# EMERGENCY CLIMATOLOGICAL BULLETIN

## COLD WAVE IN SERBIA IN THE PERIOD FROM 6 – 12 JANUARY 2017

Belgrade, January 12, 2017

# Cold wave in the period from 6 - 12 January 2017

In the period from 6 to 12 January 2017, territory of Serbia was affected by cold wave. Cold wave is defined as the period during which the minimum daily air temperature falls under the very cold and extremely cold domain, five or more consecutive days, based on the percentile method. Analysis of the cold wave for the period from 6 to 12 January was performed compared to the 1981-2010 base period based on the data obtained from the main meteorological stations in Serbia.

During winter of 2016/17, cold wave that affected Serbia ranks as the second most intense in the period of 2000 up-to-date. The most intense cold wave on record was registered in 2012 when certain places in Serbia observed 20 and more consecutive days with extremely low minimum and maximum daily air temperatures. That cold wave lasted for 19 days in Belgrade, and 18 days in Sremska Mitrovica, Kragujevac, Nis and Crni Vrh. The departure of the minimum daily air temperature from the mean minimum daily air temperature reached -26.7°C in Novi Sad.

During this winter, on January 6, cold wave first affected Vojvodina and mountain regions, subsequently expanding to the entire Serbia, on January 7 and lasting until January 12, 2017. The departure of the minimum daily air temperature from the mean minimum air temperature reached up to -20.4°C in Leskovac.

Figures 1 and 2 show spatial distribution of the cold waves across Serbia  districts for January 12 and 13, 2017. It can be concluded that on January 12 entire Serbia was affected by cold wave whereas on January 13, the cold wave was observed in districts of Kolubara, Zlatibor, Morava, Rasina, Pomoravlje, Branicevo, Bor, Nis, Pirot and Pcinja.
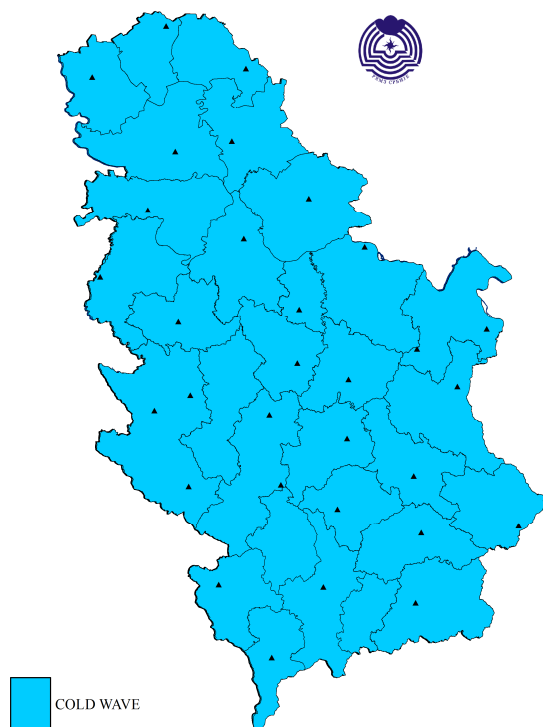
Figure 1. Spatial distribution of cold wave in Serbia across districts for 12 January 2017
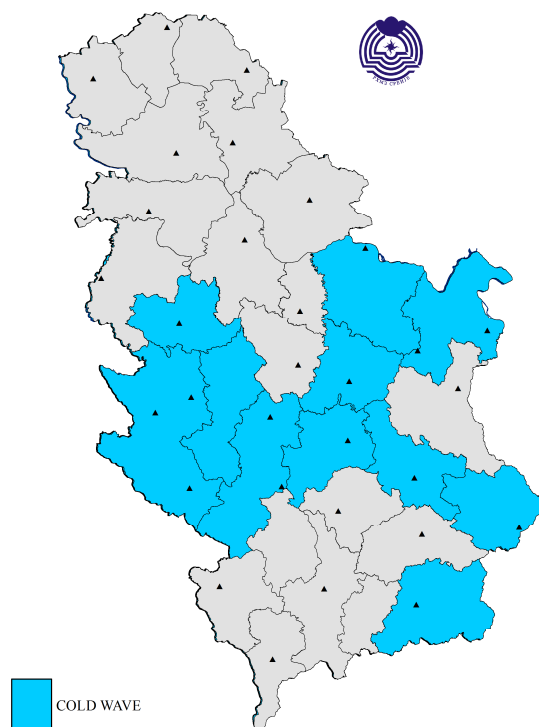
Figure 2. Spatial distribution of cold wave in Serbia across districts for 13 January 2017

From the beginning of January, Serbia experienced 5 to 8 ice days registered in the lowland whereas their number on the mountains ranged from 6 to 10 days. The average number of ice days in the lowland ranged from 6 days in Vranje to 9 days in Kikinda, 7 days in Belgrade, and on the mountains, characterized by mountain climate, from 12 on Zlatibor to 17 days on Kopaonik. The mean minimum daily air temperature of -20.4°C was observed in Leskovac.

Chart 1. Categories of the minimum daily air temperatures compared to the percentiles of December 25, 2016 to January 12, 2017 compared to the 1981-2010 base period

**DECEMBER**  **JANUARY**

| day | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PALIC | N | W | VW | W | N | N | C | C | VC | N | N | N | C | VC | EC | VC | EC | VC | VC |
| SOMBOR | N | W | VW | N | N | N | VC | C | C | N | C | N | VC | VC | EC | VC | EC | VC | VC |
| KIKINDA | N | W | W | N | N | C | C | C | C | N | C | N | VC | VC | EC | VC | EC | VC | VC |
| BECEJ | | | | | | | | | | | | | | | | | | | |
| ZRENJANIN | N | W | W | N | N | C | C | C | C | N | C | N | C | VC | EC | VC | EC | VC | VC |
| NOVI SAD | N | W | W | N | N | C | C | C | C | N | C | N | VC | EC | EC | EC | EC | VC | VC |
| SR.MIWROVICA | N | W | W | N | N | C | VC | VC | N | C | N | C | VC | EC | EC | EC | EC | EC | EC |
| BELGRADE | N | W | W | N | N | C | C | C | C | N | C | N | VC | EC | EC | VC | EC | VC | VC |
| LOZNICA | N | W | VW | W | N | N | N | C | C | N | C | N | C | VC | EC | VC | EC | VC | EC |
| VALJEVO | N | VW | VW | W | N | N | N | C | C | N | C | N | C | VC | EC | VC | EC | VC | EC |
| V.GRADISWE | N | W | W | W | N | C | VC | VC | VC | N | C | N | C | VC | EC | EC | EC | C | EC |
| SM.PALANKA | N | W | W | N | N | N | C | VC | VC | N | C | N | C | VC | EC | VC | EC | EC | EC |
| KRAGUJEVAC | N | W | W | N | N | C | C | VC | C | N | C | N | C | VC | EC | VC | EC | VC | EC |
| KRALJEVO | N | W | VW | N | N | N | C | VC | VC | N | N | N | C | VC | EC | C | EC | VC | EC |
| POZEGA | N | W | W | W | W | N | N | C | VC | N | N | N | C | EC | EC | VC | EC | VC | EC |
| ZLAWIBOR | N | W | W | N | N | N | VC | C | N | N | N | N | VC | EC | EC | EC | EC | EC | EC |
| CUPRIJA | N | W | W | W | N | N | C | VC | VC | N | N | N | C | VC | EC | EC | EC | C | EC |
| KRUSEVAC | N | W | W | W | N | N | C | VC | VC | C | C | N | C | VC | EC | VC | EC | VC | EC |
| NEGOWIN | N | EW | EW | W | N | N | N | N | C | N | N | W | C | VC | VC | VC | EC | VC | VC |
| ZAJECAR | N | EW | N | N | N | C | C | C | C | N | N | N | C | VC | VC | VC | VC | VC | EC |
| CRNI VRN | N | W | N | N | N | C | C | N | N | N | N | N | EC | EC | EC | EC | EC | VC | VC |
| KOPAONIK | N | N | N | C | C | VC | VC | C | N | N | N | C | EC | EC | EC | EC | EC | VC | VC |
| SJENICA | N | W | N | N | N | N | C | EC | VC | C | N | N | C | VC | EC | VC | EC | VC | EC |
| NIS | N | N | W | N | N | N | C | VC | VC | N | N | N | C | VC | EC | VC | EC | VC | EC |
| VRANJE | N | W | W | N | N | N | C | VC | VC | C | N | N | C | VC | EC | VC | VC | VC | EC |
| DIMIWROVGRAD | N | W | VW | N | N | N | N | VC | VC | N | N | N | C | VC | VC | VC | EC | EC | EC |
| LESKOVAC | N | N | W | W | N | N | C | VC | VC | C | N | N | C | VC | EC | VC | VC | VC | EC |
| KURSUMLIJA | N | W | W | N | N | N | C | VC | VC | N | N | N | C | VC | EC | C | VC | VC | EC |
| B.KARLOVAC | N | W | N | N | N | C | C | C | C | N | N | N | C | VC | EC | EC | EC | VC | EC |

