III. METEOROLOGICAL AND DISPERSION CONDITIONS

Apart from the respective air pollution sources, air quality is significantly affected by meteorological conditions. These conditions enable the aerial dispersion of polluting substances, influence the amount of emissions from anthropogenic or natural sources, resuspension, and affect the formation of secondary pollutants as well as their removal rate from the air. The basic meteorological variables influencing the aerial dispersion of pollutants include air temperature, wind speed and the stability of the boundary layer of the atmosphere. One of the ways in which dispersion conditions can be expressed numerically is in terms of the ventilation index (VI), which is defined as the product of the mixing layer depth and the average air flow velocity in it [1]. However, situations with poor dispersion conditions do not necessarily lead to the occurrence of high pollution concentrations. Important factors include the duration of the situation, the starting level of pollution, distribution of sources, and emissions to the layer under an inversion (Škáchová 2020). The effect of meteorological conditions on anthropogenic emissions from heating is determined on the basis of a calculation of heating days and temperatures that occurred during these days. Temperature conditions in the heating season (January–May, September–December) or parts thereof are characterized in terms of degree-days, i.e. the sum of the differences in reference indoor temperatures and the average daily outdoor temperatures on heating days. A more detailed specification of the influence of meteorological conditions on air quality is given in (CHMI 2021d).

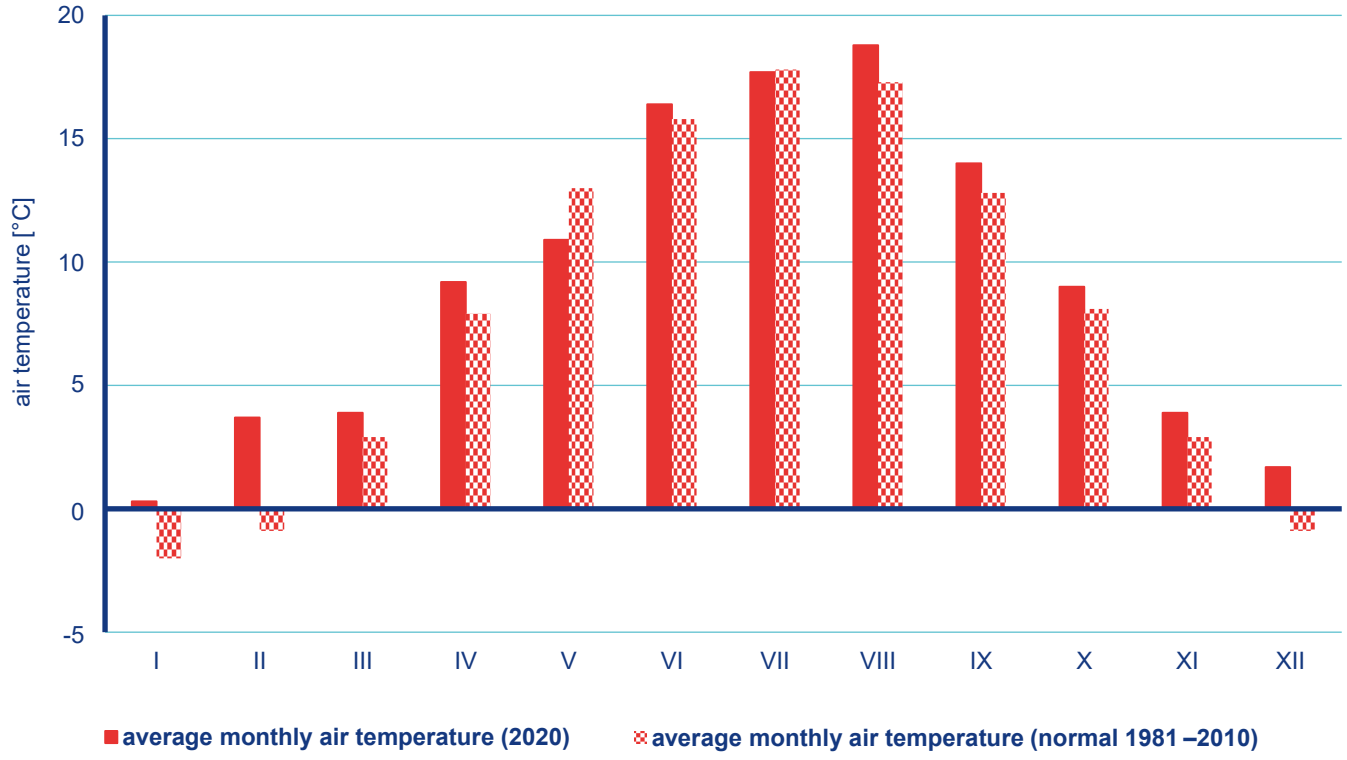

Fig. III.1 Average monthly air temperature in 2019 compared to the normal of 1981–2010

1 The mixing layer is understood as the layer of the atmosphere between the Earth's surface and the lower boundary of the lowest temperature retention layer.

