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Bioclimatological conditions in Brno city and Brno region in three different time „slices" – from Mendel's era to present days

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Abstract

Bioclimatological conditions in urban areas tend to be very specific and they are of high interest thanks to the huge density of settlement in such areas. The paper focuses on the analysis of bioclimatological conditions in Brno region representing currently the second largest concentration of urban population in the Czech Republic. It depicts the situation in three different time „slices" from Mendel's era (second half of the 19th century) when Brno had about 100 000 inhabitants to presents days with its nearly 400 000 inhabitants. These time „slices" are represented by the end of the 19th century (data measured at the station Brno-Pisárky, waterworks), the WMO normal period (1961─1990) and current period 1981─2013 (data measured at various CHMI's stations in Brno city and its surroundings). Comparative analysis of maximum temperatures, number of days with characteristic temperature and the occurrence and length of periods with low daily precipitation sums (dry periods) is performed.

Key words: hot spells, cold spells, dry spells, days with characteristic temperature, trend

Introduction

Brno is the second largest city of the Czech Republic located in its southeastern part on the „boundary" between hilly landscape of Bohemian-Moravian Highlands and rather flat sceneries of Southern Moravian lowlands. It has basin position with complex terrain characteristic by number of elevations and numerous partial basins. The landscape of Brno is very diverse. In the north and west part of Brno cadastral area we can experience hilly forested countryside in the proximity of Brno Dam Lake and nature reserve of the Moravian karst. While in the south and east we can observe rather flat landscape with strong historic touch of the ancient battlefield

(Battle of the Three Emperors). Brno region provides many beautiful natural sights, amazing cultural heritage and even rich university life. The question is whether it also offers favorable conditions for life. Does it have fresh air and pure water? And what are the bioclimatological conditions like?

Bioclimatological conditions are generally formed by several factors including air temperature and humidity, precipitation, wind speed or sunshine duration. All these together influence our feelings of warmth or chill, fatigue or vitality and so on. Sophisticated bioclimatological indices that make it possible to include numerous parameters and thus describe the real bioclimatological conditions in the most precise way were developped by the scientific community. However, with the regard to data availability, much more simple approach was used in this paper where bioclimatological conditions were evaluated with the help of extreme temperatures and precipitation only. Hot, cold and dry spells were studied as well.

It is not as sophisticated as using some other indices like Heat Index, Humidex, Wind Chill Temperature or Apparent Temperature (for more details see e.g. Novák, 2007 or Błażejczyk et al., 2012 that describe human feelings in better way), but it can be perceived as a first approximation of Brno bioclimatological conditions and their development in time. The usage of precipitation is motivated by the fact that :heat waves: combined with dry weather can lead to severe air pollution that can have negative influence on sensitive persons suffering from cardiovascular or respiratory diseases while the most problematic is pollution by particulate matter (see e.g. Urban, Kyselý, 2014).

Materials and methods

Daily maximum (Tmax) and minimum temperatures (Tmin) measured at several meteorological sites in the cadastral area of Brno were used to compute total number of summer days and tropical days (Tmax ≥ 25 °C or 30 °C) as well as ice days, arctic days (Tmax < 0 °C or -10 °C) and frost days (Tmin < 0 °C). Basic statistic characteristics (including trend) of number of all type of days with characteristic temperatures were computed. Cold spells were defined as the periods of consecutive days with Tmax < 0 °C, while hot spells were defined in the same way but with two different limit values of Tmax (Tmax ≥ 30 °C or 25 °C). Maximum length of both cold and hot spells was found for every year and analysed for trend. Due to its non-normal distribution non-parametric method was used for the trend analysis of these characteristics (Mann-Kendall trend test, Sen's method) Mann, 1945; Kendall, 1976; Sen, 1968). As we know, dry weather can make the effect of extreme temperatures on bioclimatological conditions and human health even worse (via air pollution). For this reason dry spells were studied as well. They were defined with the help of daily precipitation amounts as periods of consecutive days not reaching certain value (three different limits were used: 0,1 mm; 1,0 mm and 3,0 mm). The analysis of their annual maximum length was performed in the same way as for hot and cold spells.

