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TRENDS IN TEMPERATURE AND PRECIPITATION IN THE PERIOD OF 1961–2010 IN ŽABČICE LOCALITY

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Abstract

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The paper evaluates fifty-year series of meteorological data measured at the experimental field station of Žabčice training farm belonging to Mendel University in Brno. The evaluated temperature and precipitation data from 1961 to 2010 were divided into the normal period of 1961–1990 and the subsequent period of twenty years from 1991 to 2010. In addition to the monthly data, different parts of the year were assessed and compared. The findings of this local study carried out in the warmest and also the driest locality in the Czech Republic imply a change in the development of climate. Ten of the twelve months show higher average temperatures in the last two decades and similarly, a change in the rainfall distribution during the year has been observed. The decline in rainfall can be seen in spring period while the increase is evident in summer time. The highest difference in monthly temperatures of the two evaluated time periods was recorded in July (1.4 °C) and in August (1.7 °C). In accordance with the scenarios of climate change, lower rainfall totals were recorded in spring months (April to June), which, along with the temperature increase, negatively affects the agroclimatic conditions of the plant growth and development at the time of the intensive biomass production.

long-term meteorological trends, climate variability, climate change, temperature, precipitation, climate diagram, agrometeorology

Žabčice agroclimatic station was established in 1928 on the premises of Žabčice training farm and was aimed to monitor basic meteorological data for the needs of teaching and research at the University of Agriculture in Brno. Right in the middle of this exploration area specific measurements and observations were carried out to support field experiments. Continuous measurements of basic meteorological elements in daily step are available from the beginning of the 1960s (1961), among which air temperature (°C) and precipitation total (mm) are the most frequently used data collected on the site of the training farm. Based largely on these, Rožnovský and Svoboda (1995) work analyses selected meteorological and agroclimatic characteristics for the Žabčice area in the normal period of 1961–1990. The presented study focuses on the comparison of the same meteorological elements elaborated on the basis of daily data with the following twenty-year period of 1991–2010. It is aimed i) to compare the monthly air temperature and precipitation totals data, ii) to identify the differences for both monitored periods and from the meteorological point of view theoretically evaluate their potential impact on field crops growing, and iii) to judge whether the possible changes correspond with the climate change scenarios for the region of southern Moravia.

The detailed long-term meteorological observations connected with field crops growing experiments in one of the warmest and driest sites of the CR are also of great value for the discussion of climate change impacts. It is in climatically extreme localities, and Žabčice ranking in the warm and dry area with moderate winter (Tolasz *et al.*, 2007) in the CR meet this condition, where it is possible to confirm or refute hypotheses of the changes of meteorological elements focused on the changes of temperature or rainfall totals and distribution. At the same time, with such a long series, it is to some extent achievable to validate regionally the success rate of climate change scenarios trends resulting from the Global Circulation Models.

MATERIALS AND METHODS

Agroclimatic station, where meteorological measurements are currently carried out, is located on the grounds of the training farm between Žabčice and Židlochovice, approximately 25 km to the south of Brno. Its geographic coordinates are 49°1'18.512"N and 16°36'56.035"E and it is a locality of plane character with the altitude of 179 m a.s.l. in a typical agricultural area with a high portion of arable land and rare occurrence of woods. The main measuring instruments until 1995 were the station rain gauge, minimum and maximum thermometer, psychrometer, thermograph, and hygrograph. In the period of 1961–1995 the data were obtained from the site (a part of the station) located in the training farm in the distance of about 1 km from the present position of the agroclimatic station in the centre of the training farm grounds. Here the operation of the automated measuring systems started in 1995. Due to a very short measuring interval, this is significant also for the field experiments, e.g. in relation to the description of individual agrotechnic interventions. The basis for the current data collection is data loggers, or centrals (from Cambell firm) with a several-month data capacity, which are connected to meteorological sensors measuring in two-second intervals. The data are stored and recorded as fifteen-minute averages (e.g. temperature) or sums (e.g. precipitation). The station is equipped and the sensors are placed in accordance with the "Instructions for meteorological observers" issued as a methodical instruction by Czech Hydrometeorological Institute (Tolasz, 2003).

The database currently contains daily values of selected meteorological elements from 1961 to 2012 of which multi-day (five-day, ten-day, monthly, and annual) averages for temperature are counted for the needs of this study according to the equation (1).

$$\overline{t}_n = \frac{\sum_{i=1}^{n} \overline{t}_d}{n}, \qquad (1)$$

where

$\overline{t}_n$ .... average temperature in "n" days,

$\overline{t}_d$ .... average daily temperature,

t_7, t_{14}, t_{21} .... are temperatures in every day measuring times, and

$$\overline{t}_d = \frac{t_7 + t_{14} + 2 \times t_{21}}{4}. \qquad (2)$$

The data were processed in the form of annual, quarterly (Q1-Q4), and monthly items. At the same time, the following periods were evaluated – 1 April to 30 September, generally understood and from the practical viewpoint called growing season, and so-called climatologic seasons (climatologic spring from 1 March to 31 May; climatologic summer from 1 June to 31 August; climatologic autumn from 1 September to 30 November; climatologic winter from 1 December to 29 February).

