

## Chapter 1

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# Thermal and Pluviometric Characteristics of North-Eastern Poland in Years 1966-2005

### Source material and scope of the study

The present study analyses data from eighteen meteorological stations of the Institute of Meteorology and Water Management located within an area determined by coordinates between latitude 53° N and the northern border of Poland and between longitude 19° E to the eastern border of Poland.

The study applies terms and names derived from the description of the area by Kondracki [KONDRACKI 2000] to specify spatial locations.

The north-west (NW) of the area under analysis includes Żuławy Wiślane (the Vistula Delta), the Elbląg Upland, the Warmia Plain, the Orneta Plain and the Górowo Hills, and it is characterized using the data originating from stations in Elbląg, Frombork and Dobrocin. The north (N) includes the area with the Sępopol Lowland and the Węgorapa Land and the area characterized by stations located in Kętrzyn and Lidzbark Warmiński. The north-east (NE) part of the described area covers the Szeskie Hills, the Romnicka Primeval Forest, the North Suwałki Lake District, the East Suwałki Lake District and the Augustów Plain (meteorological stations in Suwałki, Gołdap and Olecko). The western part (W) of the research area includes the Hawa Lake District and the Olsztyn Lake District, represented by meteorological stations in Olsztyn and Prabuty. The area encompassing the Mrągowo Lake District, the Great Mazurian Lakeland and the Ełk District (with meteorological stations in Mikołajki, Szczytno and Biebrza) is described as the central (C) part of the territory. The southern part of the research area includes the Mazury Plain and the North Mazovian Lowland (NW and S), with the Mława Upheaval (NW) in the west, characterized by stations in Mława and Lidzbark Welski, and the Kurpie Plain (stations in Ostrołęka, Myszyniec and Marianów in its eastern part (E)). The south-east (SE) of the examined area includes the North Podlasie Lowland, with the Białystok Upland, the Sokółka Hills, the Kolno Upland

and the Biebrza Valley distinguished (meteorological stations in Białystok and Różanystok).

Measurement sequences of first- and second-order weather stations (synoptic stations), carrying out twenty-four-hour measurements and observations, were used as the basic analytical material. Materials from third- and fourth-order stations (the so-called climatic stations), performing measurements and observation three times a day (at 06.00, 12.00 and 18.00 GMT), were used as auxiliary data while drawing isotherms and isohyets. The analytical studies also took into consideration (due to the lack of stations determining conditions in the south-western and western end of the region) measurement materials originating from the first-order stations in Toruń. ( $\varphi 53^{\circ}02'$ ;  $\lambda 18^{\circ}35'$ ; Hs 69m above sea level).

The obtained data sets obtained were analysed in terms of their homogeneity and representative character, in reflecting the actual state. This analysis ensured correctness of statistical operations performed on the sets [VIZI *et al.* 2000/2001]. The following aggregated values were determined:

- the mean annual air temperature, locating the region or any other area under examination, was determined as 1/12 of the sum of mean monthly air temperatures;
- the mean monthly air temperature, as the basic indicator of thermal variability in the annual time space, determined as the arithmetic mean from the monthly sum of daily temperatures divided by the number of days in a month;
- the minimum air temperature was determined as the lower of minimum temperatures determined for two measurement periods: day (between 06.00 and 18.00 GMT) and night (between 18.00 and 06.00 of the following day GMT);
- the maximum air temperature was determined as the higher of maximum air temperatures determined for two measurement periods: day (between 06.00 and 18.00 GMT) and night (between 18.00 and 06.00 of the following day GMT);
- the number of frosty days was determined as the sum of days with a maximum temperature of 0°C and lower;
- the number of very frosty days was determined as the sum of days with a maximum air temperature -10°C and lower;
- the number of hot days was determined as the sum of days with a maximum temperature of 25°C and higher;
- the number of very hot days was determined as the sum of days with a maximum temperature of 30°C and higher.

Precipitation conditions in north-eastern Poland are presented by means of several parameters. Annual and multi-year mean sums of precipitation were determined. The course of annual sums of precipitation was examined in terms of space and for individual years, taking into account trends of changes, as well as the indication and determination of frequency of anomalous years [KOSSOWSKA-CEZAK, MRUGAŁA 1999]. The following values were determined:

- annual sums of precipitation (mm) based on a forty-year measurement series;
- extreme values of precipitation;

- precipitation frequency;
- monthly sums of precipitation characterizing the spatial and temporal pluvial regime in monthly brackets.

## Air Temperatures

### The annual air temperatures

The mean annual air temperature in north-eastern Poland in the period under analysis was 7.2°C. The highest mean annual air temperature for the research area (8.8°C) was found for 1989 and 2000. On the other hand, 1987 was the coldest year, with a mean annual air temperature of only 5.4°C (Fig. 1). This trend, statistically significant, indicated the growth of the mean annual temperature in the region.

Within distinguished time brackets, this value was subject to significant changes (Table 1). In five-year intervals of the forty-year period covering the years of 1966-2000, the mean five-year air temperature ranged from 6.2 to 7.8°C. The warmest five-year period was the period between 2001 and 2005, with the mean five-year air temperature of 7.8°C. The five-year period of 1976-1980 was the coldest, with the mean temperature of 6.2°C. In ten-year periods, the mean air temperature ranged from 6.7 to 7.6°C, while twenty-year intervals levelled out the difference even more, to a range between 6.9 and 7.6°C.

Spatial distribution of the mean annual air temperature in the examined area (Fig. 2) illustrated by isotherms, revealed a longitudinal pattern in the northern part of the area, and a latitudinal pattern in the southern part. The highest values of the mean annual temperature were observed in the north-west (the Warmia Plain), the west (the Iława Lake District), and in the north-west and the south of the area (the Northern Mazovian Lowland). The highest annual mean air temperature was recorded in 2000 at the meteorological station in Elbląg, when it reached the level of 9.4°C. The lowest annual mean temperature (4.4°C) was recorded in 1987 at the station in Suwałki. Those correspondent to Szwejkowski [SZWEJKOWSKI *et al.* 2001, 2002, 2005, 2009]

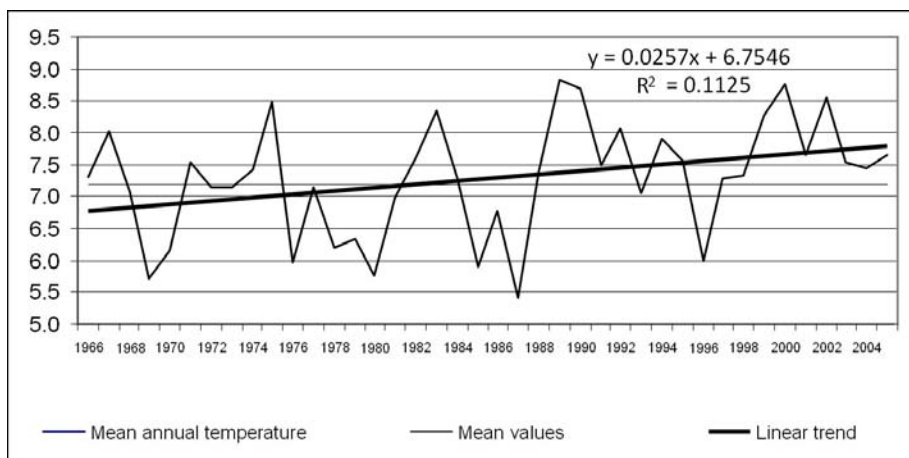


Fig. 1. Mean annual air temperature (°C) in years 1996-2005

Extreme values of mean daily temperatures in the region were confined within the amplitude of 56.7 degrees. The lowest mean daily air temperature of  $-26.5^{\circ}\text{C}$  was recorded on 7 January 2003 in Suwałki. The highest temperature was observed on 31 July 1994 in Elbląg, reaching the value of  $30.2^{\circ}\text{C}$ .

