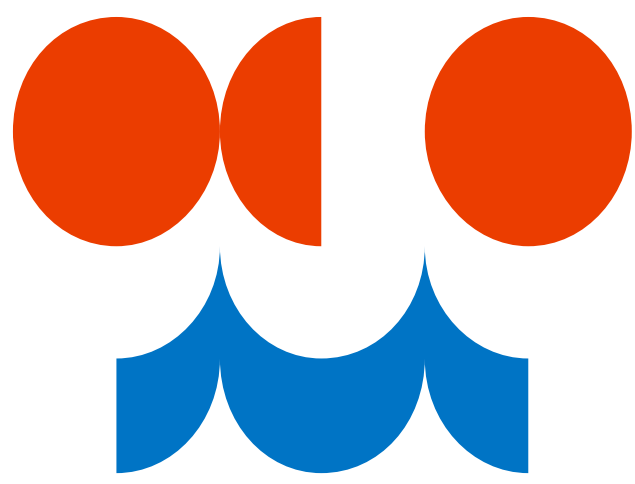


Change in duration of growing season in the period of 1951-2010 in the Czech Republic

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Introduction

Growing season is a period, when the plants can be grown, assuming sufficient water, radiation and suitable soil. For large part of Europe including the Czech Republic growing seasons are defined as periods with daily mean air temperature (TAVG) above a certain threshold. In our contribution periods with daily TAVG above 5 °C, 10 °C and 15 °C are evaluated. We focus on changes in duration of growing season between periods of 1951-1980 and 1981-2010.

Data and Methods

Data of daily (monthly) TAVG from the climatological database CLIDATA operated in the Czech Hydrometeorological Institute have been used. For the first period 1951-1980 data series from 106 stations were available, for the second period 1981-2010 from 158 stations. The length of the data series was at least 25 years.

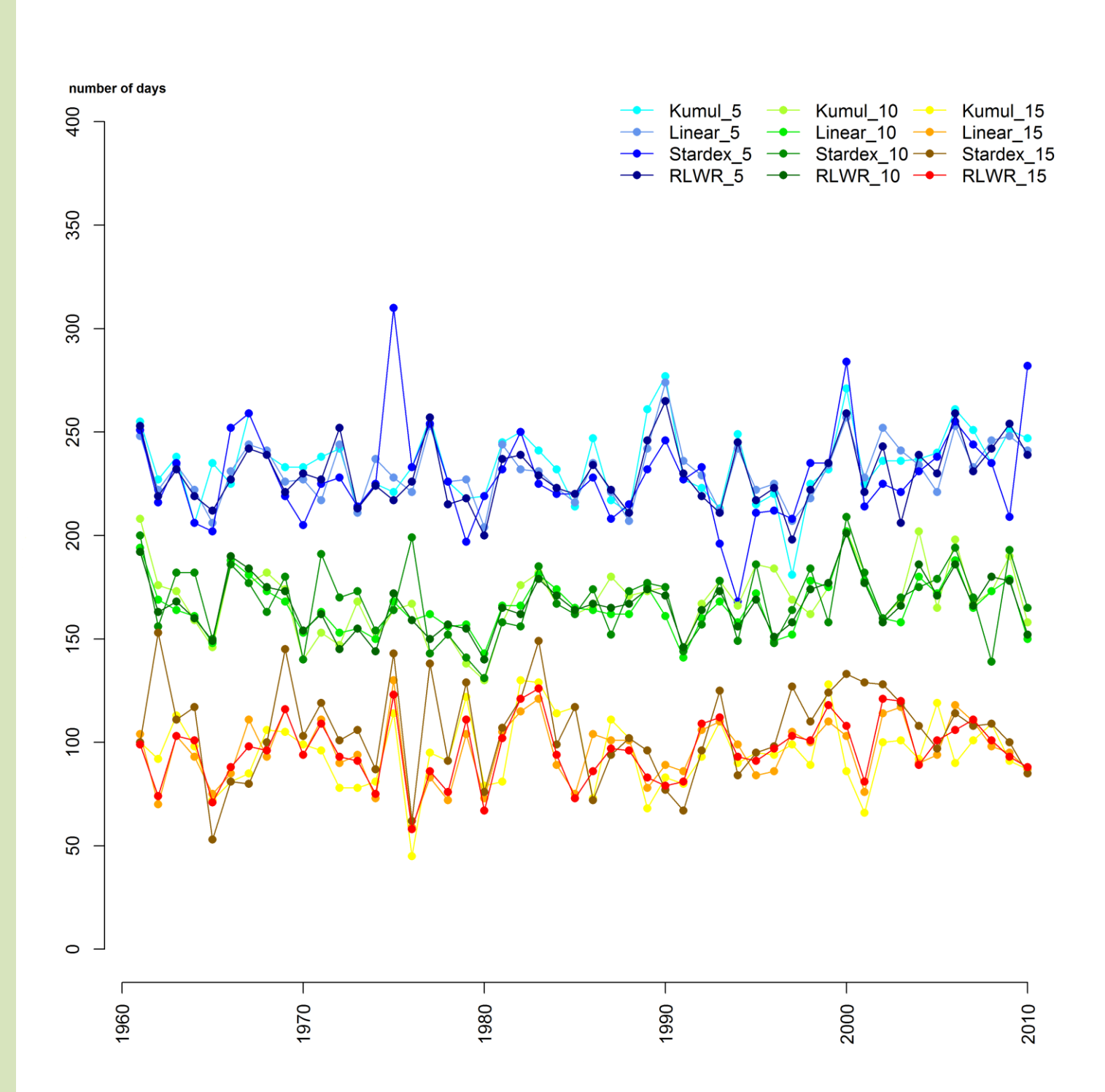
Methods used for calculation of growing season duration:

