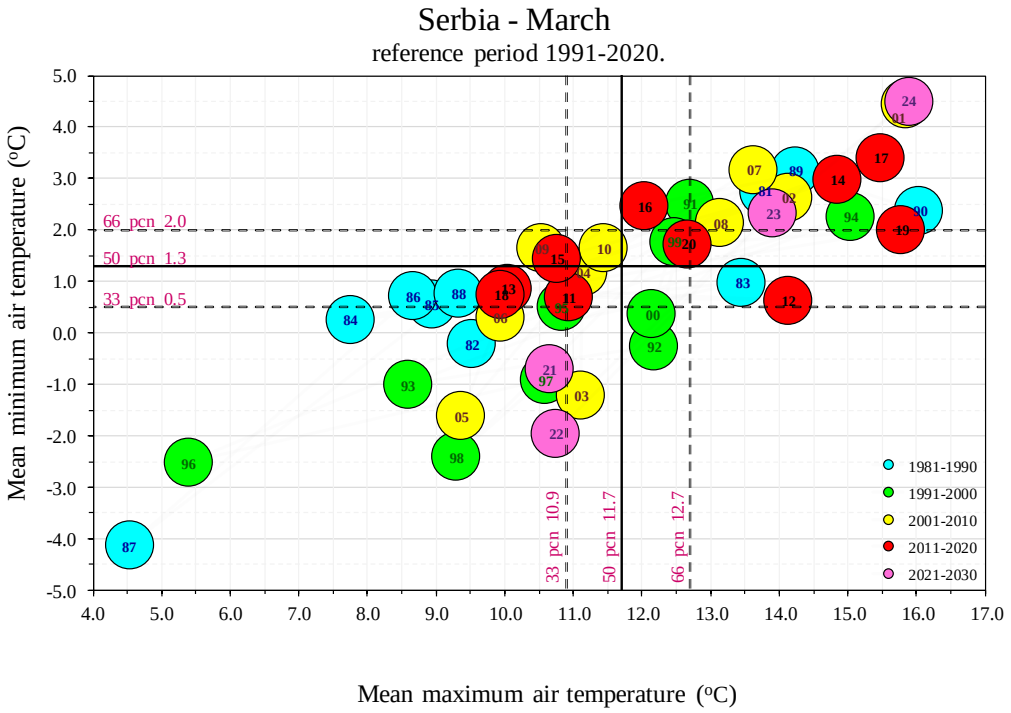


Figure 7. Assessment of minimum and maximum air temperature for Serbia with the accompanying terciles in relation to the 1991-2020 base period

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

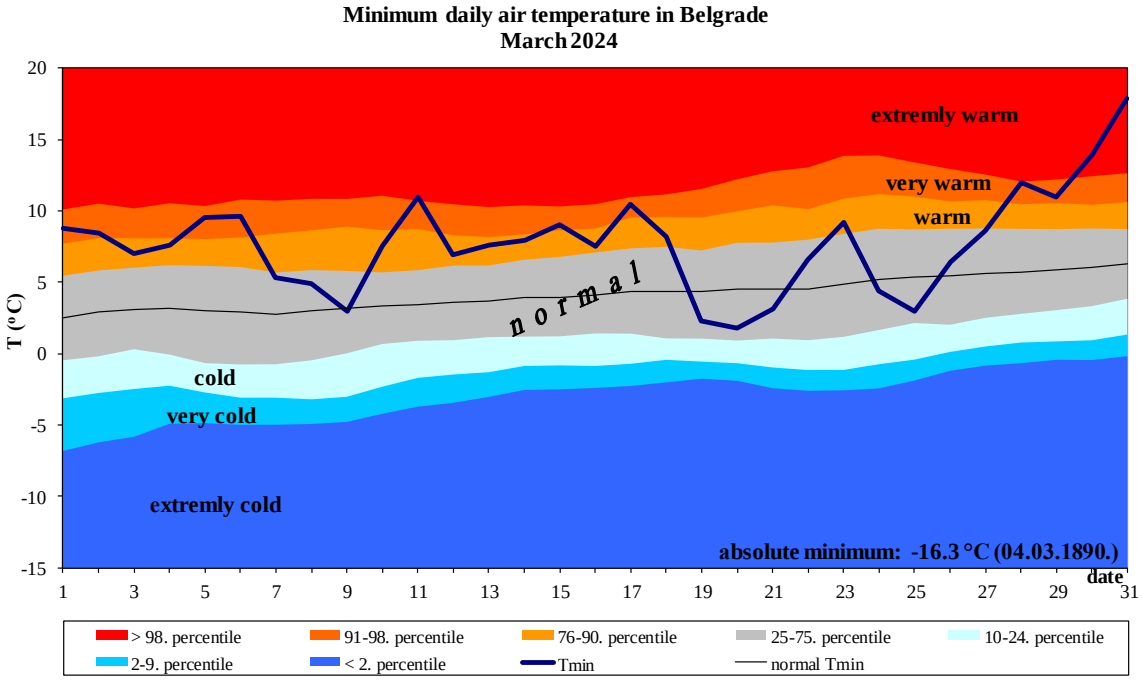


Figure 9. Daily course of the minimum daily air temperature and accompanying percentiles for Belgrade

PRECIPITATION

March 2024 was averagely rainy in Serbia. March 2024 ranks as the 7th wettest for Vranje since the record-keeping began (Figure 9), and 9th wettest for Dimitrovgrad.

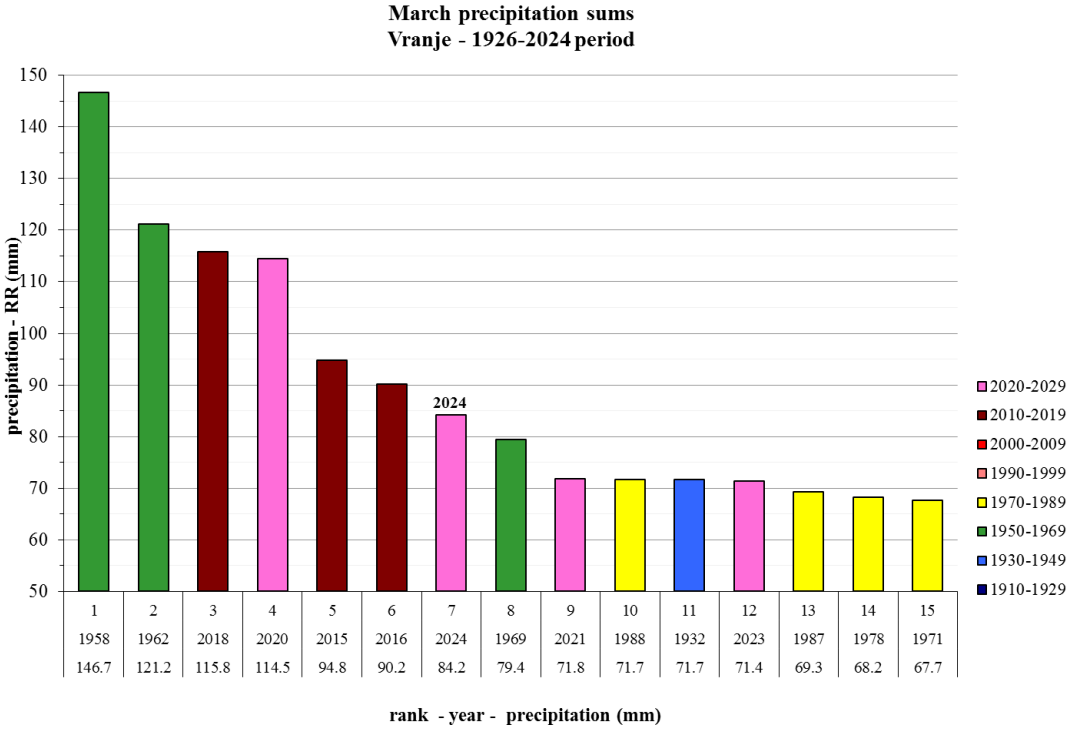


Figure 9. Rank of the highest precipitation in Vranje

March precipitation sums ranged from 13,6 mm in Kikinda to 91,8 mm at Kopaonik, while Belgrade received 26,0 mm (*Figure 10*).

Precipitation totals compared to the normal for the 1991-2020 base period ranged from 39% in Novi Sad, Kikinda and Valjevo to 193% in Vranje (*Figure 11*).

Based on the percentile method, precipitation sums were in the normal category in most of the country, dry in Novi Sad, Kikinda and Valjevo, rainy in Leskovac, Dimitrovgrad and Vranje (*Figure 12*).

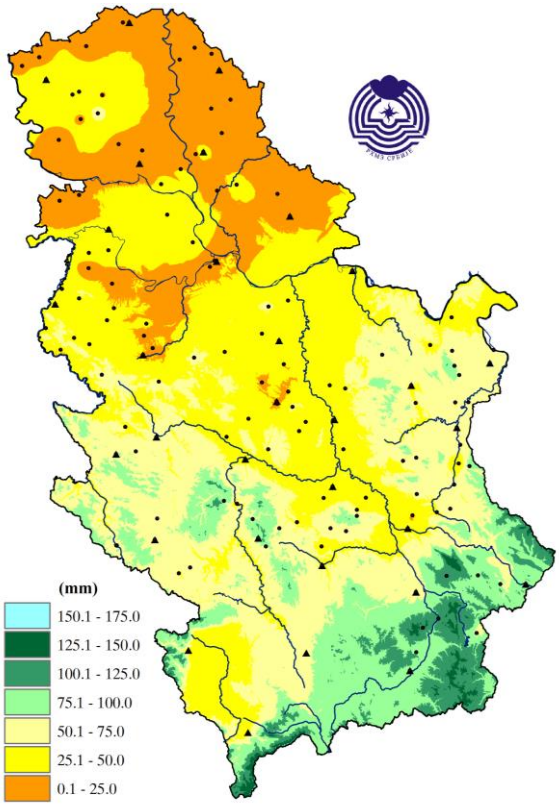


Figure 10. Spatial distribution of the monthly precipitation sums (mm) according to data from 28 major meteorological, 24 climatological and 88 rain gauge stations

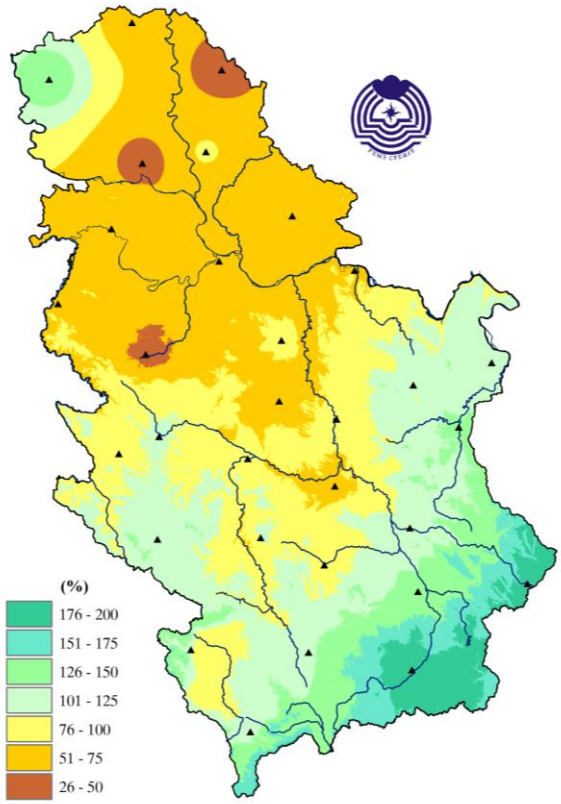


Figure 11. Spatial distribution of the monthly precipitation sums in the percentages of normal for the 1991–2020 base period

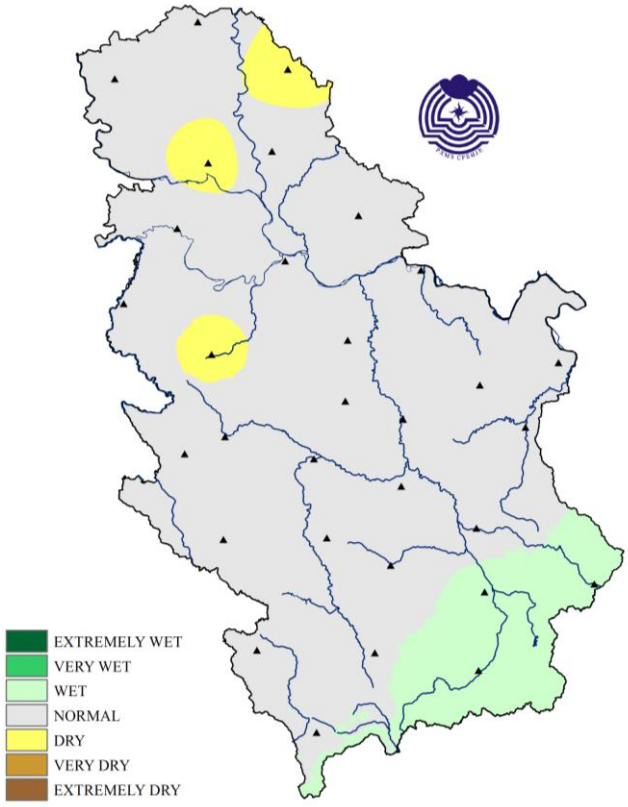


Figure 12. Monthly precipitation sums according to the percentile method

The highest daily precipitation sum of 34,3 mm was measured in Sombor on March 7. On March 25, Belgrade observed the highest daily precipitation sum of 6,2 mm.

Number of days with precipitation in March ranged from 9 in Zrenjanin to 17 at Crni Vrh and Kopaonik (*Figure 13*). The recorded number of days with precipitation was 2 to 4 days above the average in the northernmost areas, parts of eastern and southeastern Serbia, and 2 days below the March average in the western areas (*Figure 14).*

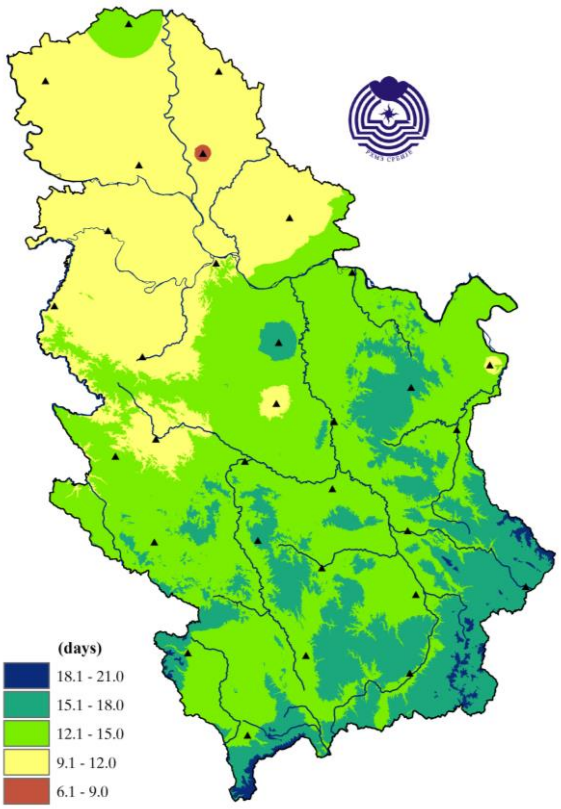


Figure 13. Spatial distribution of number of days with precipitation

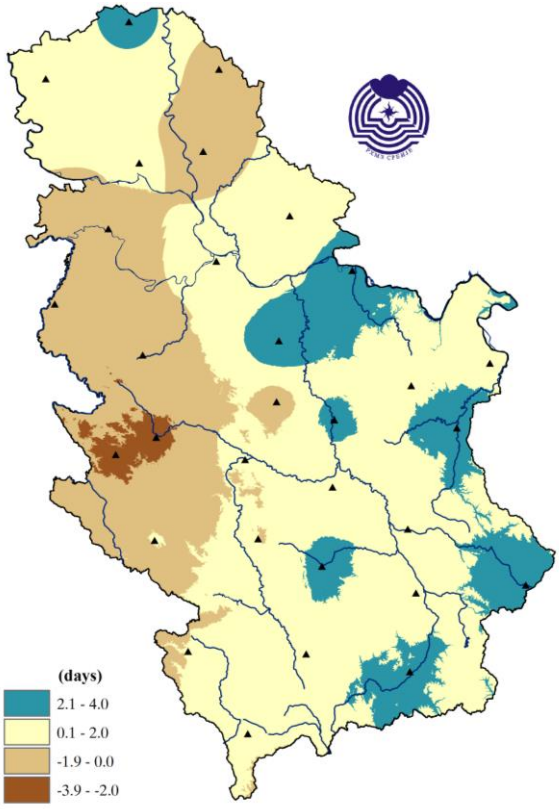


Figure 14. Spatial distribution of deviation of number of days with precipitation

Snow cover was registered in the mountains. The highest snow cover depth of 19 cm was measured at Kopaonik on March 14 which is **the lowest snow cover depth in the history of measurements** at **Kopaonik**, whereas the previous record of 26 cm was set on March 5, 1990. The lowest snow cover depth since the beginning of meteorological measurements was also registered at **Crni Vrh**, total of 3 cm. The previous record of 6 cm was set on March 26, 2002.

The highest number of days with the snow cover, total of 21 days, was recorded at Kopaonik, 5 days at Crni Vrh, 2 days at Zlatibor, 1 day in Sjenica. Never before have there been fewer days with snow cover at Zlatibor and Sjenica. The previous minimum was 4 days for Zlatibor (March 1972) and 2 days for Sjenica (March 1947).

The recorded number of days with snow cover was 2 to 5 days below the March average in the lowland, and up to 17 days below the average in the hilly-mountainous regions.

Figure 15 shows assessment of air temperature and precipitation sums for Serbia for March based on the tercile distribution relative to the 1991 – 2020 base period. It can be noted that March 2024 was marked by air temperature significantly above upper tercile threshold (**the highest** in the given period) and precipitation sums within the average.