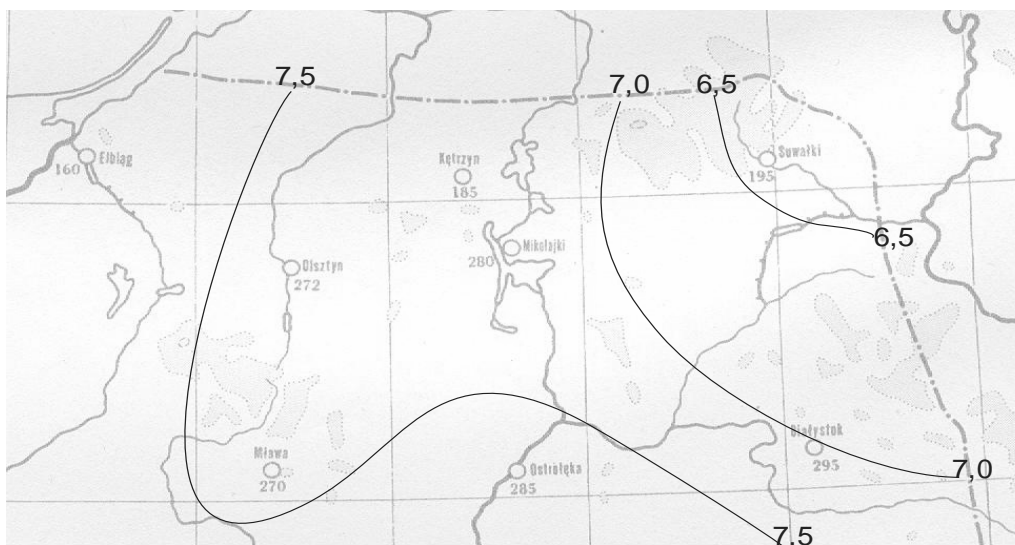


Fig. 2. Isotherms of mean annual temperature ( $^{\circ}\text{C}$ ) for years 1966-2005

Table 1

Mean air temperatures in periods ( $^{\circ}\text{C}$ )

| Periods      |             | Mean annual temperatures ( $^{\circ}\text{C}$ ) |         |           |         |      |
|--------------|-------------|---|---------|-----------|---------|------|
|              |             | mean  | maximal | year      | minimal | year |
| Five-years   | 1966 - 1970 | 6.8   | 8.0     | 1967      | 5.7     | 1969 |
|              | 1971 - 1975 | 7.5   | 8.5     | 1975      | 7.1     | 1972 |
|              | 1976 - 1980 | 6.2   | 7.1     | 1977      | 5.8     | 1980 |
|              | 1981 - 1985 | 7.2   | 8.3     | 1983      | 5.9     | 1985 |
|              | 1986 - 1990 | 7.4   | 8.8     | 1989      | 5.4     | 1987 |
|              | 1991 - 1995 | 7.6   | 8.1     | 1992      | 7.1     | 1993 |
|              | 1996 - 2000 | 7.5   | 8.8     | 2000      | 6.0     | 1996 |
| Ten-years    | 2001 - 2005 | 7.8   | 8.6     | 2002      | 7.4     | 2004 |
|              | 1966 - 1975 | 7.2   | 7.1     | 1972      | 5.7     | 1969 |
|              | 1976 - 1985 | 6.7   | 8.3     | 1983      | 5.8     | 1980 |
|              | 1986 - 1995 | 7.5   | 8.8     | 1989      | 5.4     | 1987 |
| Twenty-years | 1996 - 2005 | 7.6   | 8.8     | 2000      | 6.0     | 1996 |
|              | 1966 - 1985 | 6.9   | 8.3     | 1983      | 5.7     | 1969 |
| Forty-years  | 1986 - 2005 | 7.6   | 8.8     | 1989;2000 | 5.4     | 1987 |
|              | 1966 - 2005 | 7.2   | 8.8     | 1989;2000 | 5.4     | 1987 |

## Temperatures in monthly periods

The coldest month in north-eastern area of Poland was January. The mean monthly air temperature in the analysed area in January ranged from -2 °C in the north-western part of the area, -4.5°C in the north-western part of the area, -4°C in its eastern and south-eastern part, to -3°C in the remaining area. The distribution of isotherms characterizing the thermal conditions of January in the analysed territory had an almost longitudinal pattern, showing a decline in the mean temperature from west to east (Fig. 3). The mean monthly temperature of January determined for the research area reached -3.3°C. In the multi-year period under analysis, the lowest monthly temperature for this month, amounting to -15.5°C, was recorded in Suwałki in 1987. The highest value of the mean monthly air temperature (3.4°C) in January was recorded in 1983 in Elbląg. The first decade of January was the coldest period, with mean temperatures for the research area ranging from -4.8 °C in Suwałki to -2.4°C in Elbląg, resulting in the mean value for the research area of -3.6°C. The third decade of January was the warmest, with a mean value of -2.8 °C (Table 7).

Table 2. Thermal characteristics of January in years 1966-2005

| Mean temperature |      |                 | Locations |         |         |         |           |       |           |           | Mean for the region |      |
|------------------|------|-----------------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|------|
|                  |      |                 | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok |                     |      |
| Temperature (°C) | mean | month           | -2.0      | -3.2    | -4.5    | -2.9    | -3.3      | -3.2  | -3.2      | -3.9      | -3.3                |      |
|                  |      | ten-days period | I         | -2.4    | -3.6    | -4.8    | -3.3      | -3.7  | -3.6      | -3.5      | -4.2                | -3.6 |
|                  |      |                 | II        | -1.9    | -3.3    | -4.5    | -2.9      | -3.4  | -3.2      | -3.4      | -4.0                | -3.3 |
|                  | III  |                 | -1.5      | -2.8    | -4.1    | -2.4    | -2.9      | -2.6  | -2.7      | -3.4      | -2.8                |      |
|                  | max  | ten-days period | I         | 2.2     | 1.5     | 0.5     | 1.7       | 1.5   | 1.3       | 1.5       | 1.5                 | 1.4  |
|                  |      |                 | II        | 2.2     | 1.2     | 0.4     | 1.4       | 1.2   | 1.1       | 1.3       | 1.3                 | 1.2  |
|                  |      |                 | III       | 2.6     | 1.7     | 0.7     | 2.0       | 1.7   | 1.7       | 2.0       | 2.0                 | 1.7  |
|                  | min  | ten-days period | I         | -7.9    | -9.6    | -11.2   | -9.2      | -9.5  | -9.1      | -9.1      | -9.1                | -9.5 |
|                  |      |                 | II        | -6.8    | -9.0    | -10.4   | -8.3      | -9.1  | -8.2      | -8.8      | -8.8                | -8.8 |
|                  |      |                 | III       | -6.7    | -8.6    | -10.3   | -7.9      | -8.7  | -8.1      | -8.6      | -8.6                | -8.5 |

Mean monthly air temperatures in February ranged from -1.1°C in the north-western part of the area, to -3.7°C in its north-eastern part. The distribution of isotherms, mean monthly temperatures of February, retained a longitudinal pattern (Fig. 4). The mean monthly temperature of February for the entire research area amounted in the multi-year period under analysis to -2.3°C (Table 5). The values of this parameter ranged from -1.1°C in Elbląg to -3.7°C in Suwałki. The second decade of the month was the coldest, with a mean temperature of -3.1°C, i.e. by

0.3°C colder than the third decade of January and by 0.6°C than the first decade of February. The lowest mean temperature of February (-12.3°C) was recorded in 1985 in Suwałki, while the highest (5.1°C) was established in Elbląg in 1990.