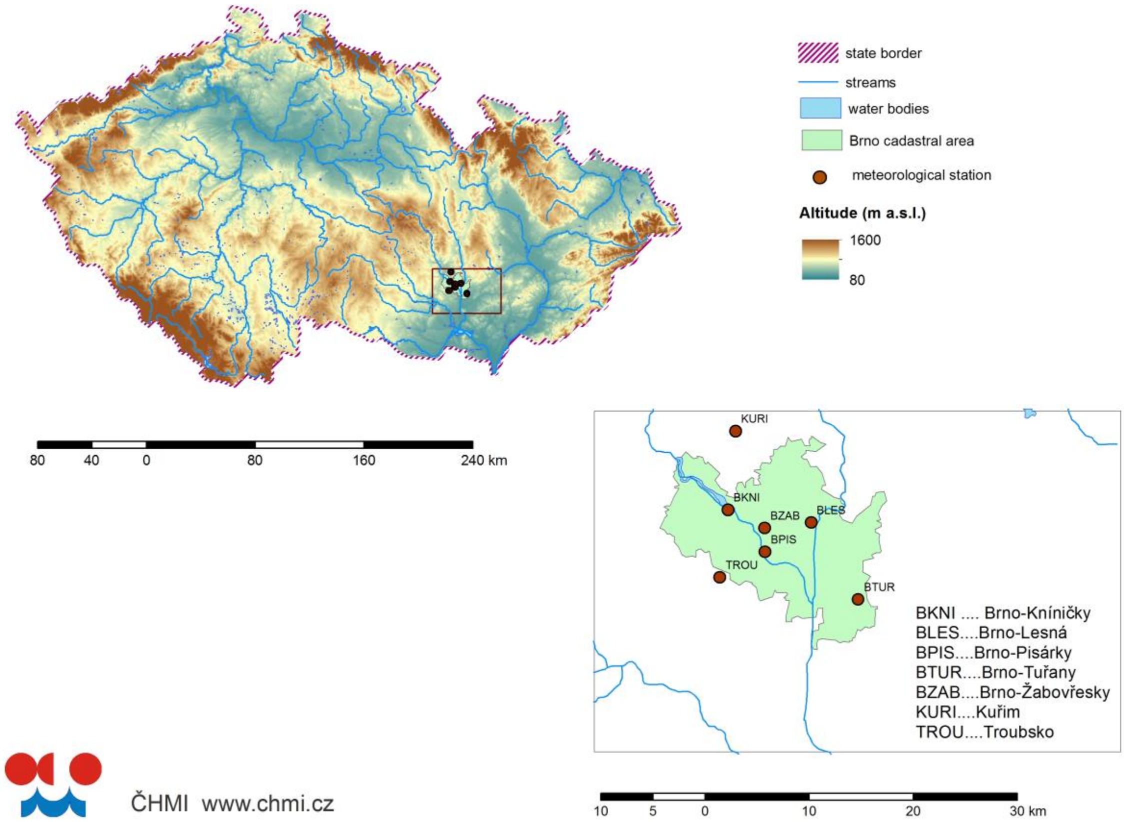

Fig. 1 Location of meteorological stations used in this study

All the analysis covered three different time periods: 1891−1921 (representing the climate in Brno just after the Mendel's era), 1961−1990 (representing „normal period" according to the WMO) and 1981−2013 (representing current climate). For the first period (1891−1921) only one meteorological station was available. This station was located in Brno-Pisárky (the city waterworks) and operated by waterworks employees. The measurements at this station represent the continuation of famous Mendel's measurements at Austin abbey conducted in the period 1878−1883 (the abbey is situated about 2 km far from the waterworks). The second period (1961−1990) is represented by the station in Brno-Tuřany situated at city airport. As far as daily precipitation amounts are concerned, data from three other meteorological stations are available: Brno-Kníničky (NW part of Brno cadastral area, located near Brno reservoir), Brno-Lesná (NE part of Brno cadastral area) and Kuřim (rural area, NW direction from Brno city). Current period (1981−2013) is represented by the data from Brno-Tuřany, Brno-Žabovřesky and Troubsko (temperature and precipitation) and Kuřim (only precipitation). Brno-Žabovřesky station is situated by CHMI's regional office in the urbanized area of NW part of Brno. Troubsko station is located outside of Brno cadastral area in SW direction. The position of all stations used in this study is shown in the figure 1.