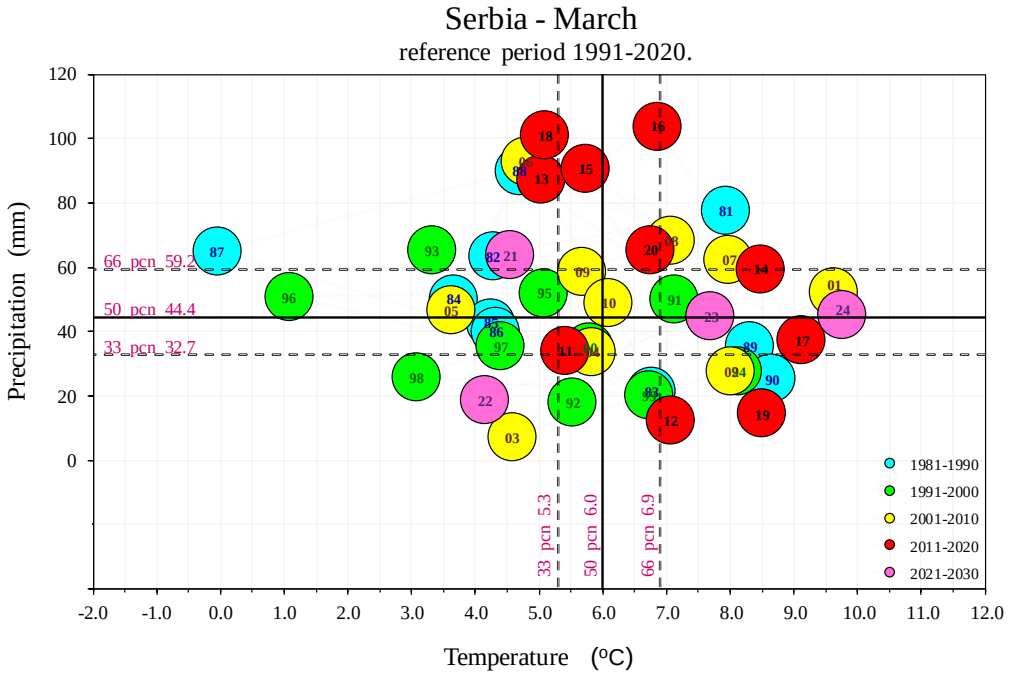


Figure 15. Assessment of air temperature and precipitation for Serbia with the accompanying terciles in relation to the 1991-2020 base period

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

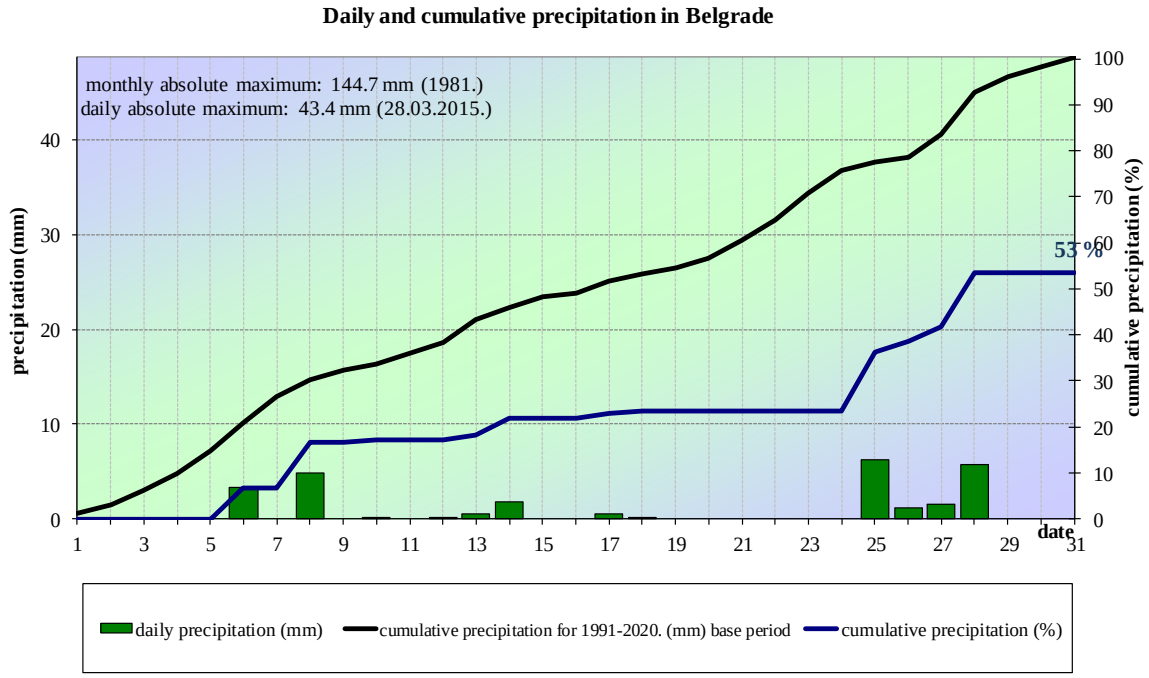


Figure 16. Daily and cumulative precipitation in Belgrade

CLOUD COVER, BRIGHT AND CLOUDY DAYS

Mean March cloud cover in Serbia was around or slight above the average, ranging from 5/10 to 8/10. Figures 17, 18 and 19 show average daily cloud cover for Belgrade, Loznica and Zajecar.

Number of bright days[8] ranged from 1 in Novi Sad, Sjenica, Kraljevo, Dimitrovgrad and Zlatibor up to 4 in Leskovac. Belgrade recorded 2 bright days. The observed number of bright days was 1 to 5 days below the March average.

The least number of cloudy days[9] was recorded in Loznica and Sremska Mitrovica, total of 4 days, whilst the highest number of cloudy days, total of 18, was recorded in Zajecar. Number of cloudy days was up to 4 days below March average in most of the country.

[8] Bright day refers to a day with cloud cover less than 2/10
[9] Cloudy day refers to a day with cloud cover over 8/10

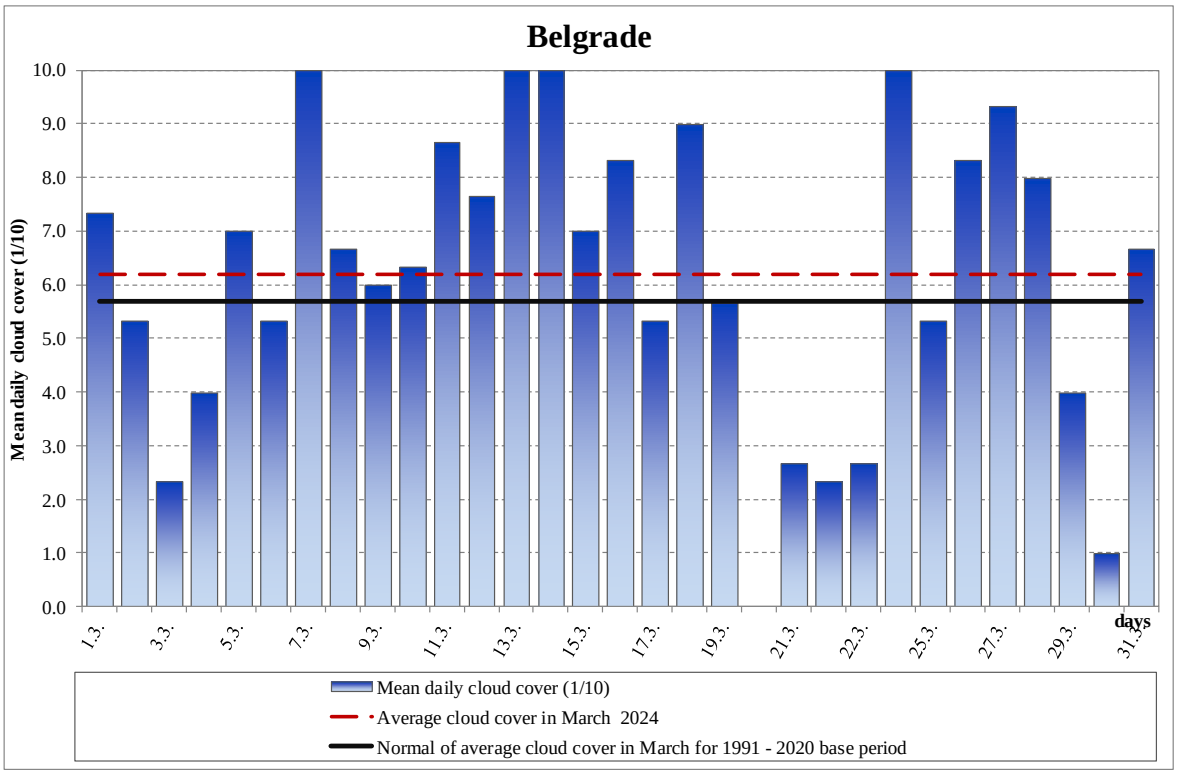


Figure 17. Mean daily cloud cover in Belgrade

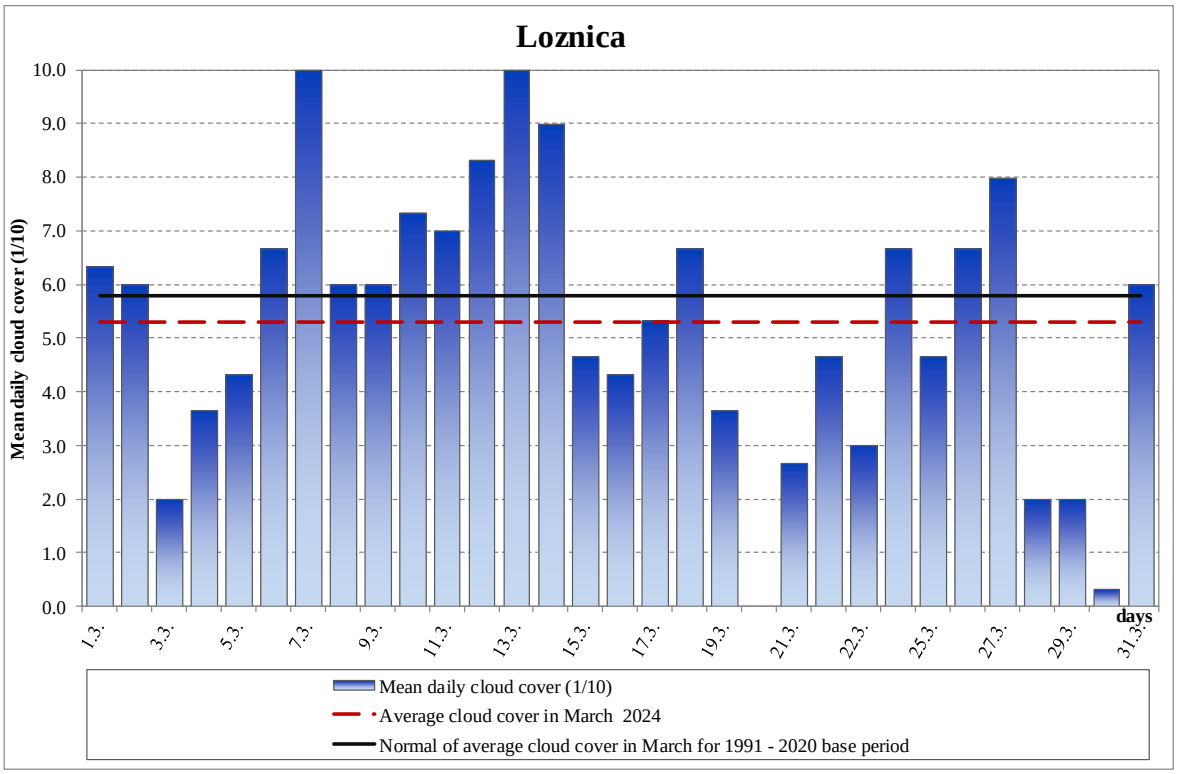


Figure 18. Mean daily cloud cover in Loznica

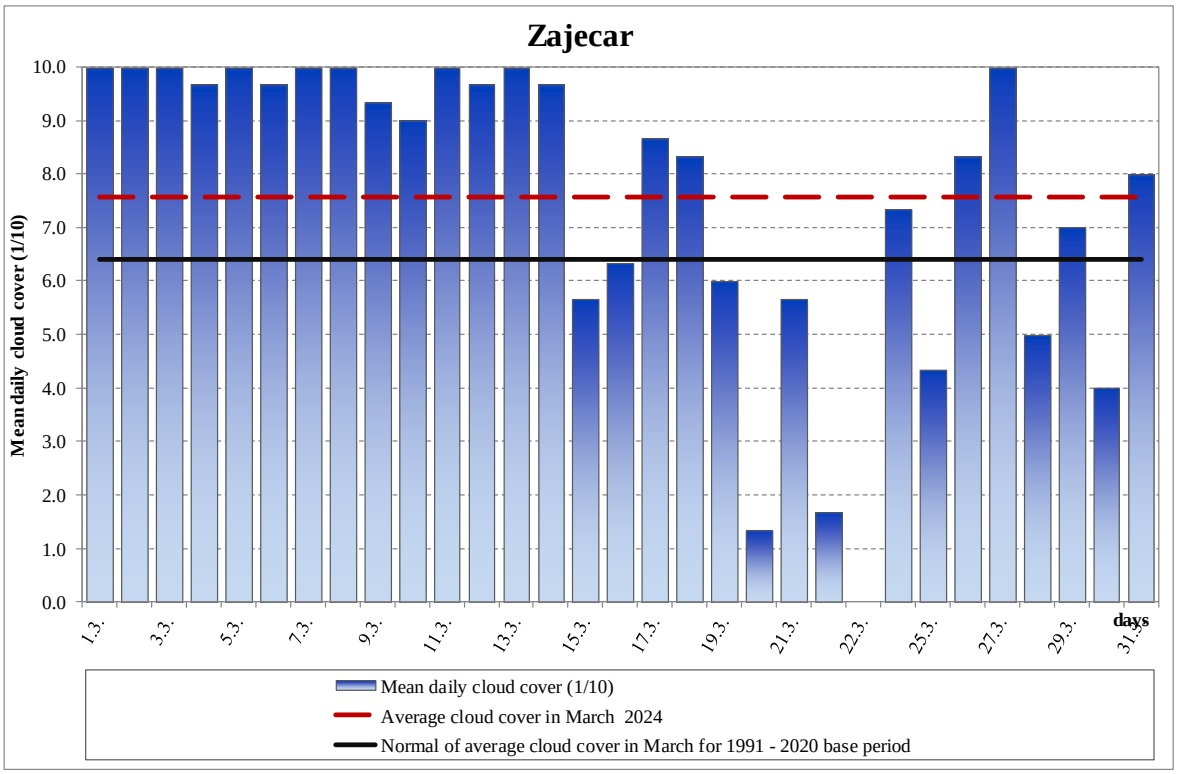


Figure 19. Mean daily cloud cover in Zajecar

SUNSHINE DURATION (INSOLATION)

Sunshine duration in March ranged from 94,7 hours in Zajecar to 188,7 hours in Kikinda (*Figure 20*).

March insolation ranged from 71% in Zajecar to 122% in Pozega relative to the normal for the 1991-2020 base period (*Figure 21*).

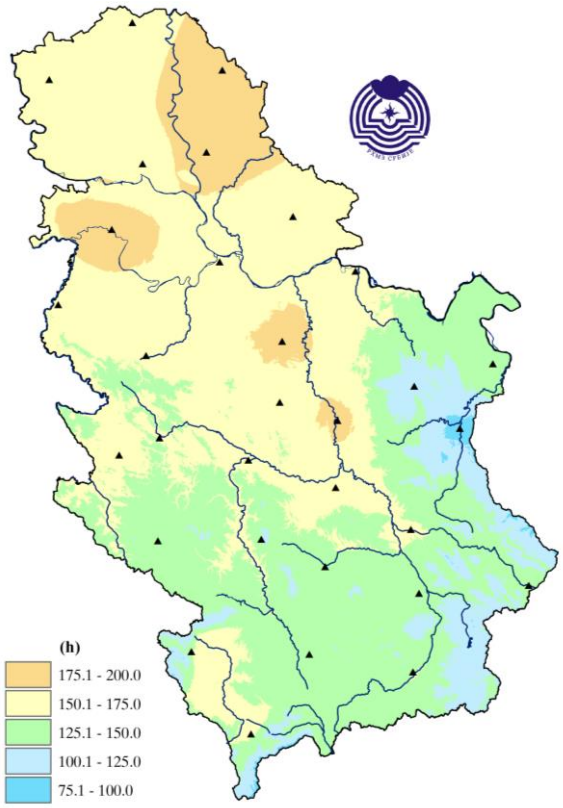


Figure 20. Insolation, expressed in hours

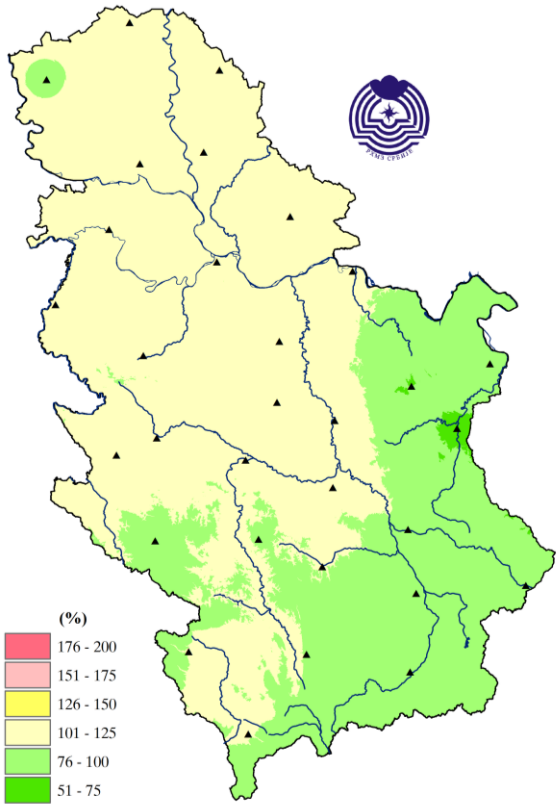


Figure 21. Insolation expressed in the percentages of normal

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

OVERVIEW OF THE SYNOPTIC SITUATION*

At the beginning and end of the month, cyclonic activity in the Eastern Atlantic, as well as cyclone genesis in the Genoa and Adriatic regions, with a prevailing southwest upper-air circulation; warm and windy weather with frequent incursion of wet air masses from the Mediterranean and from the west. Most of the month, influence from an upper-level depression from the east, changeable weather, with brief snowfall in the mountains at the beginning of the second, and beginning and middle of the third decade

Most of the first decade, due to the development of low pressure in the Atlantic, and later in the Gulf of Genoa, as well as their transfer over the Adriatic towards our region produced changeably cloudy and warm weather, occasionally with rain and brief showers, more frequently in the east and south, and then in the west and north.

Period at the end of the first decade and the beginning of the second was characterized by low pressure over France, the Genoa Bay, and a center in the northern Adriatic, along with estblishment of southwesterly circulation, followed by its transfer across our country towards the Black Sea. The weather was cloudy, with occasional rain, mostly in the southwest and south.