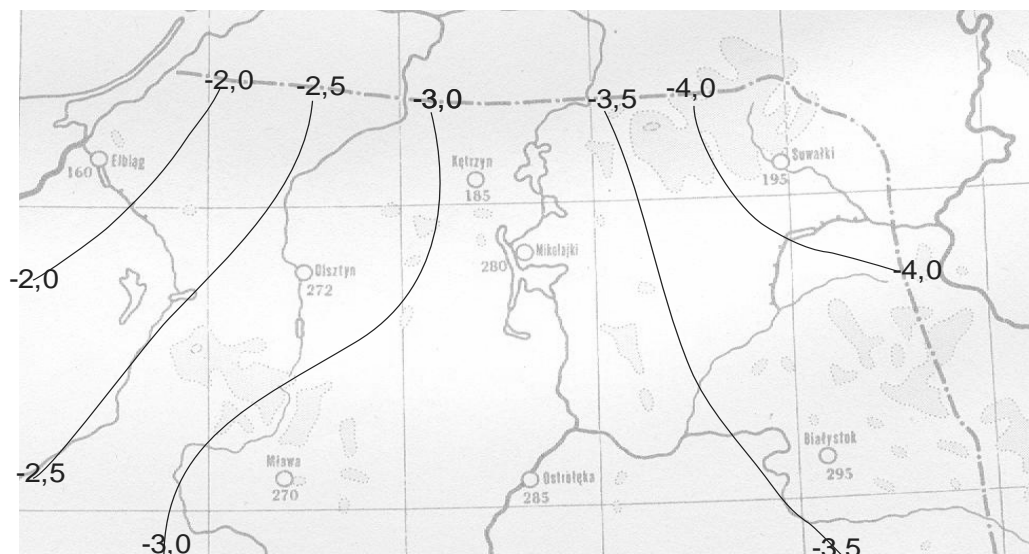


Fig. 3. Isotherms of monthly mean temperature of January (°C) in years 1966-2005

Table 3

Thermal characteristics of February in years 1966-2005

| Mean temperature |      |                  | Locations |         |         |         |           |       |           |           | Mean for the region |      |
|------------------|------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|------|
|                  |      |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok |                     |      |
| Temperature (°C) | mean | month            | -1.1      | -2.3    | -3.7    | -2.0    | -2.5      | -2.1  | -2.1      | -2.8      | -2.3                |      |
|                  |      | ten-deys period  | I         | -1.1    | -2.4    | -3.8    | -2.0      | -2.5  | -2.2      | -2.4      | -3.0                | -2.4 |
|                  |      |                  | II        | -1.8    | -3.1    | -4.4    | -2.8      | -3.3  | -2.8      | -2.9      | -3.5                | -3.1 |
|                  | III  |                  | -0.5      | -1.6    | -3.0    | -1.3    | -1.9      | -1.5  | -1.2      | -2.2      | -1.7                |      |
|                  | max  | ten-deys period  | I         | 3.0     | 2.1     | 0.9     | 2.4       | 2.2   | 2.2       | 2.2       | 1.8                 | 2.1  |
|                  |      |                  | II        | 1.5     | 0.5     | -0.6    | 0.7       | 0.3   | 0.6       | 0.7       | 0.3                 | 0.5  |
|                  |      |                  | III       | 3.0     | 2.1     | 0.9     | 2.4       | 2.0   | 2.1       | 2.5       | 1.7                 | 2.1  |
|                  | min  | ten-deys periods | I         | -5.7    | -7.3    | -9.3    | -6.9      | -7.8  | -7.0      | -7.4      | -8.6                | -7.5 |
|                  |      |                  | II        | -5.4    | -7.3    | -8.8    | -6.6      | -7.4  | -6.6      | -7.0      | -7.8                | -7.1 |
| III              |      |                  | -4.3      | -5.9    | -7.7    | -5.4    | -6.1      | -5.7  | -5.6      | -6.9      | -6.0                |      |

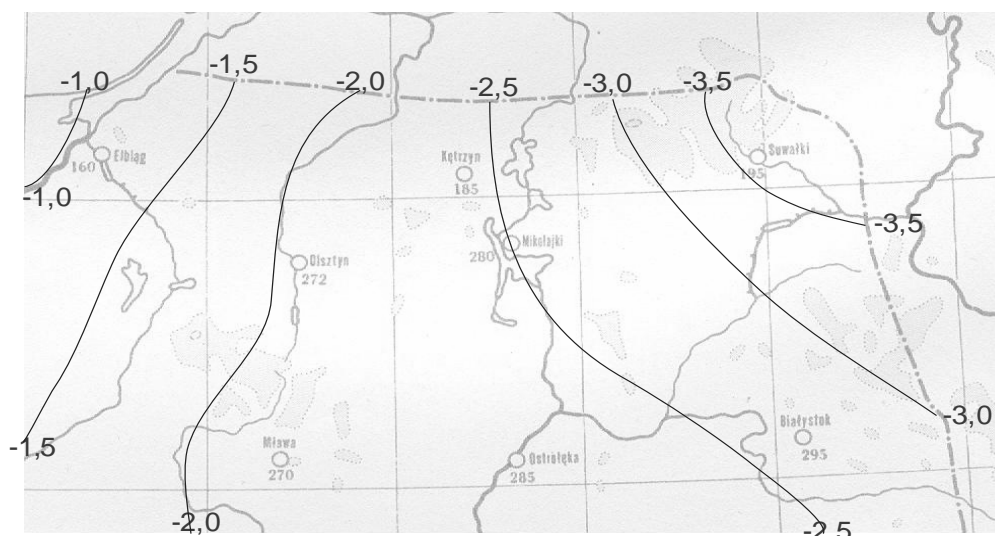


Fig. 4. Isotherms of mean monthly temperature of February (°C) in years 1966-2005

March is the month in which the transition to mean daily air temperature above the value of 0°C was observed. Mean monthly temperatures in the research area ranged from 0.1°C in the Suwałki Lake District to 1°C in the North Podlasie Lowland and the Great Mazurian Lakeland. In the area stretching from the North Mazovian Lowland to the Iława Lake District and the Warmia Plain the recorded values were above 2°C. The highest mean monthly temperature of March (6.3°C) was recorded in Elbląg in 1990, and the lowest (-5.4°C) was observed in 1987 in Suwałki. Isotherms of mean monthly air temperature in March, in the northern part of the area, preserved its longitudinal pattern, while a latitudinal arrangement was observed in its southern part (Fig. 5). The values of isotherms ranged from 2°C in the north-western, western and south-western parts of the area, to 0.5°C in its north-eastern and eastern parts. In the first decade of March, mean temperatures over the most part of the area were below zero (Table 6). Positive mean values for the decade (1°C) were recorded only in its north-western part (Żuławy Wiślane, the Warmia Plain). In the second decade, the Suwałki Lake District was the only region characterized by a negative mean temperature of the decade (-0.2°C), while in the remaining part, the mean decade temperature ranged from 1 to 2°C. The third decade of March was characterized by a mean temperature ranging from 2 to 4°C.

The beginning of April is a period in which mean daily air temperatures exceeded 5°C over the entire north-eastern Poland. The mean monthly temperature of April in the period under consideration was 6.8°C, with spatial distribution between 6.1 and 7.2°C (Table 5). The highest value (11.7°C) of the mean monthly air temperature in April was recorded in 2000 in Elbląg, and the lowest, of 3.4°C, was recorded in 1981, in Suwałki. Mean decade temperatures were evenly distributed over the area under analysis. In the first and the second decade of April, the temperature ranged from 5 to 6°C, and in the third – from 8 to 9°C.