Meteorological and dispersion conditions in 2020

In terms of temperature, the year 2020 was highly above normal with the average annual temperature of 9.1 °C being 1.2 °C above the normal of 1981–2010. Together with 2000 and 2007, the past year ranges as fifth to seventh warmest since 1961. During the year, there were only two months with a negative deviation from the normal of 1981–2010, namely May (-2.1 °C) which is assessed as strongly below normal, and July (-0.1 °C) which is assessed as temperature normal. Other temperature-normal months were March (deviation +1.0 °C), June (+0.6 °C), October (+0.9 °C) and November (+1.0 °C). The months of January (+2.3 °C), April (+1.3 °C), August (+1.5 °C), September (+1.2 °C) and December (+2.6 °C) were classified as above normal. The most significant deviation from normal was in February (+4.6 °C) which is rated as extremely above normal. With an average monthly temperature of 3.7 °C, it is, together with 1966, the warmest February since 1961 (Fig. III.1).

In view of precipitation over the territory of the Czech Republic (CR), the year 2020 was above normal. The average total annual precipitation of 766 mm corresponds to 112% of the normal of 1981–2010 and ranges as tenth highest annual total precipitation observed since 1961. The high precipitation total was mainly due to the extremely above-normal June with a precipitation total of 152 mm (192% of normal). The months of February (205% of