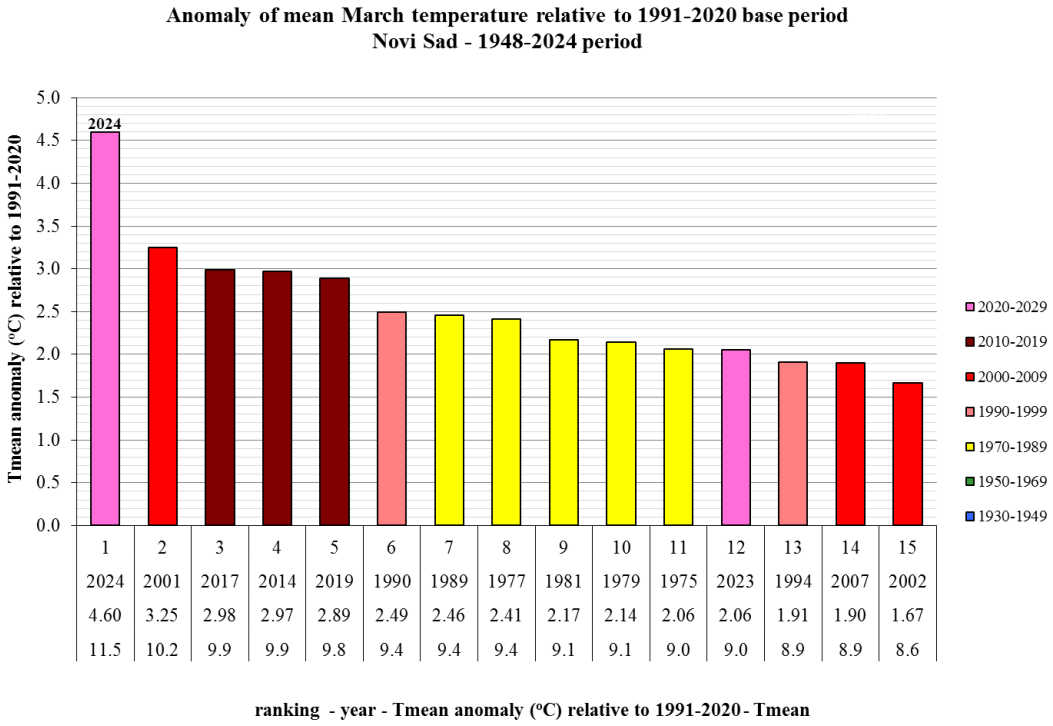
Period from the middle of the month until the middle of the third decade was marked by prevailing circulation from the northern quadrant due to the maintenance of an upper-air depression in the east, in the area of the Carpathians, the Black Sea, and Ukraine. Significant advection of cold air followed at the beginning of the second decade as a result of the strengthening of a cold air mass from the northeast and northeast upper-air circulation, followed by a brief establishment of a ridge. The weather was changeable, with plenty of sunny hours, and occasionally with rain mainly in the south and light snow in the mountains.

Period from the middle of the third decade until the end of the month was marked by alternating influences of ridges and strong southwesterly upper-air circulation on the front side of a low pressure field centered in the Gulf of Genoa. During the middle of this period, shallow deformation in the southwesterly upper-air circulation and the passage of wet air mass resulted in relatively warm and windy weather, occasionally accompanied by precipitation, rain, and brief showers. Towards the end of the month, it was dry.

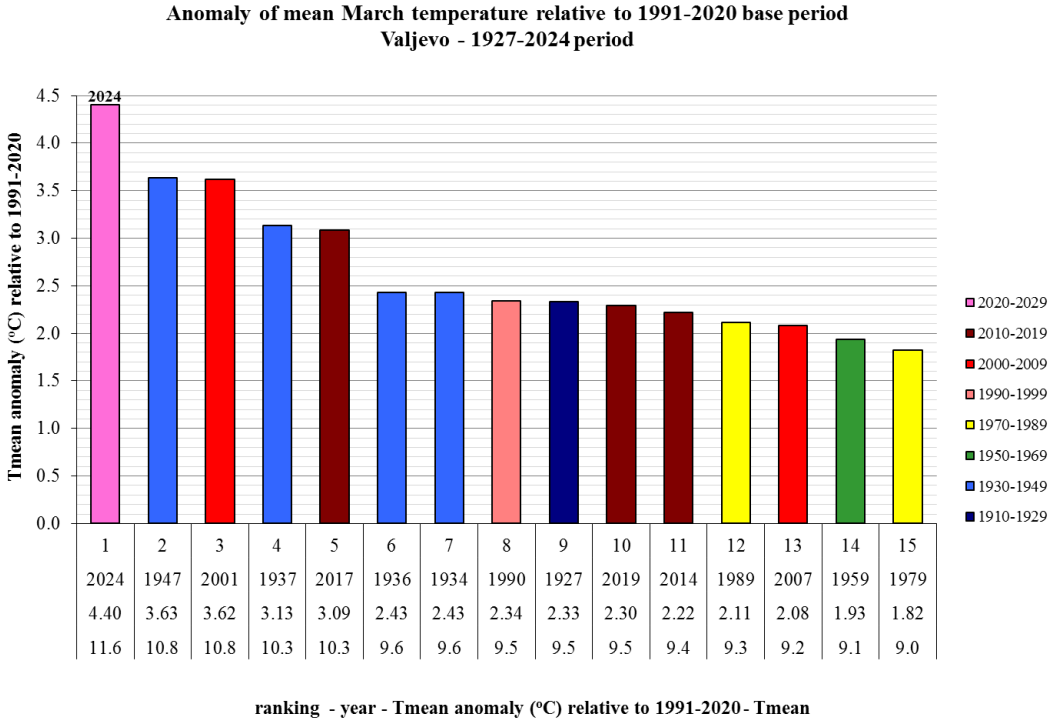
* National Center for Hydrometeorlogical Early Warning System

APPENDIX

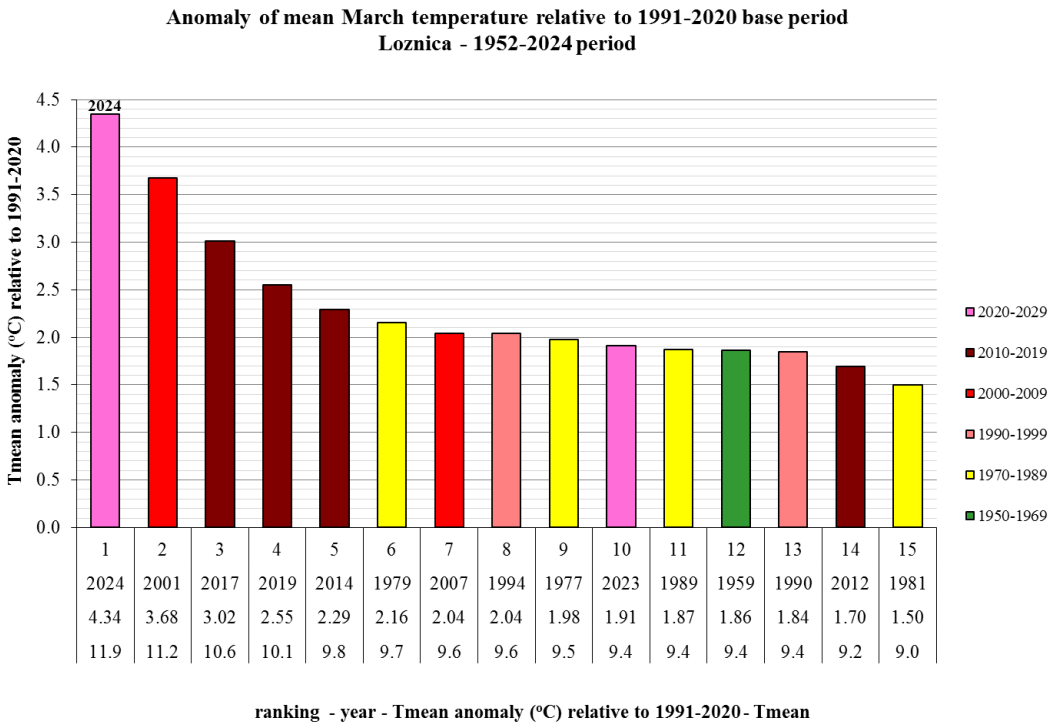
Ranks of the warmest March



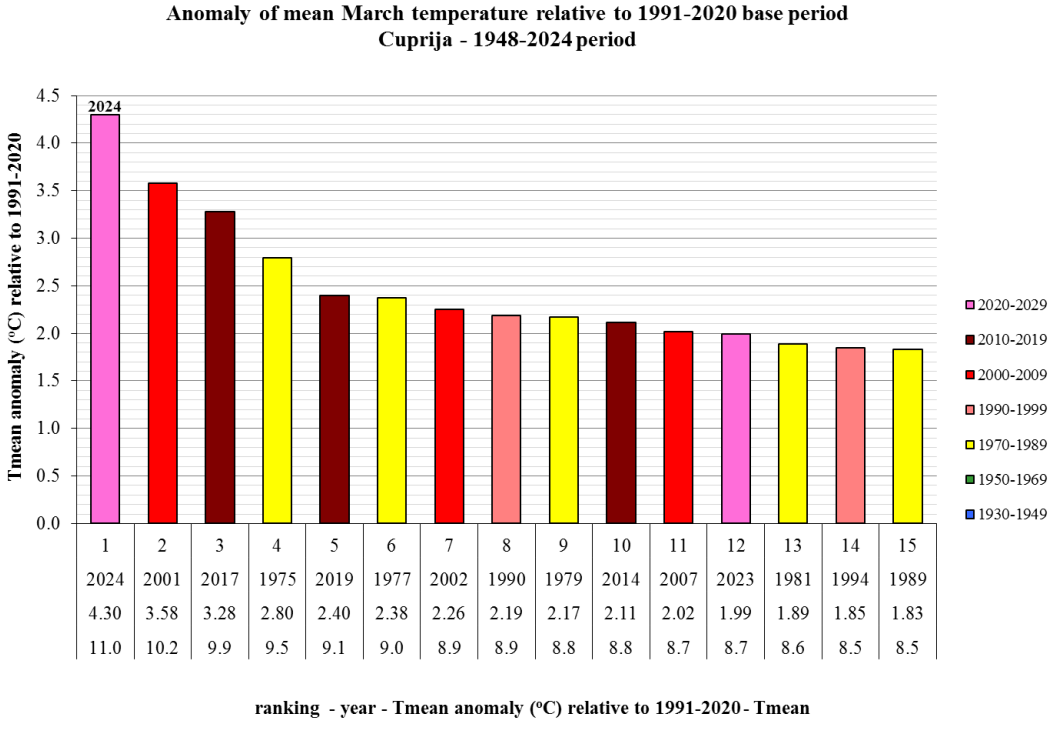
Appendix 1. Rank of the warmest March in Novi Sad



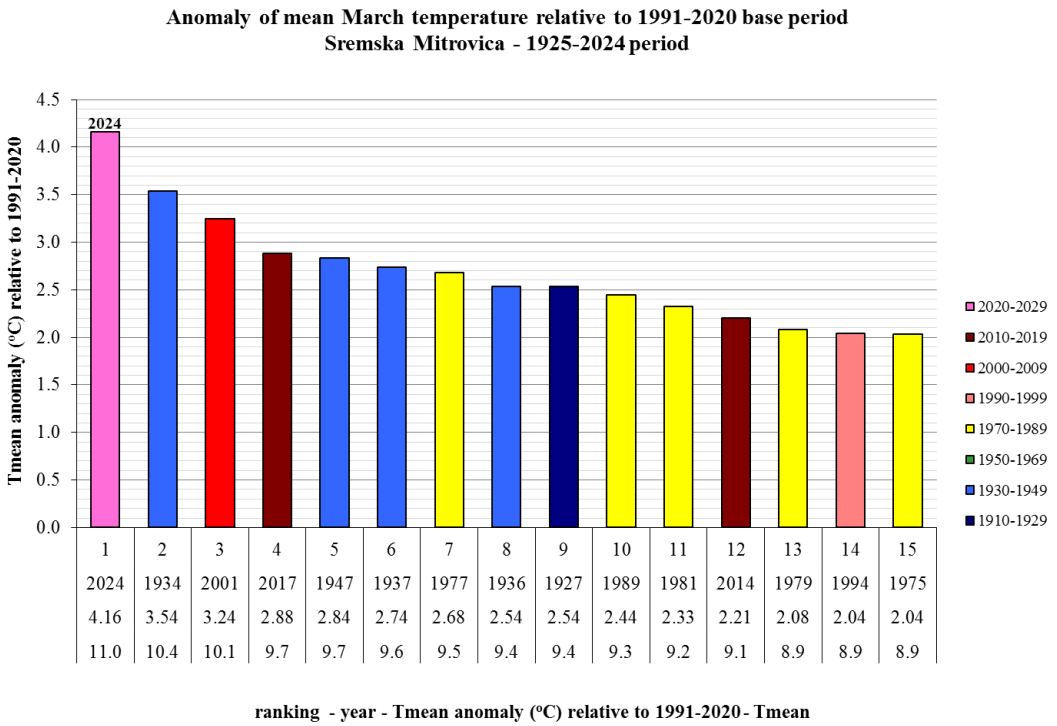
Appendix 2. Rank of the warmest March in Valjevo



Appendix 3. Rank of the warmest March in Loznica

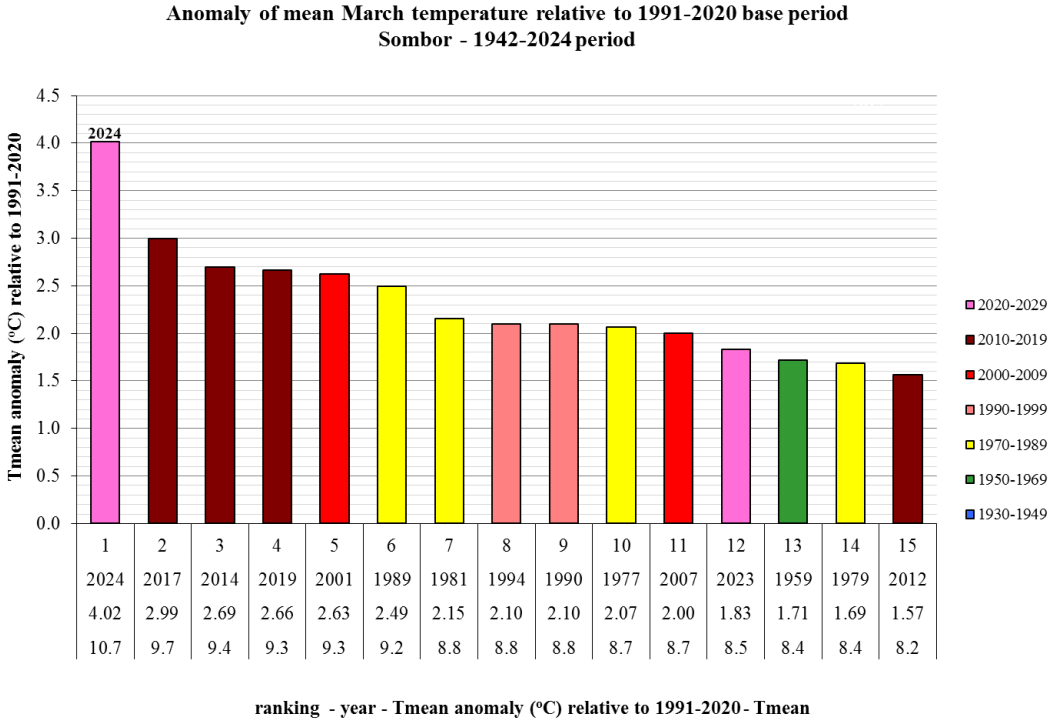


Appendix 4. Rank of the warmest March in Cuprija



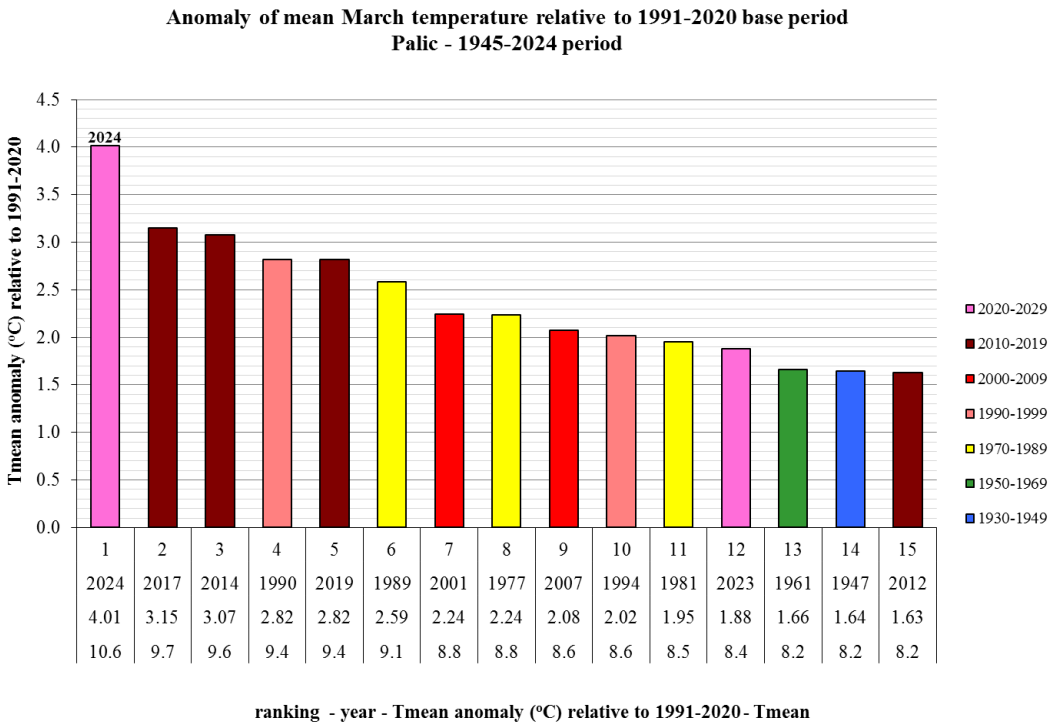
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2024	1934	2001	2017	1947	1937	1977	1936	1927	1989	1981	2014	1979	1994	1975
4.16	3.54	3.24	2.88	2.84	2.74	2.68	2.54	2.54	2.44	2.33	2.21	2.08	2.04	2.04
11.0	10.4	10.1	9.7	9.7	9.6	9.5	9.4	9.4	9.3	9.2	9.1	8.9	8.9	8.9

Appendix 5. Rank of the warmest March in Sremska Mitrovica

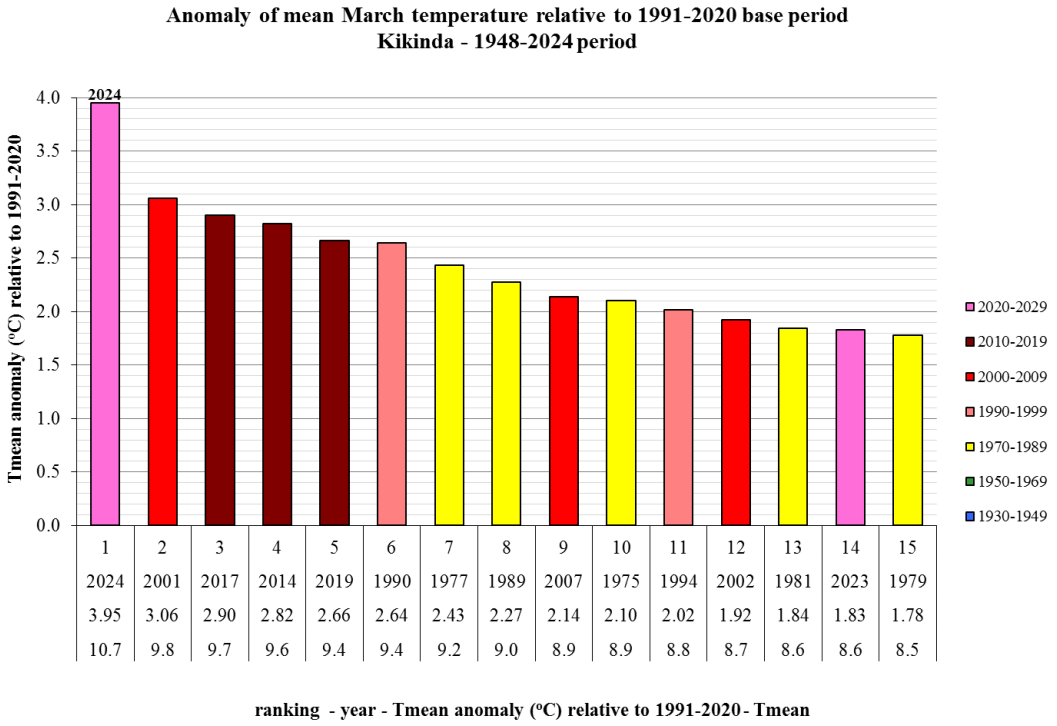


1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2024	2017	2014	2019	2001	1989	1981	1994	1990	1977	2007	2023	1959	1979	2012
4.02	2.99	2.69	2.66	2.63	2.49	2.15	2.10	2.10	2.07	2.00	1.83	1.71	1.69	1.57
10.7	9.7	9.4	9.3	9.3	9.2	8.8	8.8	8.8	8.7	8.7	8.5	8.4	8.4	8.2