For the purpose of the impact on field crops growing, the above-mentioned data were supplemented with the processing of temperature and precipitation data according to the Walter-Lieth climate diagram. This enables the overall evaluation of changes or statistically significant/insignificant trends of the meteorological elements development in both monitored periods (i.e. 1961–1990 and 1991–2010) as well as the incidence of meteorological drought.

RESULTS AND DISCUSSION

The monthly temperature and precipitation data are of high informative value regarding the course of weather during a given year. These data eliminate short-term extremes and they are also sufficiently robust to describe possible changes or trends from the long-term climatic point of view. Generally, multi-day averages and totals are always calculated from daily values. These were measured manually on the monitored area till the middle of the 1990s (on the remote site of Žabčice farm) and later with the use of automatic stations (PPS). As shown by Možný *et al.* (2012), the change of the measuring method may also bring about a change of values, most frequently in the form of systematic error. The homogenization of data series recorded by the observer and the automatic systems as well as the comparison of the simultaneously measured data from both sites was accomplished by Brotan *et. al.* (1995) who proved a statistically significant correspondence between the data measured at both localities.

The analysis of fifty-year series of monthly temperatures (Tab. I) divided into thirty-year (standard) and twenty-year (long-term average) periods shows the increase of average monthly temperatures in ten of twelve calendar months. Concerning the absolute value, there is a considerable difference in the periods of spring and summer months (April–August) while the decrease in the average monthly temperature is shown in December only. When evaluating the temperature for the given period of 1961–2010 from longer – seasonal point of view, there is an evident rise in both Q2 and Q3, that is 1.2 °C (Tab. II, Fig. 1a), which can be considered a dramatic change in the climatic conditions of the assessed locality especially in Q2 period when there is a simultaneous decrease in the monthly rainfall totals (Fig. 1b). The reason for lower rainfall totals

I: *The comparison of average monthly air temperature (°C) and monthly rainfall total (mm) at Žabčice agroclimatic station*

Period	1961–1990	1991–2010	difference	Trend 1961–2010	1961–1990	1991–2010	difference	Trend 1961–2010
Month	**°C**	**°C**	**°C**	**(°C/10 years)**	**mm**	**mm**	**mm**	**(mm/10 years)**
January	–2.0	–0.9	1.1	0.39	24.8	19.6	–5.2	–0.29
February	0.2	0.9	0.7	0.20	24.9	20.6	–4.3	–0.12
March	4.3	4.8	0.5	0.28	23.9	33.4	9.5	2.97
April	9.6	10.9	1.3	0.34*	33.2	30.5	–2.7	–0.98
May	14.6	15.8	1.2	0.50**	62.8	51.2	–11.6	–4.84
June	17.7	18.9	1.2	0.34**	**68.6**	59.6	–9.0	–2.12
July	**19.3**	**20.7**	1.4	0.51***	57.1	**73.1**	**16.0**	3.12
August	18.6	20.3	**1.7**	0.55***	54.3	60.9	6.6	2.55
September	14.7	15.1	0.4	0.13	35.5	49.8	14.3	5.07
October	9.5	9.5	0.0	0.08	31.8	34.5	2.7	–0.52
November	4.1	4.6	0.5	0.12	36.8	36.0	–0.8	–1.67
December	0.0	– 0.4	–0.4	0.09	26.3	26.9	0.6	0.56

*) p < 0.05 **) p < 0.01 ***) p < 0.001

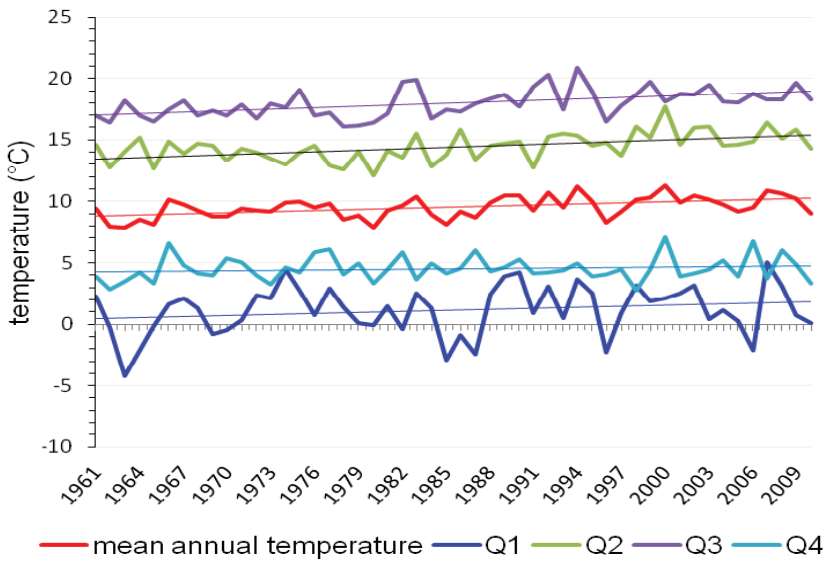
II: *The comparison of average temperature (°C) and rainfall totals (mm) at Žabčice agroclimatic station in the monitored periods*

