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THERMAL AND PRECIPITATION CONDITIONS DURING THE LONG MAY WEEKEND IN POLAND AND THEIR CIRCULATION CONDITIONS

WARUNKI TERMICZNE I OPADOWE PODCZAS DŁUGIEGO WEEKENDU MAJOWEGO W POLSCE ORAZ ICH CYRKULACYJNE UWARUNKOWANIA

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Abstract

The objective of the study was to characterise the thermal and precipitation conditions in Poland during the long May weekend and to determine their circulation conditions. This study was based on mean daily air temperature values and daily precipitation totals for the period of 1–3 May in the years 1966–2023. The data were obtained from the resources of the Institute of Meteorology and Water Management – National Research Institute, and made it possible to calculate the mean air temperature for long May weekends in all stations, as well as the precipitation totals. The study revealed the spatial variability of thermal conditions during the May weekend in Poland. The coolest areas were northern regions, and particularly the Baltic coast, because of the cooling effect of the sea. The warmest regions were the southern and southwestern areas of the country. Spatial variability was also observed for the precipitation totals. The lowest totals were primarily recorded in central Poland and in the northern regions. Three groups of May weekends were designated in the years under study. The first group was characterised by lower than

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average air temperature, but higher precipitation, the second one by lower than average air temperature and lower precipitation, and in the third group air temperature was higher than the average, and precipitation was lower. Each of the types was characterised by a different baric situation.

Keywords: air temperature, precipitation, long May weekend, atmospheric circulation, Poland.

Streszczenie

Celem pracy była charakterystyka warunków termicznych i opadowych występujących w Polsce podczas tzw. długiego weekendu majowego oraz określenie ich cyrkulacyjnych uwarunkowań. W pracy wykorzystano średnie dobowe wartości temperatury powietrza oraz dobowe sumy opadów w okresie 1–3 maja w latach 1966–2023, które pozyskano z zasobów Instytutu Meteorologii i Gospodarki Wodnej – Państwowego Instytutu Badawczego. Dane pozwoliły na obliczenie średniej temperatury powietrza oraz sum opadów w pierwszych dniach maja w poszczególnych latach. Badania wykazały przestrzenną zmienność warunków termicznych podczas weekendu majowego w Polsce. Najchłodniejszymi obszarami były regiony północne, a zwłaszcza wybrzeże Bałtyku, ze względu na chłodzące działanie morza. Najcieplejszymi regionami były południowe i południowo-zachodnie obszary kraju. Zmienność przestrzenną zaobserwowano także w przypadku sum opadów. Najniższe sumy notowano przede wszystkim w Polsce centralnej i regionach północnych. W badanych latach wyznaczono trzy grupy weekendów majowych. Pierwszą grupę charakteryzowała niższa od przeciętnej temperatura powietrza, ale wyższe opady, druga niższa od przeciętnej temperatura powietrza i mniejsze opady, a w trzeciej grupie temperatura powietrza była wyższa od przeciętnej, a opady były mniejsze. Każdy z typów był związany z inną sytuacją baryczną.

Słowa kluczowe: temperatura powietrza, opady atmosferyczne, weekend majowy, cyrkulacja atmosferyczna, Polska

INTRODUCTION

Intensively progressing climate warming has been observed in recent years, manifested in, among others, the occurrence of further record values of air temperature (*Climate Reanalyzer*, 2023). According to National Oceanic and Atmospheric Administration (NOAA, 2023), since 1880, the ten warmest years have occurred in the last ten years (2014–2023). In recent years, record values have been noted for temperatures in May. According to Copernicus (Copernicus, 2024), the warmest May in the world was observed in 2020, and in Europe in 2018. Similar results were obtained by Marosz et al. (2023) for Poland. The study showed that nine years in the first two decades of the 21st century (2001–2021) were included in the ten warmest years since 1951. This particularly concerned years from the second decade. The consequence of such changes is increasingly frequent occurrence of long and strong heat waves, e.g. in summer 2023 in the southern regions of Europe, but also in the USA and China (*Nauka o klimacie*, 2023). Such changes are of high importance for many areas of the economy, including tourism and tourist behaviour.

Current research has resulted in numerous papers regarding the analysis of thermal, nival, and biometeorological conditions in the holiday period or from the point of view of different sports events. In Poland, research has been conducted into both snow cover (Bednorz, 2006) and thermal conditions (Tomczyk, 2016) in the Christmas period. Similar research has also been carried out, among others, in Ireland (Graham, 2004) and Sweden (Rydén, 2015). In Finland, the perception of climate change by tourists around the Christmas period was analysed in the context of occurrence of snow cover in the county of Santa Claus (Tervo-Kankare et al., 2013). The cited studies revealed that tourists negatively responded to estimated changes and planned adaptation mechanisms. In recent years, biometeorological conditions have also been studied in relation to the organisation of international sports events, and particularly: FIFA World Cup in Qatar (Matzarakis, Fröhlich, 2015) and Olympic Games in Tokio (Kosaka et al., 2018; Matzarakis et al., 2019; Wu et al., 2020) and Paris (Matzarakis, Graw, 2022). In Poland, during the May weekend, the analysis also covered biometeorological conditions and their circulation conditions (Tomczyk, Mendel, 2023). The authors revealed corresponding baric situations. Conditions causing the strongest cold stress were recorded during low-pressure weather, and during high-pressure weather, numerous comfortable days and such with heat stress were observed. This type of research has been, and still is, intensively conducted, because weather and climate are highly important factors affecting tourist traffic and tourist behaviour. As evidenced in earlier research, weather conditions particularly affect unorganised tourists, including weekend and holiday travellers (Borzyszkowski, 2014; Koźmiński, Michalska, 2014; 2016). Previous research conducted in Świętokrzyski National Park revealed that the intensity of tourist traffic depended mainly on the weather factor (Janowski, 2003a, 2005). Similarly, research in the Forest Arboretum of Warmia and Mazury in Kudypy confirmed that weather conditions were one of the factors influencing the number of tourists during the May weekend (Janowski, 2003b).