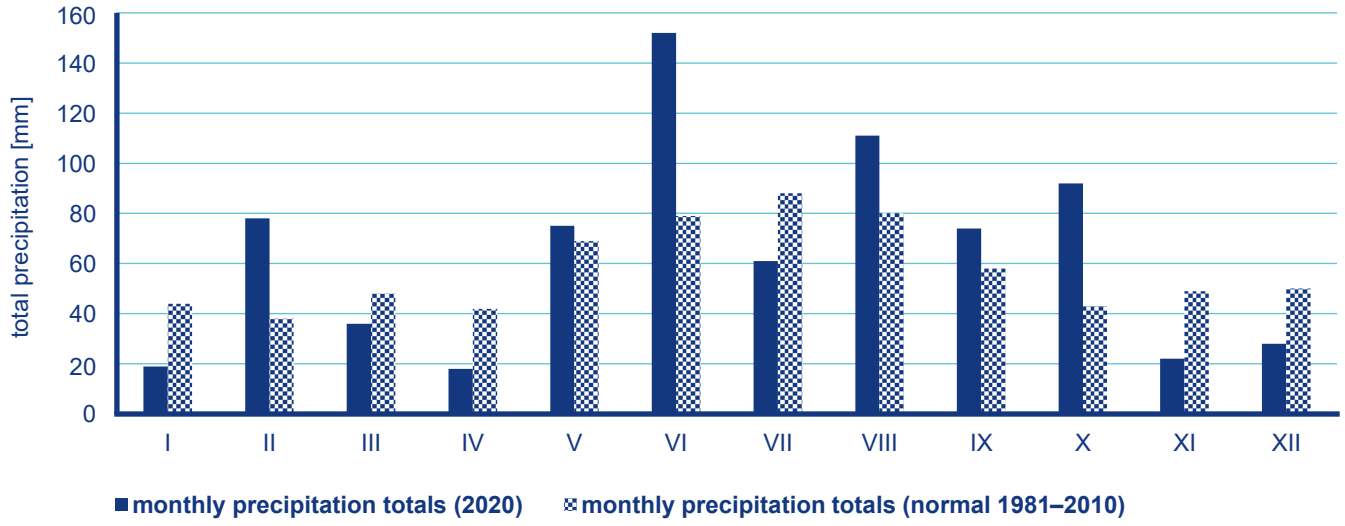

Fig. III.2 Monthly precipitation totals compared to the normal of 1981–2010

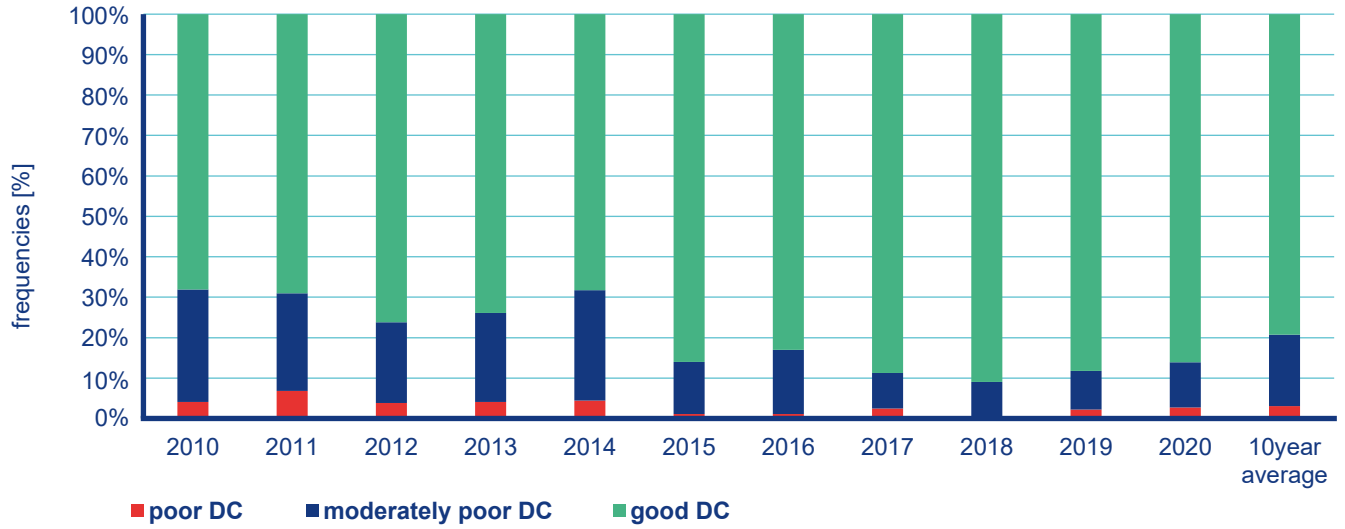

Fig. III.3 Frequency of occurrence of dispersion conditions (DC), 2010–2020

normal) and October (214% of normal) were classified as strongly above normal. The months of August (139% of normal) and September (128% of normal) were assessed as above normal. During the year, there were 3 months classified as strongly below normal in terms of precipitation, namely January (43% of normal), April (43% of normal) and November (45% of normal). Precipitation totals in July (69% of normal) and December (56% of normal) were below normal, the months of March (75% of normal) and May (109% of normal) were normal in terms of precipitation (Fig. III.2).

In 2020, dispersion conditions were standard compared to the ten-year average of 2009–2019 (Fig. III.3). Good dispersion conditions, expressed by the ventilation index for the whole of the CR, were observed in 315 days (86%) in 2020. Compared to the ten-year average (79%), this is an improvement by 7%. Moderately poor dispersion conditions occurred in 41 days (11%), and poor dispersion conditions in 10 days (3%) in 2020.

During the year, good dispersion conditions occurred the most in May (100%), the least in November (53%) (Fig. III.4). Poor dispersion conditions were observed in January (13%), and November and December (10%). Compared to the ten-year average, four months were classified as standard in 2020, namely January, April, September, and December (Fig. III.5). Six months were characterized as months with improved dispersion conditions, namely March, May, June, July, August, and October. February then becomes a month with significantly improved dispersion condi-