- Linear interpolation of long-term monthly TAVG (the method is based on curve fitting average annual course of air temperature)
- Robust Locally Weighted Regression (in this method the annual course is smoothed by Robust Locally Weighted Regression)
- STARDEX method (the beginning (ending) of growing season is given as occurrence of at least 6 consecutive days with TAVG above (below) defined threshold in the autumn-winter (winter -spring) (<http://www.cru.uea.ac.uk/projects/stardex>))
- Cumulative sum of series of deviations (the method is based on the determination of maximum and minimum of accumulated deviations of daily TAVG from a threshold value)

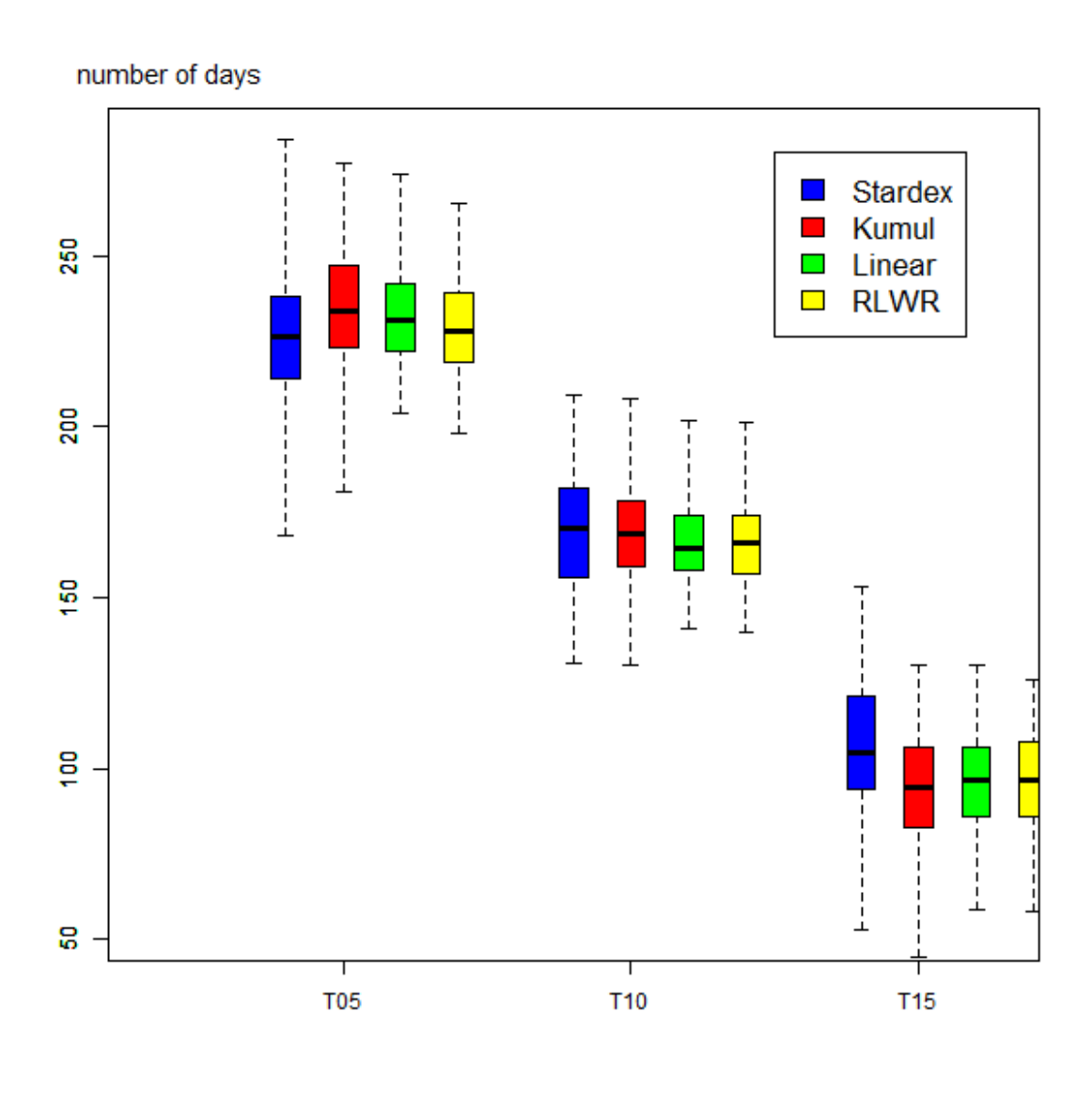
For the calculation of average duration of daily TAVG above 5 °C, 10 °C and 15 °C the linear interpolation method was used.