The objective of the study was to characterise the thermal and precipitation conditions in Poland during the long May weekend and to determine their circulation conditions. The analysed period is one of the most popular weekends in Poland, and the first spring period after Easter that can be used for tourism and recreation. The holiday period results from the accumulation of national holidays: 1 May is celebrated as International Workers Day, 2 May is the Day of the Flag of the Republic of Poland, and 3 May is the National Third of May Holiday. Because weather conditions considerably affect tourist activity, the determination of their causes can be of interest to many social groups. It particularly concerns the determination of conditions causing the occurrence of low air temperature values and precipitation during this weekend, constituting an important factor limiting human outdoor activity. Determining the current rate of changes in weather conditions may be helpful in planning the directions of tourism development in Poland in the following years. Planning tourism development in times of climate change may be a serious challenge in the near future. This problem also concerns the area of Poland, especially the northern and southern regions, where tourist traffic is high.

DATA AND STUDY METHODS

This study was based on mean daily air temperature values and daily precipitation totals for the period 1–3 May in the years 1966–2023. The data were obtained from the resources of the Institute of Meteorology and Water Management – National Research Institute (IMGW-PIB) for 36 synoptic stations in Poland (Fig. 1). All data series were homogenous.

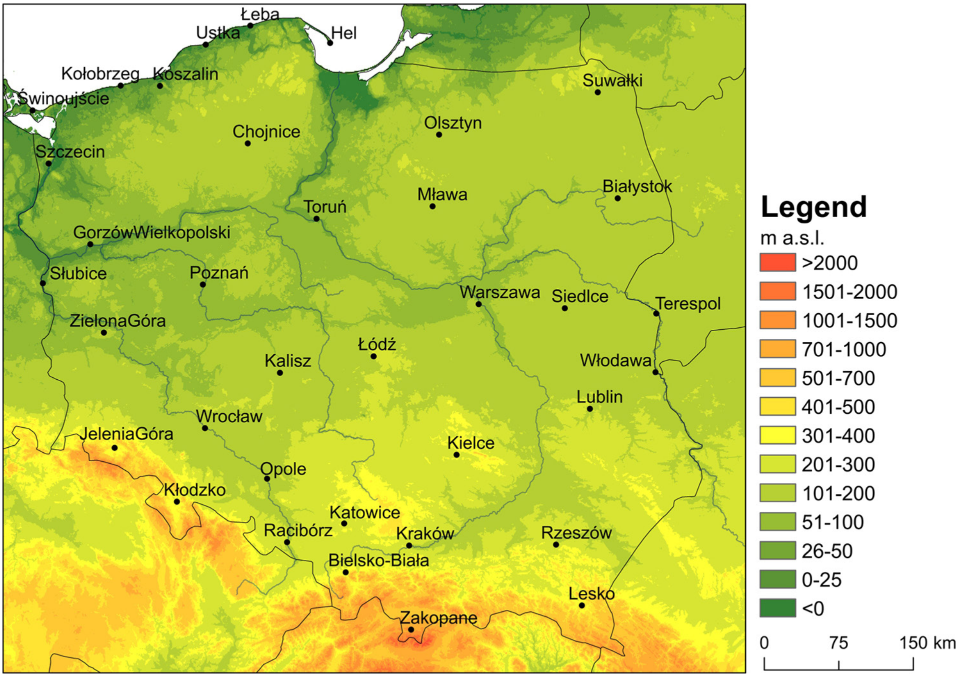

Fig. 1. Location of meteorological stations
Source: own elaboration.

The data made it possible to calculate the mean air temperature for long May weekends in all stations, as well as the precipitation totals. Moreover, the mean multiannual air temperature and precipitation total were calculated for each station. Then, changes in those characteristics in the multiannual period (1966–2023) were analysed, and their statistical significance was verified by means of a t-Student test at a level of significance of 0.05. The mean air temperature and precipitation total as well as their anomalies were presented for selected cases. The anomalies were calculated as the difference between the value of the mean air temperature and precipitation total in a given year, and the mean value of the aforementioned elements in the analysed multiannual period. Based on the mean air temperature and precipitation total, May weekends were grouped using the Ward method (Ward, 1963; Wilks, 1995). The method is based on Euclidean distances. It involves combining two clusters A and B that, as a single combined cluster, provide the minimum total square deviations of all objects from the centre of gravity of the newly formed cluster (Ward, 1963). This hierarchical clustering technique is most frequently used for climatic classification (Kalkstein et al., 1987) for the identification of atmospheric circulation patterns associated with the occurrence of specific weather phenomena (Birkeland, Mock, 1996; Bednorz, 2011).

The characteristics of baric conditions are based on daily values of sea level pressure (SLP) and a height of 500 hPa isobaric surfaces (z500 hPa), as well as their anomalies and anomalies of air temperature at the isobaric level of 850 hPa (T850). Data for the nodes of the geographic grid 2.5×2.5° for the area 25–75°N and 35°W–65°E were obtained from the collection of the National Centre for Environmental Prediction/National Centre for Atmospheric Research (NCEP/NCAR) Reanalysis (Kalnay et al., 1996) available in the archives of NOAA ESRL PSD (Earth System Research Laboratory Physical Science Division). The data permitted the preparation of a map of the mean SLP, z500 hPa and their anomalies, and T850 anomalies for the designated types of May weekends. The anomalies were calculated as the difference between the value of SLP, z500 hPa, and T850 in a given year, and the mean value of the elements in the analysed multiannual period.

RESULTS

In the years 1966–2023, the mean air temperature during the May weekend for the territory of Poland was 11.0°C (Fig. 2, Table 1). Its lowest values were recorded in the northern regions – particularly at the coast of the Baltic Sea, and the highest in the southern regions. In Hel, the mean air temperature reached 8.5°C, and in Opole 12.4°C. The year-to-year variability of the mean air temperature was similar throughout the area. This is suggested by the standard deviation values, ranging from 2.5 to 4.0°C, whereas the lowest values below 3.0°C were re-