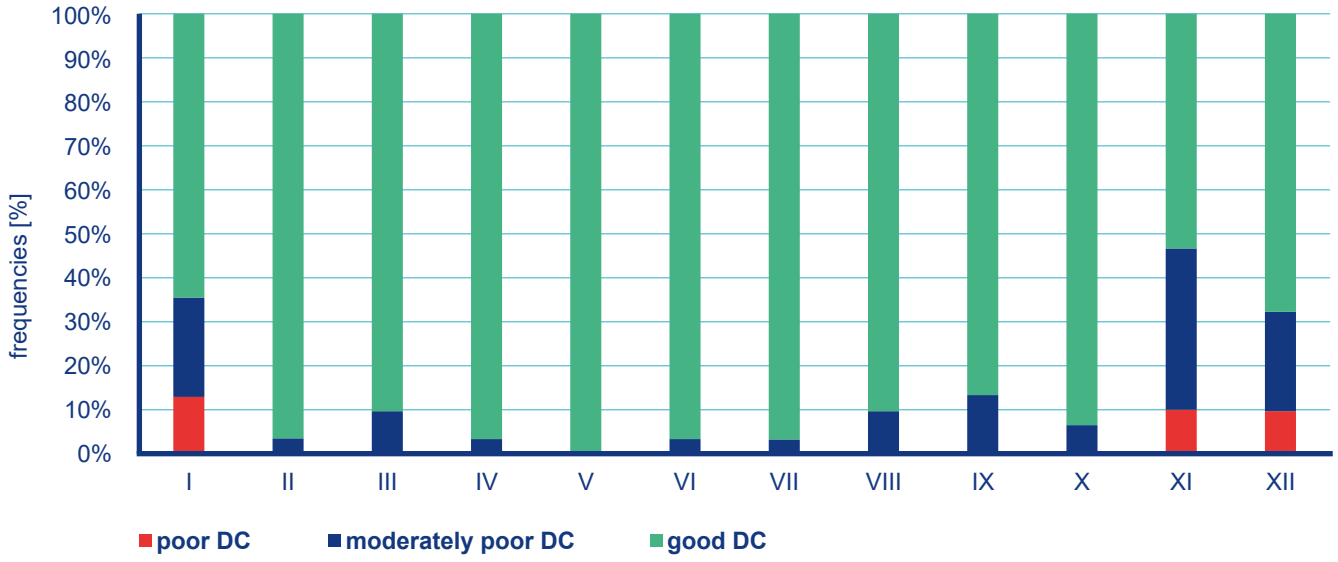

Fig. III.4 Frequency of occurrence of dispersion conditions (DC) by months, 2020

Fig. III.5 Frequency of occurrence of dispersion conditions (DC) by months, 10-year average 2010–2019

tions. The only month with worsened dispersion conditions was November classified even as significantly worsened.

The frequency distribution of dispersion conditions differs from the national average in each region (Fig. III.6). All three types of dispersion conditions were observed in all regions. The highest percentage of good dispersion conditions occurred in the Moravian-Silesia region without the O/K/F-M agglomeration and the Liberec region (90%), the lowest percentage in the South Bohemia region (77%). On the other hand, poor conditions occurred the most in the Plzeň region (6%), and the least in the Moravian-Silesia region without the O/K/F-M agglomeration and the Liberec region (1%) (Fig. III.7).

The number of degree-days during 2020 in the CR was significantly below normal compared to the long-term average 1989–2019, with lower values reached only in 2000, 2014, 2018, and 2019. In 2014, the highest average daily temperature on heating days was also reached. (Fig. III.8). During individual months, the number of degree-days was also below the long-term average. The exception is May evaluated climatologically as strongly below normal in view of temperature (Fig. III.9). The largest decrease in the number of degree-days compared to the long-term average was recorded in February which is climatologically assessed as extremely above normal in temperature and positively influences the estimated emissions from domestic heating.