Results

Regarding the low temperatures, no significant differences can be seen between particular periods. The number of frost days is always higher compared to the ice days. Frost days occur from September to May and they are the most frequent in January (about 25 days on average). Average annual number ranges from 93 to 108. Ice days can be experienced from November to March. They occur the most often in January (about 12−13 days on average), with the average annual number ranging from 26 to 33. Being defined by the lowest limit value, the arctic days are the less abundant with the shortest period of occurrence (from December to February). Maximum in their annual course is in January just like in the case of frost and ice days. Difference can be seen in their annual average number that reaches the values varying in the order of tenth (see Tab. 1). The trend in number of days with characteristic temperature is rather insignificant with some exceptions including winter and annual values for ice and frost days in the period 1891−1920. Recent period (1981−2013) is characteristic by significant negative trend of April values for frost days. According to the number of days with characteristic temperatures the coldest periods were the first half of the 1890^{s} and 1960^{s} and also the mid-1980^{s} (1985, 1986) and mid-1990^{s} (1996). This corresponds with the results for cold spells that shows the maximum lengths in the above mentioned periods (see Tab. 2).

The conditions with high temperatures can be described by the occurrence of summer and tropical days. In contrast to the low temperature conditions, the differences between particular periods are obvious. Regarding the summer days, we can see that their average annual number gets higher when we go from the most ancient (1891−1920) to the recent (1981−2013) period with the values increasing from about 35 to 69 days per year. According to these average annual values, the highest number or summer days in the recent period shows urban station Brno-Žabovřesky. The occurrence at other stations that represents rather rural environment (margins of urban area) is slightly lower but still higher than in the previous periods (see Tab. 3). Summer days normally occur from April to October being the most frequent in July. Moreover, the latest period differs from both previous by significant positive trend of annual and summer values. Statistically significant trend appears at all stations also in June.

Nearly the same is true for tropical days that are logically less frequent compared to the summer days. Their average annual number more than quadrupled from 4 in the period 1891−1920 at Brno-Pisárky to 19 in the period 1981−2013 at the urban station at Brno-Žabovřesky. The occurrence of tropical days in the annual course is about 1-2 months shorter than for summer days and is restricted to the period from April (May) to September with the maximum frequency in the month of July. Recent period 1981−2013 is characteristic by statistically significant positive trend in number of tropical days for June, July, summer season and year as a whole. As a result of this positive trend, we can see statistically significant prolongation of hot spells defined either by the limit value of Tmax ≥ 25 °C or Tmax ≥ 30 °C (see Tab. 4). According to the number of days with characteristic temperatures and to the maximum length of hot spells, the hottest periods were the very beginning of the 1890^{s}, 1970^{s} and 1980^{s}. In the latest period, the longest hot spell appeared in most cases from the-mid July to mid-August 1994 (see Tab. 4). However, the overall number of summer or tropical days was highest in 2003 when urban station in Brno-Žabovřesky experienced 101 summer days and 42 tropical days.

Regarding the dry spells, we can observe that the average of their maximum annual length decreases as we increase the limit value of daily precipitation amount. Average maximum length of periods completely without precipitation (the limit value of daily precipitation amount is 0,1 mm) is about 17-18 days. When we set the limit value to 1,0 mm, it increases to 25-27 days. The duration of longest dry periods defined by the limit of 3,0 mm ranges from 38 to 47 days while the highest values were reached in the last studied period (see Tab. 5-7). According to the absolute maximum length of dry spells, dry period lasting from the early 1970^{s} to the beginning of second half of 1970^{s} can clearly be seen during the WMO normal period. Dry spell at various stations occurred in winter 1972/1973 lasting from early December to mid-January, in winter/spring 1974 (from the end of February to the first decade of May) and in winter/spring 1976 (from mid-February to mid-April). Two stations show the occurrence of the longest dry spell defined by limit value 1,0 mm at the turn of the year 1989 and 1990 (from last decade of December to first decade of February). In other cases dry period in these days appeared as well, but it was not as long as was the dry spell during the 1970^{s}. During the last studied period (1981−2013) the driest part appeared just close to its end, in the years 2010 and 2011. The period with daily precipitation amount below 3 mm lasted from mid-December 2010 to mid-March 2011. Apparently dry was the autumn 2011. Between the end of October and the beginning of December no precipitation was detected. The period completely without precipitation lasted from 28 days (Troubsko) to 37 days (Brno-Tuřany). However, the trend in the length of dry spells is rather insignificant. Significant trend can be observed in the last studied period in winter and especially in December reaching values from 1,8 day per 10 years in Brno-Tuřany to 3,3 days per 10 years in Troubsko (see Tab. 7).