Period	1961–1990	1991–2010	Trend 1961–2010	1961–1990	1991–2010	Trend 1961–2010
	(°C)	**(°C)**	**(°C/10 years)**	**mm**	**mm**	**(mm/10 years)**
Year	9.2	10.0	0.29***	480.0	496.1	3.78
April–September	15.8	17.0		311.5	325.1	
Q1 (January–March)	0.8	1.5	0.29	73.6	73.6	2.55
Q2 (April–June)	14.0	15.2	0.39***	164.6	141.3	–7.86*
Q3 (July–September)	17.5	18.7	0.40***	146.9	183.8	10.72*
Q4 (October–December)	4.5	4.6	0.09	94.9	97.4	–1.63
climatological spring	9.5	10.5		119.9	115.1	
climatological summer	18.5	20.0		180.0	193.6	
climatological autumn	9.4	9.7		104.1	120.3	
climatological winter	– 0.6	–0.1		76.0	67.1	

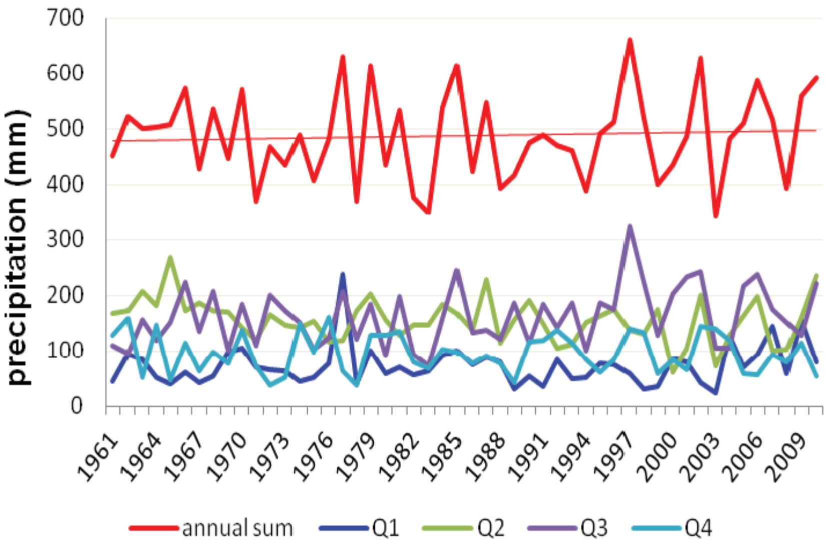
*) p < 0.05 **) p < 0.01 ***) p < 0.001

can be the change in the occurrence of synoptic situations, which is for the CR territory analyzed in detail by Trnka *et al.* (2009), in combination with the increased capability of warmer air to absorb water vapour, increasing thus the value of its dew point and causing less condensation products and clouds to be formed. It is the statistically significant rainfall decrease in spring season (Q2), at the time of intensive biomass growth that is a warning signal for ensuring the field production in this locality, as analyzed in detail by Žalud *et al.* (2009). On the other hand, the increase in rainfall in the period of 1961–2010 seems to be directly connected with the rise of temperature in this period since the stronger convective streams support the occurrence of vertical clouds and the storms related to them. The consequent precipitation is often of torrential and erosive character. The change of climatic conditions is also confirmed by ten-year trends (Tab. I), which show great statistical provability especially in the average temperatures in the period of May–August as well as in Q2 and Q3 periods (Tab. II). Concerning monthly rainfall, the statistical significance for ten-year trends was only found for Q2 (decrease) and Q3 (increase).