Table 4

Thermal characteristics of March in years 1966-2005

| Mean temperature |      |                  | Locations |         |         |         |           |       |           |           | Mean for the region |      |
|------------------|------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|------|
|                  |      |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok |                     |      |
| Temperature (°C) | mean | month            | 2.4       | 1.3     | 0.1     | 1.6     | 1.0       | 1.6   | 1.8       | 1.0       | 1.4                 |      |
|                  |      | ten-days period  | I         | 1.0     | -0.3    | -1.7    | 0.0       | -0.6  | 0.0       | 0.2       | -0.8                | -0.2 |
|                  |      |                  | II        | 2.1     | 1.0     | -0.2    | 1.3       | 0.8   | 1.3       | 1.3       | 0.7                 | 1.1  |
|                  | III  |                  | 4.1       | 3.2     | 2.1     | 3.4     | 2.9       | 3.5   | 3.9       | 3.1       | 3.3                 |      |
|                  | max  | ten-days period  | I         | 4.7     | 3.6     | 2.2     | 4.1       | 3.4   | 3.9       | 4.1       | 3.4                 | 3.7  |
|                  |      |                  | II        | 6.0     | 5.0     | 3.6     | 5.4       | 4.7   | 5.2       | 5.2       | 4.8                 | 5.0  |
|                  |      |                  | III       | 8.6     | 7.2     | 5.9     | 7.7       | 6.9   | 7.7       | 8.2       | 7.3                 | 7.4  |
|                  | min  | ten-days periods | I         | -2.4    | -3.6    | -5.4    | -3.5      | -4.0  | -3.7      | -3.5      | -4.6                | -3.8 |
|                  |      |                  | II        | -1.9    | -3.2    | -4.8    | -3.0      | -3.5  | -2.9      | -2.9      | -3.6                | -3.2 |
| III              |      |                  | 0.4       | -0.6    | -1.7    | -0.5    | -0.9      | -0.4  | -0.1      | -0.9      | -0.6                |      |

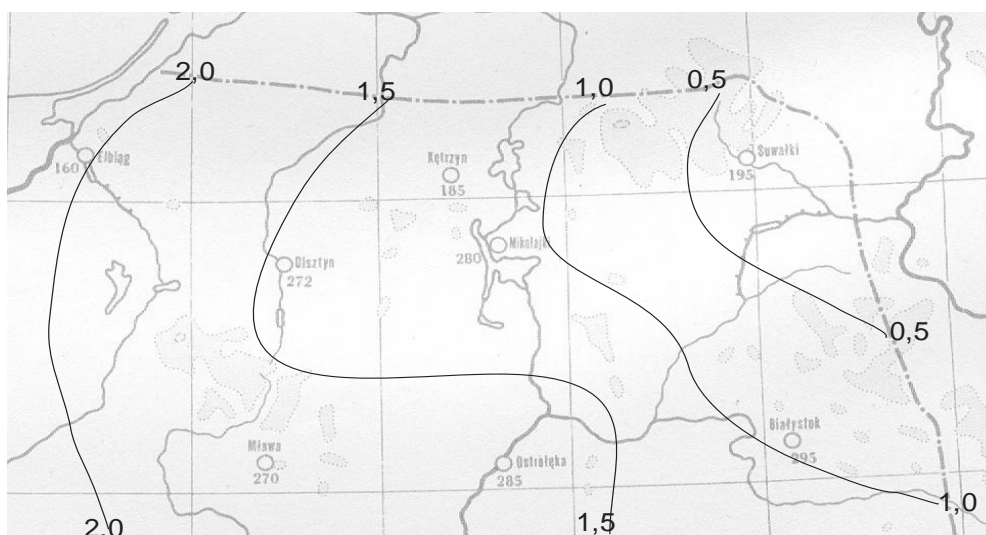


Fig. 5. Isotherms of mean monthly temperature of March (°C) in years 1966-2005

Isotherms of mean monthly temperature of April change their longitudinal pattern in the northern part of the area to the latitudinal arrangement in its southern part. The values of mean monthly temperatures of April ranged from 7°C in the western, south-western and southern part of the area, to 6 °C in its north-eastern part (Fig. 6).



In May, the mean air temperature in the examined area reached the value of 12.8°C; from 12.2°C in the north east to 13.4°C in the south (Table 6). The highest values of mean monthly air temperature were recorded in the third decade of the month, and the lowest – in the first decade. Just like mean monthly temperatures, the mean ten-day values were characterized by small spatial diversity, and ranged from 11.1 to 11.9°C in the first decade, from 12.5 to 13.0°C in the second decade, and from 13.0 to 14.1°C in the third. Isotherms of mean monthly air temperatures were arranged in a latitudinal pattern and the temperature distribution was little differentiated (Fig. 7).

Table 5

Thermal characteristics of April in years 1966-2005

| Mean temperature |      |                  | Locations |         |         |         |           |       |           | Mean for the region |           |      |
|------------------|------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|---------------------|-----------|------|
|                  |      |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka |                     | Białystok |      |
| Temperature (°C) | mean | month            | 7.2       | 6.7     | 6.1     | 6.7     | 6.6       | 7.1   | 7.3       | 7.0                 | 6.8       |      |
|                  |      | ten-deys period  | I         | 6.0     | 5.3     | 4.6     | 5.4       | 5.1   | 5.8       | 6.3                 | 5.6       | 5.5  |
|                  |      |                  | II        | 6.4     | 6.0     | 5.4     | 5.9       | 5.9   | 6.3       | 6.3                 | 6.3       | 6.1  |
|                  | III  |                  | 9.2       | 8.9     | 8.3     | 8.8     | 8.7       | 9.3   | 9.4       | 9.1                 | 9.0       |      |
|                  | max  | ten-deys period  | I         | 9.9     | 9.0     | 8.4     | 9.2       | 8.6   | 9.6       | 10.3                | 9.9       | 9.4  |
|                  |      |                  | II        | 11.3    | 10.7    | 10.1    | 10.6      | 10.2  | 10.8      | 11.0                | 10.9      | 10.7 |
|                  |      |                  | III       | 14.2    | 13.5    | 13.1    | 13.6      | 13.1  | 14.0      | 14.3                | 13.9      | 13.7 |
|                  | min  | ten-deys periods | I         | 2.1     | 1.5     | 0.9     | 1.5       | 1.6   | 1.8       | 2.4                 | 1.6       | 1.7  |
|                  |      |                  | II        | 2.4     | 1.8     | 1.2     | 1.6       | 1.9   | 2.1       | 2.1                 | 1.9       | 1.9  |
| III              |      |                  | 4.6       | 4.2     | 3.8     | 4.2     | 4.4       | 4.5   | 4.6       | 4.4                 | 4.3       |      |

June in north-eastern Poland was the first month in which the values characteristics for the thermal summer were recorded. The mean monthly air temperature in the research area reached 15.7°C. In terms of the area division, the mean monthly value ranged from 15.2°C in the north-east to 16.5°C in its southern part. The maximum values of mean monthly temperature in June ranged from 18.8°C in Suwałki to 20.3°C in Ostrołęka. The minimum values of this parameter for the area were fluctuated between 11.7°C and 12.8°C. In June, the distribution of mean ten-day temperatures was quite even. In the first decade of the month, the mean air temperature for the examined area ranged from 15.0 to 16.5°C, in the second one – from 14.9 to 15.6°C, and in the third decade from 15.7 to 16.9°C. Isotherms of mean monthly air temperatures demonstrated a latitudinal pattern.