Conclusions

Bioclimatological conditions in Brno, the second largest city of the Czech Republic, were studied. They were described with the help of temperature and precipitaiton characteristics including number of days with characteristic low and high temperatures (arctic, ice, frost, summer and tropical days), the length of cold and hot spells as well as the length of dry spells. To be able to detect the changes in the bioclimatological conditions in time, three different time „slices“ from after Mendel's era to present days were used.

It comes from the obtained results, that the biggest changes are experienced in case of high temperatures and hot spells. In the recent period (1981−2013) number of summer and tropical days was slightly higher and the hot spells were longer compared to the preceding periods. Statistically significant positive trend in number of summer and tropical days was found at all stations. This significant trend applied for year as a whole, as well as for summer season, the month of June (both types of days) and the month of July (only tropical days). The same positive tendency can be seen for the maximum length of hot spells. In the period 1981−2013 hot spells defined by the limit value 25 °C in the month of June prolonged from 2,1 days per decade in Brno-Tuřany to 2,9 days per decade in Brno-Žabovřesky. Hot spells defined by the limit value 30 °C prolonged from 1,4 days per decade in Brno-Tuřany to 1,8 days per decade in Troubsko in the summer season. The trends in both preceding periods were in the majority of cases statistically insignificant. It should be noted that the highest average number of both summer and tropical days and the biggest average and maximum length of hot spells showed urban station Brno-Žabovřesky.

In the last years, hot spells tend to occur together with the dry periods. Examples of this phenomenon can be seen in spring 2011, autumn 2011 or summer 2013. However, the trend of the maximum length of dry spells does not show systematic statistical significance even in the period 1981−2013. Their maximum annual length is on average slightly smaller in the period 1961−1990 while other two periods are comparable. Absolute maximum length of dry spells is for particular definition of the dry spells comparable between all studied periods.

Low temperature conditions and their extremes can have significant influence on mortality of elderly persons or people suffering from some chronic diseases. Regarding the parameters describing such conditions, not many differences between particular studied periods or statistically significant tendencies can be seen. The only exception is the occurrence of significant negative trend in the number of frost days in April reaching values around 1 day per decade in the recent period which corresponds with the tendency for “earlier” beginning of spring in the last years.

Generally, we can say that in the region of Southern Moravia that represents one of the warmest parts of the Czech Republic cold weather is not such a big problem as the warm weather. Last three decades are typical by the prolongation of hot spells and increasing number of characteristic days with high temperature. Hot spells are often accompanied by the shortage of precipitation that is evident in warm and cold part of the year, as well. However, the prolongation of maximum length of dry spells did not reach the statistical significance yet. This may result from changing character of precipitation in the urban environment. They occur more frequently in the form of torrential rains. Despite their short duration, such episodes interrupt long periods without precipitation.

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Summary

Článek se zabývá hodnocením bioklimatologických podmínek na území města Brna, které představuje druhou nejrozsáhlejší urbánní oblast v České republice (ČR). V katastru Brna se nacházejí zajímavá území chráněné přírody, město je významým centrem kulturního i univerzitního života. Otázkou je, zda svým obyvatelům nabízí kvalitní podmínky pro život i po jiných stránkách zahrnujících např. čistotu životního prostředí či bioklimatologické poměry.

Bioklimatologické podmínky lze hodnotit s pomocí speciálních indexů zohledňujících vlivy různých meteorologických prvků. Kromě teploty vzduchu, považované často za nejdůležitější ukazatel, se jedná o charakteristiky vlhkosti vzduchu a rychlost větru, které mají značný vliv na teplotu pocitovou, či o charakteristiky slunečního záření, které ovlivňuje tvorbu sekundárních znečištěnin v ovzduší.

Vzhledem k dostupnosti dat však byly užity pouze charakteristiky založené na maximální a minimální teplotě vzduchu a denních úhrnech srážek. Analýzy byly provedeny ve třech různých časových “řezech” zahrnujících přelom 19. a 20. století (1891−1920), normálové období Světové meteorologické organizace (1961−1990) a současné období reprezentované etapou 1981−2013. Pro všechna období byly stanoveny počty dní s charakteristickou teplotou vzduchu (letní, tropické, mrazové, ledové a arktické dny), výskyt tzv. horkých vln, studených vln a suchých period. Horká vlna byla definována jako období po sobě následujících (minimálně dvou) dní s maximální teplotou vzduchu větší nebo rovnou 30 °C, případně 25 °C (užity 2 různé definice). Studená vlna je obdobím po sobě jdoucích dní s maximální teplotou vzduchu pod 0 °C. Jako “suchá perioda” bylo označeno období, kdy denní srážkový úhrn nedosáhl hodnoty 0,1 mm, resp. 1,0 mm či 3,0 mm (3 různé limitní hodnoty).