The analysis and comparison of climate diagrams (Fig. 2a, b) for the periods of 1961–1990 and 1991–2010 indicate a clear shift of the precipitation maximum to summer season and a simultaneous increase of rainfall in autumn. Together with the rise of spring temperatures, the dry season starts to appear right at the beginning of vegetation which is an attribute of longer growing season and higher potential evapotranspiration. Providing this trend continues, the theory of drought occurrence (e.g. Brázdil *et al.*, 2009) will be confirmed as the most significant limit for the agricultural production in this particular climatic region. Alongside the incidence of extreme temperatures mainly in blossom season, this becomes a regionally important meteorological factor influencing field crops yields of the corn–production type (Trnka *et al.*, 2012). The



1a: *Trends and variability of annual and seasonal average temperatures for the period of 1961–2010*

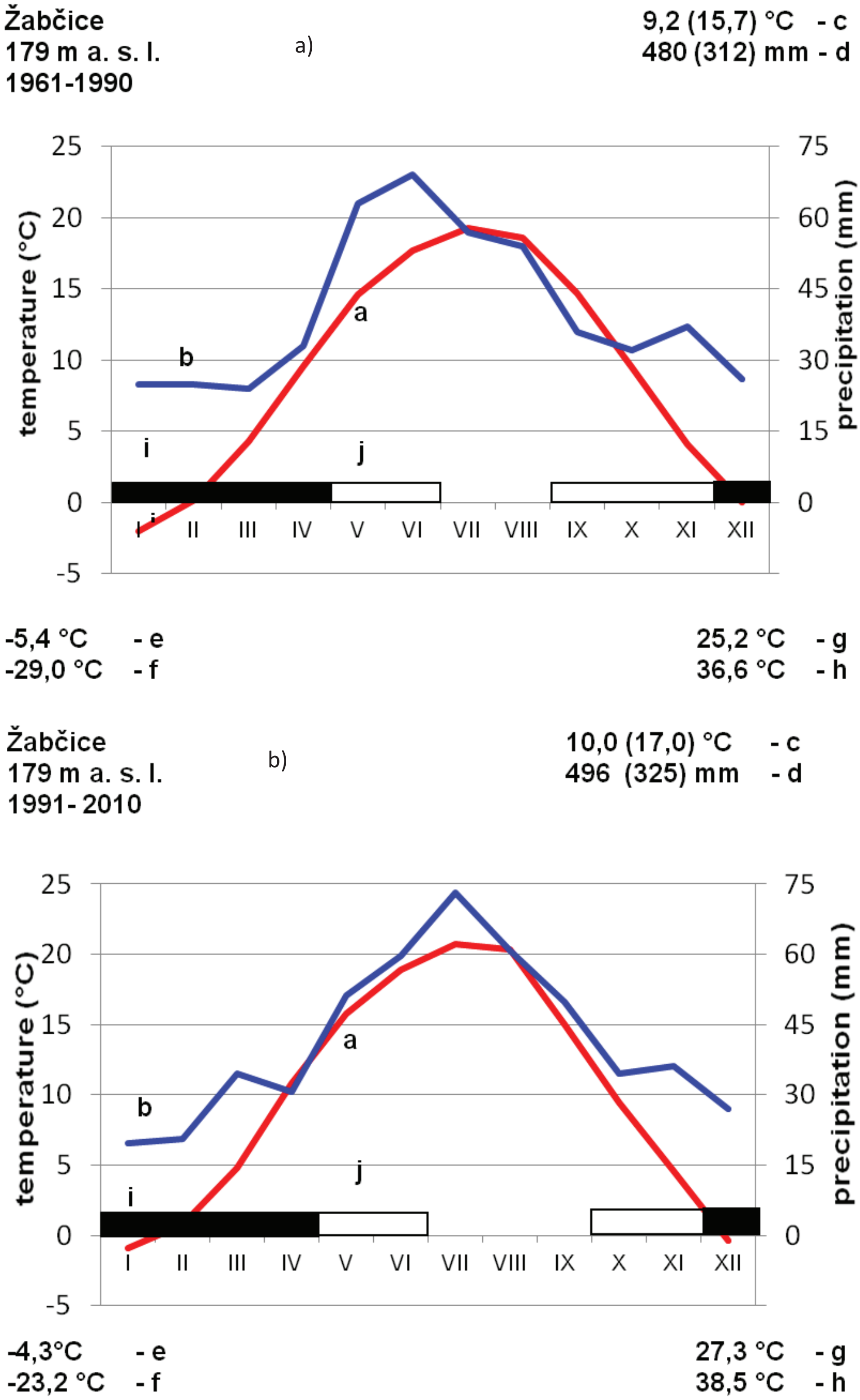


1b: *Trends and variability of annual and seasonal precipitation totals for the period of 1961–2010*

differences in climate diagrams together with the data in Tab. II may be compared with the climate prognosis relying on the first climate change scenarios, which were published at the end of 1990s. For instance, on the basis of HadCM2 (Hadley Centre Coupled Model, version 2) and ECHAM4 (European Centre Hamburg Model, version 4), Kalvová *et al.* (2002) state for the CR territory to 300 m a.s.l. the increase in temperature for all months with the highest rise in February and then in July and August while concerning precipitation, they assume an increase in winter season and decrease in spring, and contrary to the development in southern Moravia, in summer as well.