| | |
|---|---|
| EW | EXTREMELY WARM |
| VW | VERY WARM |
| W | WARM |
| N | NORMAL |
| C | COLD |
| VC | VERY COLD |
| EC | EXTREMELY COLD |

The ten most intense cold waves on record in Belgrade from 1980 up-to-date are shown in Figure 3. Belgrade observed total of 120 cold waves from 1890, out of which cold wave that affected Serbia from 6 to 12 January ranks as 89th. The longest and coldest cold wave on record was observed in winter of 1892/93, characterized by the lowest air temperature of -26.2°C, while the cold wave of 2012 ranks as the eight coldest.
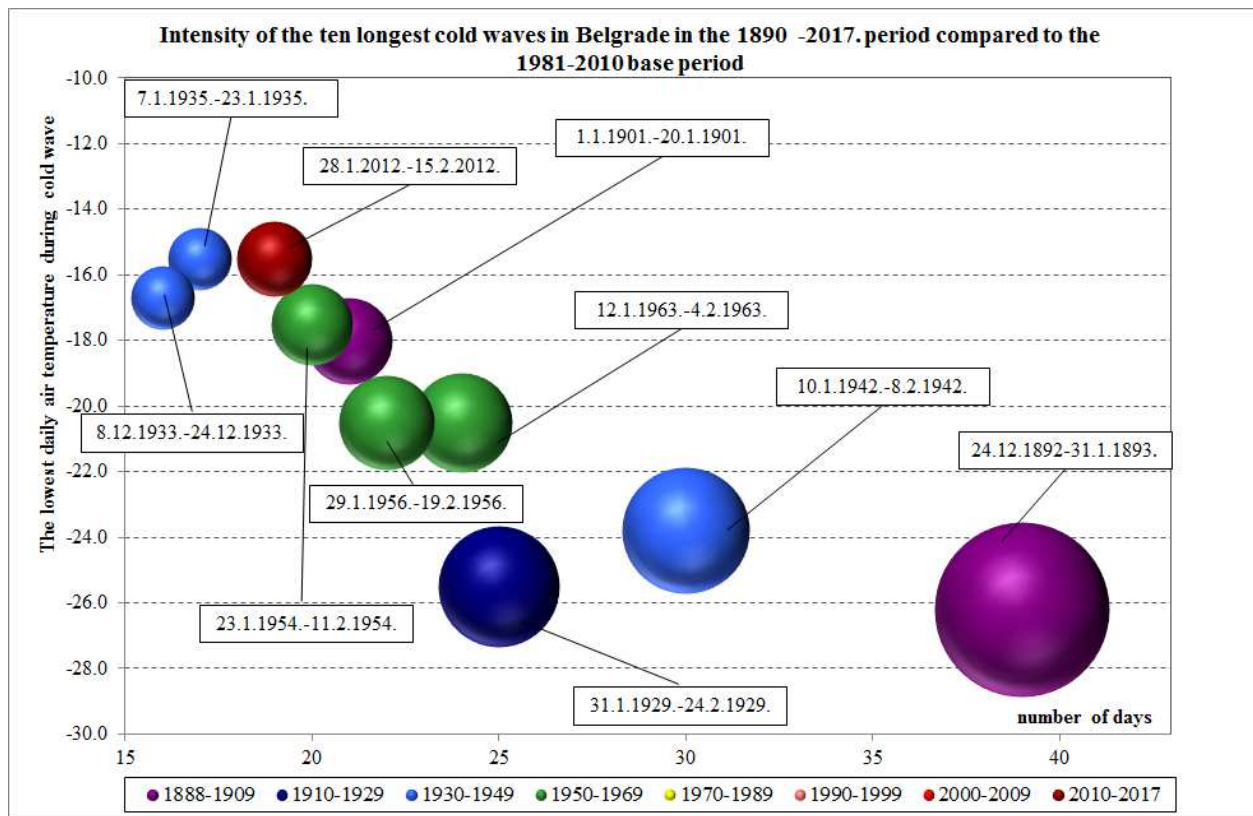
Figure 3.

The ten most intense cold waves at Kopaonik in the period from 1967 up to date are shown in Figure 4. The longest cold wave was recorded in the period from 12 to 25 February 1985, and the lowest air temperature of -24.8°C was observed during the cold wave lasting from 3 to 15 January 1968.