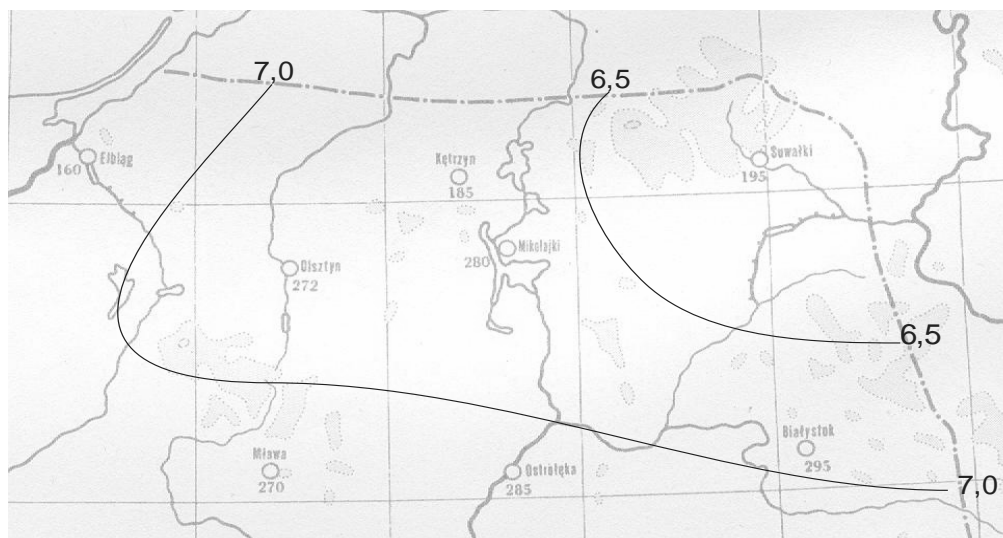


Fig. 6. Isotherms of mean monthly temperature of April (°C) in years 1966-2005

Table. 6

Thermal characteristics of May in years 1966-2005

| Mean temperature |      |                  | Locations |         |         |         |           |       |           | Mean for the region |           |      |
|------------------|------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|---------------------|-----------|------|
|                  |      |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka |                     | Białystok |      |
| Temperature (°C) | mean | month            | 12.7      | 12.6    | 12.2    | 12.5    | 12.7      | 13.0  | 13.4      | 12.9                | 12.8      |      |
|                  |      | ten-deys period  | I         | 11.6    | 11.5    | 11.1    | 11.4      | 11.4  | 11.9      | 12.0                | 11.8      | 11.6 |
|                  |      |                  | II        | 12.9    | 12.8    | 12.5    | 12.7      | 12.9  | 13.3      | 13.9                | 13.2      | 13.0 |
|                  | III  |                  | 13.6      | 13.5    | 13.0    | 13.4    | 13.7      | 13.8  | 14.1      | 13.7                | 13.6      |      |
|                  | max  | ten-deys period  | I         | 16.9    | 16.0    | 15.4    | 16.3      | 15.5  | 16.5      | 16.3                | 15.9      | 16.1 |
|                  |      |                  | II        | 18.4    | 17.6    | 17.2    | 17.7      | 17.3  | 18.0      | 18.7                | 17.7      | 17.8 |
|                  |      |                  | III       | 18.0    | 17.3    | 16.8    | 17.6      | 17.4  | 17.8      | 18.0                | 17.6      | 17.6 |
|                  | min  | ten-deys periods | I         | 6.9     | 7.0     | 6.8     | 6.7       | 7.2   | 7.1       | 7.4                 | 7.5       | 7.1  |
|                  |      |                  | II        | 8.3     | 8.2     | 8.1     | 8.2       | 8.7   | 8.6       | 9.4                 | 8.8       | 8.5  |
| III              |      |                  | 9.6       | 9.5     | 9.2     | 9.4     | 9.9       | 9.6   | 10.2      | 9.8                 | 9.7       |      |

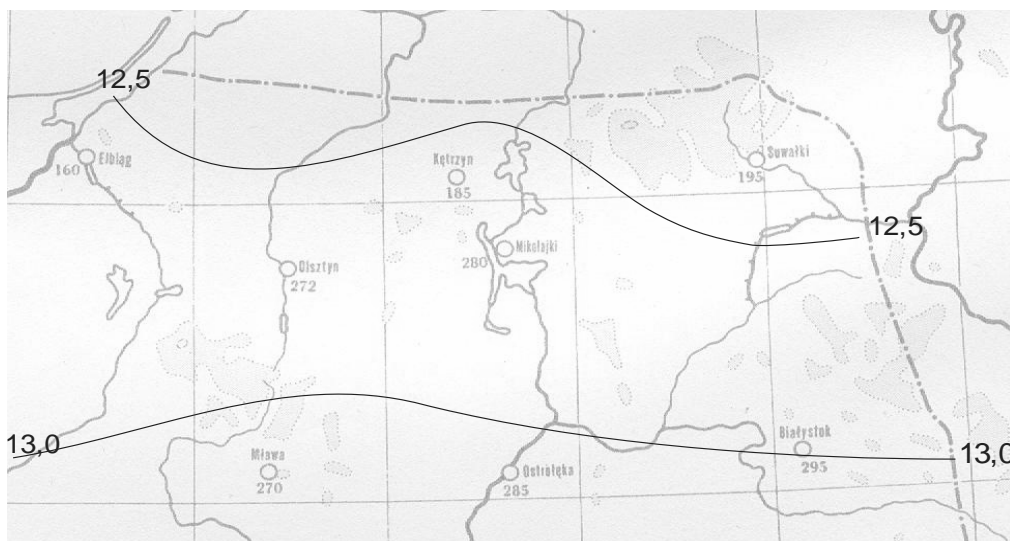


Fig. 7. Isotherms of mean monthly temperature of May (°C) in years 1966-2005

Table 7

Thermal characteristics of June in years 1966-2005

| Mean temperature |      |                  | Locations |         |         |         |           |       |           |           | Mean for the region |      |
|------------------|------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|------|
|                  |      |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikolajki | Mława | Ostrołęka | Białystok |                     |      |
| Temperature (°C) | mean | month            | 15.7      | 15.5    | 15.2    | 15.5    | 15.8      | 15.8  | 16.5      | 15.8      | 15.7                |      |
|                  |      | ten-days period  | I         | 15.6    | 15.4    | 15.0    | 15.4      | 15.7  | 15.8      | 16.5      | 15.6                | 15.6 |
|                  |      |                  | II        | 15.2    | 15.0    | 14.9    | 15.0      | 15.4  | 15.4      | 16.0      | 15.6                | 15.3 |
|                  | III  |                  | 16.2      | 16.0    | 15.7    | 16.1    | 16.4      | 16.3  | 16.9      | 16.3      | 16.2                |      |
|                  | max  | ten-days period  | I         | 20.2    | 19.3    | 18.6    | 19.6      | 19.4  | 19.6      | 20.3      | 19.2                | 19.5 |
|                  |      |                  | II        | 19.1    | 18.9    | 18.5    | 18.9      | 19.2  | 19.4      | 19.9      | 19.5                | 19.2 |
|                  |      |                  | III       | 20.2    | 19.7    | 19.3    | 20.1      | 20.0  | 20.3      | 20.6      | 20.0                | 20.0 |
|                  | min  | ten-days periods | I         | 11.4    | 11.3    | 11.2    | 11.2      | 11.8  | 11.6      | 12.3      | 11.9                | 11.6 |
|                  |      |                  | II        | 12.1    | 11.8    | 11.7    | 11.7      | 12.2  | 11.8      | 12.7      | 12.2                | 12.0 |
| III              |      |                  | 13.1      | 12.6    | 12.2    | 12.5    | 12.9      | 12.8  | 13.3      | 12.6      | 12.8                |      |



Fig. 8. Isotherms of mean monthly temperature of June (°C) in years 1966-2005

Mean monthly air temperature in July reached the value of 17.5°C, and in terms of the spatial division, it ranged from 17.0°C in its north-east to 17.9°C in the south (Table 8). The highest average value of the mean monthly air temperature (21.6°C) in July was recorded in 1994 in Mława. On the other hand, the lowest value of this parameter (13.3°C) was recorded in 1979 in Suwałki. Ten-day temperatures of July belonged to the highest temperatures in the year. In the first decade of the month, they were evenly distributed between 16.9 and 17.7°C, in the second one – between 16.9 and 17.9°C, and in the third one between 17.5 and 18.2°C. The average highest values of mean daily air temperatures for this area ranged in July from 20.1 to 21.7°C, and the lowest – from 13.3 to 15.0°C. The highest mean daily air temperatures in the period of 1966-2005 recorded in July by meteorological stations amounted to: 30.2°C in Elbląg (31.07.1994), in Mława (31.07.1994), 28.0°C in Mikołajki (31.07.1994), 27.8°C in Suwałki (31.07.1994) and 26.6°C in Białystok (16.07.2001). In July, the pattern of isotherms illustrating mean monthly air temperatures loses its latitudinal distribution characteristics for May and June. Isotherms begin to be arranged in the north-south direction (Fig. 9). The 17.5°C isotherm divides warmer areas of the south of the region (the North Mazovian Lowland). This isotherm ran in a line from the north-west to the south-east of the area, clearly dividing characteristic parts of the region (the north-west with the Warmia Plain, the Orneta Plain and the Sepopol Lowland to the Olsztyn Lake District). The south-western part with the Iława Lake District, the south with the Mazurian Plain to the Mrągowo Lake District, and the eastern part from the Great Mazurian Lakeland to the Suwałki Lake District in the north-east, the Augustów Plain and the North Podlasie Lowland in the south-east of the area.