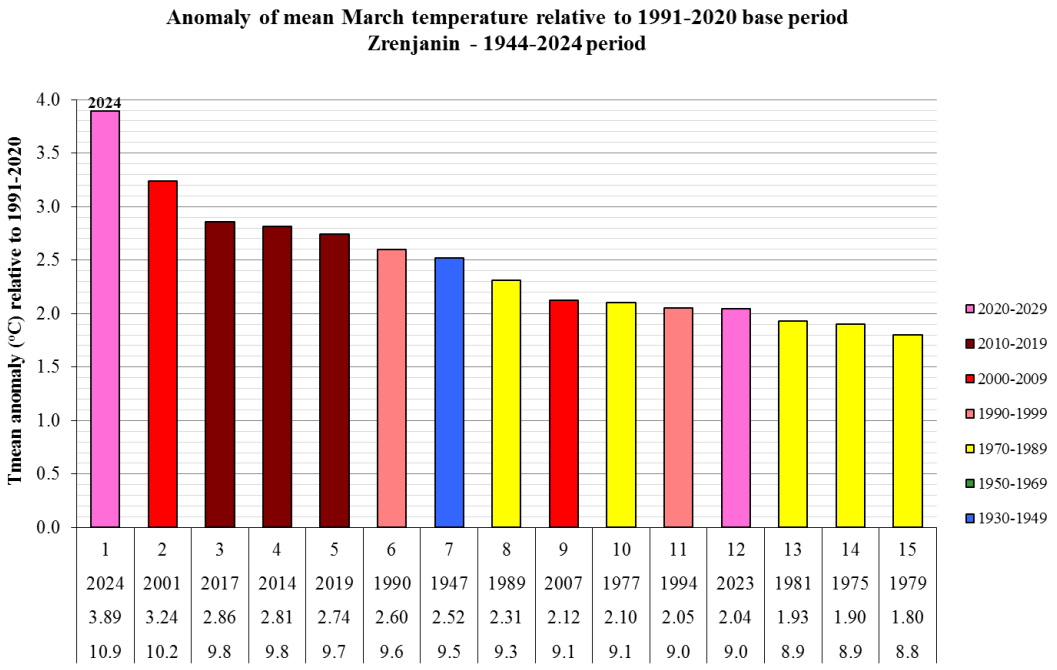
Appendix 6. Rank of the warmest March in Sombor



Appendix 7. Rank of the warmest March in Palic

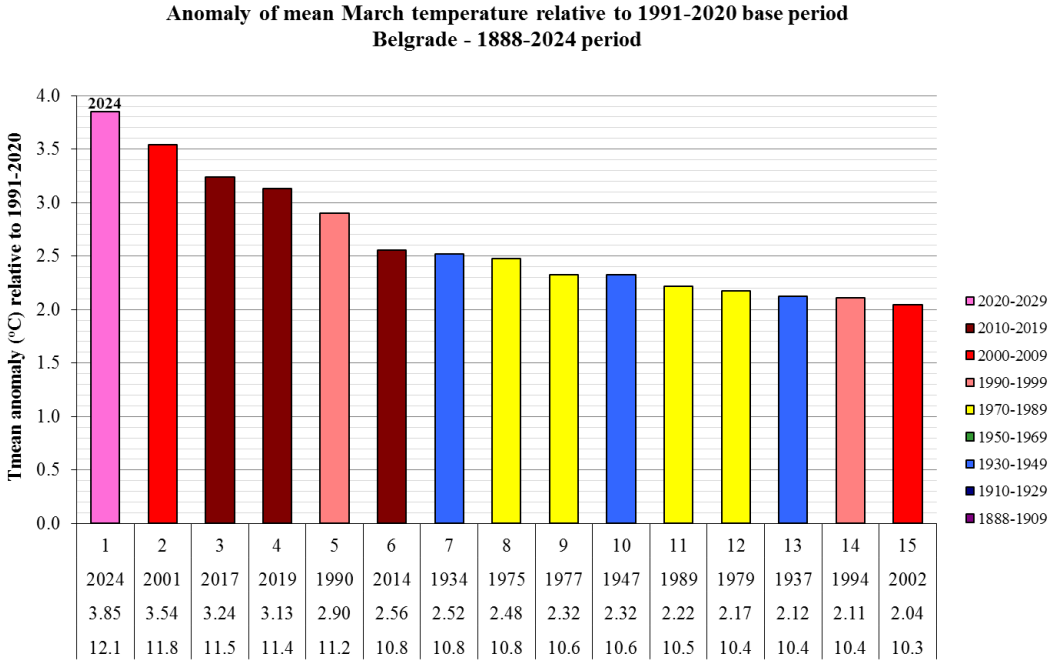


Appendix 8. Rank of the warmest March in Kikinda



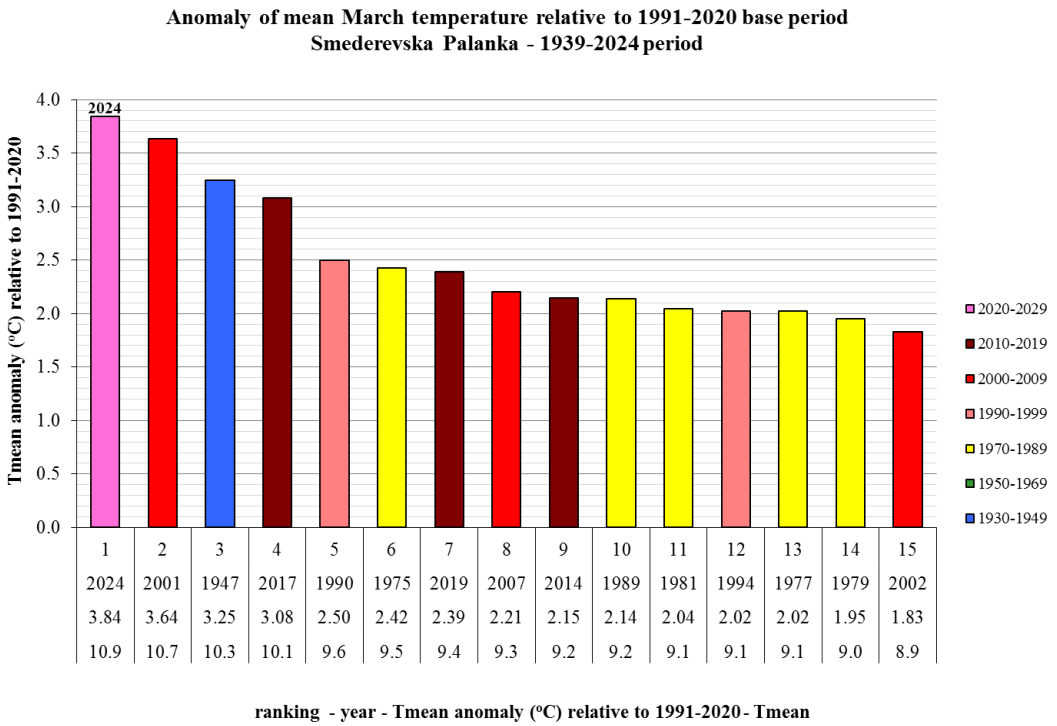
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2024	2001	2017	2014	2019	1990	1947	1989	2007	1977	1994	2023	1981	1975	1979
3.89	3.24	2.86	2.81	2.74	2.60	2.52	2.31	2.12	2.10	2.05	2.04	1.93	1.90	1.80
10.9	10.2	9.8	9.8	9.7	9.6	9.5	9.3	9.1	9.1	9.0	9.0	8.9	8.9	8.8

Appendix 9. Rank of the warmest March in Zrenjanin

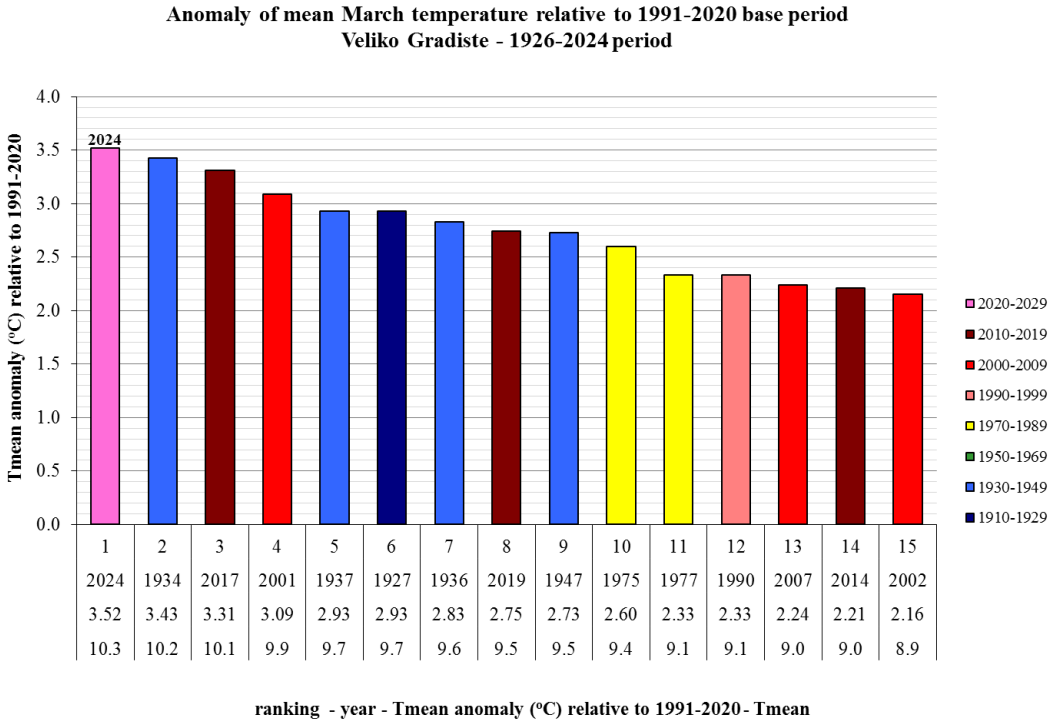


1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2024	2001	2017	2019	1990	2014	1934	1975	1977	1947	1989	1979	1937	1994	2002
3.85	3.54	3.24	3.13	2.90	2.56	2.52	2.48	2.32	2.32	2.22	2.17	2.12	2.11	2.04
12.1	11.8	11.5	11.4	11.2	10.8	10.8	10.8	10.6	10.6	10.5	10.4	10.4	10.4	10.3

