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CONTEMPORARY AIR TEMPERATURE CHARACTERISTICS IN THE REGION OF OLSZTYNEK, POLAND

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Monika Ostrovska, Nina Nikolova. CONTEMPORARY AIR TEMPERATURE CHARACTERISTICS IN THE REGION OF OLSZTYNEK, POLAND

The topicality of present research work is determined by the importance of air temperature for the ecosystems and human activity. The paper investigates the peculiarities of air temperature at the region of Olsztynek, northeastern Poland. The study is based on the daily data for the period 2014–2017. The annual cycle of monthly average, maximum and minimum temperature is analysed. The air temperature characteristics are presented by the following climate indices: number of frost days, number of icing days, summer days and growing season length. The results from the investigation show that contemporary air temperature characteristics in the region of Olsztynek are in coincidence with the regional and global climate change tendencies. From other side the local peculiarities are important for climate change mitigation and adaptation.

Key words: air temperature, climate indices, Olsztynek, Poland.

INTRODUCTION

Climate change is one of the most important challenges in the recent decades. According to World Meteorological Organization (WMO, 2018.) the year 2018 is the fourth warmest year since the beginning of the meteorological observation after 2016, 2017 and 2015. Many research works point out that due to climate change more frequent storms, floods, heat waves, droughts, storms, fires, sudden frost hits, rising sea and ocean levels and economic losses associated with them, climate migrations, easier spread of infectious diseases and even increased political tensions await us (World Wide Fund for Nature, 2019). The scientists are agree that the anthropogenic activity is the main cause for recent climate change. Even if we assume that global carbon dioxide emissions stop growing now, it will still need costly adaptation to the effects of climate change that can no longer be prevented (Starkel i Kundzewicz, 2008). That is why it is important to monitor temperature tendency and be aware of climate change. If some trends in weather changes will be estimated, we can more easily adjust to them and take action to make adaptation strategy. Making climatic research means also rising of public awareness about the climate changes.

The tendency to warming is a characteristic feature of the climate change in Poland in the second half of the 20th century when the air temperature increased by 0,8 °C (Fortuniak et al. 2001; Kożuchowski and Żmudzka 2001). The strongest temperature increase occurred in the western part of Poland. A significant increase in temperature occurred in the spring, winter was warmer. In June and in the autumn, there was a slight cooling. The consequence of the seasonally different trends in air temperature, were changes in the start and end dates of the growing season (Żmudzka 2012). The trends of average annual air temperature in 10-year periods indicated its decline until the end of the 1970s. Then there was a clear increase in the last decades. A particularly large increase in temperature was observed in this century (Michalska 2011).

On the basis of daily air temperature for the period 1951–2005 Kejna et al. (2009) make conclusion that the number of days with Tmin < 0 °C decreases for most parts of Poland and there is a positive trend in the occurrence of hot days (Tmax > 25 °C).

The effects of climate change are observed in agriculture and forestry. There are changes in the phenology of crop plants and the extent of pests. In Poland, as well as in Central and Northern Europe, the length of the growing season increased, and this affects the shift of the crops calendar and agricultural practices (Kundzewicz 2011).

Despite of growing publication on the topic of climate change and air temperature in Poland in particular, there is a need to clarify the local feature of climate. The aim of present research work is to assess the thermal conditions at the Olsztynek station in the northeast of Poland in the period 2014–2017. In order to achieve this aim the following tacks are solved: 1) analysis of annual cycle of air temperature; 2) determination of frequency of occurrence of extreme cold and extreme hot days; 3) assessment of growing season length (GSL).

STUDY AREA, DATA AND METHODS

Olsztynek it is a city situated in northern Poland near the bigger city Olsztyn. It is around 100 km far from the Baltic Sea at the altitude 164 m a.s.l. (fig. 1.)

Fig. 1. Geographical position of the study area

The region has a moderate climate with continental and oceanic influence. There is a large variation in temperatures during the winter and summer seasons. The winters are very mild with no ice and snow cover, and from other side the days with extremely low temperatures and very cold weather can be observed. The winter is the cloudiest season with the negative monthly air temperatures during all winter months (December–January–February). The hottest month is July with average air temperature 18,3 °C (for the period 1982–2012, https://en.climate-data.org). Fromm the other side very hot or very cold air advections can be observed in summer. The annual precipitation total is around 550–570 mm. The prevailing winds are with western directions, but there is a relatively large number of windless days.

The present research work is based on the daily data for air temperature at the Olsztynek station. The data are published in Monthly Climate Report available at website (Miesięczne raporty klimatyczne, 2018). The studied period is determined by data availability. The paper investigates the observed changed in air temperature at the region of Olsztynek for the period 2014–2017. These years are between the five warmest years in the record on global scale. From the daily data monthly average, maximal and minimal temperatures are calculated. In order to achieve the aim of the study the extreme temperature insides as frost days (FD), icing dais (ID) and summer days (SD) are analyzed. The indices are determined according the definitions given by Climdex project (https://www.climdex.org/).