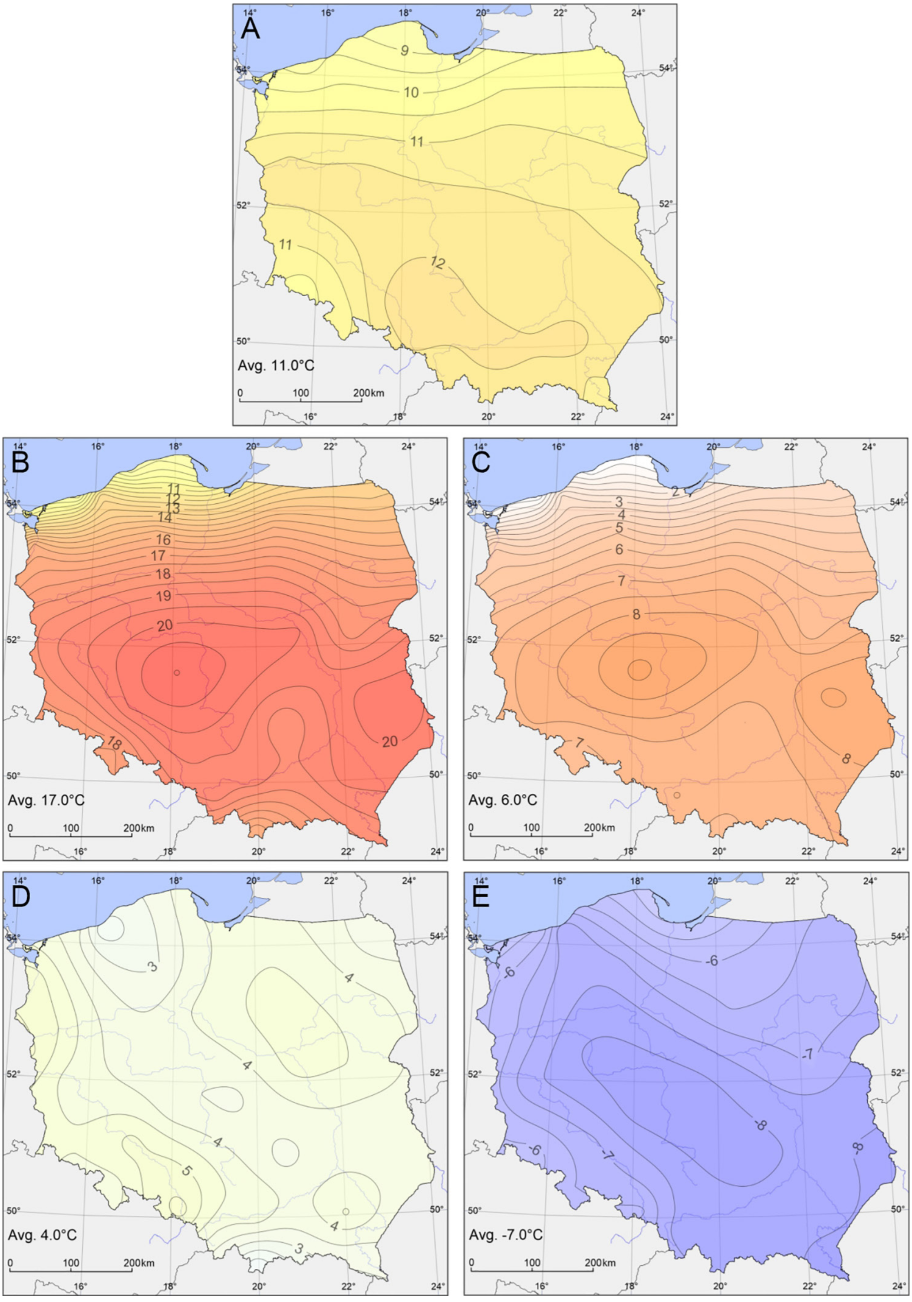

Fig. 2. The average air temperature during the long May weekend in Poland in the period 1966–2023 (A), in 2012 (B) and anomalies (C), in 1985 (D) and anomalies (E)

Source: own elaboration based on IMGW-PIB data.

Table 1. Characteristics of thermal and precipitation conditions during the long May weekend in Poland

Station	Mean temperature [°C]	Warmest weekend		Coldest weekend		Mean precipitation [mm]	Highest precipitation	
		T	Year	T	Year		P	Year
Białystok	10.9	20.1	1977	4.0	1985	4.7	27.2	1991
Bielsko-Biała	11.8	19.3	2012	3.5	1971	8.3	41.0	1989
Chojnice	10.2	16.6	2002	2.9	1981	4.3	25.2	2010
Gorzów Wielkopolski	11.5	18.3	2005	5.0	1985	4.7	34.8	2012
Hel	8.5	13.5	2002	3.6	1970	3.3	30.1	1967
Jelenia Góra	10.3	17.9	2012	3.5	1971	9.4	66.4	1983
Kalisz	11.8	21.0	2012	3.5	1985	5.6	35.9	1985
Katowice	12.2	19.3	2012	4.0	1971	6.0	39.4	2013
Kielce	11.5	18.9	2018	3.3	1985	5.5	37.5	2013
Kłodzko	10.7	17.4	2012	3.5	1971	6.2	48.7	1983
Kołobrzeg	9.1	15.1	1998	3.6	1985	4.2	34.2	1985
Koszalin	9.7	16.4	1972	2.2	1985	5.8	50.5	1988
Kraków	12.2	19.3	2012	4.2	1971	5.3	44.1	2013
Lesko	11.4	19.0	2018	3.3	1985	8.2	52.3	1989
Lublin	11.6	20.2	2012	3.6	1985	6.7	40.0	1983
Łeba	8.6	15.0	1998	3.3	1985	3.4	23.8	2010
Łódź	11.7	20.4	2012	3.4	1985	5.2	34.8	1996
Mława	11.2	18.8	1977	3.5	1970	4.3	40.9	2021
Olsztyn	10.6	17.6	1977	3.3	1970	4.3	49.4	2021
Opole	12.4	19.8	2012	4.6	1971	5.7	36.0	1983
Poznań	11.8	19.5	2012	3.7	1985	4.0	31.5	2021
Racibórz	12.1	19.3	2012	4.7	1971	6.8	48.3	2013
Rzeszów	12.2	20.3	2018	4.6	1985	6.0	53.4	1989
Siedlce	11.5	20.0	1977	4.5	1985	5.7	41.0	2008
Słubice	11.7	19.3	2005	5.6	1985	6.1	56.5	1983
Suwałki	10.1	19.5	1977	3.2	1985	3.7	38.1	2021
Szczecin	11.2	17.1	2005	5.2	1979	3.7	31.4	1998
Świnoujście	9.6	15.2	1988	4.3	1970	3.3	19.9	2015
Terespol	11.8	21.0	1977	4.0	1985	4.2	39.1	2008
Toruń	11.5	18.3	2002	4.1	1985	4.1	53.9	2021
Ustka	8.6	15.0	1972	2.7	1985	4.1	28.6	1987
Warsaw	12.1	20.1	2012	4.7	1985	4.9	36.8	1970
Włodawa	11.8	20.4	1977	3.8	1985	4.1	31.8	1975
Wrocław	12.0	20.1	2012	5.2	1985	6.8	57.5	1983
Zakopane	9.2	16.8	1977	1.6	1985	9.7	67.3	1989
Zielona Góra	11.7	19.9	2005	4.2	1985	5.7	40.5	2021

Source: own elaboration based on IMGW-PIB data.

corded in the coastal zone. The analysed multiannual period showed changes in thermal conditions during the May weekend. Except for one station (Białystok), an increase in the mean air temperature was observed. It was the most intense in southeastern and southwestern Poland, and the least in northeastern Poland. Stations with the highest increase included Zakopane (0.45°C/10 years), Wrocław (0.43°C/10 years), and Rzeszów (0.41°C/10 years).