CONCLUSION

The fifty–year analysis (1961–2010) of climatic conditions in Žabčice area divided into standard (1961–1990) and the subsequent twenty–year (1991–2010) periods specifies several absolute changes and at the same time indicates some trends in climate change at the monitored locality. The results comparing the average monthly temperatures confirm the climate change scenarios, which as early as the end of 1990s predicted the temperature increase practically in all seasons for the given area and it was also possible to derive higher expected variability of precipitation from them with a great degree of probability. Meteorological trends are closely related to the changes of agroclimatic characteristics, which comprise for example higher potential evapotranspiration or the occurrence of agricultural drought.



2: *Climate diagram characterizing Žabčice locality on the basis of agroclimatic station data in a) the standard period of 1961–1990 b) in the period of 1991–2010. The individual elements in the climate diagram are denoted as follows: a – the course of average monthly air temperatures, b – the course of average monthly precipitation totals, c – the average annual air temperature (the period = April to September), d – the average annual precipitation total (the period = April to September), e – the average of daily minima of air temperature in the coldest month, f – absolute minimum air temperature, g – the average of daily maxima of air temperature in the warmest month, h – absolute maximum air temperature, i – months with the average minimum temperature < 0 °C, j – months with the absolute minimum temperature < 0 °C.*

Appendix I: *Monthly average temperatures at Žabčice training farm in the period of 1961–2010*

	Average temperature (°C)					
Year/Month	**January**	**February**	**March**	**April**	**May**	**June**
1961	–2.8	2.8	6.8	12.6	12.8	18.4
1962	–0.5	–0.8	0.6	10.8	11.7	15.7
1963	–7.6	–6.1	1.0	9.9	14.3	18.0
1964	–6.3	–0.7	0.6	11.2	14.6	19.8
1965	–0.6	–2.8	3.0	8.4	12.1	17.6
1966	–4.3	4.7	4.4	11.5	14.7	18.3
1967	–1.3	1.6	6.0	9.5	14.9	17.2
1968	–3.1	1.7	5.3	11.2	14.3	18.6
1969	–2.5	–1.4	1.5	9.7	17.0	16.9
1970	–2.3	–1.7	2.5	8.5	13.1	18.4
1971	–3.2	2.2	2.0	10.5	16.1	16.4
1972	–2.2	2.9	6.5	9.3	14.2	18.4
1973	–0.5	1.6	5.3	7.9	14.9	17.7
1974	1.7	4.2	7.6	9.6	13.9	15.5
1975	2.4	0.3	5.6	9.0	15.6	17.4
1976	0.8	–0.4	1.9	9.8	15.2	18.6
1977	–0.6	2.5	7.0	7.6	13.2	18.0
1978	0.4	–1.9	5.7	8.4	12.9	16.4
1979	–5.0	–0.2	5.5	8.0	14.9	19.3
1980	–4.0	0.9	2.8	6.8	12.3	17.1
1981	–3.3	0.2	7.4	8.5	15.3	18.6
1982	–5.0	–1.1	4.9	7.4	14.9	18.5
1983	3.7	–1.4	5.3	11.9	16.2	18.5
1984	–0.1	0.1	3.9	8.9	13.6	15.9
1985	–8.2	–4.3	3.8	9.6	16.4	15.5
1986	–0.5	–5.7	3.5	11.8	17.5	18.2
1987	–6.6	–0.7	–0.1	9.7	12.9	17.7
1988	1.9	2.3	3.2	9.7	16.6	17.4
1989	–0.1	4.2	7.5	10.7	16.3	17.1
1990	0.2	4.3	8.1	9.0	16.1	19.5
1991	–0.4	–3.5	6.7	9.0	11.5	17.8
1992	1.0	3.0	5.3	10.2	16.0	19.5
1993	–0.2	–1.7	3.5	11.2	17.5	17.8
1994	3.2	0.5	7.4	10.9	15.8	19.3
1995	–0.6	4.3	3.9	10.6	15.1	17.8
1996	–3.5	–4.0	0.7	9.5	16.0	18.9
1997	–3.5	1.8	4.3	6.8	15.5	18.9
1998	1.2	3.6	4.8	12.3	15.8	20.1
1999	–0.7	–0.1	6.5	11.6	15.8	18.2
2000	–2.1	3.0	5.4	14.6	17.7	20.8
2001	0.2	1.5	5.8	9.3	17.6	17.0
2002	–0.8	4.5	5.8	10.5	18.2	19.3
2003	–1.5	–2.3	5.1	9.5	17.4	21.4
2004	–2.9	2.1	4.3	11.8	13.9	18.0
2005	0.1	–2.0	2.6	11.0	15.0	17.9
2006	–6.1	–2.2	1.9	11.1	14.7	18.7
2007	3.8	4.1	7.1	12.2	16.7	20.3
2008	1.8	2.6	4.8	10.1	15.4	19.8
2009	–3.3	0.4	5.0	14.5	15.6	17.3
2010	–3.9	–0.6	4.8	10.2	14.0	18.7
1961–2010	–1.5	0.5	4.5	10.1	15.1	18.2
1961–1990	–2.0	0.2	4.3	9.6	14.6	17.7
1991–2010	–0.9	0.9	4.8	10.9	15.8	18.9