The frost days (FD) are the days with daily minimum temperature < 0 °C and the icing days (ID) are the days with daily maximum temperature < 0 °C. As summer days (SU) we consider the days with the daily maximum temperature > 25 °C.

The thermal conditions in the investigated area are characterized also by the growing season length (GSL). The first occurrence of at least six consecutive days with *daily average temperature* > 5 °C is accepted as the beginning of GSL and the first occurrence after 1st July of at least six consecutive days with *daily average temperature* < 5 °C is the end of GSL.

RESULTS AND DISCUSSION

Annual cycle of air temperature

For the investigated period (2014–2017) the annual cycle of the air temperature shows the maximum in June (18,6 °C) and minimum in January (-3,6 °C) which determines the annual temperature range of 22,1 °C. The average maximum air temperature reach the highest value in August (24,4 °C) and average minimum temperature is the lowest in January (-5,8 °C), Fig. 2. The data for the period 1982–2012 show similar values for summer time (July is the warmest month with monthly average 18,3 °C) but the average temperature in January is lower (-5,7 °C). According to Grabowska and Panfil (2007) the highest average maximum temperatures in the north-eastern Poland for the period 1951–2005 occurred in the summer months (July and August) exceeding 22 °C. The coldest months were January and then February; the average minimum temperatures from December to March were negative.

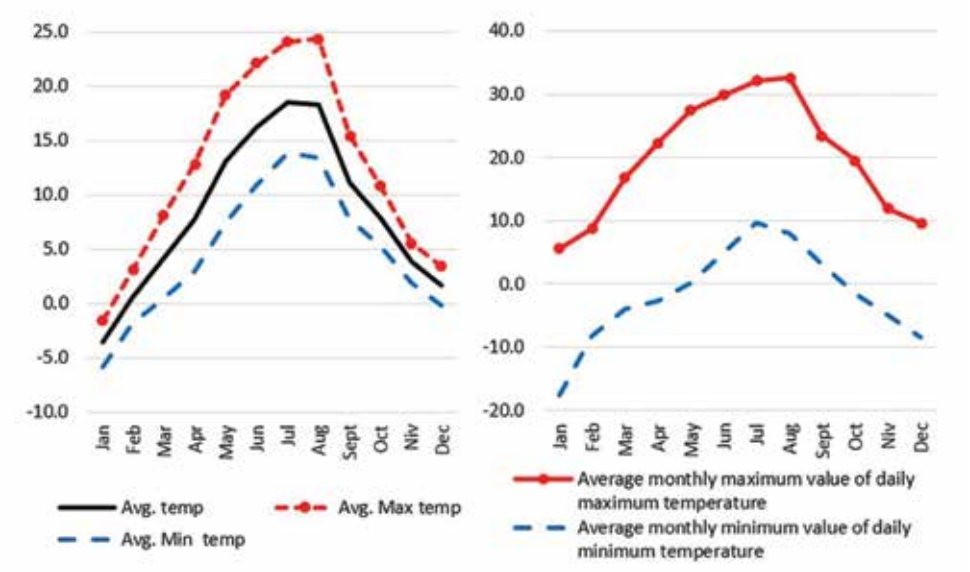

Fig. 2. Annual cycle of air temperature at station Olsztynek for the period 2015–2018

The absolute maximum and minimum temperatures at the region of Olsztynek vary in wide limits – for absolute maximum temperature between 5,6 °C (January) and 32,6 °C (August) and for absolute minimum temperatures between -17,5 °C (January) and 9,7 °C (July), fig. 2. Grabowska and Panfil (2007) report the following values for the absolute maximum in north-eastern Poland: 36,5 °C recorded in Elbląg in 1994; 36,2°C in 1992 in Olsztyn and 35,3 °C in Suwałki in 1959.

Number of frost days (FD)

The frost days are characteristic for the winter season but some FD are observed also in autumn and spring (tabl. 1.). According the occurrence of FD the coldest month is January 2017 when all days were FD. The average number of FD for the investigated period is 83 and the highest number is established for 2017. From the other side in September only in 2015 there were FD, and in May FD are occurred in 2014 (2 days) and in 2017 (3 days). The investigated area is one with the shortest frost-free period in Poland. According to Tomczyk et al. (2015) the frequency of occurrence of May frosts increases from west to east. The highest number of frosts was recorded in May 1980 in Olsztyn (12 days). Tomczyk et al. (2015) point out that the severe frosts are associated mainly with the anticyclonic circulation.

Table 1

Number of frost days (Tmin < 0 °C)

month/year	2014	2015	2016	2017
September	0	3	0	0
October	4	5	1	1
November	6	6	14	4
December	16	8	20	18
January	20	no data	24	31
February	21	20	13	19
March	9	14	15	14
April	6	3	4	6
May	2	0	0	3
Annual sum	84		91	96

Number of icing days (ID)

The icing days are observed between November and February. The highest number of icing days occurred in 2014. The highest number of ID is observed in January (fig. 3).