Table 8

Thermal characteristics of July in years 1966-2005

| Mean temperature |      |                 | Locations |         |        |         |           |       |           |           |                     |      |
|------------------|------|-----------------|-----------|---------|--------|---------|-----------|-------|-----------|-----------|---------------------|------|
|                  |      |                 | Elbląg    | Kętrzyn | Suwaki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok | Mean for the region |      |
| Temperature (°C) | mean | month           | 17.5      | 17.4    | 17.0   | 17.4    | 17.7      | 17.6  | 17.9      | 17.5      | 17.5                |      |
|                  |      | ten-days period | I         | 17.1    | 16.9   | 16.6    | 17.0      | 17.3  | 17.2      | 17.7      | 17.1                | 17.1 |
|                  |      |                 | II        | 17.4    | 17.3   | 16.9    | 17.3      | 17.6  | 17.5      | 17.9      | 17.5                | 17.4 |
|                  | III  |                 | 18.0      | 17.9    | 17.5   | 17.8    | 18.2      | 18.1  | 18.2      | 17.9      | 18.0                |      |
|                  | max  | I               | 21.1      | 20.5    | 20.1   | 20.7    | 20.8      | 20.9  | 21.3      | 20.5      | 20.7                |      |
|                  |      | II              | 21.3      | 21.1    | 20.4   | 21.2    | 21.2      | 21.5  | 21.7      | 21.0      | 21.2                |      |
|                  |      | III             | 21.5      | 21.1    | 20.8   | 21.3    | 21.4      | 21.6  | 21.5      | 21.1      | 21.3                |      |
|                  | min  | I               | 13.9      | 13.6    | 13.3   | 13.7    | 14.0      | 13.7  | 14.2      | 13.9      | 13.8                |      |
|                  |      | II              | 14.4      | 14.3    | 13.9   | 14.2    | 14.7      | 14.2  | 14.6      | 14.4      | 14.3                |      |
| III              |      | 14.9            | 14.7      | 14.3    | 14.6   | 15.1    | 14.7      | 15.0  | 14.8      | 14.8      |                     |      |



Fig. 9. Isotherms of mean monthly temperature of July (°C) in years 1966-2005

Table 9

Thermal characteristics of August in years 1966-2005

| Mean temperature |      |                  | Locations |         |         |         |           |       |           | Mean for the region |           |      |
|------------------|------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|---------------------|-----------|------|
|                  |      |                  | Elbląg    | Kętrzyn | Suwątki | Olsztyn | Mikołajki | Mława | Ostrołęka |                     | Białystok |      |
| Temperature (°C) | mean | month            | 17.3      | 17.0    | 16.5    | 16.9    | 17.3      | 17.2  | 17.2      | 16.7                | 17.0      |      |
|                  |      | ten-days period  | I         | 18.4    | 18.2    | 17.8    | 18.2      | 18.6  | 18.5      | 18.7                | 18.1      | 18.3 |
|                  |      |                  | II        | 17.3    | 17.1    | 16.6    | 17.0      | 17.4  | 17.4      | 17.3                | 16.8      | 17.1 |
|                  | III  |                  | 16.1      | 15.7    | 15.0    | 15.5    | 16.0      | 15.8  | 15.7      | 15.2                | 15.6      |      |
|                  | max  | ten-days period  | I         | 21.8    | 21.3    | 20.8    | 21.2      | 21.5  | 21.7      | 21.8                | 21.2      | 21.4 |
|                  |      |                  | II        | 20.5    | 20.4    | 19.8    | 20.3      | 20.6  | 20.9      | 20.7                | 20.1      | 20.4 |
|                  |      |                  | III       | 19.3    | 18.8    | 18.1    | 18.7      | 19.0  | 19.1      | 18.9                | 18.4      | 18.8 |
|                  | min  | ten-days periods | I         | 15.5    | 15.3    | 14.9    | 15.4      | 15.7  | 15.4      | 15.7                | 15.2      | 15.4 |
|                  |      |                  | II        | 14.6    | 14.2    | 13.5    | 14.1      | 14.5  | 14.2      | 14.2                | 13.7      | 14.1 |
| III              |      |                  | 13.5      | 13.0    | 12.3    | 12.9    | 13.4      | 13.1  | 13.0      | 12.4                | 13.0      |      |

The mean monthly air temperature in August reached the value of 17.0°C and ranged for the area under analysis from 16.5°C on its north-east to 17.3°C in the centre and the north-west (Table 13). The highest value of the mean monthly air temperature in August was recorded in 2002 in Elbląg, where it amounted to 21.5°C. The lowest value of mean monthly air temperature (13.9°C) in August was recorded in 1987 in Suwątki. The highest values in the year of mean ten-day air temperatures over the entire area under analysis were recorded in the first decade of August. The distribution of mean temperatures in the decades was even, with slight spatial differentiation, but with gradual differentiation between individual decades. The first decade of August was characterized by values ranging from 17.8 to 18.6°C, the second one from 16.6 to 17.4°C, and in the third decade the value ranged only from 15.0 to 16.1°C. The highest mean ten-day air temperature in August (21.8°C) was observed in the first decade, and the lowest (12.3°C) in its third decade. The distribution of August isotherms (Fig. 10.) was similar to the distribution of the July isotherms, but with a value lower by one degree. In the area under examination, the mean monthly temperature of April ranged from 16.5 to 17.3°C.

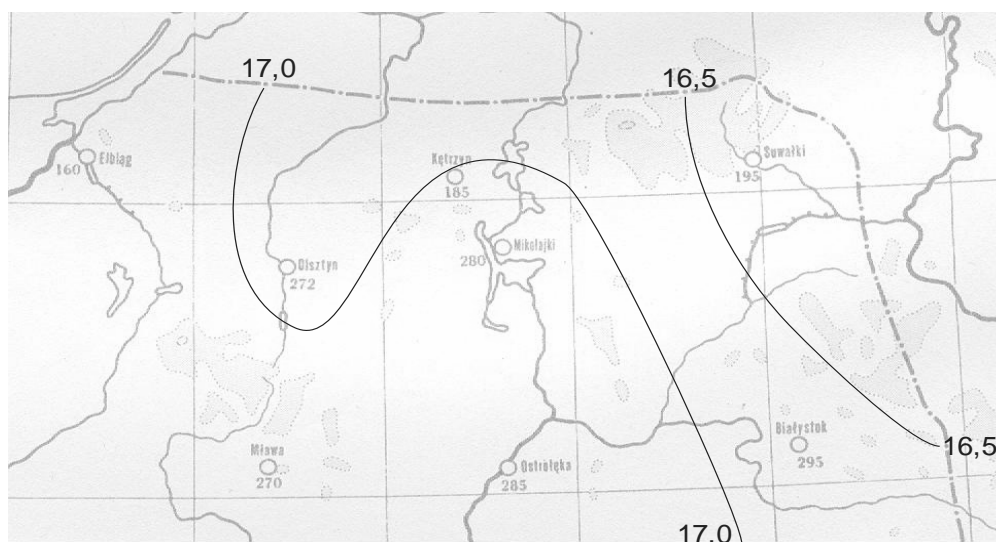


Fig. 10. Isotherms of mean monthly temperature of August (°C) in years 1966-2005

In September, the mean multi-year air temperature average for the research area amounted to 12.5°C, ranging from 11.7°C in Suwałki to 13.1°C in Elbląg (Table 10). The lowest value (16.2°C) of the mean monthly air temperature in September was recorded in 2000 in Elbląg, and the lowest, of 8.9°C, was recorded in 1986, in Suwałki. The values of mean ten-day temperatures of September for the research area demonstrated an increasingly higher differentiation both between individual decades and spatially. In the first decade, the means took the values from 13.6°C in the north-east, to 14.9°C in the north-western part of the area. The second decade was definitely cooler with temperatures between 11.6 and 11.9°C in the eastern part, 12.4-12.6°C in the centre and in the south, to 12.3-12.9°C in the west. The picture of the third decade was similar, but with lower temperature ranges, respectively: east 10.0-10.4°C, centre: 12.3-12.6°C and west up to 12.9°C. The distribution of September isotherms clearly indicates an increasing differentiation of the examined area and a clear drop in temperatures from the north-western and northern end, through central areas of the region and its east to the north-east (Fig. 11).