The analysed period showed a considerable variability of thermal conditions. The coolest May weekend was recorded in 1985, and the warmest in 2012 (Fig. 2, Table 1). In the former case, the mean air temperature for the area was 4.0°C, and it was lower than the average from the multiannual period by 7.0°C (Fig. 3). Its lowest values were recorded in mountain areas and at the coast, with a minimum in Zakopane (1.6°C). The highest values occurred in western and southwestern Poland with a maximum in Racibórz (5.7°C). In those stations, the mean air temperature was lower than average by 7.6°C and 6.4°C, respectively. Nonetheless, these were not the lowest and highest values of anomalies in the study area. These extreme values ranged from −8.4°C (Łódź) to −4.4°C (Hel). The greatest deviations from the multiannual average were observed in central Poland. In 64% of stations, this May weekend was the coolest throughout the analysed period. In the remaining stations, minimum values were recorded in one of the following years: 1970, 1971, 1979, 1981.

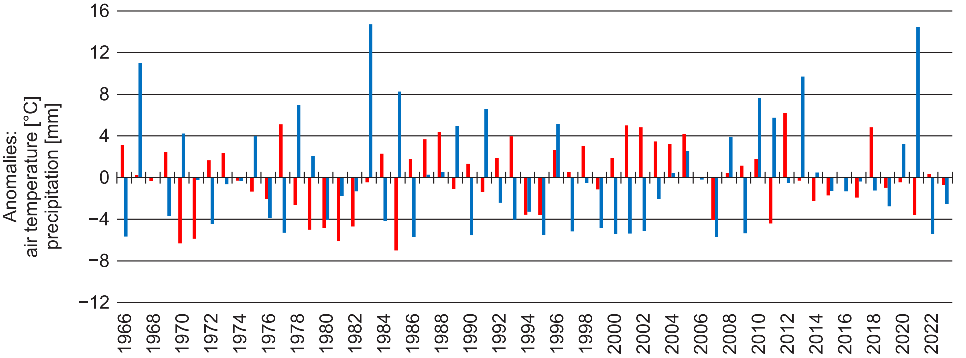

Fig. 3. The average air temperature (red) and precipitation (blue) anomalies in Poland during the long May weekend in the period 1966–2023
Source: own elaboration based on IMGW-PIB data.

The warmest May weekend was noted in 2012. The average for the territory of Poland reached 17.0°C, and was higher than average by 6.0°C (Figs 2 and 3, Table 1). The lowest values of the mean air temperature were recorded at the coast of the Baltic Sea. They gradually increased southwards, reaching the highest values in central and southwestern Poland. In particular stations, its values varied from

8.7°C in Hel to 21.0°C in Kalisz. Throughout the area during that May weekend, the mean air temperature was higher than average. The smallest deviations were recorded at the coast with a minimum in Świnoujście (0.1°C), and similar values were observed in Hel, Kołobrzeg, and Ustka (0.2°C). The highest anomalies were recorded in the area of the highest mean air temperature values with a maximum in Kalisz (9.2°C). In 36% of the stations, it was the warmest May weekend in the entire multiannual period. In the remaining stations, minimum values were recorded in one of the following years: 1972, 1977, 1988, 1998, 2001, 2002, 2005, 2018.

In the period of 1966–2023, the mean precipitation total in Poland during the May weekend was 5.4 mm (Fig. 4, Table 1). The lowest totals were recorded in

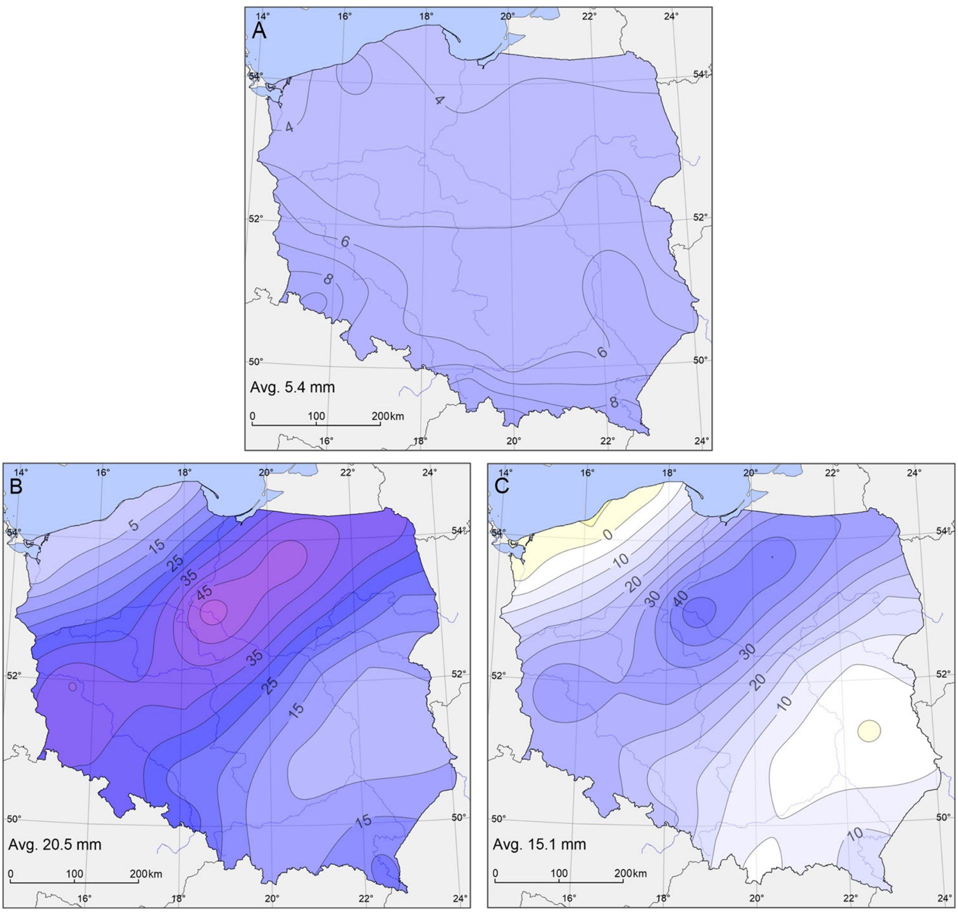

Fig. 4. The average precipitation total during the long May weekend in Poland in the period of 1966–2023 (A), in 2021 (B) and anomalies (C)
Source: own elaboration based on IMGW-PIB data.