	Average temperature (°C)						
Year/month	July	August	September	October	November	December	Year
1961	17.8	18.6	14.4	9.8	4.0	–2.2	9.4
1962	17.4	18.9	13.0	8.3	4.2	–3.9	8.0
1963	20.4	18.7	15.5	8.6	6.8	–4.9	7.9
1964	19.6	17.2	14.1	8.5	5.1	–1.0	8.6
1965	18.1	16.6	14.8	7.5	1.5	1.0	8.1
1966	19.0	18.2	15.2	13.3	4.4	2.0	10.1
1967	20.7	18.2	15.6	11.1	3.7	–0.3	9.7
1968	18.8	17.4	14.6	9.3	5.8	–2.7	9.3
1969	19.6	17.5	15.1	10.5	5.5	–4.1	8.8
1970	18.7	18.5	13.7	8.7	6.5	0.8	8.8
1971	19.9	20.8	13.0	8.0	3.8	3.2	9.4
1972	20.1	17.8	12.4	7.5	4.3	0.2	9.3
1973	19.0	19.3	15.6	7.5	2.0	0.3	9.2
1974	17.6	20.5	14.7	6.2	4.2	3.4	9.9
1975	20.0	19.6	17.6	9.2	3.0	0.4	10.0
1976	20.7	17.3	13.0	10.7	6.2	0.7	9.5
1977	18.4	18.2	15.1	11.9	6.4	0.0	9.8
1978	17.1	17.1	14.1	10.1	2.1	0.1	8.5
1979	17.2	17.1	14.1	7.7	4.2	3.0	8.8
1980	17.8	17.8	13.6	8.3	2.0	–0.4	7.9
1981	17.7	18.3	15.3	10.0	4.7	–1.3	9.3
1982	20.7	20.1	18.4	10.9	4.6	2.0	9.7
1983	23.5	21.0	15.3	9.8	2.1	–0.8	10.4
1984	17.7	18.3	14.3	10.2	5.1	–0.4	9.0
1985	19.4	18.6	14.4	9.2	1.1	2.2	8.1
1986	18.9	19.1	13.9	9.4	4.9	–0.6	9.2
1987	20.8	17.4	15.7	11.1	5.3	1.6	8.7
1988	20.5	19.3	15.3	10.5	0.4	2.1	9.9
1989	20.8	19.4	15.8	10.6	2.7	0.6	10.5
1990	19.6	20.1	13.3	10.2	5.5	0.2	10.5
1991	21.5	19.6	16.8	8.9	4.5	–1.0	9.3
1992	21.5	23.8	15.6	8.3	4.3	0.0	10.7
1993	18.7	19.3	14.5	10.0	1.6	1.5	9.5
1994	23.8	21.6	17.1	7.7	6.1	1.1	11.2
1995	22.9	20.0	13.8	10.8	1.9	–0.9	10.0
1996	18.5	19.1	11.8	10.4	5.6	–3.7	8.3
1997	18.7	20.2	14.4	6.8	4.5	2.0	9.2
1998	20.6	20.7	14.7	9.3	1.1	–2.0	10.2
1999	21.2	19.5	18.6	10.2	3.4	–0.2	10.3
2000	18.3	21.5	14.6	12.3	7.5	1.5	11.3
2001	21.2	21.6	13.6	12.1	2.9	–3.4	10.0
2002	21.3	20.6	14.1	8.1	6.7	–2.3	10.5
2003	20.6	22.6	15.2	7.2	6.1	0.2	10.1
2004	19.6	20.1	14.6	11.0	4.5	0.0	9.8
2005	19.9	18.1	16.1	9.9	2.8	–0.9	9.2
2006	22.6	16.8	16.8	11.1	6.4	2.7	9.5
2007	20.9	20.8	13.2	8.6	2.8	–0.2	10.9
2008	20.4	20.0	14.3	9.8	6.5	1.8	10.6
2009	20.7	21.1	17.2	8.9	5.7	0.1	10.3
2010	21.9	19.3	13.7	7.3	6.7	–3.9	9.0
1961–2010	19.8	19.3	14.8	9.5	4.3	–0.1	9.5
1961–1990	19.3	18.6	14.7	9.5	4.1	0.0	9.2
1991–2010	20.7	20.3	15.1	9.5	4.6	–0.4	10.0

Appendix II: Monthly rainfall totals at Žabčice training farm in the period of 1961–2010