The mean monthly temperature of October in the north-eastern part of Poland, determined for the period of 1966-2005, was 7.7°C. In the area under examination, the mean monthly air temperatures in October ranged from 6.7 to 8.6°C (Table 11). The highest value of mean monthly temperature was recorded in Elbląg in 2000 (12.0°C). The lowest mean monthly temperature of October observed for the area (3.5°C) was recorded in 1976 in Suwałki. There were observed large differences between decades with reference to the values of mean temperatures, with definitely lower differentiation found in the spatial distribution in individual decades. In the first decade of October, the range of mean temperatures was between 8.9°C (Suwałki Lakeland) to 10.7°C in the Warmia Plain. In the second decade, respectively: between 6.7 and 8.5°C. The third decade was already much cooler with mean temperatures between 4.5 and 6.5°C. No negative minimal mean values of temperatures have been recorded yet. The distribution of isotherms illustrating mean

monthly air temperatures in the north-eastern area of Poland fluctuated from 8.5°C in the north-western part to 7.0°C in the north-eastern and eastern part of the area. The course of isotherms was similar to the longitudinal pattern (Fig. 12).

Table 10

Thermal characteristics of September in years 1966-2005

| Mean temperature |      |                 | Locations |         |         |         |           |       |           |           | Mean for the region |      |
|------------------|------|-----------------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|------|
|                  |      |                 | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok |                     |      |
| Temperature (°C) | mean | month           | 13.1      | 12.5    | 11.7    | 12.5    | 12.8      | 12.6  | 12.7      | 12.1      | 12.5                |      |
|                  |      | ten-days period | I         | 14.9    | 14.3    | 13.6    | 14.2      | 14.6  | 14.4      | 14.5      | 13.9                | 14.3 |
|                  |      |                 | II        | 12.9    | 12.3    | 11.6    | 12.3      | 12.6  | 12.4      | 12.4      | 11.9                | 12.3 |
|                  | III  |                 | 11.6      | 10.9    | 10.0    | 10.9    | 11.2      | 10.9  | 11.0      | 10.4      | 10.9                |      |
|                  | max  | I               | 18.6      | 17.7    | 17.0    | 17.8    | 17.9      | 18.1  | 18.1      | 17.4      | 17.8                |      |
|                  |      | II              | 16.2      | 15.8    | 15.1    | 15.9    | 15.9      | 16.0  | 16.1      | 15.6      | 15.8                |      |
|                  |      | III             | 15.1      | 14.3    | 13.5    | 14.5    | 14.4      | 14.6  | 14.7      | 14.1      | 14.4                |      |
|                  | min  | I               | 11.6      | 11.1    | 10.4    | 11.0    | 11.5      | 11.1  | 11.3      | 10.7      | 11.1                |      |
|                  |      | II              | 10.1      | 9.5     | 8.6     | 9.2     | 9.9       | 9.3   | 9.2       | 8.6       | 9.3                 |      |
|                  |      | III             | 8.5       | 7.8     | 6.7     | 7.6     | 8.2       | 7.7   | 7.6       | 6.9       | 7.6                 |      |

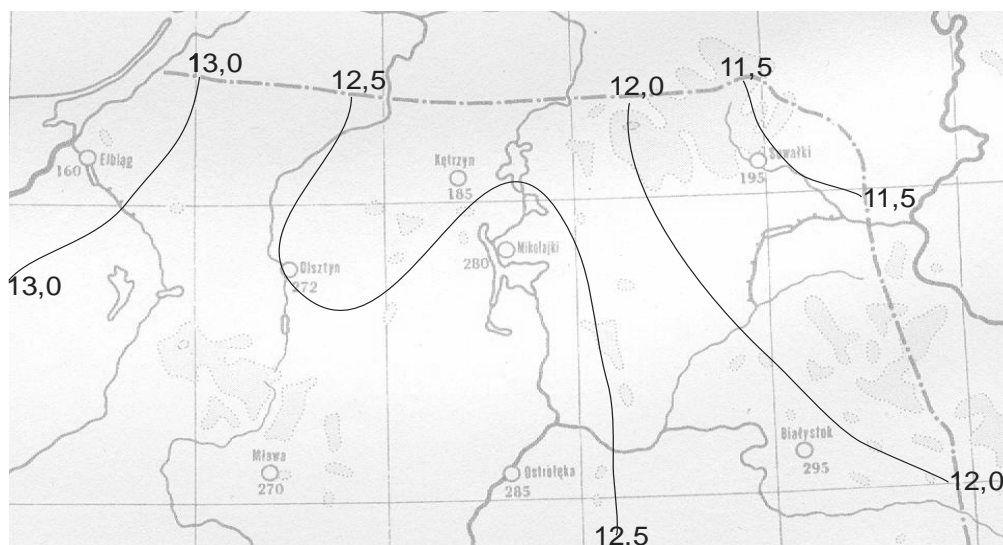


Fig. 11. Isotherms of mean monthly temperature of September (°C) in years 1966-2005



Table 11

Thermal characteristics of October in years 1966-2005

| Mean temperature |      |                  | Locations |         |         |         |           |       |           | Mean for the region |            |      |
|------------------|------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|---------------------|------------|------|
|                  |      |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikolajki | Mława | Ostrołęka |                     | Białystok  |      |
| Temperature (°C) | mean | month            | 8.6       | 7.8     | 6.7     | 7.8     | 7.9       | 7.7   | 7.7       | 7.2                 | <b>7.7</b> |      |
|                  |      | ten-deys period  | I         | 10.7    | 9.9     | 8.9     | 10.0      | 10.1  | 9.9       | 9.8                 | 9.5        | 9.9  |
|                  |      |                  | II        | 8.5     | 7.8     | 6.7     | 7.8       | 7.9   | 7.6       | 7.8                 | 7.2        | 7.7  |
|                  | III  |                  | 6.5       | 5.7     | 4.5     | 5.8     | 5.8       | 5.5   | 5.4       | 5.0                 | 5.5        |      |
|                  | max  | ten-deys period  | I         | 14.3    | 13.5    | 12.6    | 13.7      | 13.5  | 13.7      | 13.6                | 13.4       | 13.5 |
|                  |      |                  | II        | 12.4    | 11.6    | 10.5    | 11.7      | 11.6  | 11.6      | 11.7                | 11.4       | 11.6 |
|                  |      |                  | III       | 10.2    | 9.4     | 8.5     | 9.6       | 9.5   | 9.3       | 9.2                 | 9.3        | 9.4  |
|                  | min  | ten-deys periods | I         | 7.2     | 6.4     | 5.2     | 6.4       | 6.7   | 6.5       | 6.1                 | 5.5        | 6.3  |
|                  |      |                  | II        | 4.6     | 3.6     | 2.4     | 3.6       | 4.0   | 3.3       | 3.1                 | 2.5        | 3.4  |
| III              |      |                  | 2.9       | 2.0     | 0.6     | 2.1     | 2.2       | 1.8   | 1.6       | 0.8                 | 1.8        |      |

Thermal conditions of November in north-eastern Poland were characterized by mean monthly temperatures of 2.4°C, which were distributed between 1.5°C in Suwałki to 3.4°C in Elbląg (Table 12). The highest mean monthly air temperature in November in the given area, at the level of 6.8°C, was recorded in Elbląg in 2000. The lowest temperature, amounting to -4.4°C, was observed in 1993 in Suwałki. The distribution of mean ten-day air temperatures in November was definitely varied in time and space, both between individual decades and in the examined area. The first decade represented the differentiated arrangement between 3.3°C in the north-eastern part of the area to 4.6°C in its central part and 5.2°C in the north-western part of the area. In the second decade, by analogy, the temperature recorded took the value between 1.3 through 2.4 to 3.1°C. In the third decade, in the north-eastern part of the region (the Suwałki Lake District) – the mean ten-day temperature was -0.2°C. The centre of the region (the Great Mazurian Lakeland, the Mrągowo Lake District) was an area characterized by the temperature of 0.9°C, the temperature of 1.0°C was recorded further to the west (the Olsztyn Lake District), while the western and north-western parts (the Iława Lake District, the Warmia Plain, the Elbląg Region) were characterized by a mean value of the temperature reaching 1.8°C. The thermal conditions of November are presented on the map showing the distribution of isotherms illustrating mean monthly air temperatures (Fig. 13). This map shows isotherms between 1.5°C and 3.0°C. The 3.0°C isotherm cuts off the western part of the area under analysis. The 2.5°C isotherm forms the border of the eastern part of the area, along the Łyna-Drwęca

line, with clear inclusion of the heat island formed by the central area of the Great Mazurian Lakeland. The 2 °C and 1.5°C isotherms separate eastern, cooler part of the area.