The analysis of the cold wave in Serbia was done on the basis of the Climate Index CSDI (Cold Spell Duration Indicator) presenting the total number of days with the minimum daily air temperature below 10th percentile, at least 6 consecutive days. Analysis exhibits that there is no statistically significant trend in terms of cold wave duration in most of Serbia.
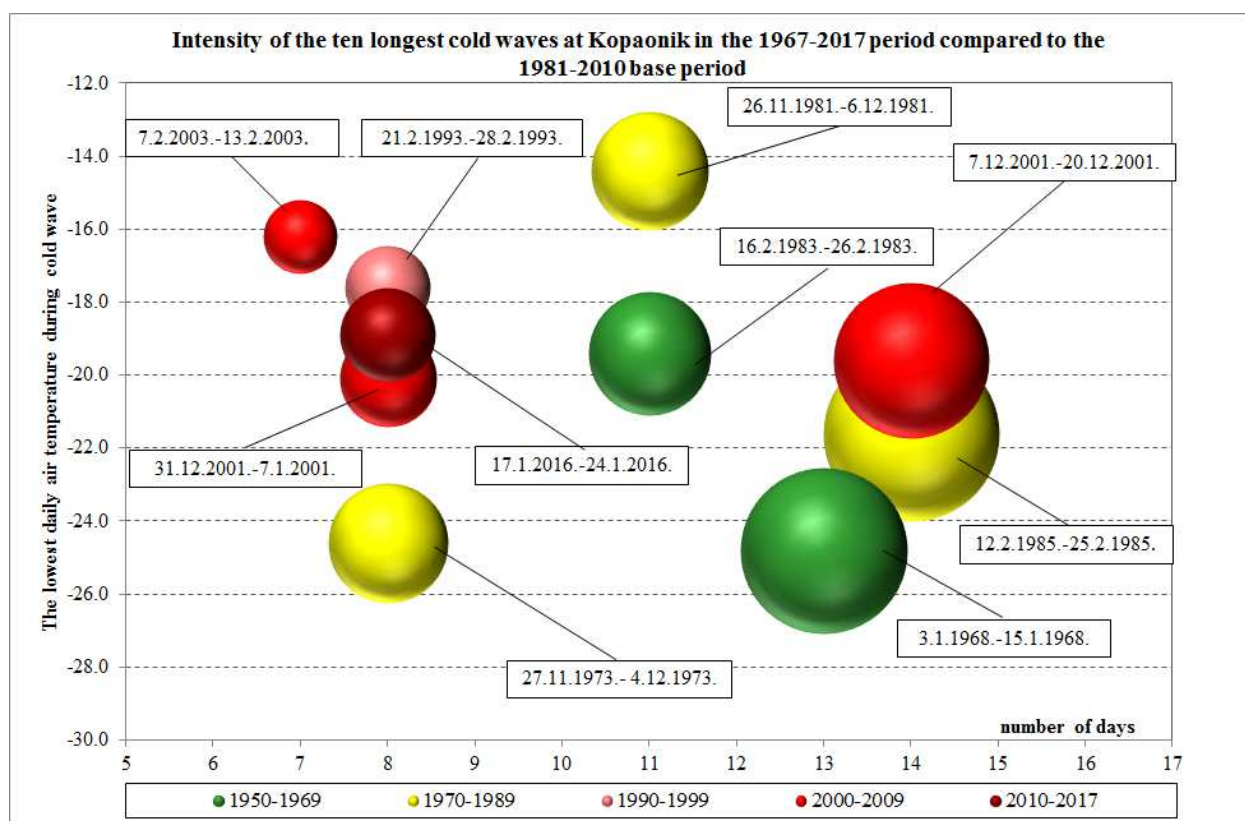
Figure 4.

Cold wave with the duration of 7 days, which was observed in Sjenica in the first decade of January, ranks as the 26th out of 64 cold waves in the 1950-2017 period.

Cold wave recorded in Leskovac during winter 2016/17, with the duration of 7 days, ranks as the 17th, out of 30 cold waves in the 1961-2017 period.
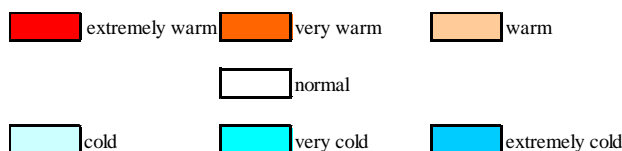
In the period from 1 to 12 January 2017, the lowest daily air temperature of -27.6°C was measured in Sjenica on January 8, while the historical minimum of -38°C was observed on January 26, 1954. The lowest daily air temperature of -24.7°C was measured at Kopaonik on January 8, whereas the lowest air temperature on record since the measurements began was recorded on January 25, 1954 measuring -26.6°C.

As for the lowland, the lowest air temperature of -25.2°C was measured in Leskovac, whereas the historical minimum of -30.5°C was observed on January 25, 1963. On January 8, Belgrade observed the minimum daily air temperature of -14.6°C and the lowest air temperature on record was measured on January 10, 1893 measuring -26.2°C. Minimum air temperature in January wasn't exceeded on any stations, but only daily minimum air temperature on January 8 at 11 stations (Sombor, Banatski Karlovac, Loznica, Cuprija, Zlatibor, Kopaonik, Crni Vrh, Nis, Vranje, Leskovac and Kursmulija).

Chart 2 shows minimum and maximum daily air temperatures for the period 5-12 January 2017.

Chart 2.

| MINIMUM DAILY AIR TEMPERATURE DURING COLD WAVE IN SERBIA FOR THE PERIOD 5 - 12 JANUARY 2017 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| station/day | JANUARY | | | | | | | |
| | 5.1.2017. | 6.1.2017. | 7.1.2017. | 8.1.2017. | 9.1.2017. | 10.1.2017. | 11.1.2017. | 12.1.2017. |
| PALIC | -3.6 | -10.7 | -14.6 | -17.0 | -12.4 | -16.6 | -10.6 | -12.8 |
| SOMBOR | -3.5 | -11.4 | -14.0 | -22.8 | -13.0 | -20.5 | -13.6 | -16.6 |
| KIKINDA | -3.2 | -11.4 | -14.1 | -18.1 | -10.7 | -15.5 | -10.9 | -13.2 |
| ZRENJANIN | -3.3 | -11.2 | -14.5 | -18.8 | -13.2 | -17.4 | -11.3 | -13.5 |
| NOVI SAD | -2.7 | -13.8 | -16.1 | -18.2 | -14.8 | -19.4 | -13.0 | -16.3 |
| SR.MITROVICA | -2.6 | -10.4 | -15.1 | -18.6 | -16.0 | -17.0 | -18.0 | -19.0 |
| BELGRADE | -1.2 | -9.3 | -12.2 | -14.6 | -10.2 | -13.1 | -10.0 | -11.0 |
| LOZNICA | -1.9 | -7.9 | -13.2 | -16.3 | -11.5 | -14.6 | -12.6 | -15.7 |
| VALJEVO | -1.8 | -8.9 | -13.4 | -16.9 | -10.1 | -18.8 | -14.7 | -18.1 |
| V.GRADISTE | -1.0 | -9.7 | -14.8 | -17.5 | -16.9 | -20.0 | -9.5 | -17.5 |
| SM.PALANKA | -2.6 | -10.0 | -14.0 | -19.1 | -15.9 | -22.9 | -19.1 | -21.0 |
| KRAGUJEVAC | -1.2 | -9.6 | -14.4 | -19.0 | -14.6 | -19.7 | -14.6 | -17.0 |
| KRALJEVO | -2.4 | -9.3 | -13.4 | -17.5 | -11.5 | -16.7 | -14.1 | -19.6 |
| POZEGA | -2.2 | -9.3 | -19.5 | -23.0 | -15.8 | -19.7 | -18.4 | -21.6 |
| ZLATIBOR | -7.7 | -14.6 | -19.4 | -21.4 | -17.8 | -18.2 | -18.4 | -16.7 |
| CUPRIJA | -1.5 | -9.2 | -14.0 | -20.9 | -17.3 | -22.4 | -10.4 | -18.2 |
| KRUSEVAC | -3.3 | -8.8 | -13.1 | -21.2 | -16.0 | -19.6 | -14.5 | -19.9 |
| NEGOTIN | 1.9 | -8.4 | -12.3 | -12.8 | -14.3 | -16.5 | -9.4 | -14.8 |
| ZAJECAR | -0.7 | -9.3 | -16.5 | -18.2 | -11.0 | -14.4 | -15.3 | -17.1 |
| CRNI VRH | -6.7 | -17.4 | -21.2 | -21.6 | -17.6 | -18.3 | -15.6 | -15.7 |
| KOPAONIK | -11.5 | -21.5 | -24.4 | -24.7 | -22.5 | -22.2 | -16.6 | -14.8 |
| SJENICA | -7.5 | -14.8 | -19.7 | -27.6 | -22.5 | -25.2 | -22.5 | -26.1 |
| NIS | -1.2 | -9.9 | -12.7 | -19.0 | -12.7 | -15.5 | -13.4 | -17.6 |
| VRANJE | -2.5 | -11.2 | -14.2 | -21.8 | -14.4 | -13.6 | -15.1 | -17.6 |
| DIMITROVGRAD | -1.9 | -11.4 | -15.4 | -17.4 | -14.0 | -17.1 | -18.5 | -19.4 |
| LESKOVAC | -2.5 | -10.0 | -15.6 | -25.2 | -16.4 | -17.2 | -16.8 | -20.8 |
| KURSUMLIJA | -2.1 | -10.2 | -13.3 | -23.5 | -12.4 | -15.5 | -14.8 | -19.7 |
| B.KARLOVAC | -2.1 | -10.6 | -14.0 | -16.4 | -16.3 | -19.2 | -13.0 | -14.0 |