central and northern Poland except for the middle coast, and the highest in the southern regions, particularly in areas located higher above sea level. In particular stations, the mean precipitation total varied from 3.3 mm in Hel and Świnoujście to 9.7 mm in Zakopane and 9.4 mm in Jelenia Góra. The analysed multiannual period showed high year-to-year variability of precipitation. Only in one year no precipitation was recorded in any of the stations during the first three days of May, namely in 1986. Similar conditions were observed in 2007, when in only two stations (Łeba, Olsztyn) precipitation of 0.1 mm was recorded in each.

Against the background of the entire multiannual period, two years particularly stood out in terms of the precipitation total, namely 2021 and 1983. Each of these years saw the highest precipitation total in five stations throughout the period. In 2021, the mean precipitation total for the entire area was 20.5 mm (the total was higher than the multiannual average by 15.1 mm) despite its high spatial variability. The highest totals were recorded in the belt from the northeast through the central regions, reaching the southwestern borders of the country. In northwestern and southeastern regions, the totals were considerably lower, and in two stations no precipitation occurred. The highest precipitation total was recorded in Toruń, reaching 53.9 mm, i.e. higher than the multiannual average by as much as 49.8 mm. The anomalies were negative only at the coast, where rainfall was lower during the May weekend than average in the multiannual period. In 1983, the mean precipitation total for the entire area was somewhat lower, and reached 19.7 mm (the total was higher than the multiannual average by 14.3 mm). The spatial distribution of the recorded totals differed from the distribution in 2021 (Figs 3 and 4, Table 1). The highest precipitation totals were observed in southwestern and southeastern Poland. In seven stations (mainly from the northern regions), no precipitation was recorded. The highest precipitation total was recorded in Jelenia Góra. It reached 66.4 mm and was higher by 57.0 mm than the multiannual average. In northern regions, the anomalies were negative.

The study permitted the designation of three types (groups) of May weekends depending on thermal and precipitation conditions. At the first stage, 14 weekends were classified, characterised by air temperature lower than the average for the multiannual period, and precipitation totals higher than the average. The coolest May weekend in the period (from 1985) was classified in this group, as well as May weekends with high precipitation totals (from 1983 and 2021). The mean air temperature in the analysed periods increased from the north to the south, and particularly towards the southeast (Fig. 5). In particular stations, it varied from 6.5°C in Łeba to 11.5°C in Rzeszów, whereas the average for the entire area reached 9.4°C. On the discussed May weekends, the mean air temperature was lower than average in Poland by 1.7°C, and the greatest deviations were determined in western Poland. In all stations thermal conditions were below the multiannual average, and the anomalies ranged from –2.5°C in Zielona Góra to

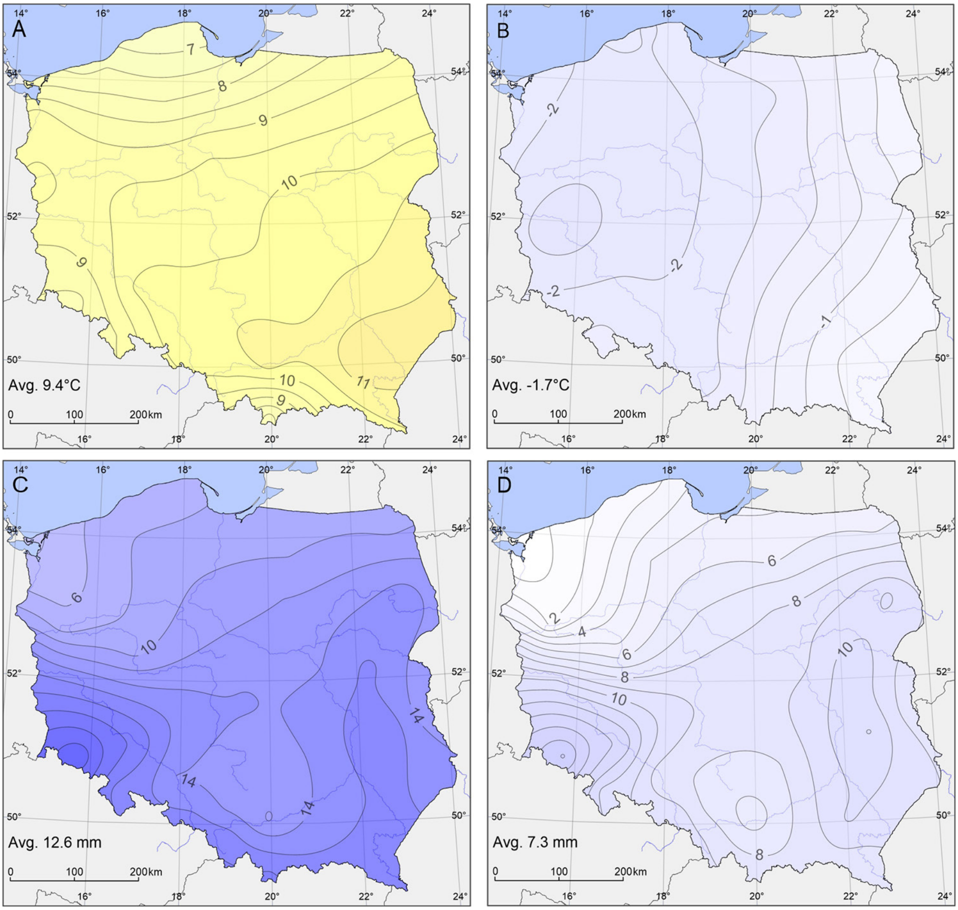

Fig. 5. The average air temperature (A) and anomalies (B), the average precipitation total (C) and anomalies (D) in type 1
Source: own elaboration based on IMGW-PIB data.