	Precipitation sums (mm)					
Year/Month	**January**	**February**	**March**	**April**	**May**	**June**
1961	13.8	21.0	10.7	33.4	70.7	63.5
1962	20.9	25.1	47.6	40.7	111.1	20.8
1963	28.2	19.1	37.7	25.8	102.4	79.1
1964	2.1	11.8	38.8	30.2	90.7	60.5
1965	12.4	6.1	22.2	63.5	113.0	91.7
1966	4.7	43.7	12.1	24.7	69.4	78.6
1967	18.1	9.6	14.4	23.6	63.4	100.2
1968	26.7	15.9	11.9	34.2	76.7	62.0
1969	32.3	35.5	31.1	6.4	57.8	106.0
1970	7.9	60.3	37.9	34.6	25.0	82.3
1971	17.6	13.6	39.2	28.5	35.6	54.5
1972	31.6	25.2	9.2	69.2	56.8	39.0
1973	25.8	29.7	8.1	58.5	18.7	70.6
1974	25.2	13.5	5.3	1.9	41.6	99.8
1975	18.1	1.1	33.2	20.4	54.1	79.3
1976	51.5	18.7	7.8	17.8	69.0	31.3
1977	113.0	88.0	38.0	50.6	42.1	27.3
1978	16.1	15.0	9.2	38.4	66.6	67.2
1979	27.4	32.2	40.9	75.0	9.0	118.0
1980	22.6	19.1	17.1	54.3	34.3	68.3
1981	15.7	16.9	38.0	6.8	61.3	59.8
1982	27.7	0.6	28.3	7.2	70.2	69.7
1983	24.9	25.1	13.6	33.2	49.3	64.1
1984	29.0	32.3	29.1	38.6	115.0	31.1
1985	22.8	31.3	47.7	11.6	92.1	63.4
1986	26.0	27.4	22.2	11.6	71.5	54.8
1987	43.7	25.9	19.5	16.2	99.7	112.5
1988	25.4	37.9	17.5	14.8	32.3	66.8
1989	11.9	8.5	10.9	60.1	45.8	50.6
1990	1.3	36.0	16.8	66.3	40.3	84.2
1991	7.0	10.3	18.2	14.0	85.2	50.9
1992	8.4	11.5	65.4	35.5	24.1	45.1
1993	15.4	15.7	18.0	10.6	33.7	67.2
1994	19.4	13.1	20.1	53.8	76.0	21.1
1995	20.9	15.9	41.0	38.5	57.0	68.5
1996	24.8	30.5	20.4	49.8	50.1	75.7
1997	14.3	18.6	25.6	14.3	51.4	71.1
1998	12.0	2.8	15.3	39.3	20.2	71.4
1999	5.0	10.6	20.8	49.8	44.4	81.6
2000	28.6	16.8	40.5	2.4	44.6	13.6
2001	25.3	9.5	46.0	31.6	31.8	42.0
2002	3.1	17.4	21.2	28.6	68.8	103.8
2003	18.2	1.9	3.0	18.2	42.2	11.6
2004	41.9	27.6	59.8	34.0	28.3	65.2
2005	19.4	44.4	5.8	49.5	66.8	46.2
2006	22.3	26.4	46.2	50.5	75.3	71.40
2007	22.7	42.2	80.8	4.4	24.8	71.7
2008	15.7	10.4	32.9	29.3	53.5	19.6
2009	20.0	57.6	78.1	3.6	42.4	114.7
2010	46.8	22.8	9.8	53.1	102.4	79.8
1961–2010	22.7	23.0	27.7	32.2	58.2	65.0
1961–1990	24.8	24.9	23.9	33.2	62.8	68.6
1991–2010	19.6	20.6	33.4	30.5	51.2	59.6