Appendix 10. Rank of the warmest March in Belgrade

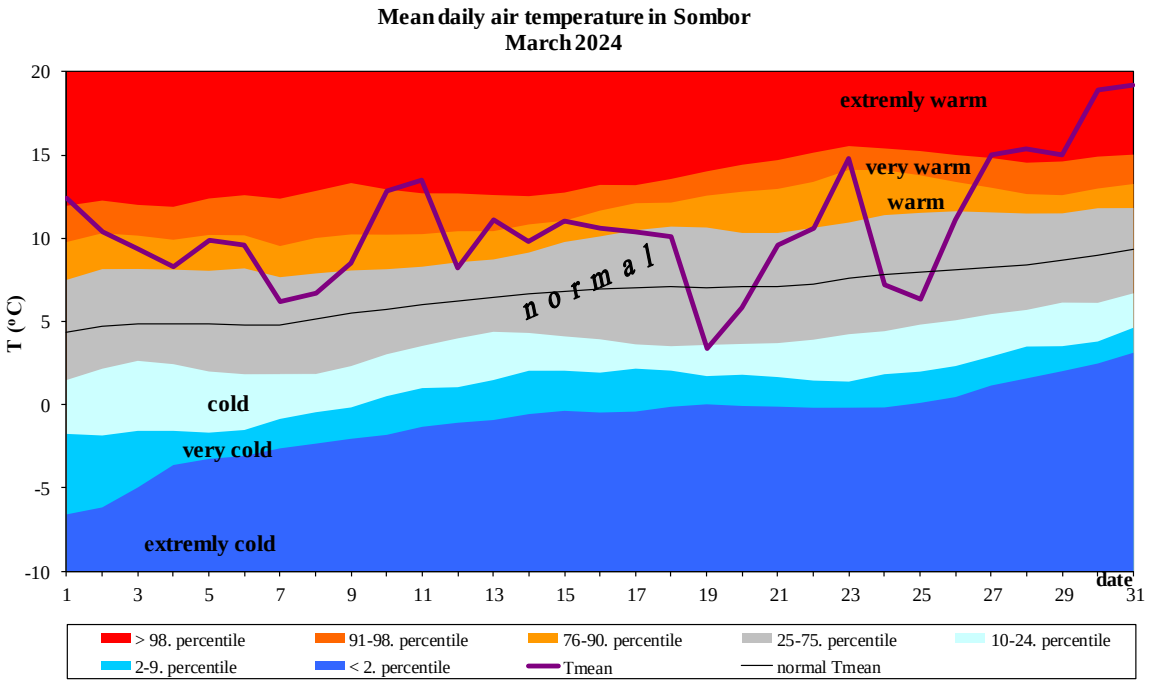


Appendix 11. Rank of the warmest March in Smederevska Palanka

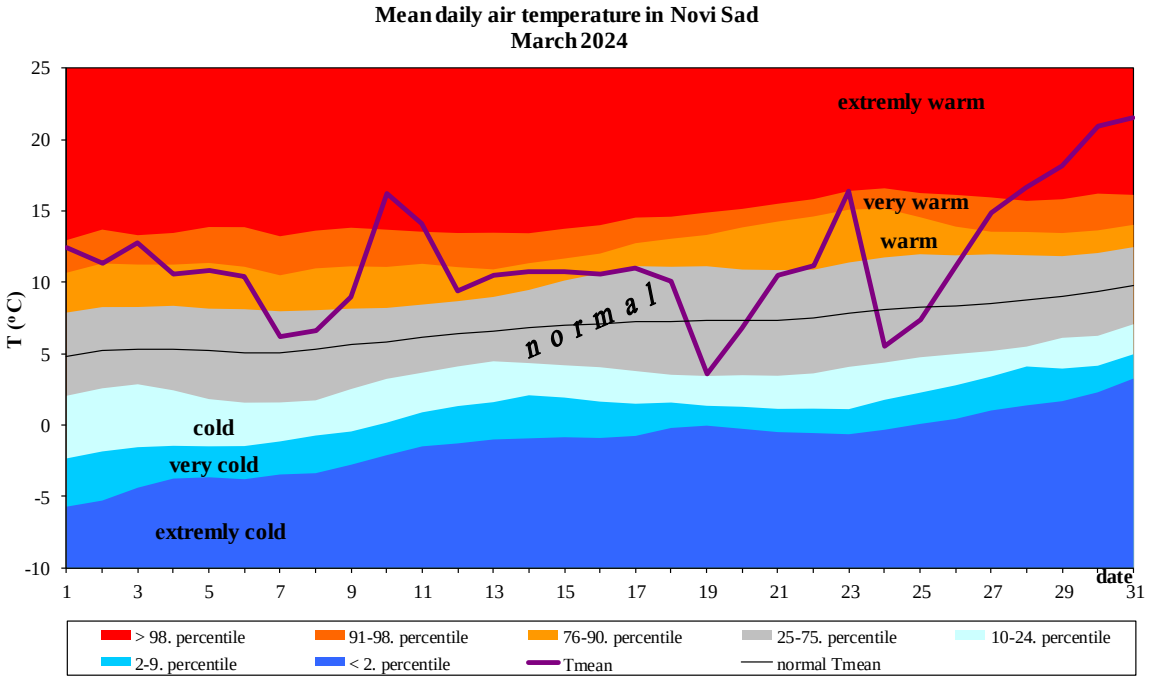


Appendix 12. Rank of the warmest March in Veliko Gradiste

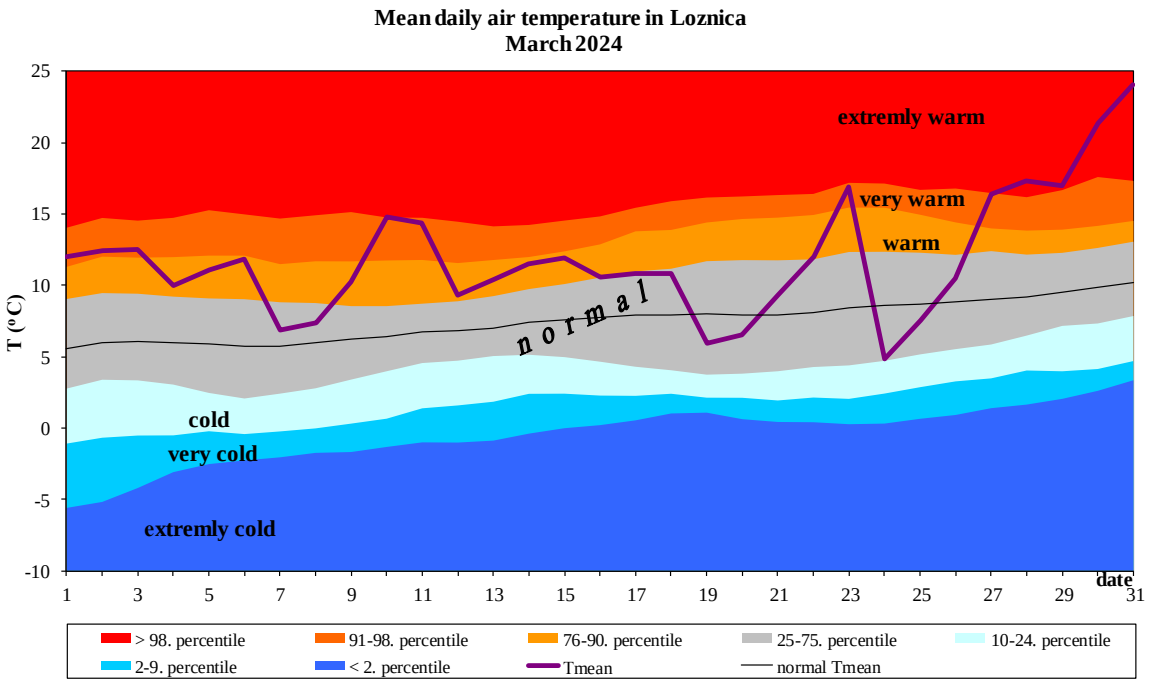
Mean air temperature



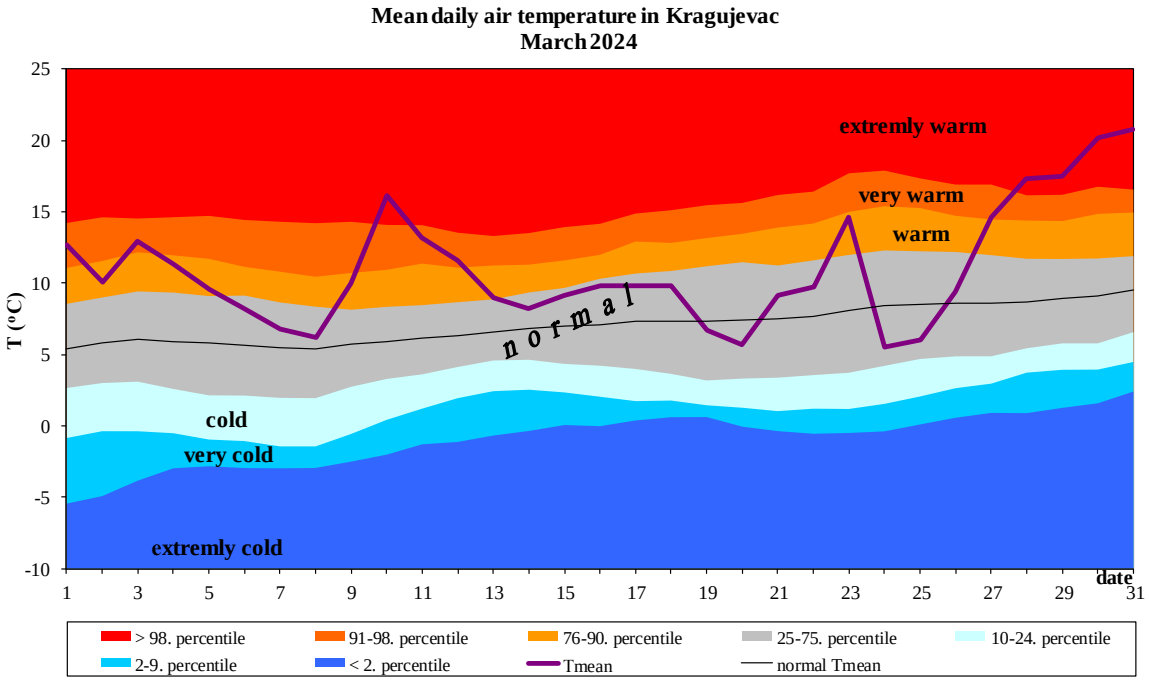
Appendix 13. Daily course of the mean daily air temperature and accompanying percentile for Sombor



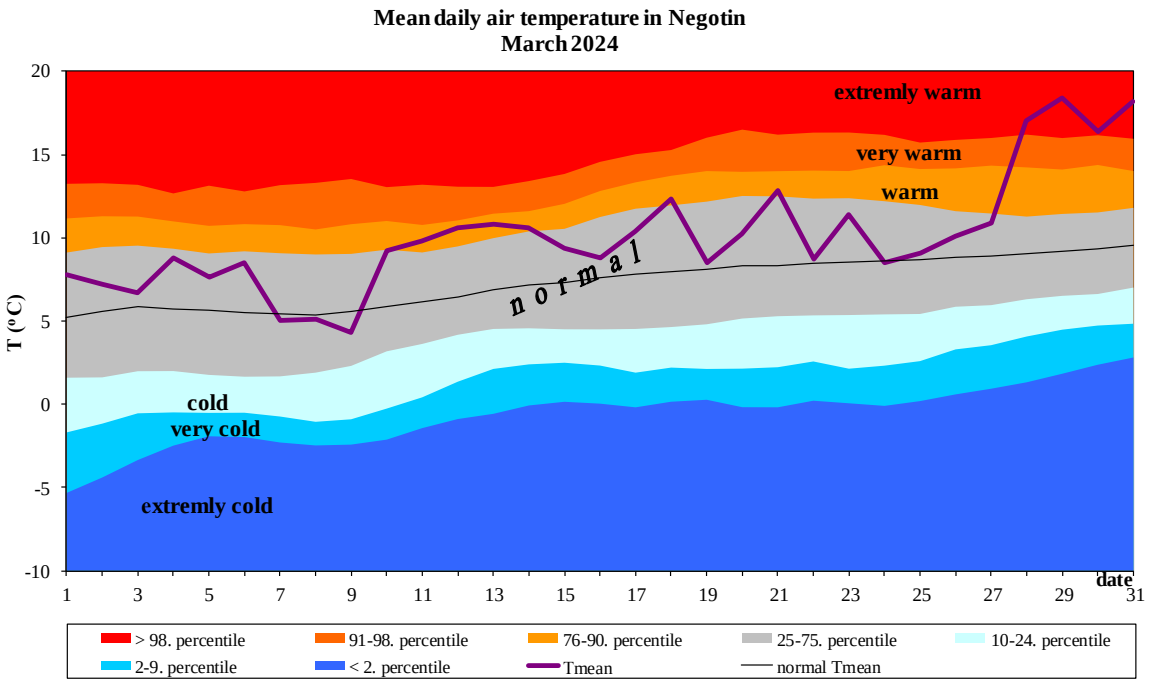
Appendix 14. Daily course of the mean daily air temperature and accompanying percentile for Novi Sad



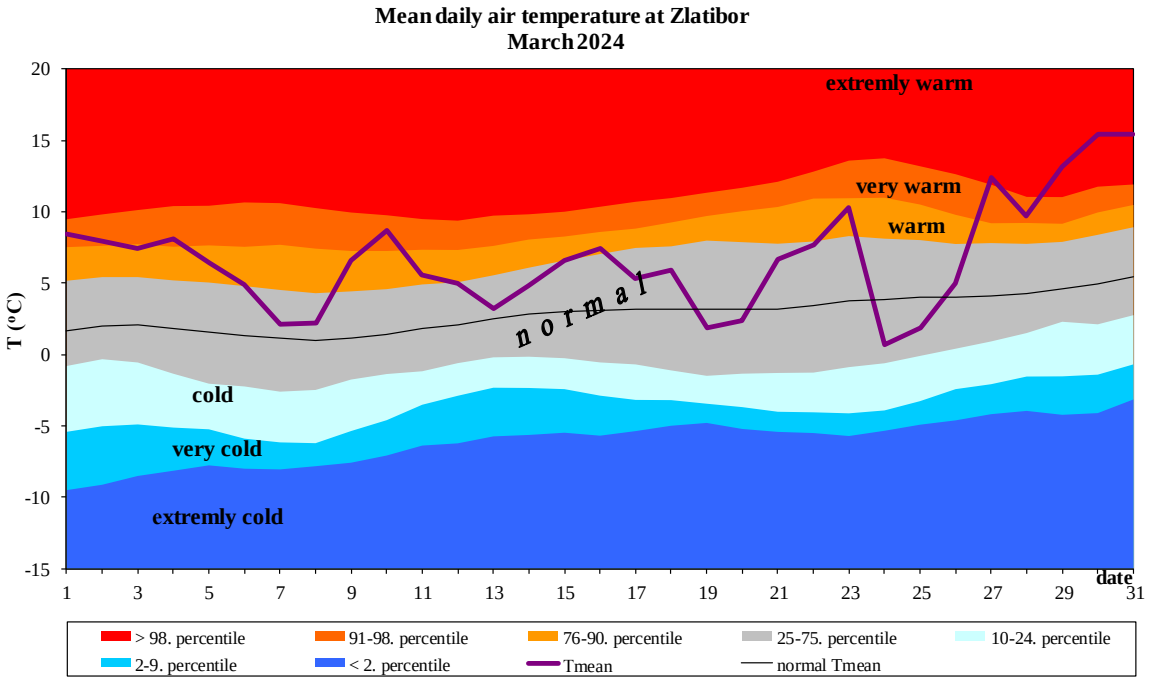
Appendix 15. Daily course of the mean daily air temperature and accompanying percentile for Loznica



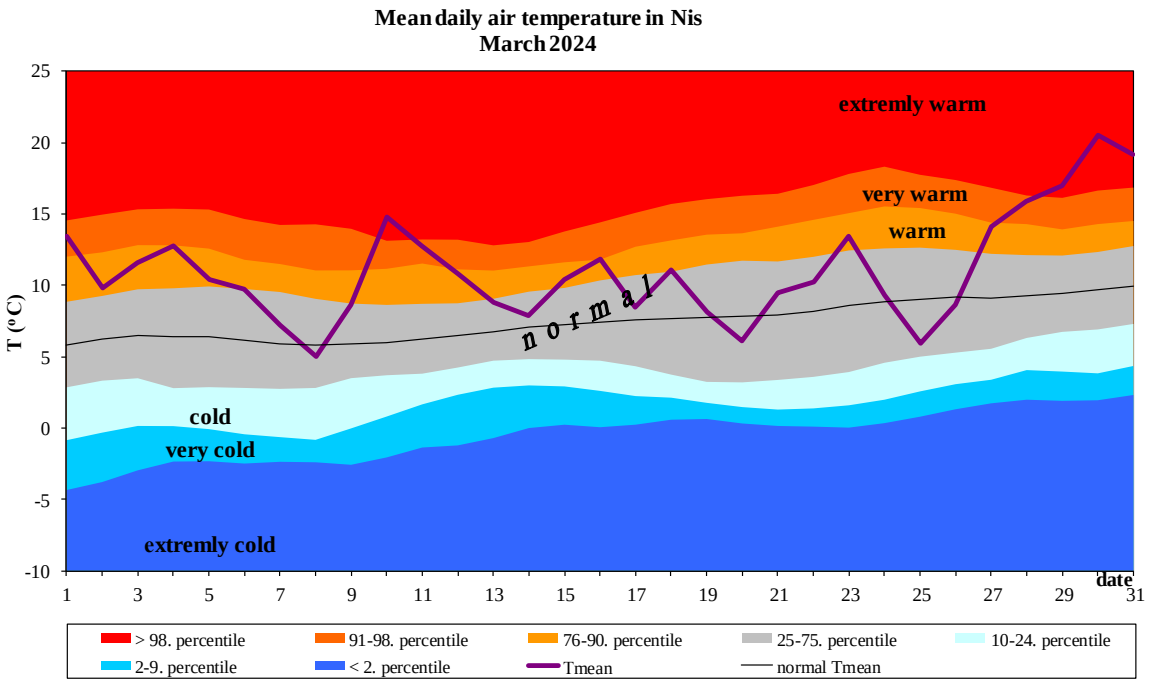
Appendix 16. Daily course of the mean daily air temperature and accompanying percentile for Kragujevac



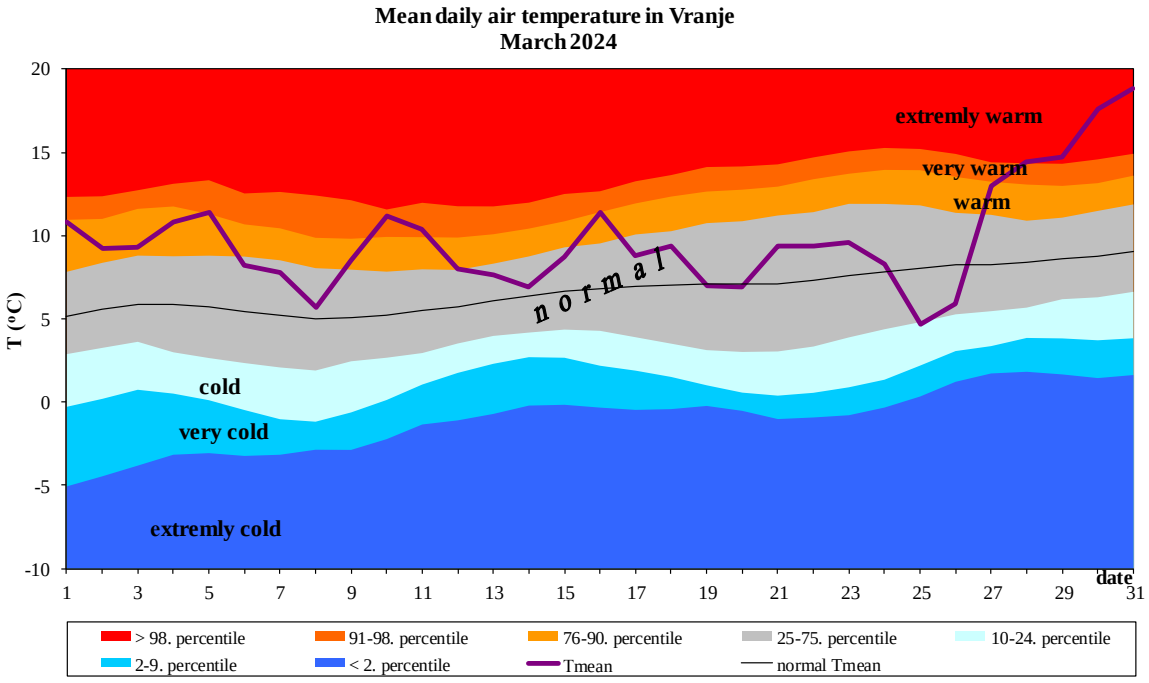
Appendix 17. Daily course of the mean daily air temperature and accompanying percentile for Negotin



Appendix 18. Daily course of the mean daily air temperature and accompanying percentile on Zlatiboru

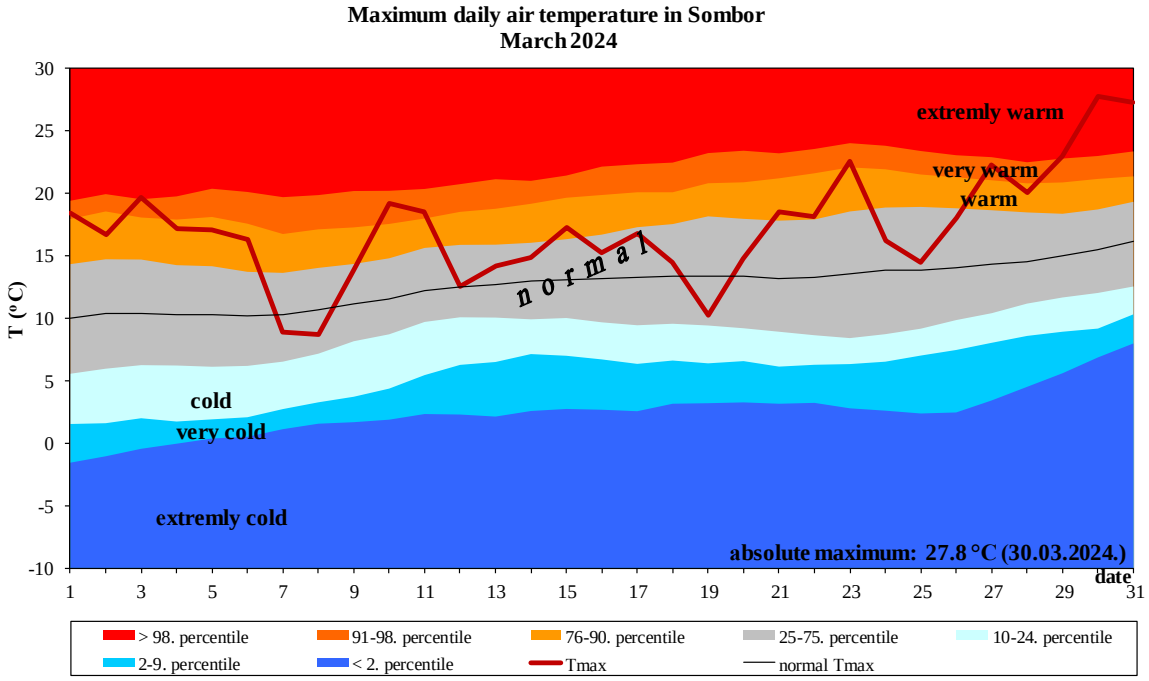


Appendix 19. Daily course of the mean daily air temperature and accompanying percentile for Nis

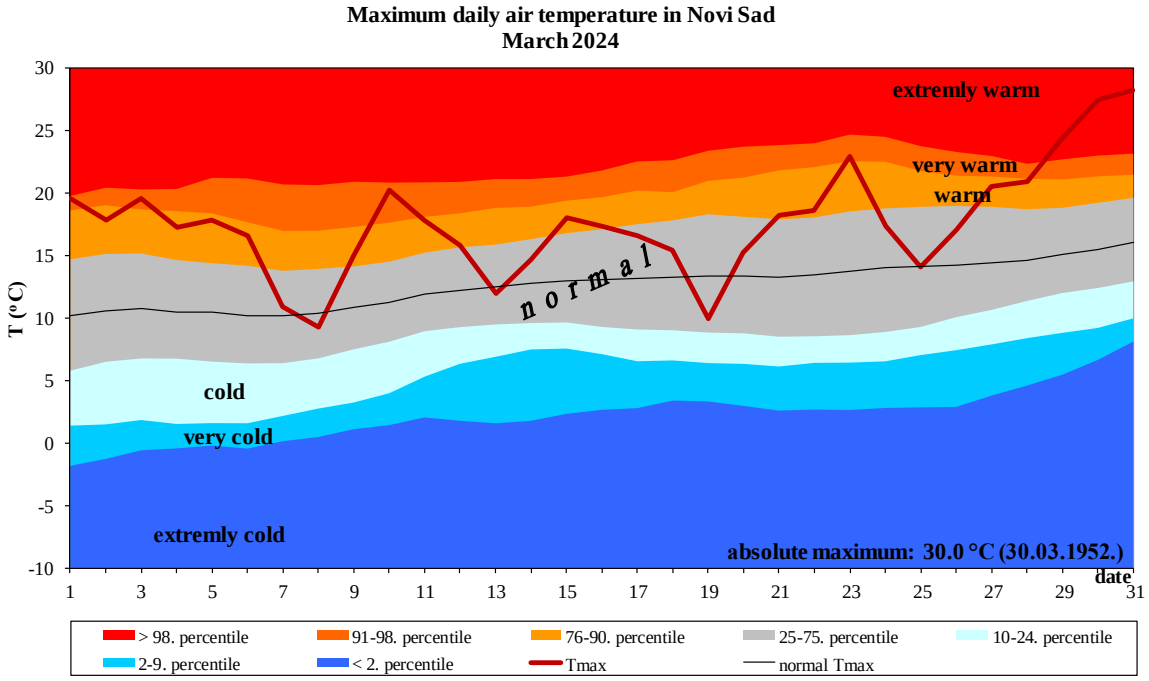


Appendix 20. Daily course of the mean daily air temperature and accompanying percentile for Vranje