−0.7°C in Lesko. In this type, precipitation totals were higher than average. The mean total for the entire area was 12.6 mm, although high spatial variability was observed. Precipitation totals increased from the northwest southwards, and particularly towards the southwest. In particular stations they varied from 3.5 mm in Świnoujście to 25.6 mm in Jelenia Góra. In the aforementioned stations the lowest and highest deviations from the multiannual average were recorded, reaching 0.2 mm and 16.1 mm, respectively. The greatest anomalies occurred in southwestern and southeastern Poland. On the analysed days over central Europe, a low-pressure system persisted (in the centre <1011 hPa), and over eastern and southwestern Europe, high-pressure systems were noted (Fig. 8). In Poland, SLP was lower than average by 1.5 up to more than 4 hPa. Such a location of the system caused advection of humid air masses from the south, as well as cool air masses from the northwest. Advection of cool air masses is confirmed by negative T850 anomalies (covering Poland with their range) and lower persistence of z500 hPa over a considerable area of Europe. The presence of warm air masses was also recorded over eastern Europe.

At the second stage, 21 May weekends were classified. They were cooler and drier than the multiannual average. The mean air temperature for the entire area was 8.8°C, and it was lower by 2.2°C (Fig. 6). The spatial thermal conditions were variable, and an increase in the mean air temperature was recorded from the north southward, particularly towards the southwest part of the country. A decrease in the mean air temperature was also recorded with an increase in height above sea

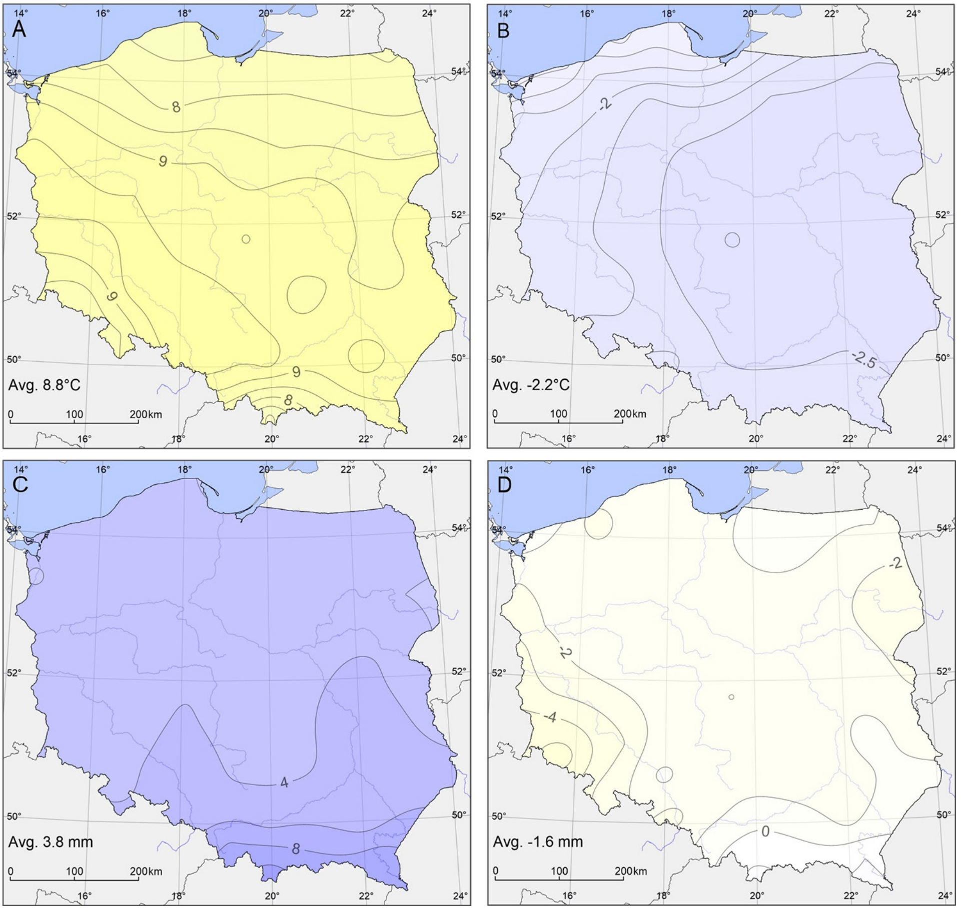

Fig. 6. The average air temperature (A) and anomalies (B), the average precipitation total (C) and anomalies (D) in type 2
Source: own elaboration based on IMGW-PIB data.

level. Its lowest value was 6.9°C in Zakopane, and the highest 10.0°C in Opole. The greatest deviations from the multiannual average were recorded in central eastern Poland. In particular stations the anomalies varied from –2.8°C in Łódź to 1.1°C in Świnoujście. As already mentioned, the analysed May weekends showed lower precipitation totals. The mean precipitation total for the entire area was 3.8 mm, and it was lower by 1.6 mm. Its value increased from the north to the south of the country, and ranged from 1.8 mm in Szczecin to 10.9 mm in Zakopane. Only in southeastern Poland precipitation was somewhat higher than the multiannual average, and lower over the remaining area, particularly in the southwest part of the country. In particular stations the anomalies varied from –5.5 mm in Jelenia Góra to 1.1 mm in Zakopane. On the analysed days, central Europe was in the range of a weak gradient area, within a system similar to a baric col (Fig. 8). A local weak high-pressure system was observed over Poland. SLP anomalies over Poland varied from −0.5 to 0.5 hPa. Over the northern and northwestern regions of the Euro-Atlantic sector, low-pressure systems persisted. The described situation ensured advection of cool air masses from the west. The distribution of T850 anomalies confirmed advection of air masses from the west, with the centre of the anomalies over Poland (<–3°C). The presence of cool air masses over a considerable area of the continent is confirmed by negative z500 hPa anomalies.