	Precipitation sums (mm)						
ear/month	July	August	September	October	November	December	Year
1961	69.7	27.4	12.8	51.8	44.5	31.5	450.8
1962	29.5	31.6	33.9	49.7	86.2	23.7	520.8
1963	10.9	84.4	60.9	15.8	34.5	1.3	500.1
1964	48.8	62.1	9.1	109.6	9.9	28.7	502.3
1965	66.5	58.3	27.4	3.4	24.0	19.8	508.3
1966	134.9	64.2	24.2	24.5	39.5	50.9	571.4
1967	44.0	10.3	81.9	13.9	20.6	29.2	429.2
1968	83.3	105.9	19.4	25.9	58.5	15.1	535.5
1969	21.1	71.7	8.3	3.5	44.4	29.9	448.0
1970	92.5	74.6	16.8	47.9	71.3	18.4	569.5
1971	46.1	26.4	36.4	19.0	38.3	15.9	371.1
1972	138.8	38.6	22.4	9.5	24.9	3.8	469.0
1973	89.0	27.3	55.9	22.1	16.7	13.6	436.0
1974	96.1	35.0	20.8	61.8	39.2	48.4	488.6
1975	33.6	52.3	17.8	67.5	20.0	10.6	408.0
1976	24.5	55.0	43.6	55.0	71.5	35.0	480.7
1977	55.0	97.6	56.2	15.1	37.4	11.4	631.7
1978	61.4	46.4	13.8	18.3	1.0	17.6	371.0
1979	58.1	67.1	60.0	5.3	80.6	41.8	615.4
1980	30.9	28.0	33.0	58.4	41.2	28.4	435.6
1981	79.5	20.9	98.6	49.5	20.9	64.2	532.1
1982	56.7	21.6	16.3	24.1	16.8	38.5	377.7
1983	26.9	9.3	36.4	28.4	14.5	24.7	350.4
1984	67.9	24.5	67.1	31.0	51.3	21.7	538.6
1985	67.7	162.4	15.1	6.0	72.0	21.1	613.2
1986	29.6	77.3	25.8	24.6	23.9	28.3	423.0
1987	57.6	42.9	37.3	37.7	23.4	31.5	547.9
1988	30.5	49.3	42.0	20.1	11.5	46.0	394.1
1989	11.3	142.9	31.8	10.7	11.0	20.7	416.2
1990	51.2	13.3	49.7	44.4	54.0	18.5	476.0
1991	66.1	95.4	23.3	8.9	85.2	24.1	488.6
1992	24.7	70.2	47.0	61.9	44.3	32.4	470.5
1993	73.6	68.1	43.9	35.4	24.0	56.0	461.6
1994	23.0	55.4	22.5	42.1	13.4	29.1	389.0
1995	25.8	54.1	107.5	5.3	28.3	27.8	490.6
1996	43.4	89.3	42.4	45.4	23.4	16.0	511.2
1997	273.5	38.2	13.3	25.7	72.3	42.1	660.4
1998	53.8	37.6	133.2	95.0	27.4	10.8	518.8
1999	82.4	10.4	35.6	11.2	42.2	5.6	399.6
2000	116.6	48.4	37.8	17.6	38.4	29.1	434.4
2001	68.6	57.6	107.0	10.6	41.2	14.8	486.0
2002	107.5	98.2	36.5	91.1	28.6	24.6	629.4
2003	48.6	29.6	28.2	57.6	31.6	51.0	341.7
2004	28.6	33.2	43.8	66.2	35.0	18.0	481.6
2005	103.1	80.7	33.2	6.2	23.4	30.2	508.9
2006	78.4	151.3	9.0	13.9	21.4	20.8	586.9
2007	31.6	39.5	103.8	37.9	30.5	26.0	515.9
2008	49.9	55.9	46.1	27.3	22.1	31.1	393.8
2009	74.0	29.6	24.7	21.2	55.4	37.6	558.9
2010	87.9	75.8	57.8	10.4	32.8	11.1	590.5
1961–2010	63.5	56.9	41.4	32.9	36.5	26.6	486.6
1961–1990	57.1	54.3	35.5	31.8	36.8	26.3	480.0
1991–2010	73.1	60.9	49.8	34.5	36.0	29.6	496.1

SUMMARY

The article deals with the analysis of meteorological elements in one of the driest and warmest areas of intensive agricultural production in the Czech Republic. Contrary to numerous spatial studies of European or regional (central–European) character, here the local analysis was performed on the basis of the measurements of basic meteorological elements such as air temperature (°C) and rainfall total (mm). Annual, monthly, quarterly, and climatologically defined periods of time were elaborated and assessed for the normal period of 1961–1990 and subsequently for the period of 1991–2010, relying on daily data. It was found out that ten months (except October and December) have higher average temperatures in 1991–2010. The greatest differences were reached in spring (April–June = Q2) and summer months (July–September = Q3) when there is an identical increase of 1.2 °C in both Q2 and Q3 periods. The greatest difference of average temperature occurs in August and that is 1.7 °C followed by July with 1.4 °C. The increased temperature causes e.g. prolonged growing season, when mainly fruit trees or grapevine may be more threatened by spring frosts or the accelerated achievement of temperature sums necessary for the coming of individual phenological phases. In combination with the decrease of rainfall in spring season, in 1991–2010 it is possible to observe more frequent occurrence of meteorological and consequent agricultural drought, which is confirmed by climate diagrams (Walter, Lieth, 1960) data for both assessed periods. Monthly average temperatures are in contrast with precipitation change, especially from the point of view of Q2 and Q3 periods, when in Q2 a significant decrease of monthly totals occurs while in Q3 the precipitation total is higher. A probable cause of this situation may be the increasing air temperature and the development of convection currents which in spring season act against the falling of rain while in summer season they contribute to the formation of storm clouds and the incidence of intensive erosion–causing rains.

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