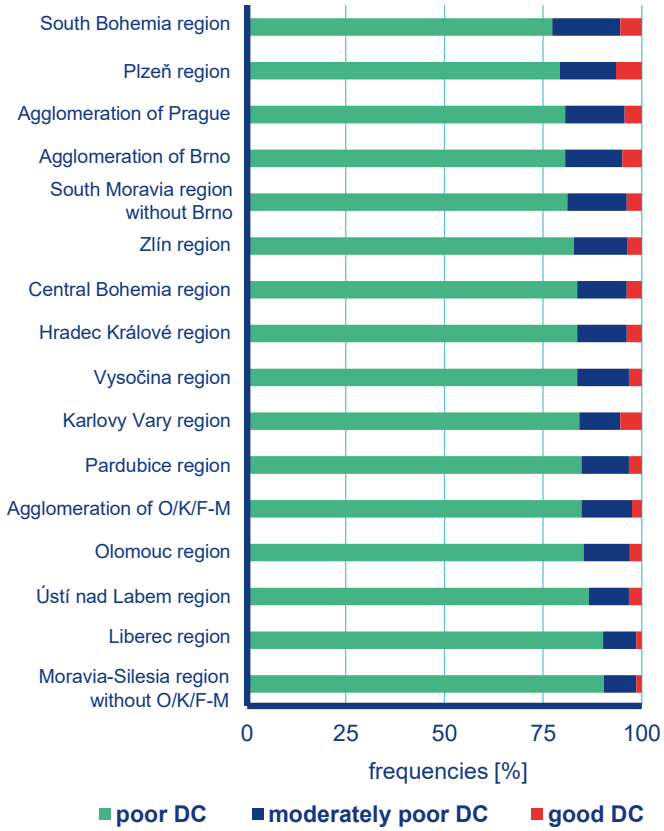

Fig. III.7 Frequency of occurrence of dispersion conditions in regions, 2020

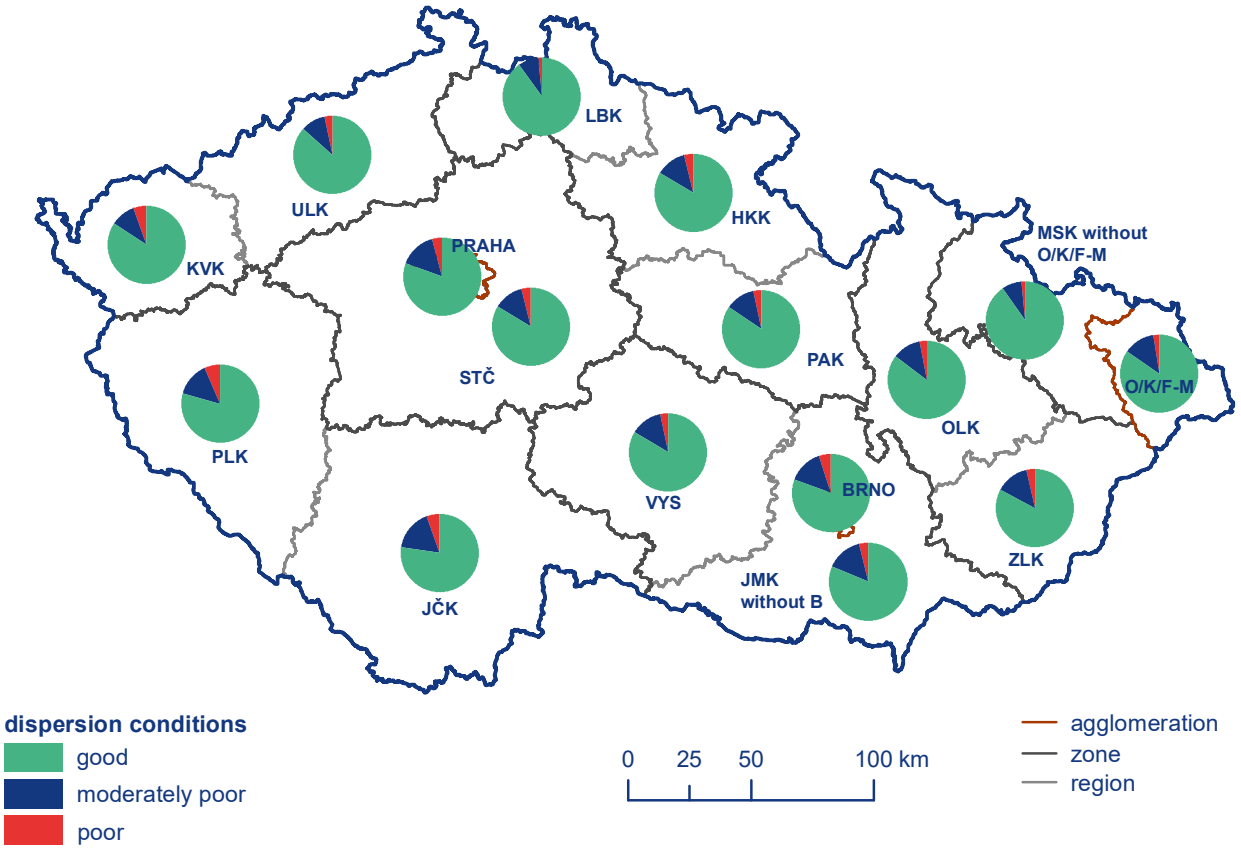

Fig. III.6 Composition of dispersion conditions in regions, 2020

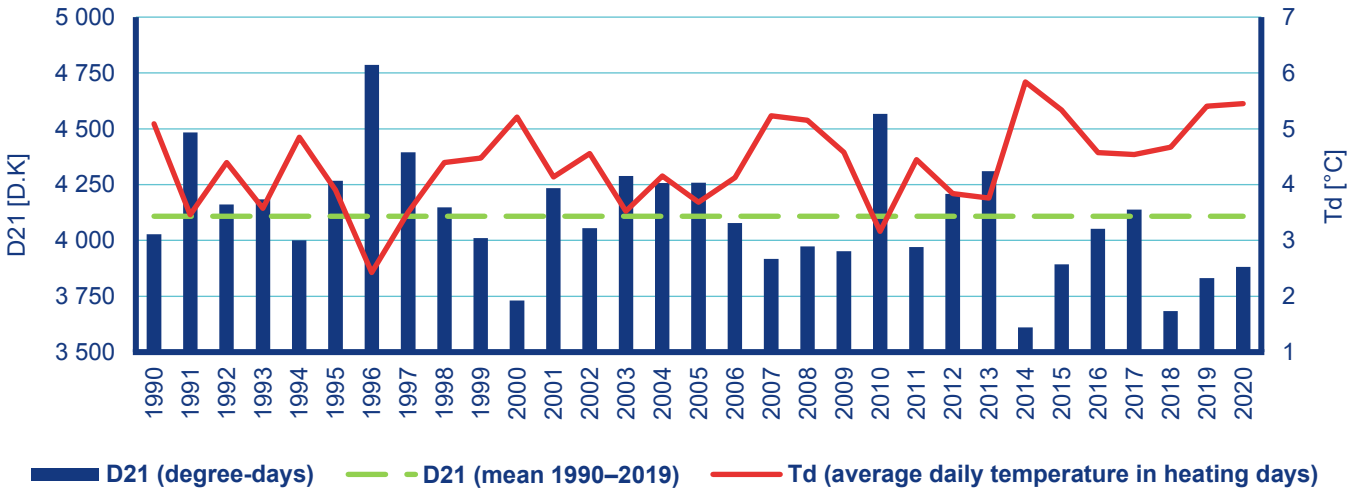