Comparison of Methods

For comparison of the methods the 1961-2010 TAVG data series for the station Opava have been used.



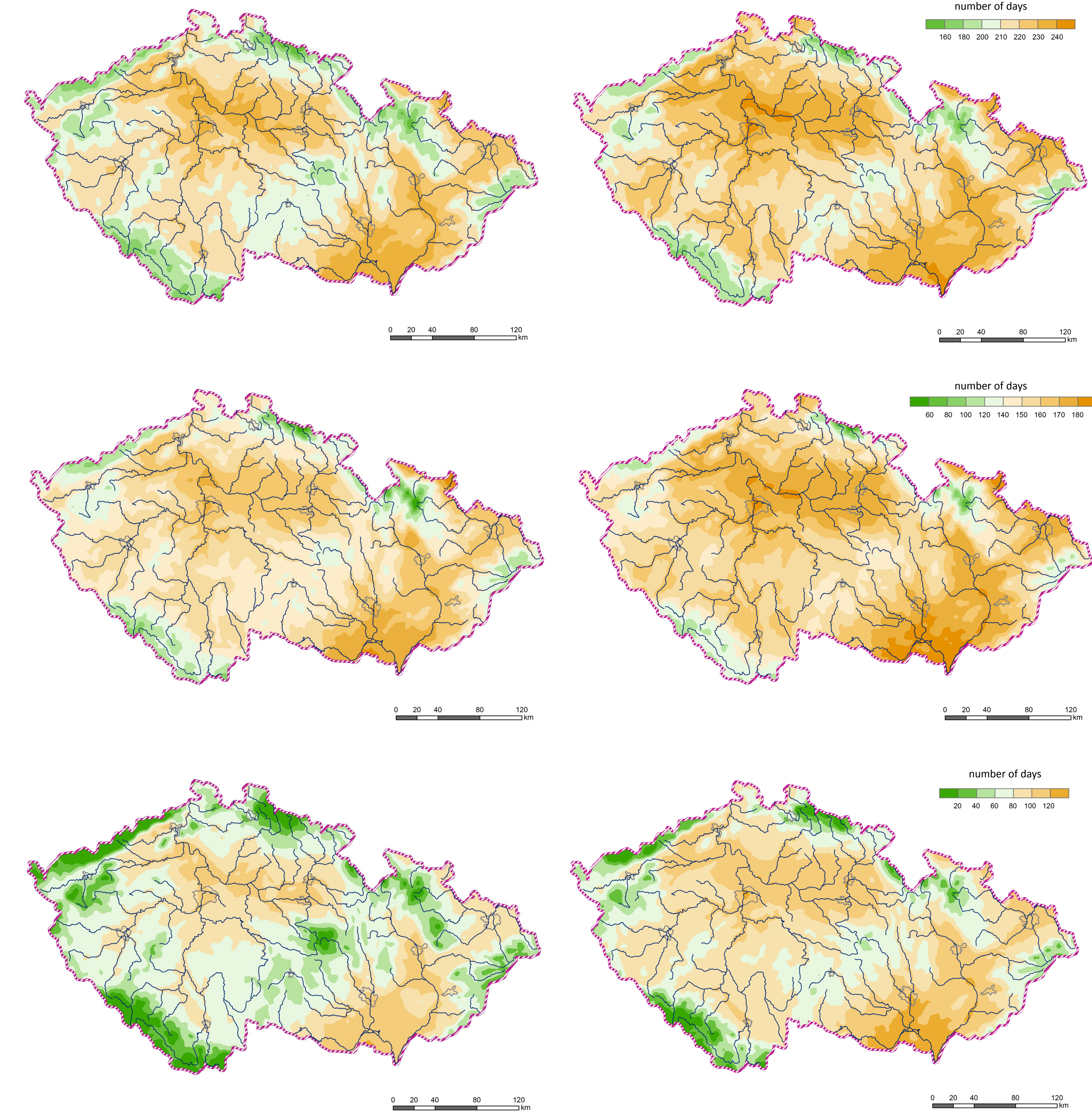
Duration of periods with characteristic air temperature 5 °C (denoted as T_{5}), 10 °C (T_{10}) and 15 °C (T_{15}) in individual years of 1961-2010 calculated by the methods of cumulative sums (Kumul), linear interpolation (Linear), Stardex and robust locally weighted regression (RLWR).