The third type covered 23 May weekends that were characterised by higher than average air temperature and lower than average precipitation totals. This group included the warmest May weekend (from 2012), and one with no recorded days with precipitation in any of the stations (from 1986). The mean air temperature for the entire area was 14.1°C, and it was higher than the multiannual mean by 3.1°C (Fig. 7). An increase in that value occurred from the north towards the south of the country. In particular stations the mean air temperature varied from 10.6°C in Hel to 15.7°C in Opole. The greatest deviations from the multiannual average were recorded in the central part of the country. Throughout the area, anomalies were positive and varied from 2.1°C in Hel to 3.6 in Łódź. On the analysed days, lower precipitation totals were also observed. The mean precipitation total in Poland was 2.4 mm and it was lower than the multiannual average by 3.0 mm. The highest precipitation totals were recorded in northwestern Poland, and the lowest in the east of the country. In particular stations, its values ranged from 0.5 mm in Siedlce to 6.8 mm in Koszalin. Except for the northwest regions, the anomalies were negative, and the greatest deviations in minus were observed in Zakopane (–6.3 mm). During the analysed May weekends, Poland remained within the range of high atmospheric pressure (Fig. 8). The centre of the high was over the border of Belarus and Russia (>1018 hPa). The high-pressure area extended towards the southwest, where in the centre of the Azores High pressure exceeded 1024 hPa. A major part of the continent was within the range of positive SLP anomalies that over Poland varied from 1 to 2.5 hPa. Simultaneously, an area of

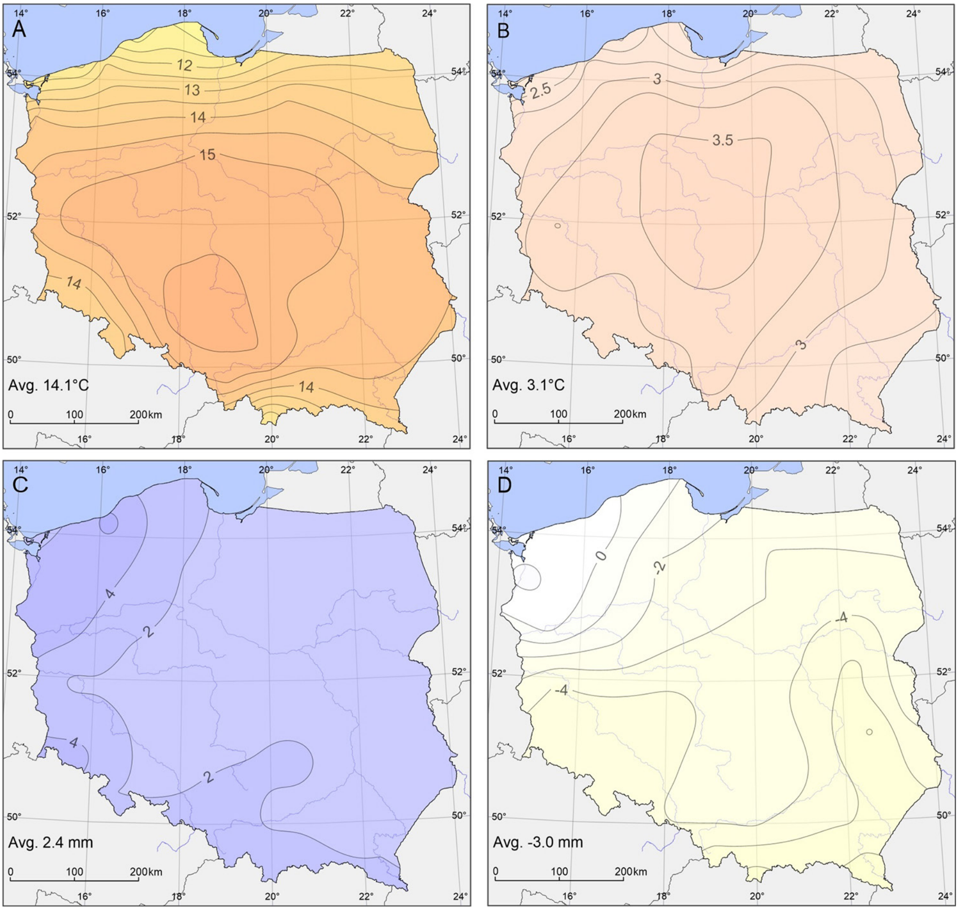

Fig. 7. The average air temperature (A) and anomalies (B), the average precipitation total (C) and anomalies (D) in type 3
Source: own elaboration based on IMGW-PIB data.

low pressure was observed over the Mediterranean Sea and North Africa. The described situation caused advection of warm air masses from the south and southeast. A characteristic feature of high-pressure weather is low or lack of cloudiness, therefore an intensive inflow of solar radiation affects air temperature values and contributes to low precipitation totals. Central and northern Europe was covered by positive T850 and z500 hPa anomalies, pointing to the presence of warm air masses. The highest T850 anomalies were recorded over northwestern Poland, exceeding 4.0°C.