| MAXIMUM DAILY AIR TEMPERATURE DURING COLD WAVE IN SERBIA FOR THE PERIOD 5 - 12 JANUARY 2017 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| station/day | JANUARY | | | | | | | |
| | 5.1.2017. | 6.1.2017. | 7.1.2017. | 8.1.2017. | 9.1.2017. | 10.1.2017. | 11.1.2017. | 12.1.2017. |
| PALIC | 3.3 | -2.4 | -7.3 | -5.0 | -5.2 | -6.1 | -4.0 | 4.1 |
| SOMBOR | 1.3 | -2.3 | -8.2 | -6.5 | -4.6 | -8.3 | -4.8 | 3.4 |
| KIKINDA | 2.7 | -3.2 | -8.3 | -5.3 | -4.7 | -6.4 | -5.0 | 3.6 |
| ZRENJANIN | 0.3 | -3.3 | -8.0 | -6.2 | -5.5 | -6.8 | -7.2 | 1.3 |
| NOVI SAD | 0.7 | -2.7 | -10.4 | -8.9 | -5.7 | -7.8 | -7.6 | 1.7 |
| SR.MITROVICA | -0.2 | -2.6 | -8.6 | -7.3 | -6.4 | -8.2 | -7.5 | -1.4 |
| BELGRADE | 1.3 | -1.2 | -8.9 | -7.1 | -7.0 | -7.9 | -7.1 | 1.4 |
| LOZNICA | 1.8 | -1.9 | -8.5 | -6.0 | -6.9 | -7.3 | -6.3 | 2.5 |
| VALJEVO | 2.0 | -1.8 | -8.7 | -6.8 | -7.1 | -8.6 | -5.4 | 1.0 |
| V.GRADISTE | 2.0 | 0.2 | -10.3 | -8.7 | -6.7 | -6.5 | -6.0 | -3.8 |
| SM.PALANKA | 2.0 | -0.9 | -9.0 | -7.3 | -6.6 | -7.3 | -5.5 | 0.3 |
| KRAGUJEVAC | 1.2 | -1.2 | -9.6 | -7.4 | -7.8 | -9.0 | -5.0 | 3.7 |
| KRALJEVO | 1.0 | -6.4 | -9.0 | -6.9 | -7.5 | -11.0 | -6.0 | -3.9 |
| POZEGA | 0.8 | -2.2 | -9.8 | -7.2 | -7.5 | -10.8 | -5.5 | -6.4 |
| ZLATIBOR | 0.3 | -7.7 | -14.5 | -11.5 | -13.0 | -15.0 | -9.6 | 0.3 |
| CUPRIJA | 0.9 | -0.5 | -8.9 | -8.5 | -7.8 | -8.8 | -6.2 | -0.4 |
| KRUSEVAC | 1.0 | -0.3 | -8.8 | -8.0 | -7.7 | -10.0 | -5.8 | -2.7 |
| NEGOTIN | 4.5 | 2.2 | -8.4 | -7.6 | -7.0 | -8.5 | -1.7 | 2.7 |
| ZAJECAR | 3.4 | 0.1 | -8.6 | -8.6 | -6.9 | -9.0 | -5.6 | 3.9 |
| CRNI VRH | -1.9 | -6.7 | -17.4 | -17.3 | -14.8 | -14.9 | -11.1 | -3.2 |
| KOPAONIK | -3.9 | -11.7 | -21.5 | -16.6 | -18.2 | -15.0 | -11.2 | -6.5 |
| SJENICA | 0.9 | -7.3 | -14.5 | -13.6 | -12.6 | -14.1 | -12.6 | 0.4 |
| NIS | 0.9 | -1.2 | -9.4 | -9.2 | -7.6 | -7.4 | -6.7 | -3.6 |
| VRANJE | 1.6 | -1.7 | -10.7 | -10.0 | -8.0 | -10.0 | -5.0 | -5.3 |
| DIMITROVGRAD | 0.9 | -1.7 | -11.2 | -11.7 | -8.7 | -9.7 | -8.0 | -7.2 |
| LESKOVAC | 1.5 | -1.0 | -10.8 | -10.3 | -7.0 | -9.3 | -7.6 | 0.0 |
| KURSUMLIJA | 3.7 | -2.1 | -9.4 | -8.4 | -7.8 | -10.2 | -6.7 | 2.6 |
| B.KARLOVAC | 1.1 | -2.1 | -8.9 | -7.0 | -6.9 | -8.7 | -7.3 | -2.5 |

| | | | |
|---|---|---|---|
| extremely warm | very warm | warm | |
| normal | | | |
| cold | very cold | extremely cold | |

The maximum daily air temperature for the period 6-11 January was in the domain of extremely cold across most of Serbia. The lowest maximum daily air temperature of -21.5°C was measured at Kopaonik on January 7. In the lowland, the lowest maximum daily air temperature of -11.7°C was observed in Dimitrovgrad on January 7.