Byly stanoveny počty dní s charakteristickou teplotou vzduchu, jejich roční chod a trend a trend maximálních ročních délek horkých a studených vln a suchých period. Vzhledem k charakteru analyzovaných časových řad byly pro určení velikosti trendu a hodnocení jeho statistické významnosti aplikovány neparametrické metody (Senova metoda, Mann-Kendallův test). Pro každé ze studovaných období byl k dispozici jiný počet stanic (1891−1920: 1 klimatologická stanice, 1961−1990: 1 klimatologická a 3 srážkoměrné stanice, 1981−2013: 3 klimatologické a 1 srážkoměrná stanice).

Z dosažených výsledků vyplývá, že největší změny v čase se týkají podmínek s vysokou teplotou vzduchu. V posledním studovaném období došlo ke zvýšení počtu letních i tropických dní a byl detekován statisticky významný trend pro rok, letní sezonu, červen a červenec. Dále se projevilo statisticky významné prodloužení maximální délky horkých vln.

V posledních letech bylo na jižní Moravě extrémně teplé počasí často doprovázeno výskytem nízkých srážkových úhrnů (např. roky 2011 a 2013), což může být z bioklimatologického hlediska nebezpečné kvůli akumulaci znečištěnin. Statistická významnost trendu maximální délky suchých period však potvrzena nebyla.

Charakteristiky založené na nízké teplotě vzduchu nevykazují významný trend ani výrazné změny mezi jednotlivými obdobími. Výjimku představuje pouze počet mrazových dní, u nehož byl v posledním studovaném období detekován významný klesající trend na jaře. Je patrné, že z bioklimatologického hlediska v regionu jižní Moravy, který patří k nejteplejším oblastem ČR, nepředstavuje chladné počasí či výskyt studených vln tak výrazný problém jako počasí extrémně teplé.

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Tab. 1 Basic statistics and trends of days with characteristic low temperatures in 3 different periods

1891−1920					
Station / characteristic	**Occurrence**	**Max.average monthly number, month of occurrence**	**Average annual number**	**Absolute annual max, year of occurrence**	**Significant trend** (days / year)
BPIS- arctic days	XII-I	0,37 (I)	0,47	3 (1893)	−
BPIS- ice days	XI-III	12,87 (I)	29,33	57 (1895)	-0,30 (XII), -0,81(year), -0,64 (DJF)
BPIS- frost days	IX-V	25,83 (I)	107,47	131 (1891)	-0,19 (I), -0,17(II), -0,19 (XII), -0,80 (year), -0,50 (DJF)
1961−1990					
Station / characteristic	**Occurrence**	**Max.average monthly number, month of occurrence**	**Average annual number**	**Absolute annual max, year of occurrence**	**Significant trend** (days / year)
BTUR- arctic days	XII-II	0,47 (I)	0,70	7 (1985)	−
BTUR- ice days	XI-III	13,53 (I)	32,60	70 (1963)	−
BTUR- frost days	IX-V	26,03 (I)	104,23	135 (1965)	-0,29 (XII)
1981−2013					
Station / characteristic	**Occurrence**	**Max.average monthly number, month of occurrence**	**Average annual number**	**Absolute annual max, year of occurrence**	**Significant trend** (days / year)
BTUR- arctic days	XII-II	0,42 (I)	0,61	7 (1985)	−
BTUR- ice days	XI-III	12,15 (I)	31,06	58 (1996)	−
BTUR- frost days	X-V	24,18 (I)	99,49	129 (1996)	-0,10 (IV)
BZAB- arctic days	XII-II	0,27 (I)	0,33	7 (1985)	−
B ZAB- ice days	XI-III	10,70 (I)	25,94	49 (1986)	−

BZAB- frost days	X-V	23,73 (I)	93,90	121 (1996)	-0,11 (IV)
TROU- arctic days	XII-II	0,27 (I)	0,31	6 (1985)	−
TROU - ice days	XI-III	11,64 (I)	29,09	57 (1996)	−
TROU - frost days	X-V	25,00 (I)	107,94	126 (1986)	-0,12 (IV)