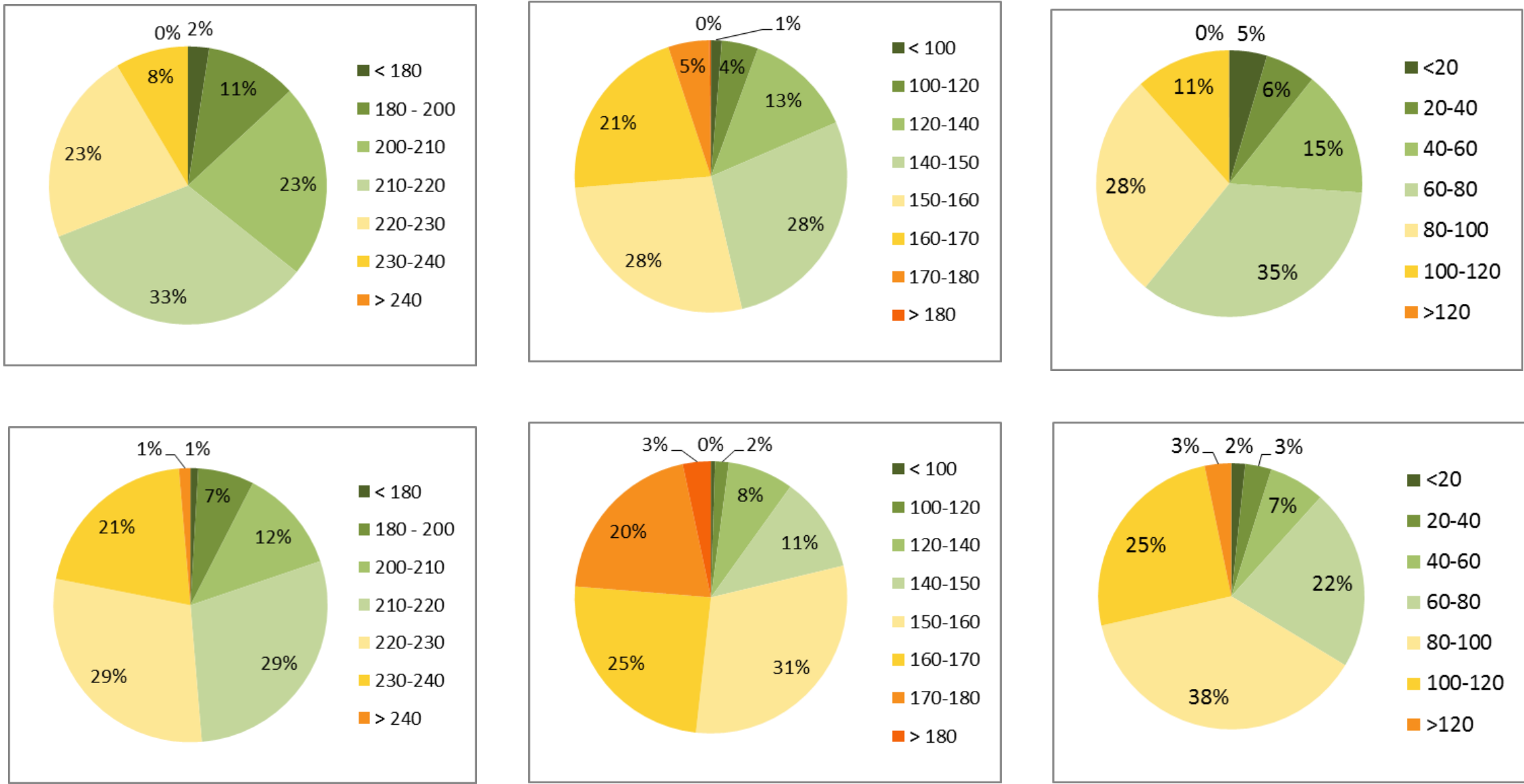
Boxplots of duration of periods with TAVG above 5 °C, 10 °C and 15 °C in individual years of 1961-2010 calculated by the methods of cumulative sums (Kumul), linear interpolation (Linear), Stardex (Stardex) and robust locally weighted regression (RLWR). Median, upper and lower quartiles and minimum and maximum are visualized in the boxplots.