Figures 5, 6, 7, 8 and 9 depict the minimum daily air temperature for Belgrade, Sombor, Sjenica Leskovac and Kopaonik.
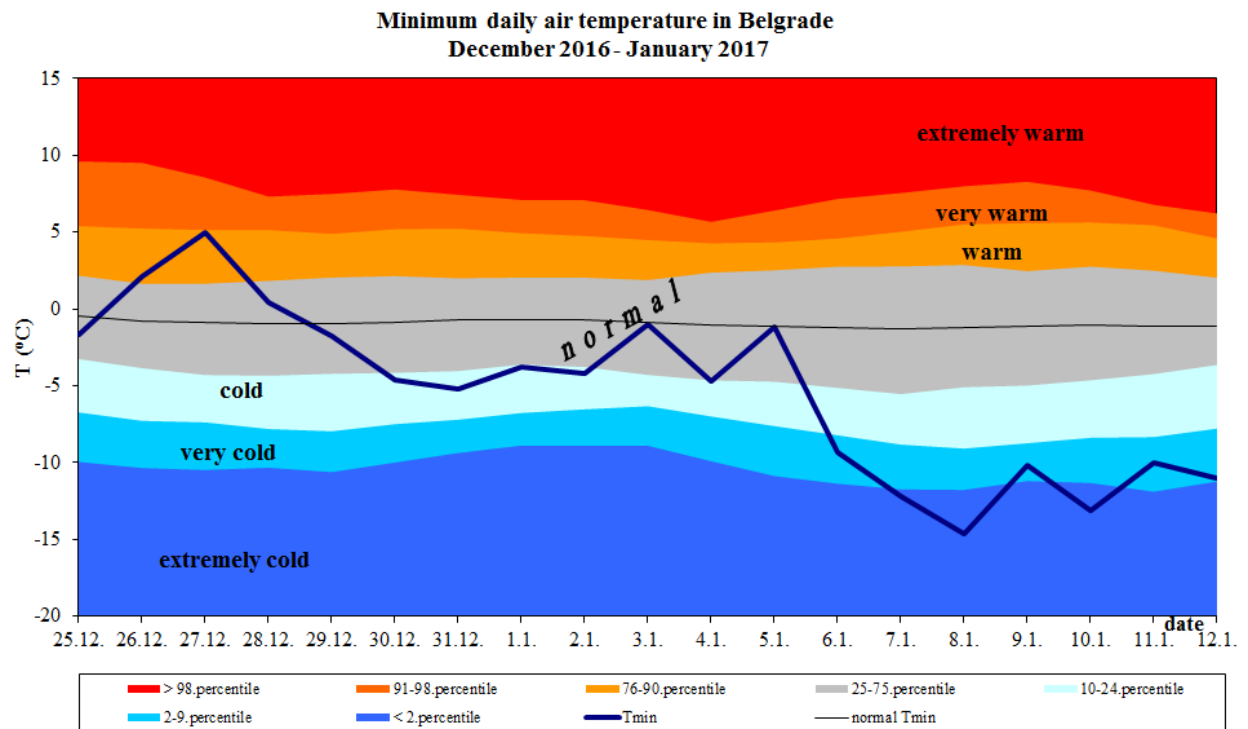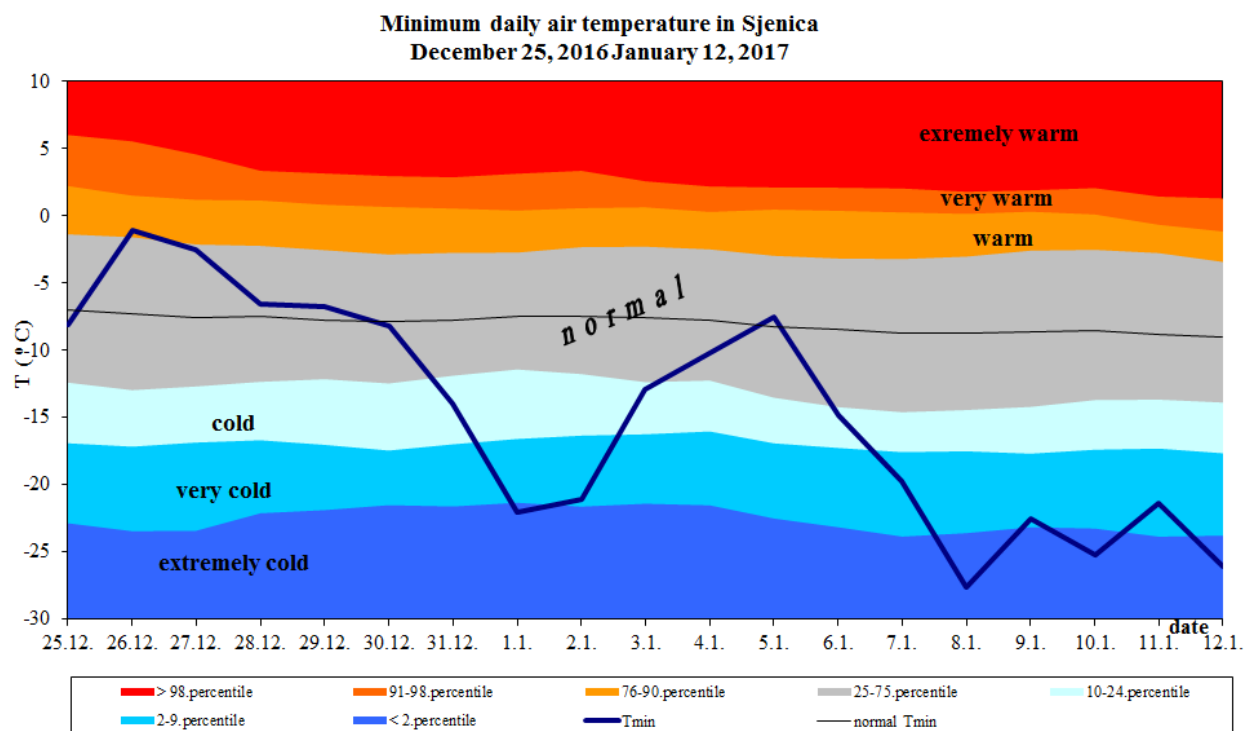
**Figure 5.** Minimum air temperature in Belgrade from 25 December 2016 to 12 January 2017 and the accompanying categories based on the percentiles
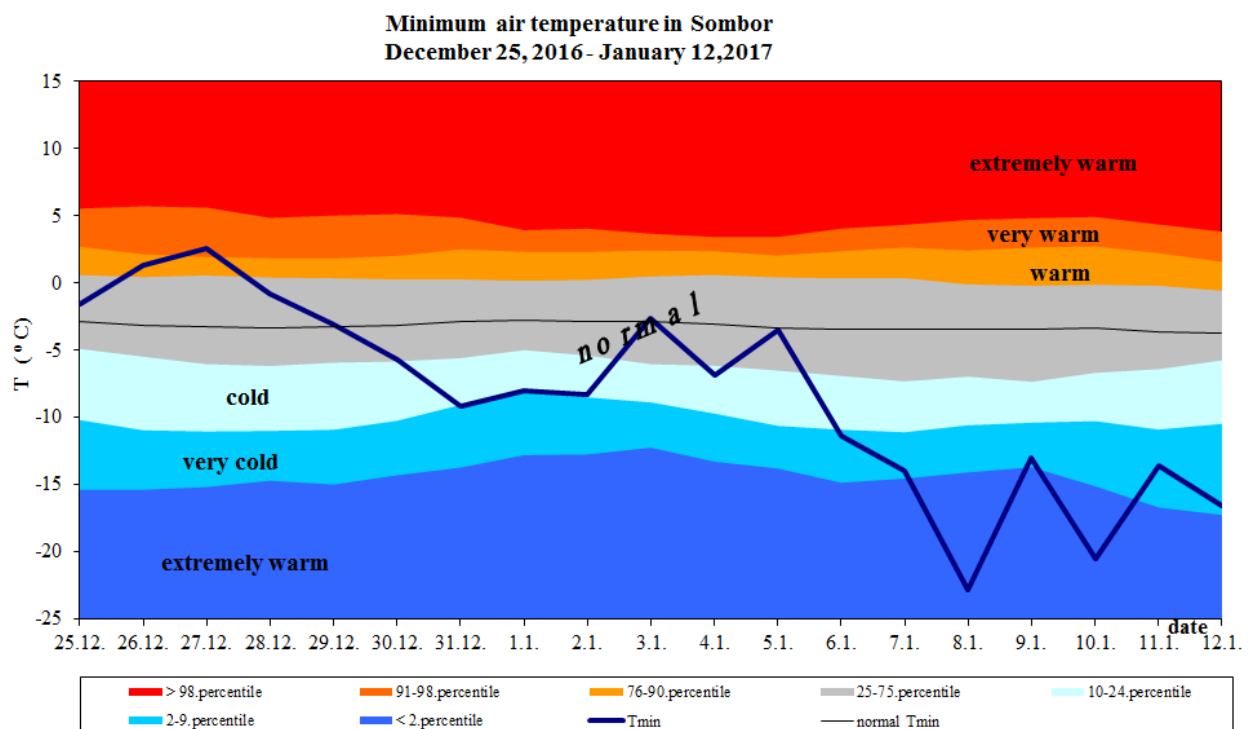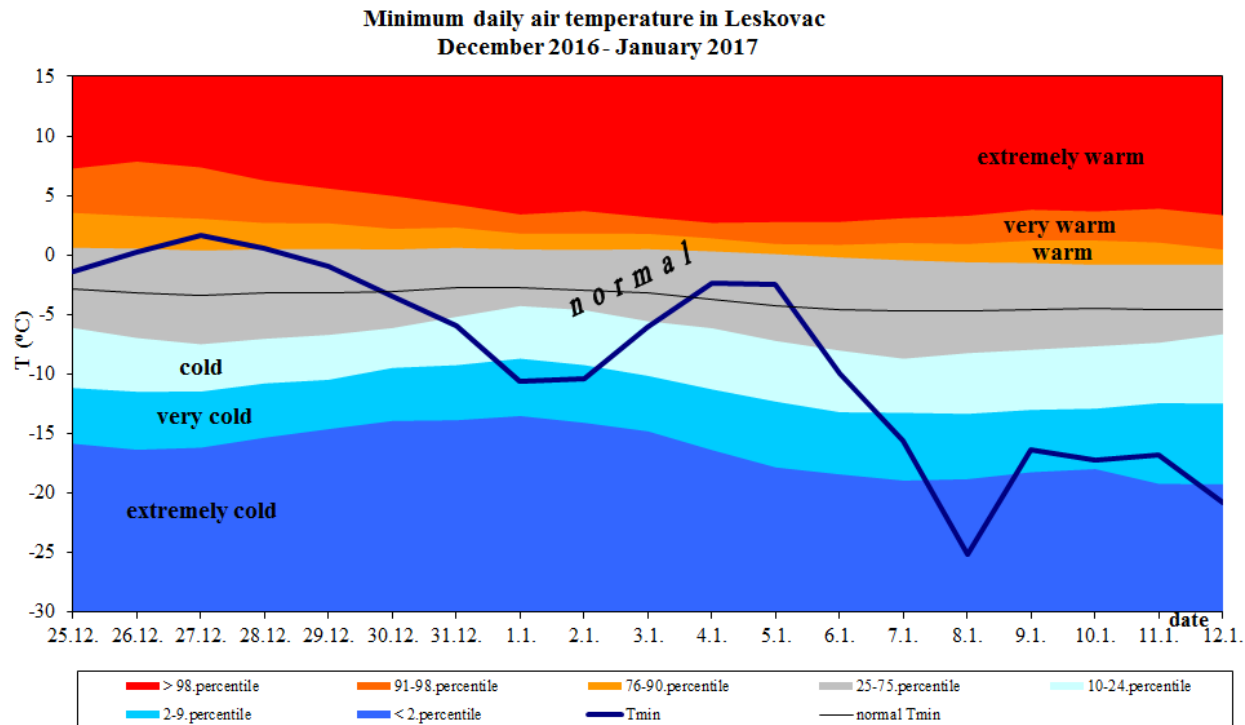