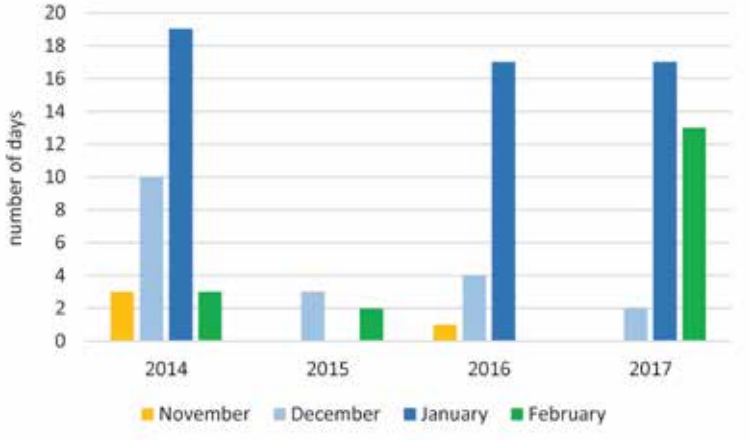

Fig. 3. Number of icing days for the period 2014–2017

Despite there is no data in the record for January 2015 this year is most likely to be with the lowest number of ID followed by the year 2016. On the average level there is an opposite distribution between FD and ID – the number of FD increases from 2014 to 2017 while the number of ID decrease.

Number of summer days (SU)

According to the distribution of SU the warmest year is 2015 followed by 2014. The lowest number of SU is established for the year 2017. The average annual number of SU for the investigated period is 37. The maximum number of SU is observed in August, 2015 and July, 2014, fig. 4. The extreme heat during the summers of 2015 have been noticed by Wypych et al. (2015) who confirmed the significant increase in summer maximum air temperature in Poland.

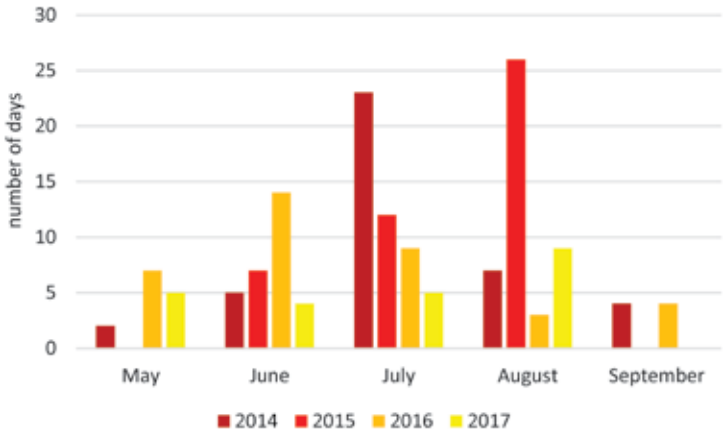

Fig. 4. Monthly distribution of number of summer days (SU)

Summer days are observed in September 2014 and 2016 (four days each year) and in May with maximum value in 2016 (7).

Growing season length

The growing season length (GSL) is an important indicator for thermal conditions at the territory which has big influence on development of agricultural plants and natural vegetation. At the investigated region the GSL has duration about 230–240 days (tabl. 2).

Table 2

		Duration of growing season length	
	GSL – days	beginning	end
2014	242	17 Mar	15 Nov
2015	229	8 Apr	21 Nov
2016	213	2 Apr	31 Oct
2017	234	27 Mar	17 Nov

Despite that the year 2016 is the warmest year on the record in global scale and the number of summer days at the investigated region is higher in this year the GSL is shorter that in other years from the analyzed period. Generally the growing season starts at the end of March and the beginning of April and finish in the middle of November.

The effects of climate change are observed in agriculture and forestry. There are changes in the phenology of crop plants and the extent of pests. In Poland, as well as in Central and Northern Europe, the length of the growing season increased, and this affects the shift of the crops calendar and agricultural practices. (Kundzewicz 2011).

CONCLUSION

The present paper investigates the peculiarities in air temperature regime at the region of Olsztynek, northeastern Poland during the last years (2014–2018). The annual cycle of the air temperature is in coincidence with the regional characteristics. The annual temperature range is about 22–24 °C but the absolute extreme temperatures vary in wide limits: from -17,5 °C in January to 32,6 °C in August.

The highest number of frost days is established during the winter period December–February while the icing days are characteristic mainly for January.

The distribution of summer days confirms the regional and global climate features that the year 2016 is the warmest in the record. There is no tropical nights in the investigated area during the period 2014–2017.

The results from present research work are important for clarification local peculiarities of climate which could bring to better development of measurements for climate change mitigation and adaptation.

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