Tab. 2 Basic statistics and trends of length of cold spells in 3 different periods

1891−1920			
Station	**Average annual max** (days)	**Absolute max** (days)	**Significant trend** (days / year)
BPIS	10,83	33 (23.12. 1892 – 24.1. 1893)	-0,09 (II), -0,18 (XII)
1961−1990			
Station	**Average annual max** (days)	**Absolute max** (days)	**Significant trend** (days / year)
BTUR	11,93	33 (8.1.– 9.2. 1963)	−
1981−2013			
Station	**Average annual max** (days)	**Absolute max** (days)	**Significant trend** (days / year)
BTUR	11,00	31 (21.12. 1996 −20.1. 1997)	−
BZAB	8,91	29 (24.12.1984 – 21.1. 1985)	−
TROU	9,79	28 (25.12.1984 – 21.1. 1985)	−

Tab.3 Basic statistics and trends of days with characteristic high temperatures in 3 different periods

1891‒1920					
Station / characteristic	**Occurrence**	**Max.average monthly number, month of occurrence**	**Average annual number**	**Absolute annual max, year of occurrence**	**Significant trend** (days / year)
BPIS - summer days	IV-X	11,47 (VII)	35,30	73 (1917)	‒
BPIS- tropical days	V-IX	1,80 (VII)	4,17	15 (1892)	‒
1961‒1990					
Station / characteristic	**Occurrence**	**Max.average monthly number, month of occurrence**	**Average annual number**	**Absolute annual max, year of occurrence**	**Significant trend** (days / year)
BTUR-summer days	IV-X	14,97 (VII)	46,53	74 (1983)	‒
BTUR- tropical days	VI-IX	6,20 (VII)	7,30	18 (1971)	‒
1981‒2013					
Station / characteristic	**Occurrence**	**Max.average monthly number, monthof occurrence**	**Average annual number**	**Absolute annual max, year of occurrence**	**Significant trend** (days / year)
BTUR-summer days	IV-X	17,76 (VIII)	55,12	81 (2003)	0,20 (VI), 0,49 (year), 0,34 (JJA)
BTUR- tropical days	V-IX	5,42 (VII)	11,97	28 (1994)	0,15 (VI), 0,18 (VII), 0,32 (year), 0,31 (JJA)
BZAB- summer days	IV-X	20,88 (VII)	69,15	101 (2003)	0,25 (VI), 0,16 (VIII), 0,82 (year), 0,25 (MAM), 0,50 (JJA)
BZAB- tropical days	IV-IX	7,85 (VII)	19,24	42 (2003)	0,16 (VI), 0,25 (VII), 0,55 (year), 0,50 (JJA)
TROU-summer days	IV-X	18,39 (VII)	58,12	89 (2003)	0,17 (V), 0,25 (VI), 0,83 (year), 0,17

					(MAM), 0,46 (JJA)
TROU- tropical days	IV-IX	5,85 (VII)	13,03	36 (2003)	0,08 (VI), 0,25 (VII), 0,49 (year), 0,44 (JJA)

Tab. 4 Basic statistics and trends of length of hot spells in 3 different periods (hot spells are defined by 2 limit values of Tmax: 25 °C and 30 °C)

1891−1920			
Station	**Average annual max** (days)	**Absolute max** (days)	**Significant trend** (days / year)
BPIS (25°C)	7,90	14 (30.7. – 12.8.1904, 18.7. – 31.7. 1911, 2.8. – 15.8. 1911)	−
BPIS (30°C)	2,03	11 (15.8. – 25.8. 1892)	−
1961−1990			
Station	**Average annual max** (days)	**Absolute max** (days)	**Significant trend** (days / year)
BTUR (25 °C)	11,03	20 (23.7. – 11.8. 1971)	-0,11 (VI)
BTUR (30 °C)	2,73	6 (16.7. – 21.7. 1972)	−
1981−2013			
Station	**Average annual max** (days)	**Absolute max** (days)	**Significant trend** (days / year)
BTUR (25 °C)	13,58	32 (11.7. – 11.8. 1994)	0,21 (VI)
BTUR (30 °C)	4,52	17 (22.7. – 7.8. 1994)	0,08 (VII), 0,14 (year), 0,14 (JJA)
BZAB (25°C)	17,18	39 (6.7. – 13.8. 1995)	0,29 (VI)
BZAB (30°C)	5,88	19 (21.7. – 8.8. 1994)	0,13 (VI), 0,17 (year), 0,17 (JJA)
TROU (25 °C)	13,42	32 (11.7. – 11.8. 1994)	0,25 (VI), 0,21 (year), 0,21 (JJA)
TROU (30 °C)	4,82	17 (22.7. – 7.8. 1994)	0,12 (VII), 0,18 (year), 0,18 (JJA)