Figure 6. Minimum air temperature in Sombor from 25 December 2016 to 12 January 2017 and the accompanying categories based on the percentiles
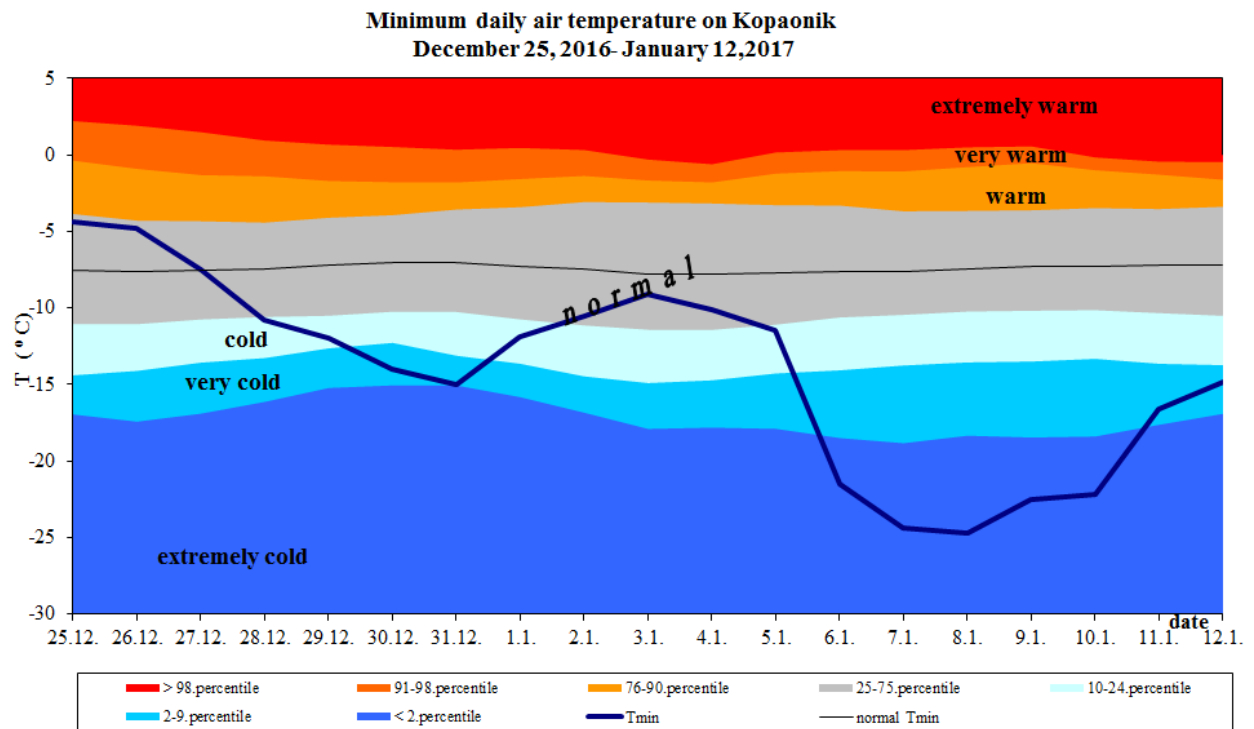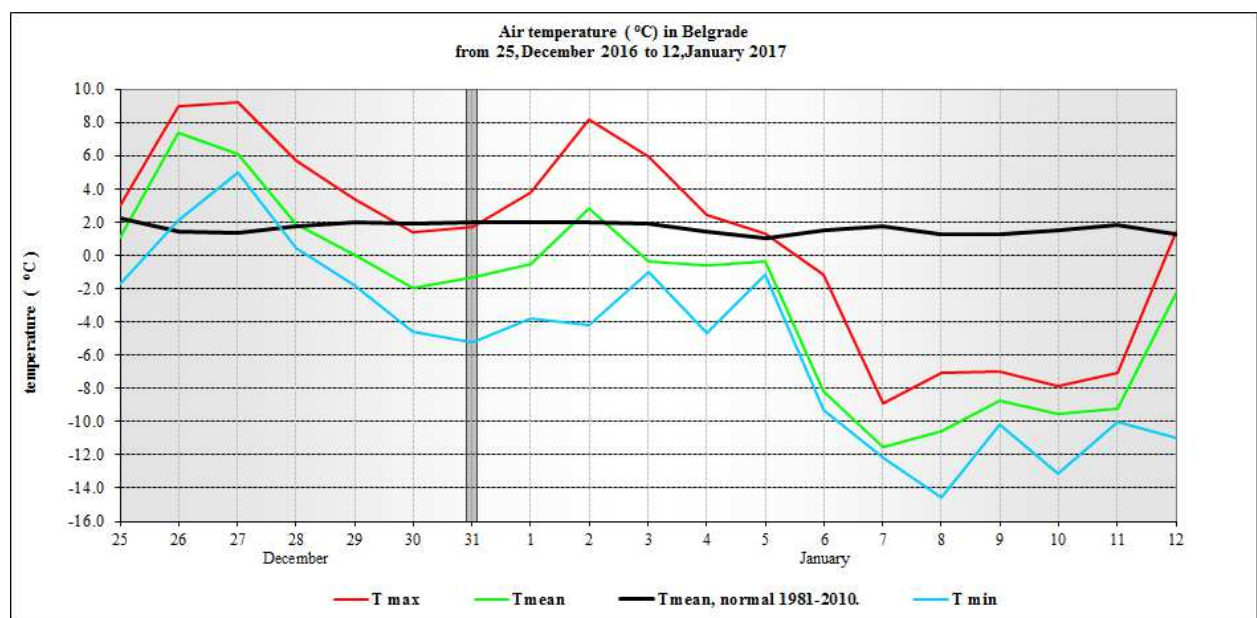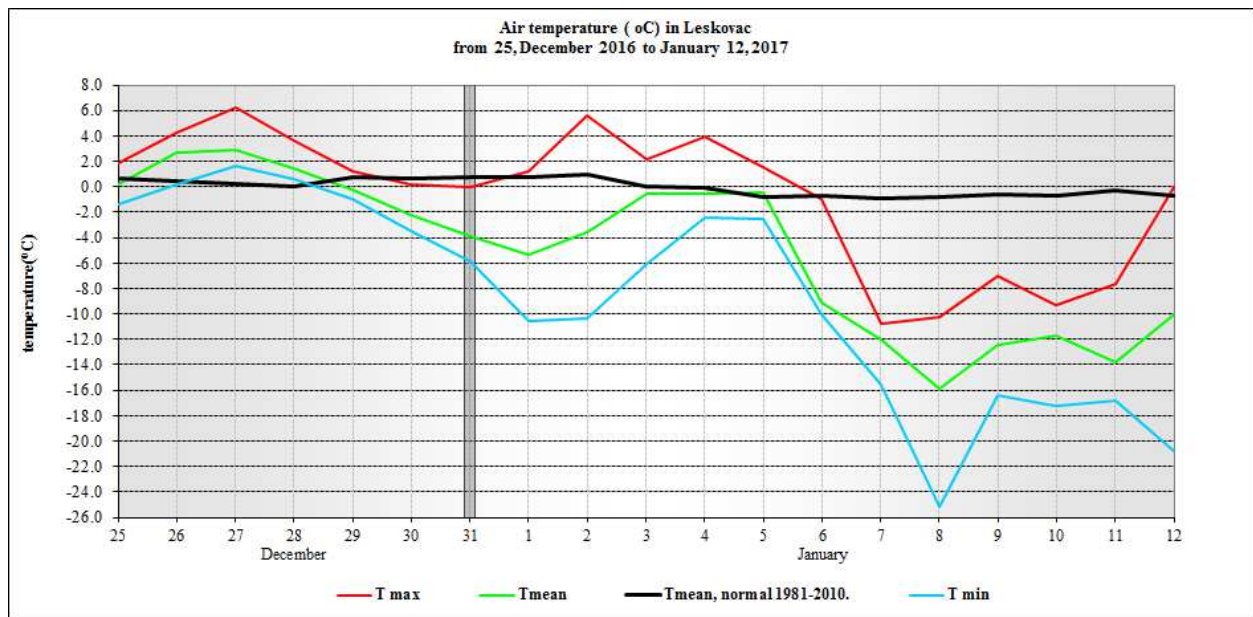
**Minimum daily air temperature in Sjenica**
**December 25, 2016 January 12, 2017**