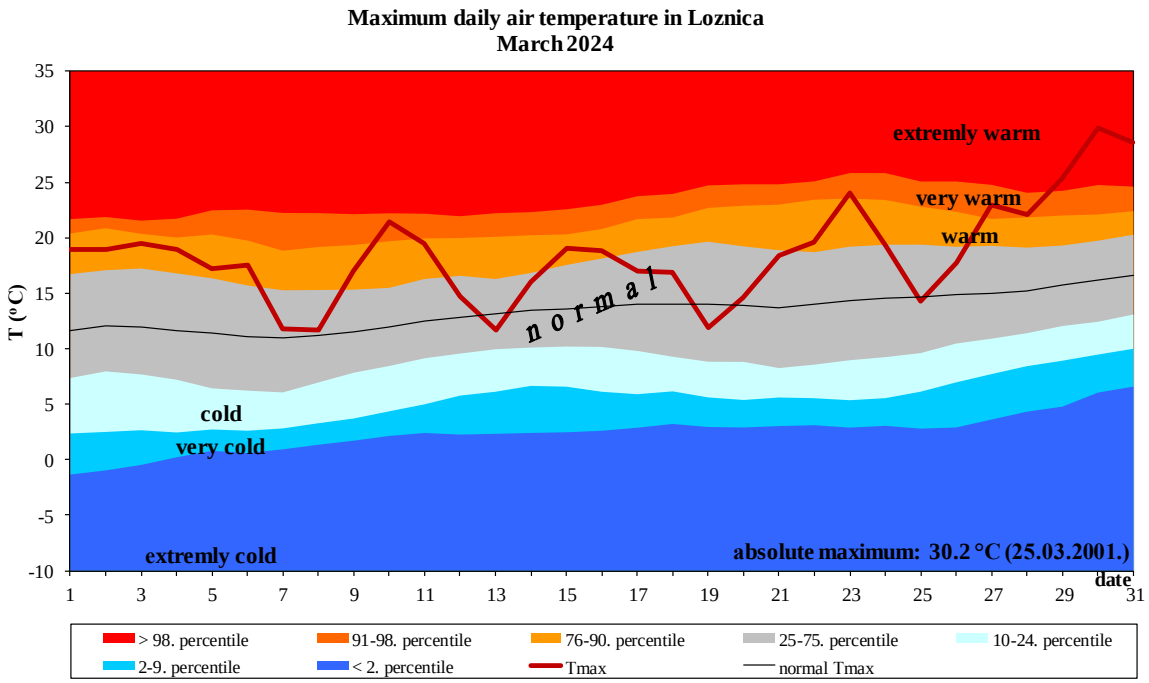
Maximum air temperature



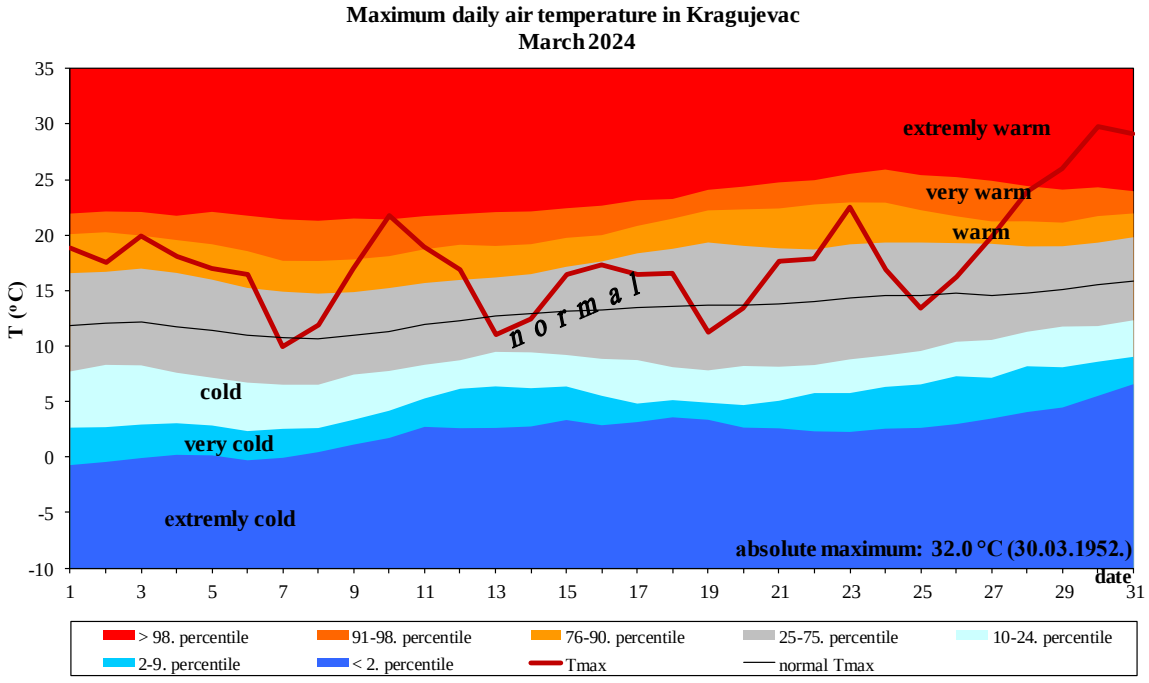
Appendix 21. Daily course of the maximum daily air temeperature and the accompanying percentile for Sombor



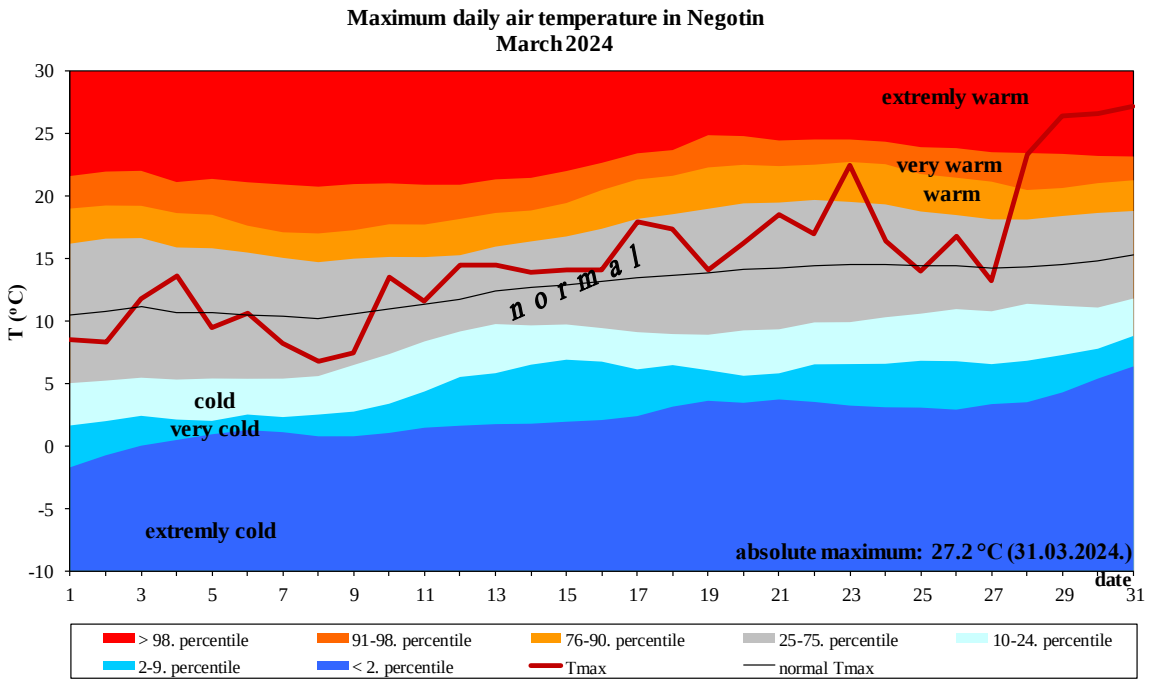
Appendix 22. Daily course of the maximum daily air temeperature and the accompanying percentile for Novi Sad



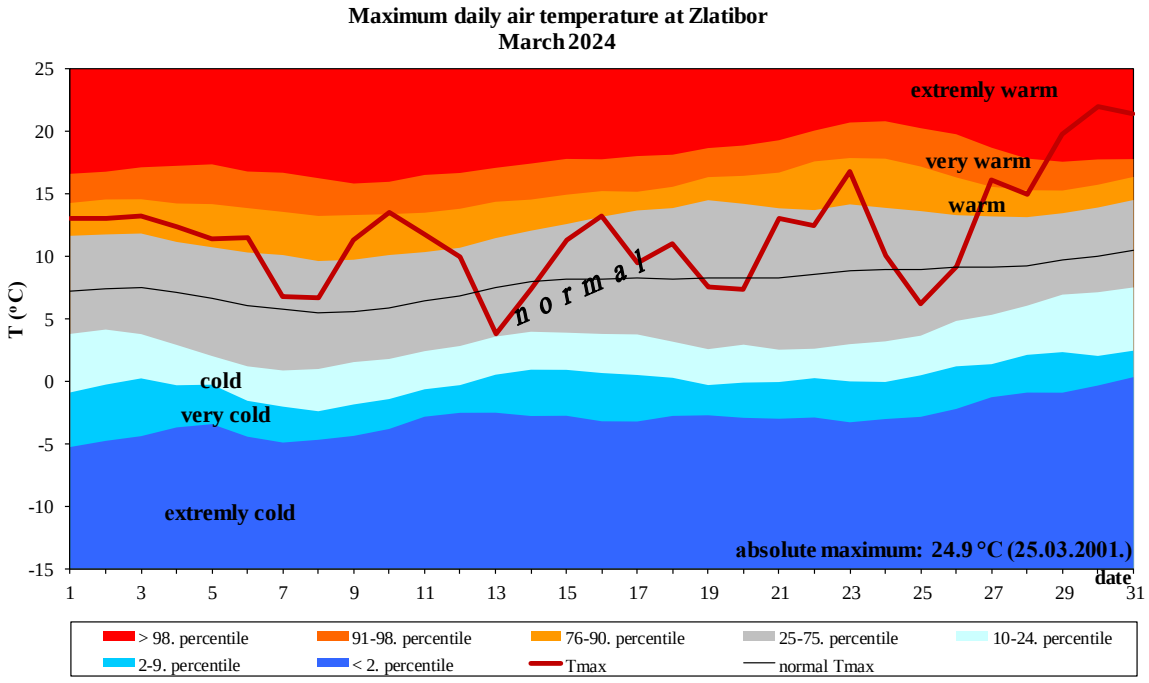
Appendix 23. Daily course of the maximum daily air temeperature and the accompanying percentile for Loznica



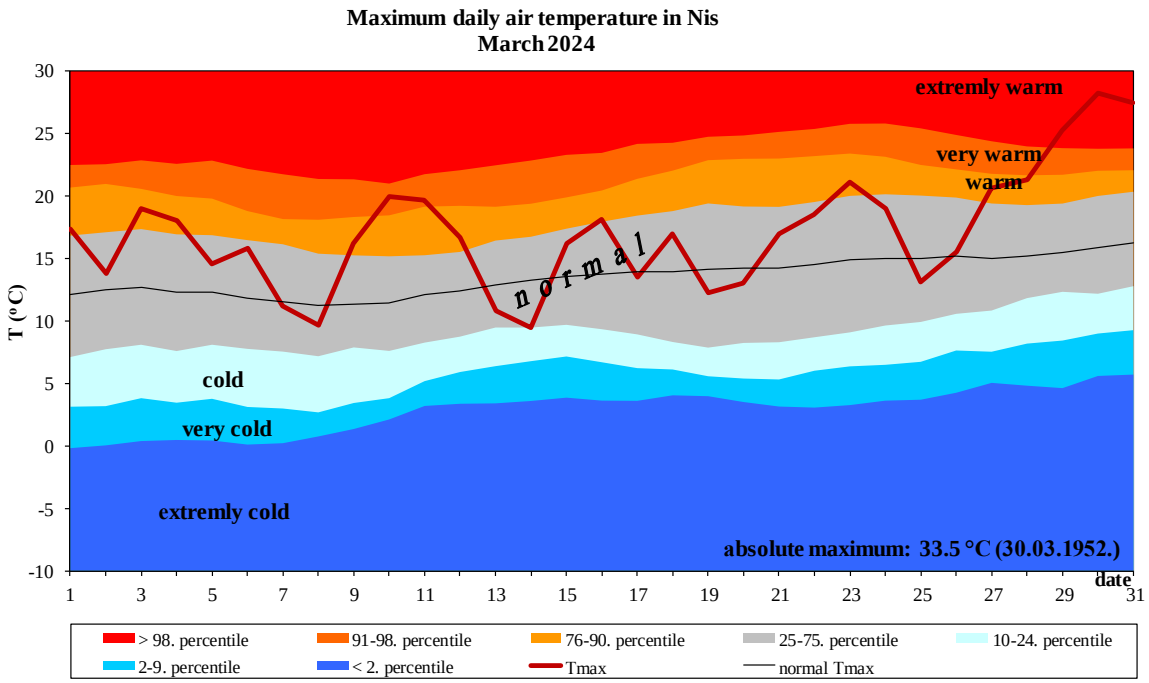
Appendix 24. Daily course of the maximum daily air temeperature and the accompanying percentile for Kragujevac



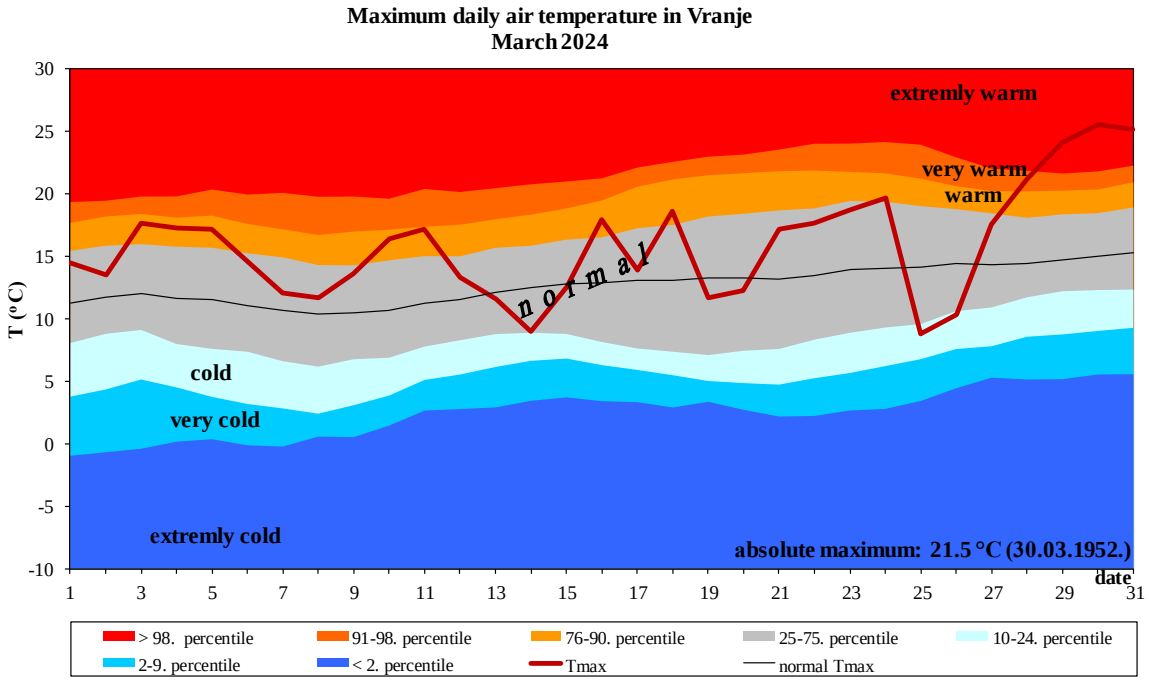
Appendix 25. Daily course of the maximum daily air temeperature and the accompanying percentile for Negotin



Appendix 26. Daily course of the maximum daily air temeperature and the accompanying percentile on Zlatibor

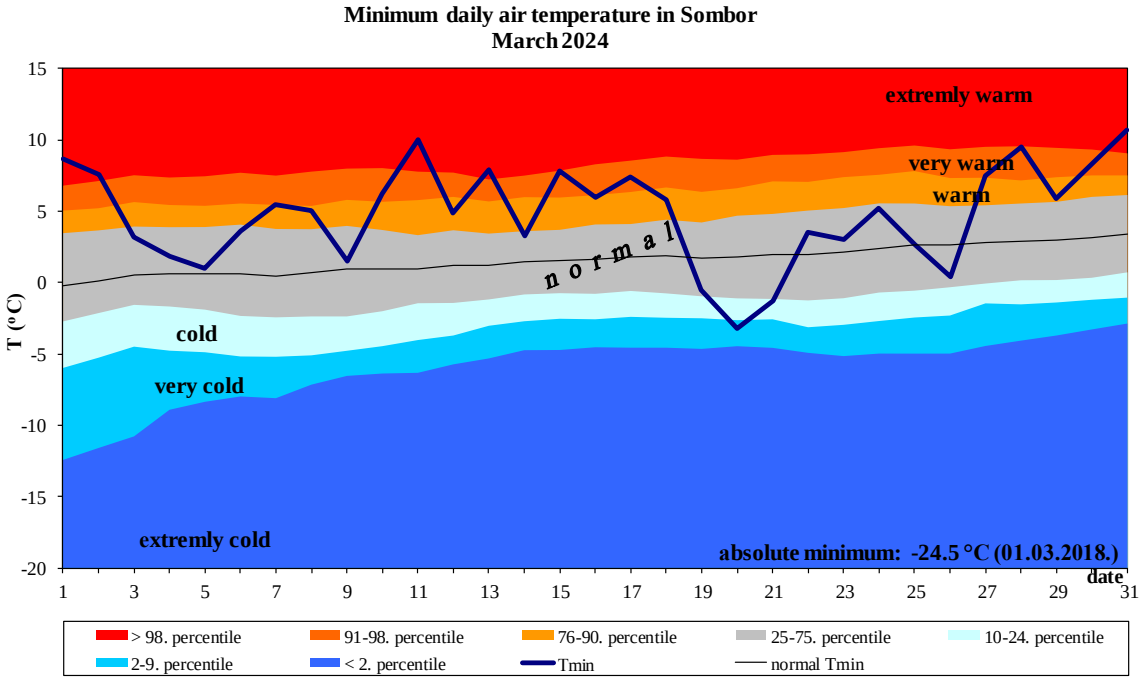


Appendix 27. Daily course of the maximum daily air temeperature and the accompanying percentile for Nis