- methods Linear and RLWR provide similar results (95 % differences < 11 days)
- the highest differences from other methods have been observed for Stardex

Number of days with daily TAVG above 5 °C, 10 °C and 15 °C in the periods 1951-1980 and 1981-2010



Average duration of TAVG above 5 °C (top), 10 °C (middle) and 15 °C (bottom) in the periods of 1951-1980 (left) and 1981-2010 (right).



Distribution of the area of CZ (in % of area CZ) according to the average duration of daily TAVG above 5 °C (left), 10 °C (middle) and 15 °C (right) in the periods of 1951-1980 (top) and 1981-2010 (bottom).

Beginning and ending of growing season

The observed prolongation of growing seasons in the period of 1981-2010 over most of the area of the Czech Republic is mainly caused by an earlier beginning of growing season. In average the beginning of the period with TAVG above 5 °C and 10 °C is shifted about 5–7 days earlier, the ending in the autumn is shifted only about 1–2 days later. Comparable shift about 3–8 days in the beginning and in the ending of the period is noticed for the period with TAVG above 15 °C. This corresponds to the determined trend for TAVG in the spring in the Czech Republic (see the poster EMS2018 - 444).

The earliest and latest date of beginning and ending of the period with TAVG above 5 °C, 10 °C and 15 °C, the date for latest beginning TAVG above 15 °C is not mentioned, at mountain stations period with daily TAVG above 15 °C was 0.

TAVG	station	altitude m a.s.l.	beginning (1951-1980)	ending (1951-1980)	beginning (1981-2010)	ending (1981-2010)
5 °C	Prague, Klementinum	191	18.3.	16.11.	3.3.	18.11.
	Praděd	1490	21.5.	24.9.	14.5.	24.9.
10 °C	Prague, Klementinum	191	18.4.	14.10.	6.4.	19.10.
	Chrást	1118	4.6.	8.9.	26.5.	12.9.
	Mikulov	268	16.4.	14.10.	17.4.	17.10.
	Lysá hora	1322	19.6.	25.8.	11.6.	1.9.
15 °C	Mikulov	268	19.5.	16.9.	12.5.	25.9.
	Brno, Žabovřesky	236	—	—	7.5.	14.9.

Results

Maximum duration of TAVG above 5 °C in the period 1951-1980 was 244 days, for the period 1981-2010 256 days, minimum 110 days and 119 days, respectively. The areas with growing season (TAVG above 5 °C) duration 230-240 days increased their share of the Czech Republic from 8 % to 21% (graph on the left).

For the highest mountain location Sněžka the duration of TAVG above 10 °C was 0 day for both periods (according to the chosen method), maximum duration was 182 days (1st period) and 193 days (second period).

The areas with main growing season (TAVG above 10 °C) duration 170 -180 days increased their share of the Czech Republic from 5 % to 20%.

For TAVG above 15 °C 0 day duration was observed for 11 stations with altitude above 730 m a.s.l. as determined by the chosen method for the first period and for 10 stations above 770 m a.s.l. for the second period. Unfortunately, the results for the two periods can not be compared for stations with altitude above 730 m a.s.l. due to changes in the stations network.

Maximum period with TAVG above 15 °C took 121 days for 1951-1980 and 132 days for 1981-2010.

Conclusion

- prolongation of TAVG duration above 5 °C, 10 °C and 15 °C is observed for the whole territory of the Czech Republic in the period 1981-2010 compared to 1951-1980
- the biggest changes occur at lower and middle altitudes