**Figure 7.** Minimum air temperature in Sjenica from 25 December 2016 to 12 January 2017 and the accompanying categories based on the percentiles
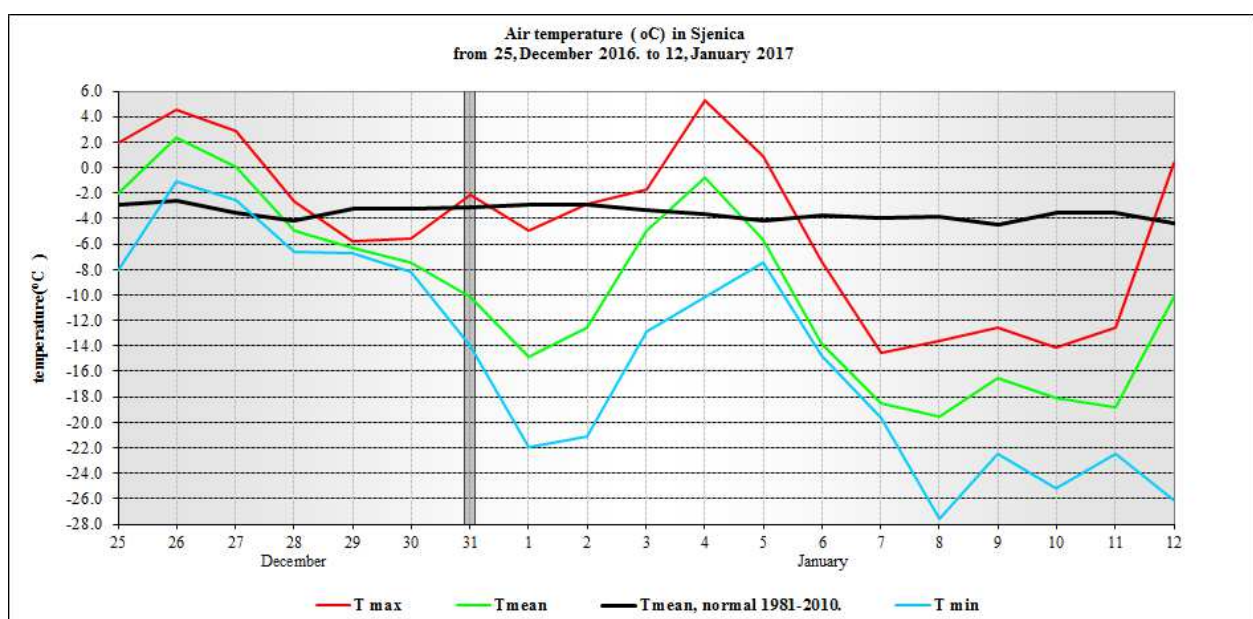
**Minimum daily air temperature in Leskovac**
**December 2016 - January 2017**



Figure 8. Minimum air temperature in Leskovac from 25 December 2016 to 12 January 2017 and the accompanying categories based on the percentiles

**Figure 9.** Minimum air temperature on Kopaonic from 25 December 2016 to 12 January 2017 and the accompanying categories based on the percentiles

Figures 10, 11 and 12 show mean, maximum and minimum daily air temperature in Belgrade, Leskovac and Sjenica.



**Figure 10.** Mean, maximum and minimum air temperature in Belgrade, for the period December 25, 2016 – January 12, 2017 compared to the 1981-2010 base period

**Figure 11.** Mean, maximum and minimum air temperature in Leskovac, for the period December 25, 2016 – January 12, 2017 compared to the 1981-2010 base period



**Figure 12.** Mean, maximum and minimum air temperature in Sjenica for the period December 25, 2016 to January 12, 2017 compared to the 1981-2010 base period

**Biometeorological conditions:** due to the combination of wind and very low minimum daily air temperatures, wind chill was additionally aggravated for human body, making it feel up to 10°C colder than the real temperature is (Figure 13).