Fig. III.8 Annual heating seasons in the CR expressed as degree-days (D21) and their average for the 1990–2020 period

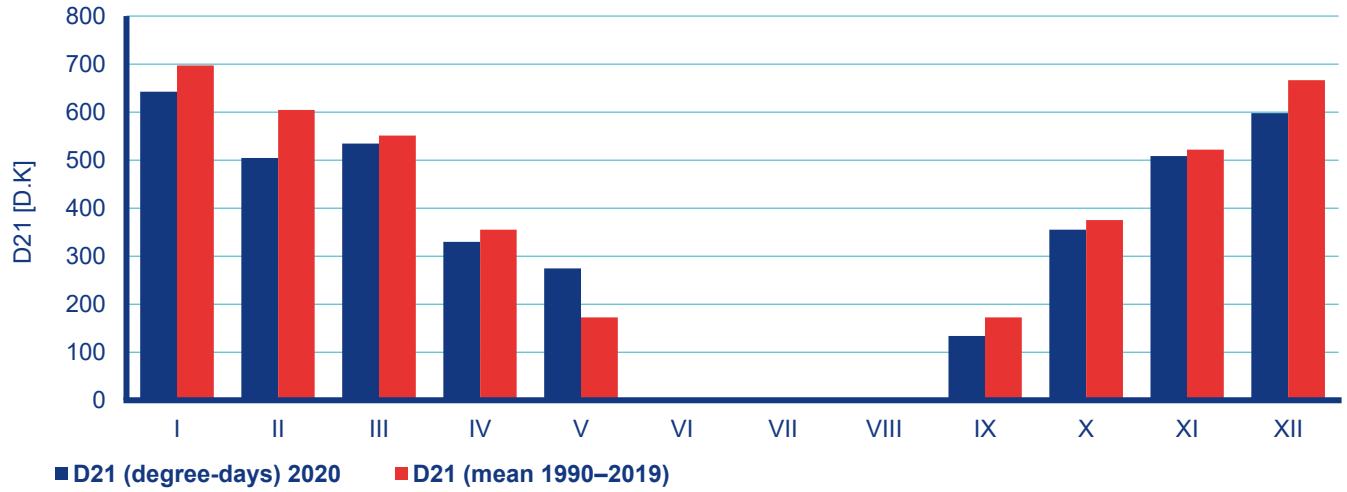

Fig. III.9 Annual variation of degree-days in the territory of the CR in the heating season 2019 (I–V, IX–XII) in comparison with the average of 1990–2020