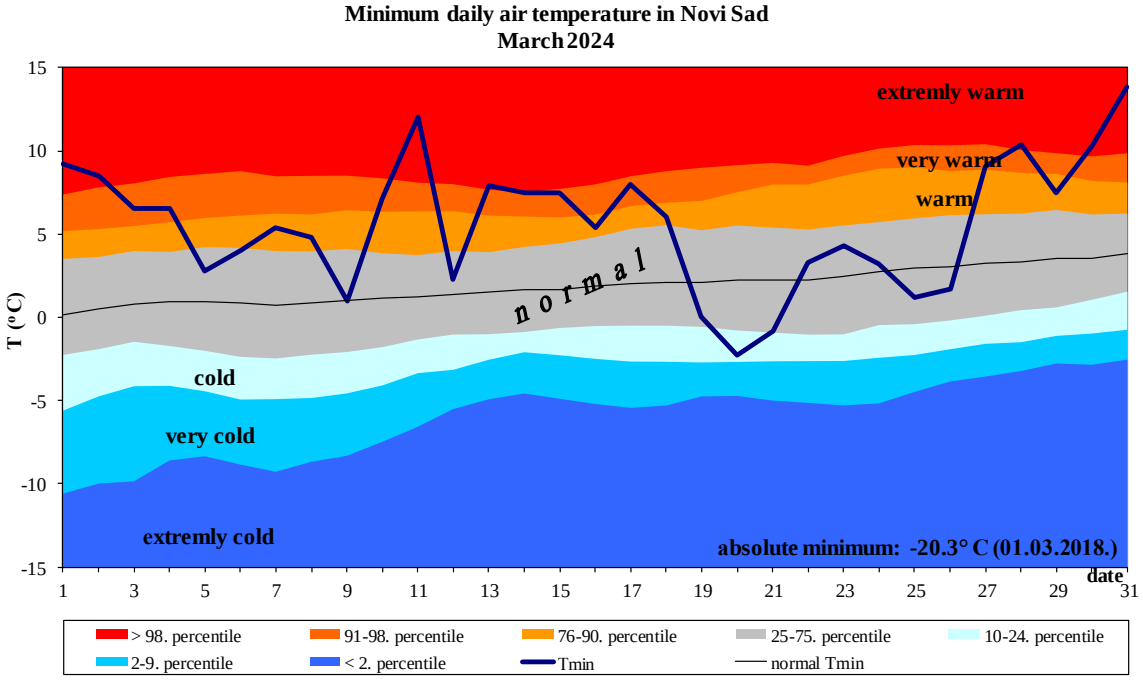


Appendix 28. Daily course of the maximum daily air temeperature and the accompanying percentile for Vranje

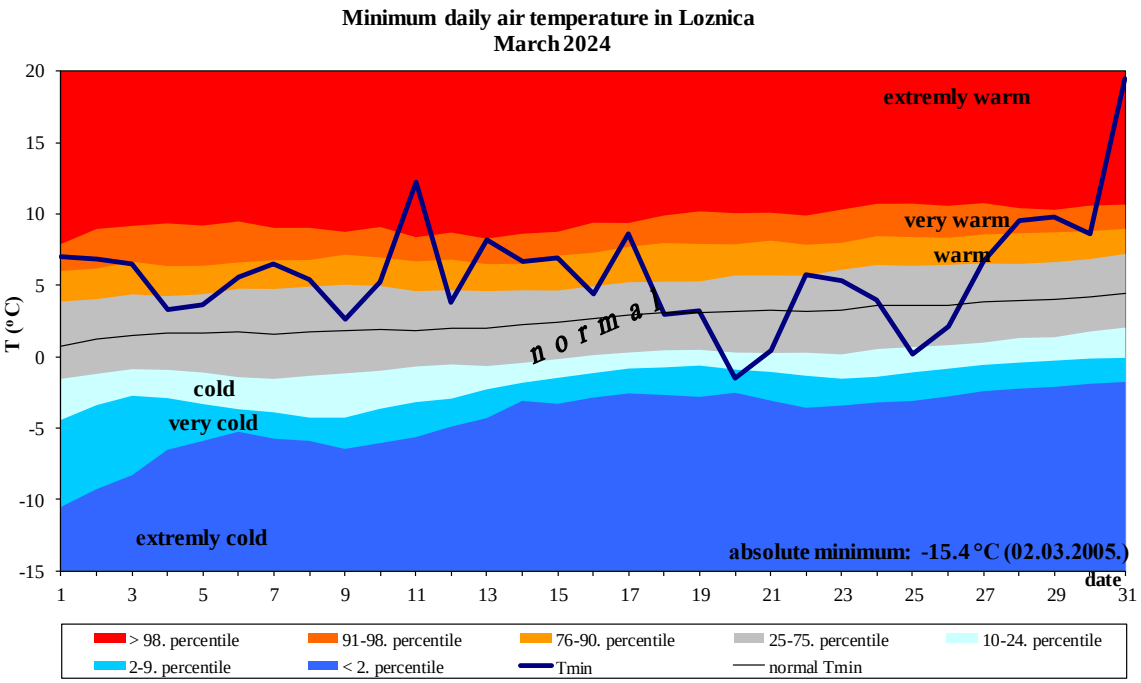
Minimum air temperature



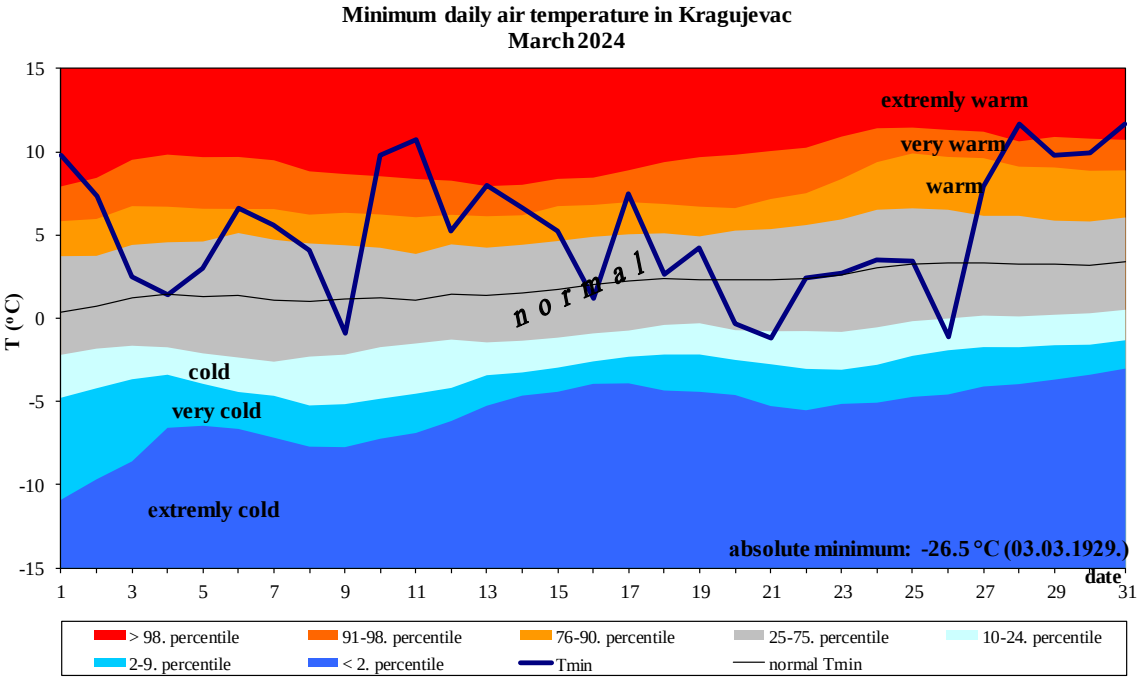
Appendix 29. Daily course of the minimum daily air temperature and the accompanying percentile for Sombor



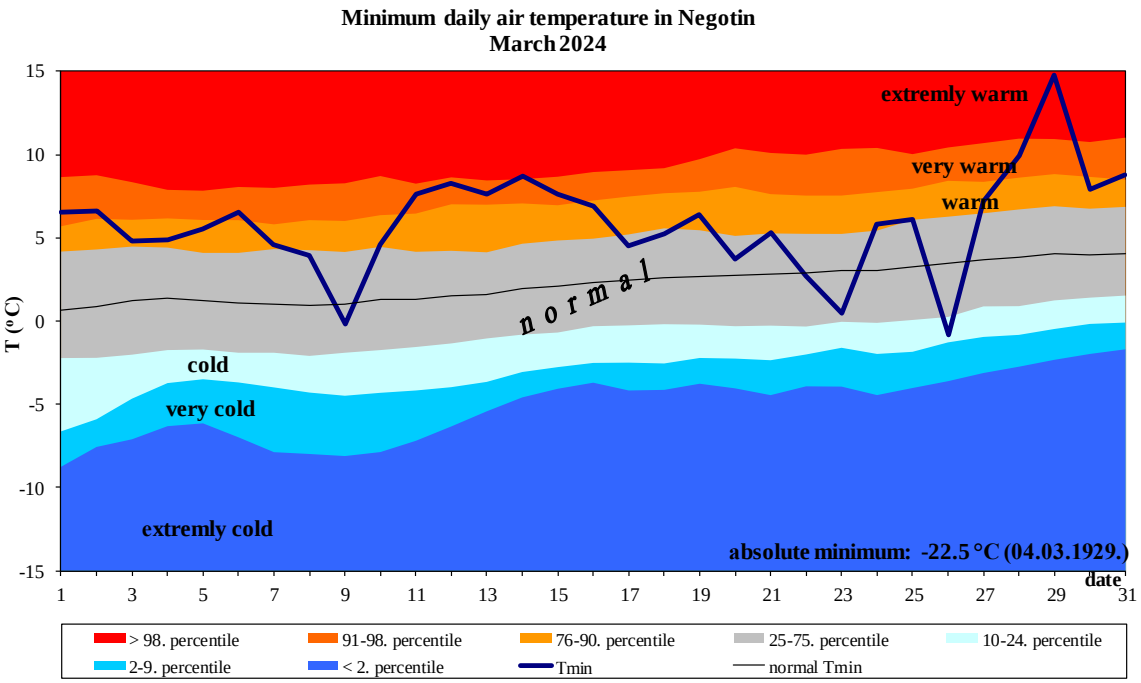
Appendix 30. Daily course of the minimum daily air temperature and the accompanying percentile for Novi Sad



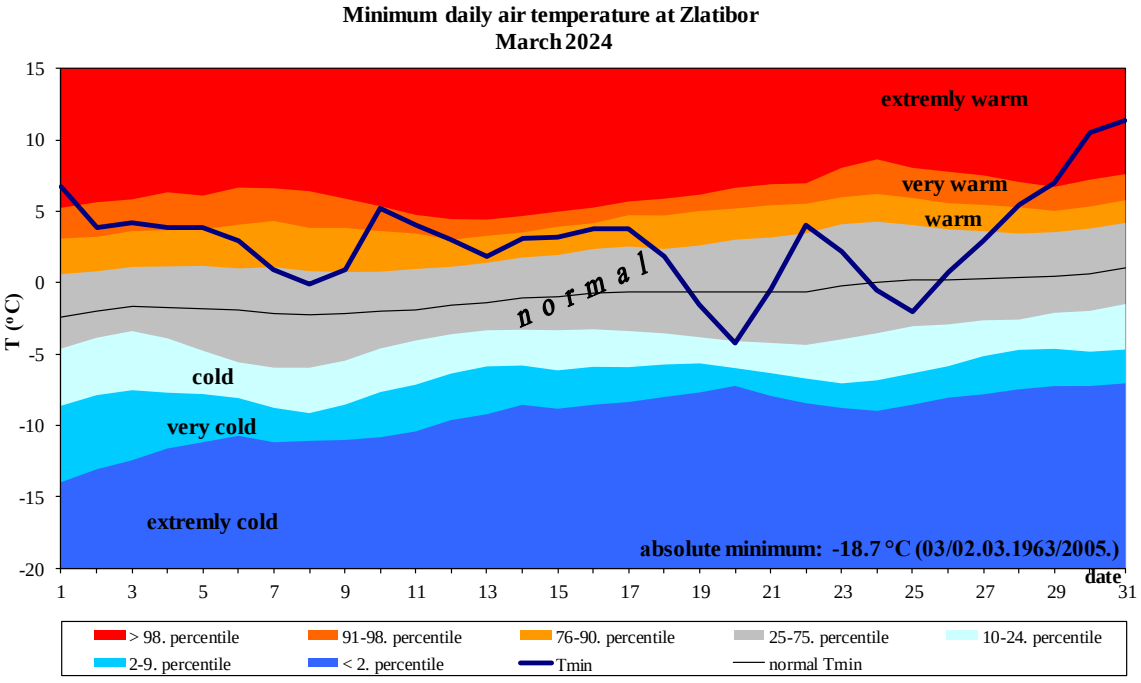
Appendix 31. Daily course of the minimum daily air temperature and the accompanying percentile for Loznica



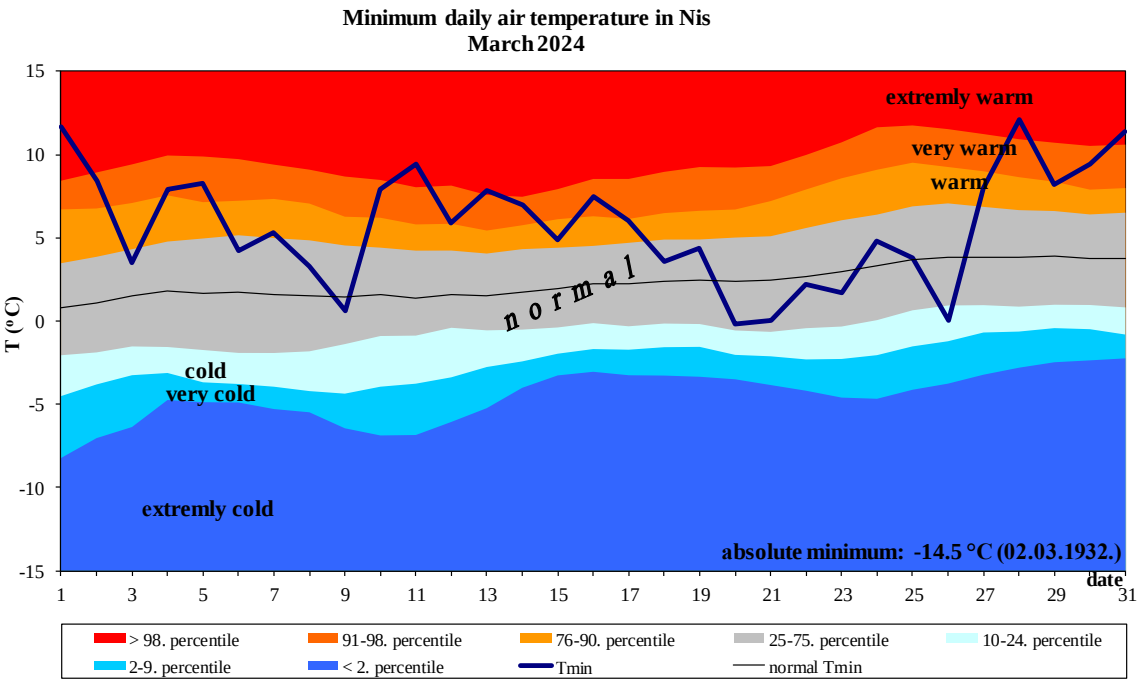
Appendix 32. Daily course of the minimum daily air temperature and the accompanying percentile for Kragujevac



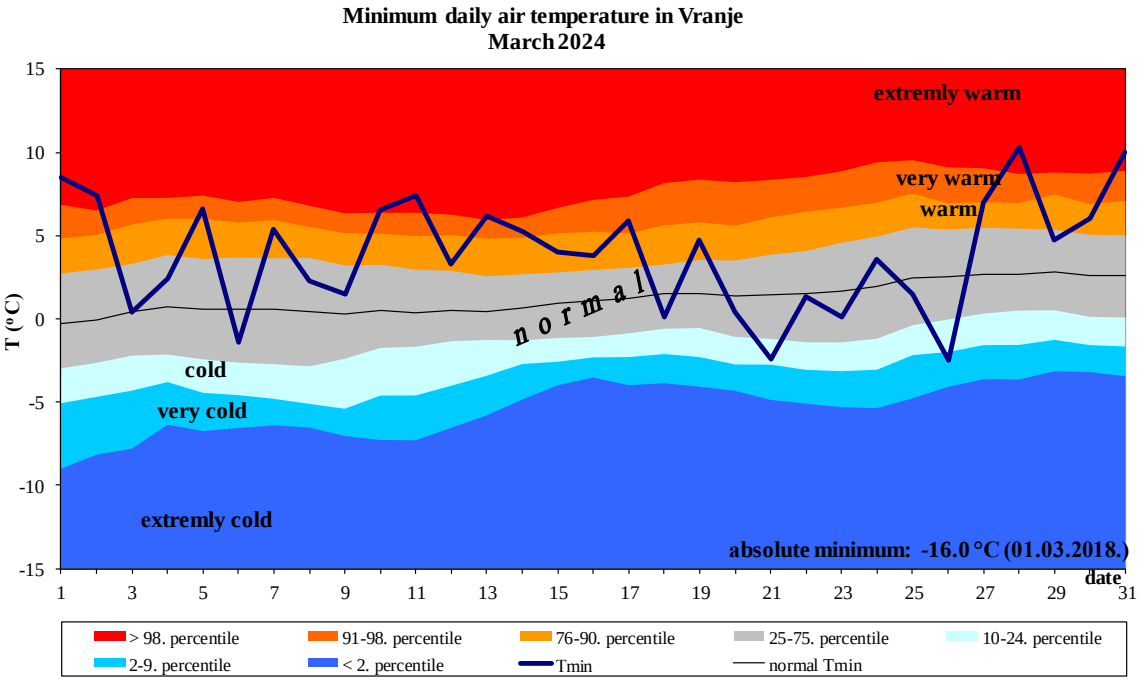
Appendix 33. Daily course of the minimum daily air temperature and the accompanying percentile for Negotin



Appendix 34. Daily course of the minimum daily air temperature and the accompanying percentile on Zlatibor

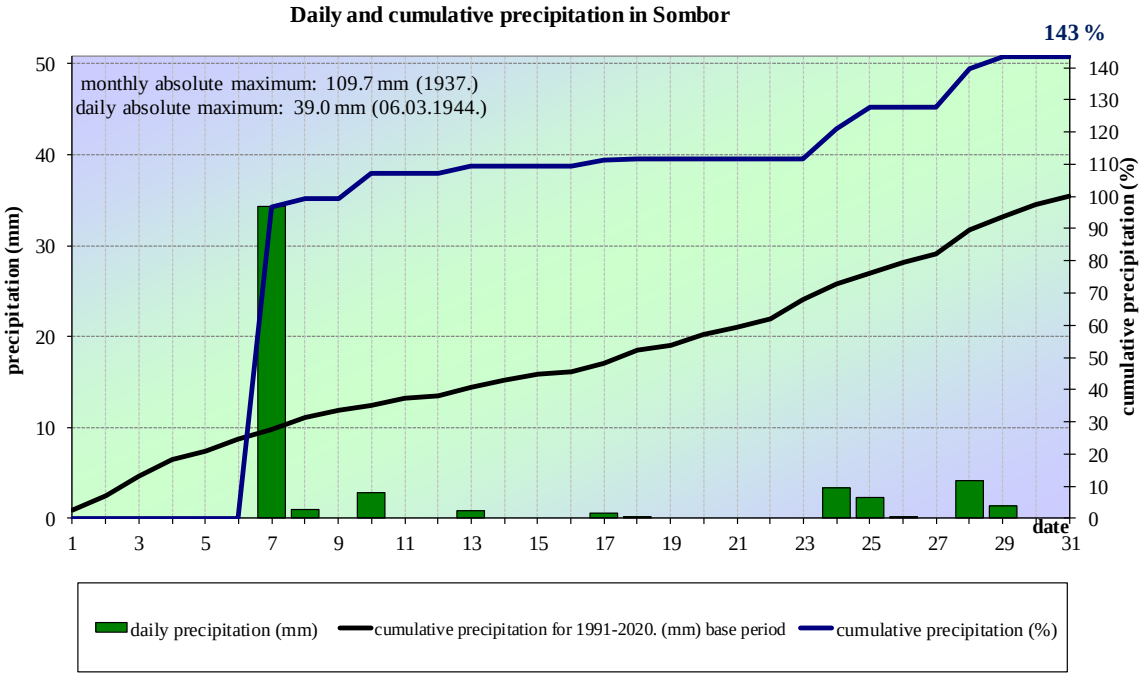


Appendix 35. Daily course of the minimum daily air temperature and the accompanying percentile for Nis