Wind chill Index (Wind chill Index – WCI) refers to the measure of relative discomfort due to the loss of body warmth in specific combinations of extremely low air temperatures and wind speed (WMO No.182 Internat. Meteorolog. Vocabulary), showing probability of the occurrence of frostbite, freezing and other acute symptoms of body stress. WCI is done in the period from December to February.

| Wind chill | Exposure risk | Health concerns | What to do |
|---|---|---|---|
| -10 to -27 | **Moderate risk** | • Uncomfortable<br>• Risk of hypothermia and frostbite if outside for long periods without adequate protection | • Dress in layers of warm clothing, outer layer that is wind-resistant<br>• Wear a hat, mittens, scarf and waterproof footwear<br>• Stay dry<br>• Keep active |
| -28 to -39 | **High risk**<br>Exposed skin can freeze in 10 to 30 minutes | • High risk of frostbite: check face and extremities for numbness and whiteness<br>• High risk of hypothermia if outside for long periods without adequate clothing or shelter from wind and cold | • Dress in layers of warm clothing, outer layer that is wind-resistant<br>• Cover exposed skin<br>• Wear a hat, mittens, scarf, neck tube, or face mask and waterproof footwear<br>• Stay dry<br>• Stay active |
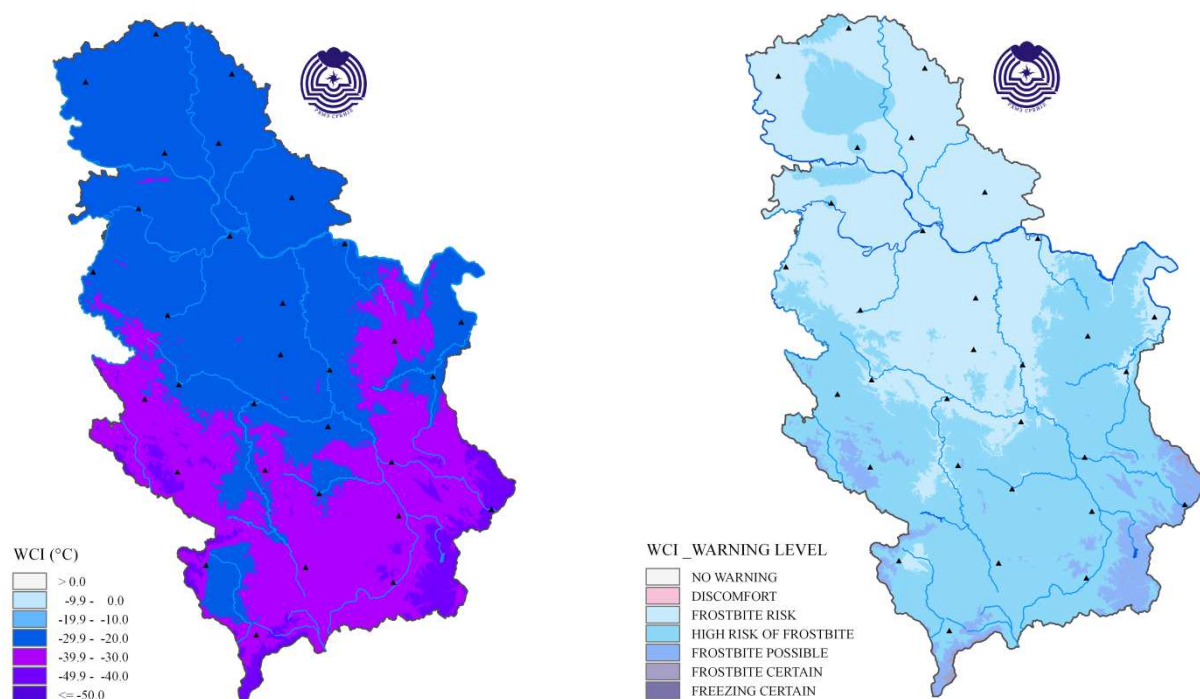


Figure 13. Spatial distribution of the minimum value of WCI Index for 8 January 2017 (left) and warning level (right)

During the cold wave, at the main meteorological stations in Serbia snow depth ranged from 37cm observed in Dimitrovgrad on January 7 up to 60cm at Kopaonik on January 11, 2017. Belgrade observed 20cm of snow cover on January 11. On the basis of the detailed analysis of the snow depth at the climatological and precipitation stations, it can be concluded that the greatest snow depth of 120cm was measured at RS Kukavica, on January 7, followed by 97 cm in Barelic (MMS Vranje), observed on January 11 and 12. Figure 14 depicts spatial distribution of snow depth in Serbia for January 10, 2017.
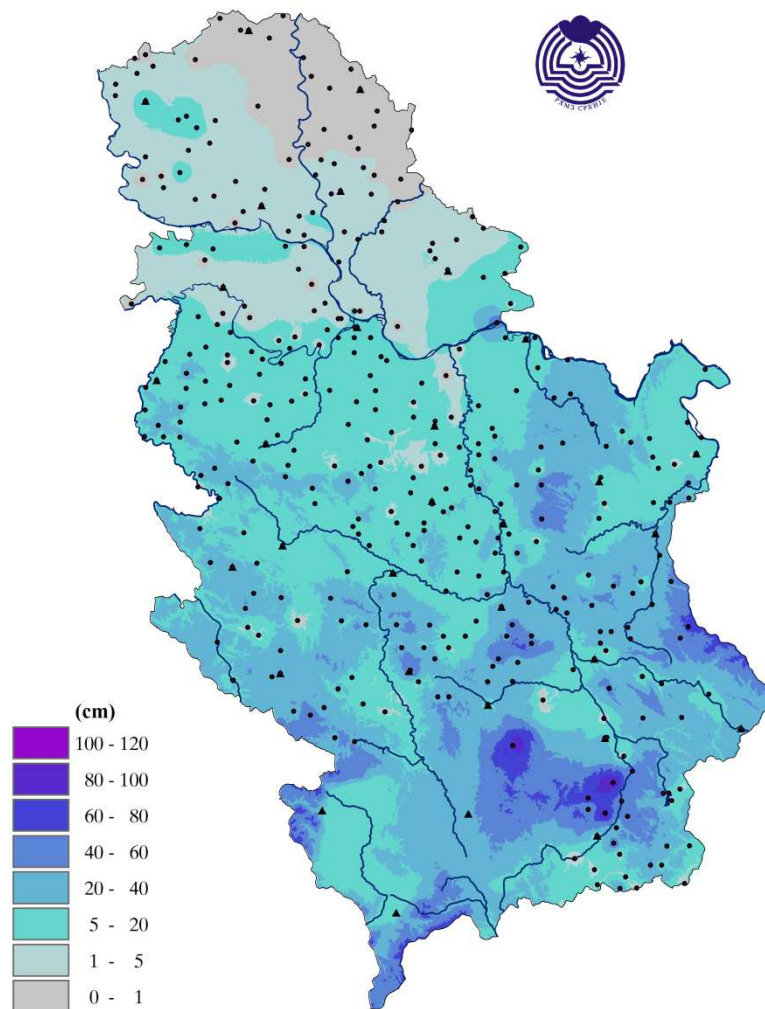
Figure 14. Spatial distribution of the maximum snow depth in Serbia on January 10, 2017 based on the data obtained from 28 MMS, 51 climatological and 315 precipitation stations