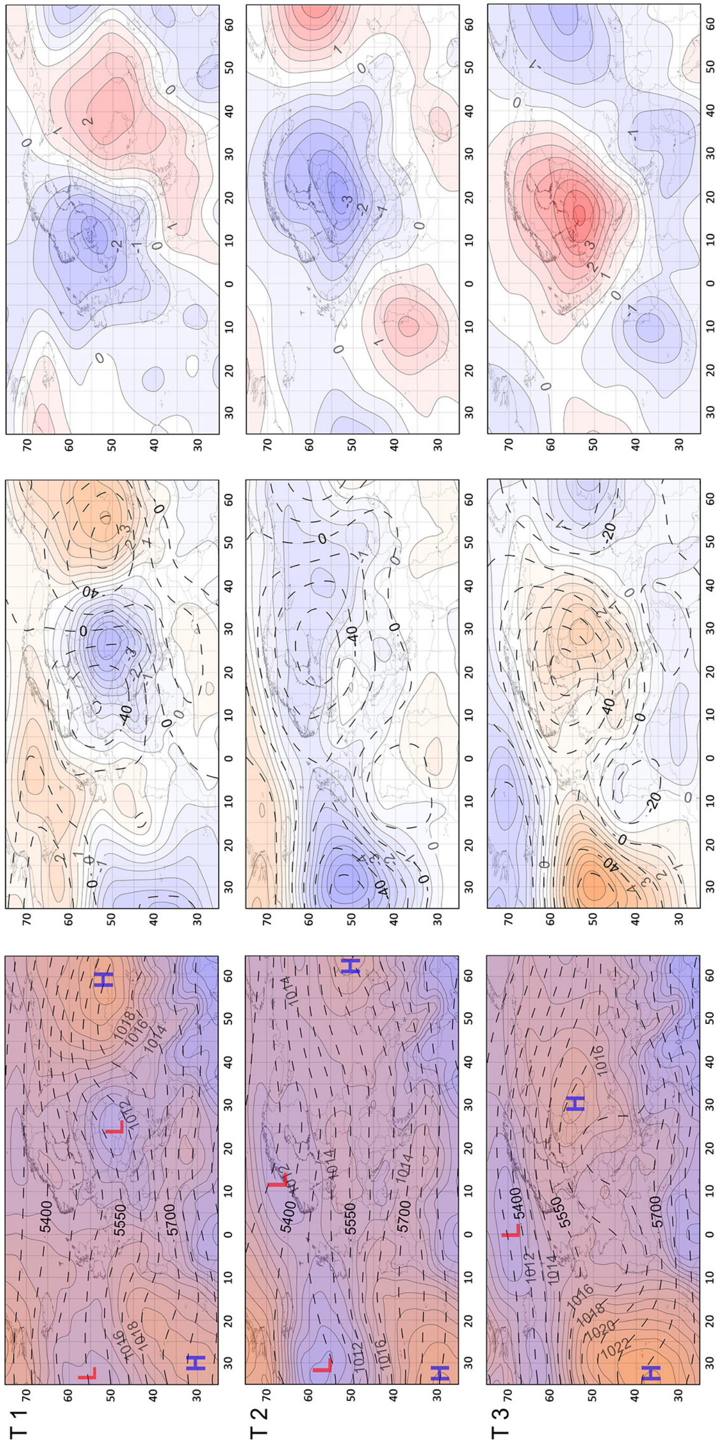

Fig. 8. The average SLP (colour scale) and z500 hPa (left column); SLP (colour scale) and z500 hPa anomalies (middle column) and T850 anomalies (right column) in the distinguished types

Source: own elaboration based on NCEP/NCAR data.

SUMMARY AND DISCUSSION

The study revealed the spatial variability of thermal conditions during the May weekend in Poland. The coolest areas were northern regions, and particularly the Baltic coast, because of the cooling effect of the sea. The warmest regions were the southern and southwestern areas of the country. This distribution was similar to the spatial distribution of the mean air temperature in spring (Ustrnul et al., 2021; Tomczyk, 2022), and particularly in May (Kejna, Rudzki, 2021). In the analysed period, except for one station, an increase in air temperature was identified. Its course was the most intense in the southern regions, where the highest change values were recorded. In the spring, warming was observed throughout the country. It was somewhat more intense in western Poland (Ustrnul et al., 2021). In the following years, a further increase in air temperature can be expected, and at the end of the 21st century it may be several degrees higher in spring in Poland (RCP 8.5) (Piniewski et al., 2017).

Against the background of the entire multiannual period, two May weekends stood out in terms of thermal conditions, namely those from 1985 and 2012. The former was characterised by the lowest mean air temperature at the scale of the country. In 64% of stations it was the coldest one in the entire analysed period. The latter showed the highest mean air temperature for the study area, and in 36% of the stations it was the warmest May weekend in the entire multiannual period. According to the study by Ustrnul et al. (2021), 1985 was classified as an anomalously cool (percentile: 0.05–0.10) year, but spring was within the multiannual norm (percentile: 0.40–0.60). The year of 2012 was slightly warm (percentile: 0.60–0.70), but spring was classified as anomalously warm (percentile: 0.90–0.95). As shown by previous research, these years were also characteristic in biometeorological terms, because they showed the lowest and highest values of the Universal Thermal Climate Index, respectively, the rates of which strongly depend on the air temperature (Tomczyk, Mendel, 2023).

Like in the case of the mean air temperature, spatial variability was also observed for precipitation totals. The lowest totals were primarily recorded in central Poland and in the northern regions. Such spatial variability was similar to the distribution of the mean annual precipitation total in the country. Areas in central Poland are characterised by the lowest totals, whereas mountain and northwestern areas by the highest (Łupikasza, Małarzewski, 2021; Bednorz, 2022). May weekends in 2021 and 1983 stood out in the multiannual period, because in each of those years, the highest precipitation total throughout the period was recorded in five stations. Also 1986 can be distinguished in the study period, because only in that year no precipitation was recorded in any of the stations on the first three days of May.

Three groups of May weekends were designated in the years under study, i.e. cool and humid, cool and dry, and warm and dry. The first group was characterised by lower than average air temperature, but higher precipitation, the second group had lower than average air temperature and lower precipitation, and in the third one air temperature was higher than average, and precipitation was lower. The greatest deviations in minus from the multiannual average in the case of air temperature was recorded in the second type, and for precipitation in the third type. The highest deviations in plus for air temperature were recorded in the third type, and for precipitation in the first type. Each of the types was characterised by a different baric situation. May weekends with precipitation above the average were related to a low-pressure system with a centre persisting southeast of Poland. Low-pressure systems moving from over southern Europe, from over the Mediterranean Sea, cause intensive rainfall (Degirmendžić, Kożuchowski, 2015). Most of these systems arrive over central eastern Europe on route Vb designated by van Bebber (1981). Warm and dry May weekends were related to the presence of high-pressure systems and advection of warm air masses from the southern sector. The presence of high-pressure systems over central Europe (west of the system) can cause different weather conditions. Such a situation can favour the occurrence of considerable air temperature decreases in the first half of May, i.e. the occurrence of so-called mid-May cold spell – a short period with frosts (Tomczyk et al., 2015, 2020). Sometimes such situations occur earlier (as April passes into May) and are recorded during the May weekend.

CONCLUSIONS

The study showed a high range of variability of weather conditions from year to year during the May weekend in Poland. Three groups of May weekends with different weather conditions were designated in the analysed years, i.e. cool and humid, cool and dry, and warm and dry. Each of the types was characterised by a different baric situation. Weather conditions most favourable for tourism and recreation could be observed during high-pressure weather, featuring low or lack of cloudiness and intensive solar radiation. In this situation, the air temperature was higher than average and precipitation was lower. In each of the separated types, the lowest air temperature was recorded in the northern regions (on the coast of the Baltic Sea) and in the south of the country (in the mountains). As can be concluded from media reports, these are regions frequently visited during the analysed days. In such conditions, the main factor limiting tourist traffic is precipitation. The study is limited by lack of the statistical determination of the effect of the recorded conditions on tourist traffic because such data are largely inaccessible. The authors believe the development of research in this direction should be treated as a priority in the future.

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