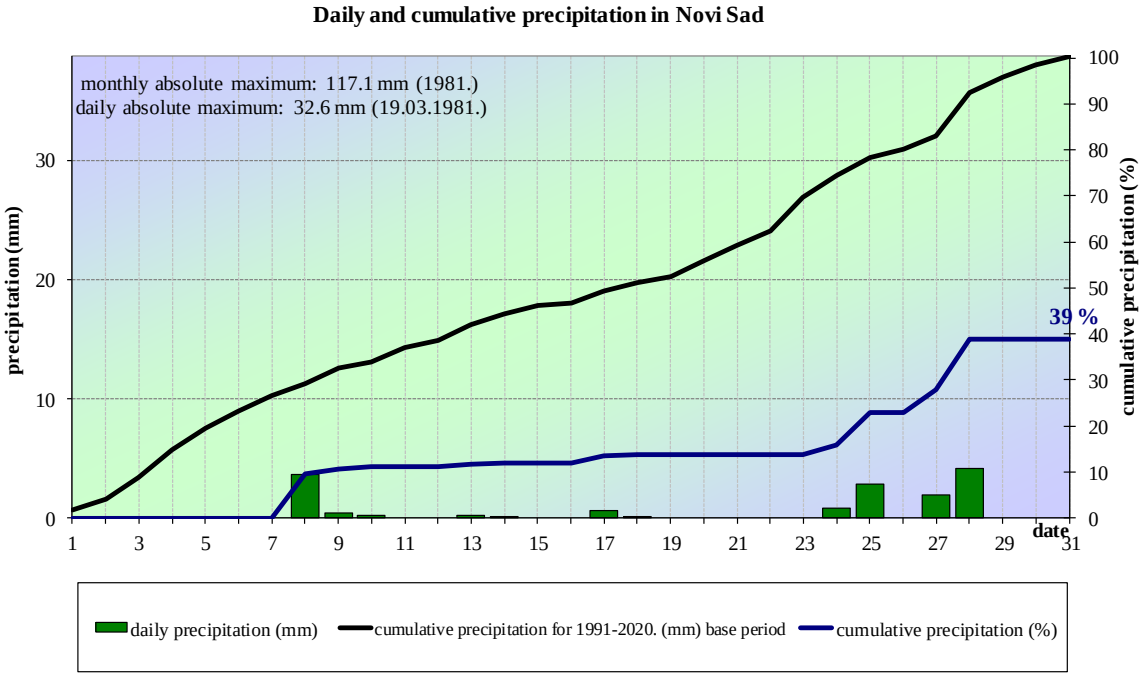


Appendix 36. Daily course of the minimum daily air temperature and the accompanying percentile for Vranje

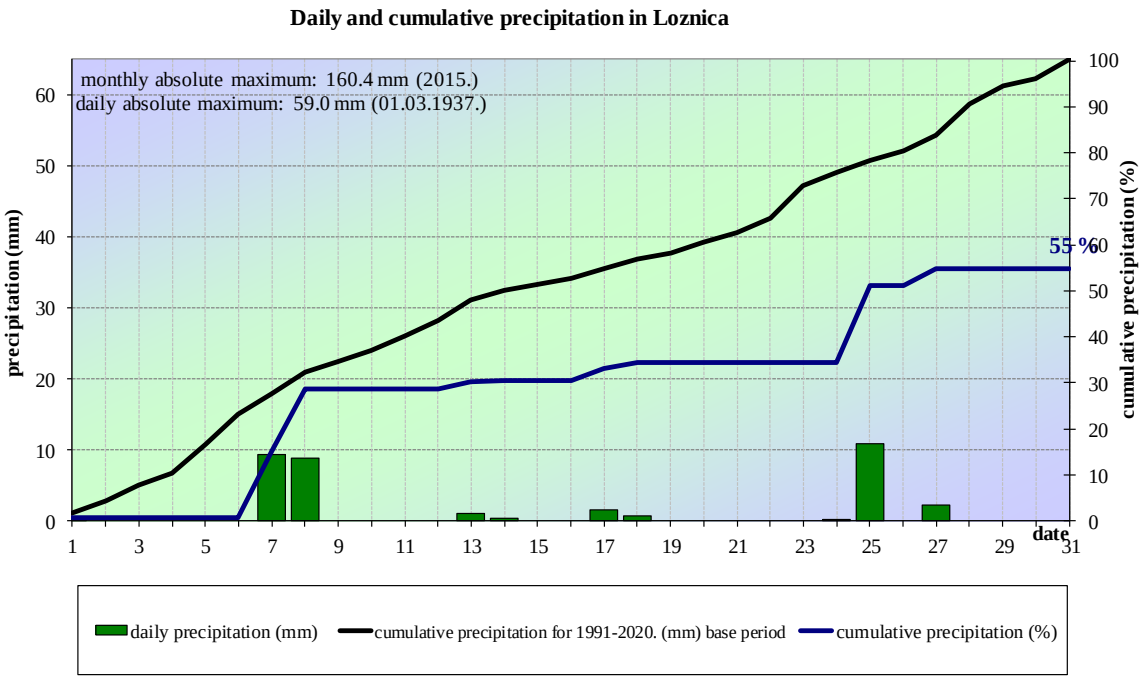
Precipitation



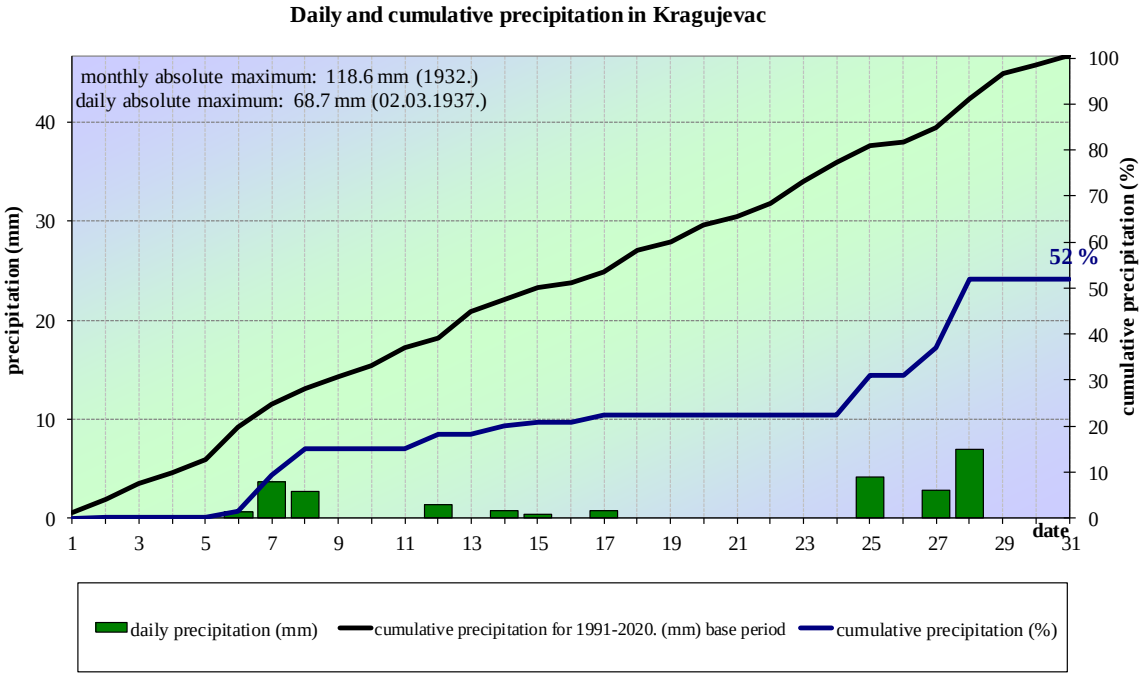
Appendix 37. Daily and cumulative precipitation sums for Sombor



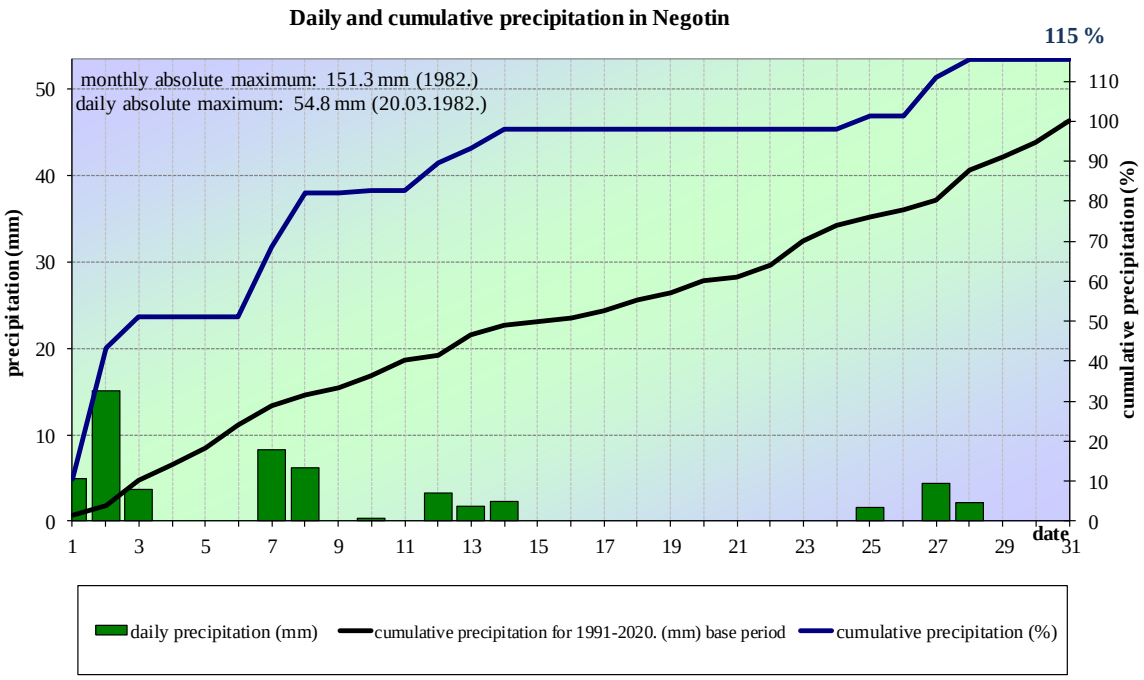
Appendix 38. Daily and cumulative precipitation sums for Novi Sad



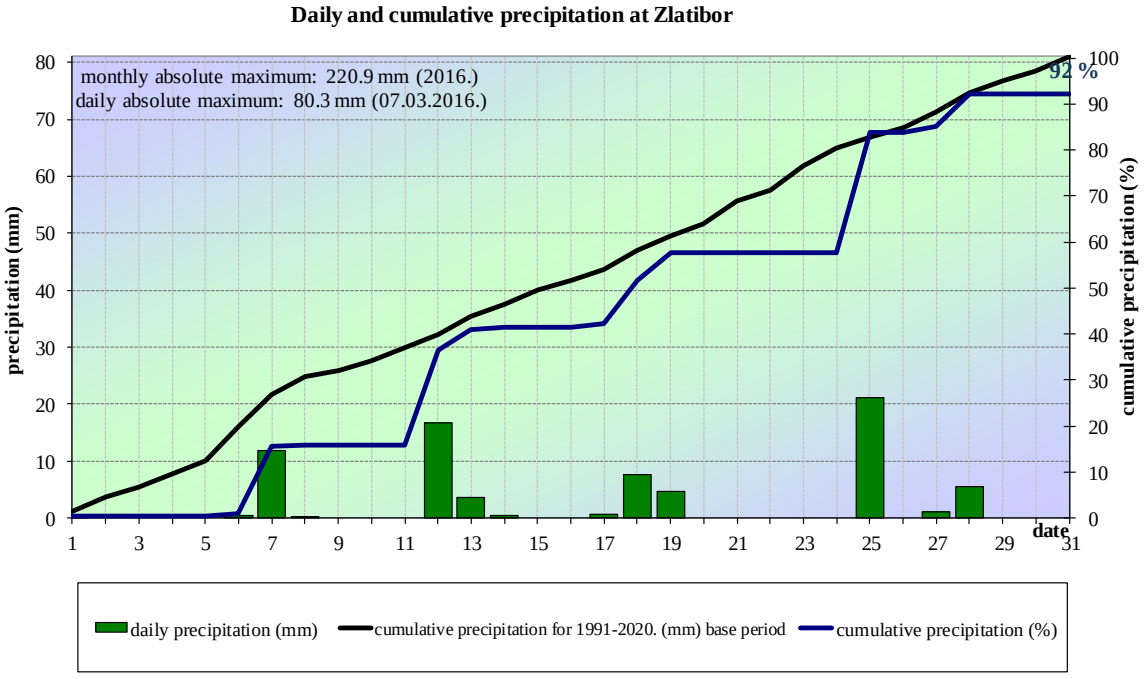
Appendix 39. Daily and cumulative precipitation sums for Loznica



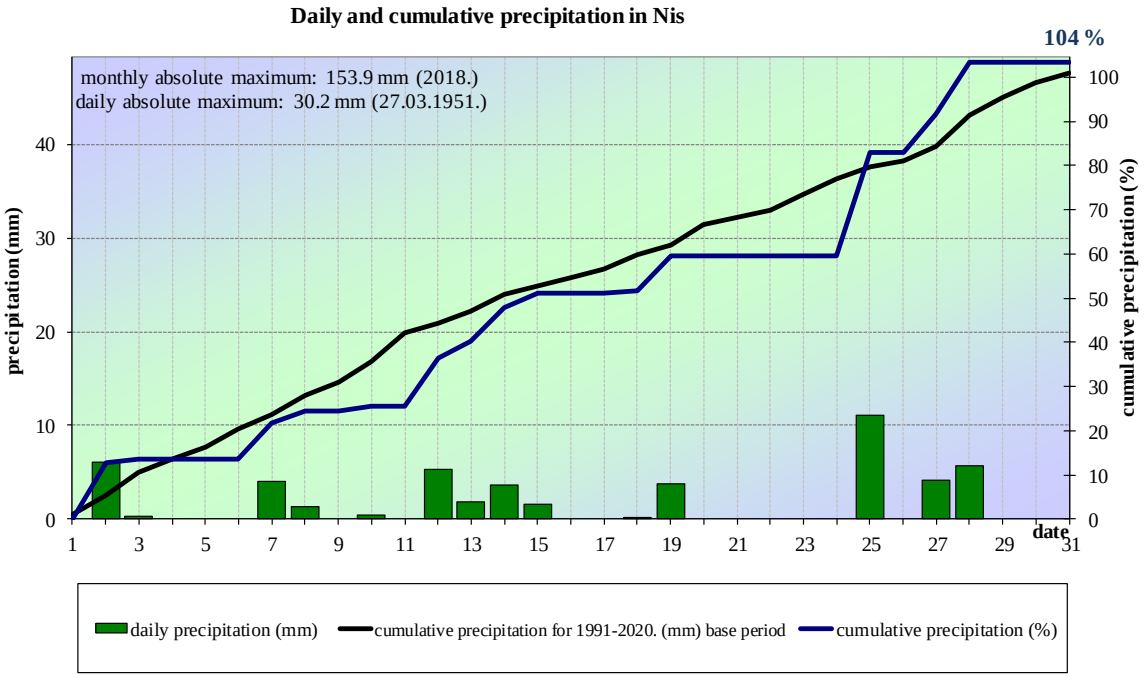
Appendix 40. Daily and cumulative precipitation sums for Kragujevac



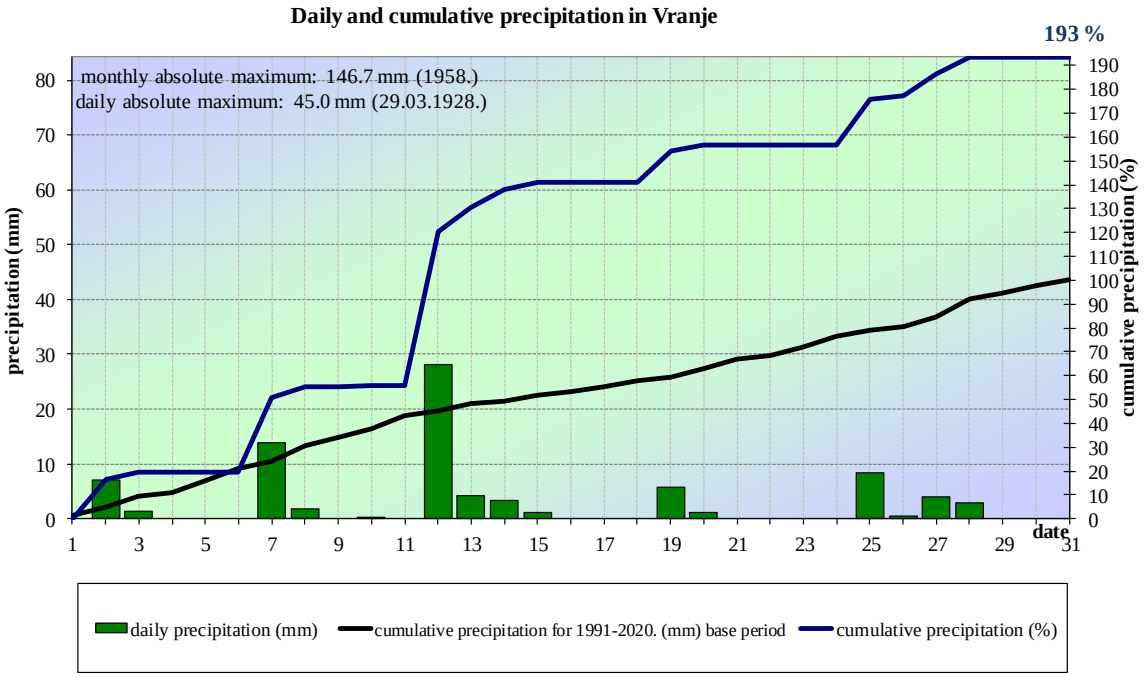
Appendix 41. Daily and cumulative precipitation sums for Negotin



Appendix 42. Daily and cumulative precipitation sums on Zlatibor



Appendix 43. Daily and cumulative precipitation sums for Nis



Appendix 44. Daily and cumulative precipitation sums for Vranje