Tab. 5 Basic statistics and trends of length of dry spells in the period 1891–1920 (dry spells are defined by 3 limit values of daily precipitation amount: 0,1 mm; 1,0 mm a 3,0 mm)

1891−1920			
Station	**Average annual max** (days)	**Absolute max** (days)	**Significant trend** (days / year)
BPIS (0,1 mm)	18,70	41 (18.10. – 27.11. 1920)	+0,08 (VI), -0,14 (IX)
BPIS (1,0 mm)	28,63	50 (12.2. – 2.4. 1899)	−
BPIS (3,0 mm)	44,83	90 (24.8. – 21.11. 1891)	−

Tab. 6 Basic statistics and trends of length of dry spells in the period 1961–1990 (dry spells are defined by 3 limit values of daily precipitation amount: 0,1 mm; 1,0 mm a 3,0 mm)

1961−1990			
Station	**Average annual max** (days)	**Absolute max** (days)	**Significant trend** (days / year)
BKNI (0,1 mm)	16,57	29 (17.2. – 16.3. 1976)	−
BKNI (1,0 mm)	25,37	44 (6.12. 1972 –18.1. 1973)	−
BKNI (3,0 mm)	40,47	81 (20.2. – 11.5. 1974)	−
BLES (0,1 mm)	18,00	34 (13.12. 1972 – 15.1. 1973)	−
BLES (1,0 mm)	27,13	65 (16.2. –20.4. 1976)	−
BLES (3,0 mm)	41,43	75 (28.11. 1963– 10.2. 1964)	-0,44 (IX)
BTUR (0,1 mm)	17,97	39 (8.12. 1972 – 15.1. 1973)	0,14 (V); -0,11 (VI)
BTUR (1,0 mm)	27,60	49 (24.12. 1989 – 10.2. 1990)	−
BTUR (3,0 mm)	41,90	81 (20.2. – 11.5. 1974)	−
KURI (0,1 mm)	18,03	33 (19.3. – 20. 4. 1974)	0,13 (V)
KURI (1,0 mm)	26,33	50 (23.12. 1989 – 10.2. 1990)	0,33 (X)
KURI (3,0 mm)	38,47	69 (16.9. – 23.11. 1969)	−

Tab. 7 Basic statistics and trends of length of dry spells in the period 1981–2013 (dry spells are defined by 3 limit values of daily precipitation amount: 0,1 mm; 1,0 mm a 3,0 mm)

1981−2013			
Station	**Average annual max** (days)	**Absolute max** (days)	**Significant trend** (days / year)
BTUR (0,1 mm)	18,00	37 (27.10. – 2.12. 2011)	−
BTUR (1,0 mm)	28,30	49 (24.12. 1989 – 10.2. 1990)	0,18 (XII) ; -0,25 (year)
BTUR (3,0 mm)	43,42	86 (11.11. 1998 – 4.2. 1999; 21.12. 1997 – 16.3. 1998)	−
BZAB (0,1 mm)	18,27	35 (27.10. – 30.11. 2011)	−
BZAB (1,0 mm)	26,42	50 (23.12. 1989 – 10.2. 1990)	−
BZAB (3,0 mm)	44,06	93 (13.12. 2010 – 15.3. 2011)	−
KURI (0,1 mm)	18,15	36 (27.10. – 1.12. 2011)	0,16 (III); -0,11 (XI)
KURI (1,0 mm)	27,55	50 (23.12. 1989 – 10.2. 1990)	-0,30 (II); -0,25 (III); 0,14 (VI); -0,13 (VII); 0,15 (XII)
KURI (3,0 mm)	40,42	85 (21.12. 2010 –15.3. 2011)	-0,33 (X)
TROU (0,1 mm)	17,94	28 (5.11. – 2.12. 2011)	0,14 (XII); 0,18 (DJF)
TROU (1,0 mm)	26,30	42 (6.4. – 17.5. 2000)	0,33 (XII)
TROU (3,0 mm)	46,49	86 (11.11. 1998 – 4.2. 1999)	−