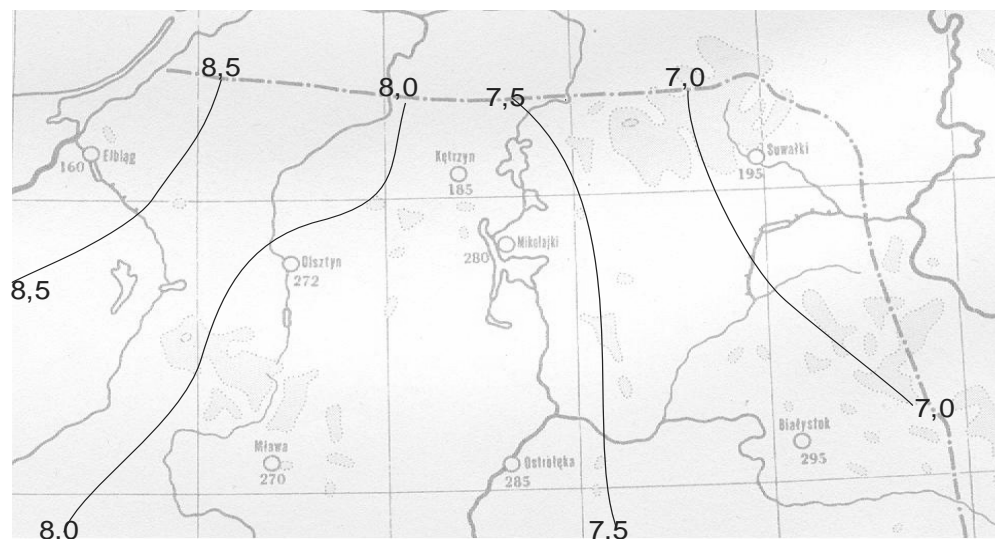


Fig. 12. Isotherms of mean monthly temperature of October (°C) in years 1966-2005

December in the area of the north-eastern Poland was the month marking the beginning of the thermal winter and showing definite variability of temperatures both in the scale of the month and decades. The mean monthly temperature of December was  $-1.5^{\circ}\text{C}$ , while mean monthly temperatures in the research area ranged from  $-0.3$  to  $-2.6^{\circ}\text{C}$  (Table 13). The highest mean temperature of December, of  $3.2^{\circ}\text{C}$ , was recorded in Elbląg in 1971. The lowest mean temperature of December, of  $-10.3^{\circ}\text{C}$ , was observed in 1969 in Suwałki. Only in the first decade of December did the mean ten-day temperature in the north-west reach a value above zero ( $0.4^{\circ}\text{C}$ ). In other decades over the entire area under analysis, the ten-day means took values below zero. The first decade of December was characterized by mean temperatures from  $0.4$  to  $-1.7^{\circ}\text{C}$ . In the second decade, the range of mean temperatures included the values between  $-2.8^{\circ}\text{C}$  in the Suwałki Lake District, through  $-2.1^{\circ}\text{C}$  in the Augustów Plain and the North Podlasie Lowland, and  $-2.0^{\circ}\text{C}$  in the Mazurian Plain, in the Great Mazurian Lakeland and the Olsztyn Lake District, and  $-1.0^{\circ}\text{C}$  in the Iława Lake District and the Warmia Plain (Table 13). The distribution of December isotherms, of the clearly longitudinal pattern, demonstrated a clear drop in temperatures from the western part of the area to its eastern borders (Fig. 14).

Table 12

Thermal characteristics of November in years 1966-2005

| Mean temperature |      |                  | Locations |         |         |         |           |       |           |           | Mean for the region |      |
|------------------|------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|------|
|                  |      |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok |                     |      |
| Temperature (°C) | mean | month            | 3.4       | 2.5     | 1.5     | 2.6     | 2.6       | 2.4   | 2.5       | 2.0       | 2.4                 |      |
|                  |      | ten-deys period  | I         | 5.2     | 4.4     | 3.3     | 4.5       | 4.6   | 4.3       | 4.4       | 3.9                 | 4.3  |
|                  |      |                  | II        | 3.1     | 2.3     | 1.3     | 2.4       | 2.4   | 2.2       | 2.2       | 1.9                 | 2.2  |
|                  | III  |                  | 1.8       | 0.8     | -0.2    | 1.0     | 0.9       | 0.7   | 0.7       | 0.4       | 0.8                 |      |
|                  | max  | ten-deys period  | I         | 8.7     | 8.0     | 7.0     | 8.1       | 8.1   | 8.1       | 8.3       | 7.8                 | 8.0  |
|                  |      |                  | II        | 7.1     | 6.2     | 5.4     | 6.4       | 6.3   | 6.3       | 6.4       | 6.2                 | 6.3  |
|                  |      |                  | III       | 5.4     | 4.7     | 3.7     | 4.9       | 4.8   | 4.6       | 4.9       | 4.3                 | 4.7  |
|                  | min  | ten-deys periods | I         | 1.6     | 0.6     | -0.5    | 0.7       | 0.9   | 0.4       | 0.3       | -0.2                | 0.5  |
|                  |      |                  | II        | -0.9    | -1.9    | -3.1    | -1.7      | -1.6  | -1.8      | -2.0      | -2.4                | -1.9 |
|                  |      |                  | III       | -2.0    | -3.1    | -4.3    | -2.9      | -2.9  | -3.0      | -3.3      | -3.6                | -3.1 |



Fig. 13. Isotherms of mean monthly temperature of November (°C) in years 1966-2005

Table 13

Thermal characteristics of December in years 1966-2005

| Mean temperature |      |                  | Locations |         |         |         |           |       |           |           | Mean for the region |      |
|------------------|------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|------|
|                  |      |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok |                     |      |
| Temperature (°C) | mean | month            | -0.3      | -1.4    | -2.6    | -1.2    | -1.3      | -1.5  | -1.2      | -2.0      | -1.4                |      |
|                  |      | ten-deys period  | I         | 0.4     | -0.6    | -1.7    | -0.5      | -0.5  | -0.8      | -0.6      | -1.3                | -0.7 |
|                  |      |                  | II        | -0.5    | -1.5    | -2.8    | -1.3      | -1.4  | -1.5      | -1.3      | -2.1                | -1.6 |
|                  | III  |                  | -0.9      | -2.1    | -3.4    | -1.9    | -2.1      | -2.1  | -1.8      | -2.7      | -2.1                |      |
|                  | min  | ten-deys period  | I         | 4.1     | 3.3     | 2.3     | 3.3       | 3.3   | 3.0       | 3.5       | 2.7                 | 3.2  |
|                  |      |                  | II        | 3.9     | 3.1     | 1.9     | 3.3       | 3.1   | 3.1       | 3.4       | 2.7                 | 3.1  |
|                  |      |                  | III       | 3.4     | 2.6     | 1.6     | 2.9       | 2.7   | 2.4       | 3.0       | 2.4                 | 2.6  |
|                  | max  | ten-deys periods | I         | -3.9    | -5.4    | -6.6    | -5.1      | -5.1  | -5.4      | -5.4      | -6.2                | -5.4 |
|                  |      |                  | II        | -5.7    | -7.3    | -8.8    | -7.0      | -6.9  | -7.2      | -7.0      | -8.2                | -7.3 |
|                  |      |                  | III       | -5.4    | -6.9    | -8.6    | -6.8      | -7.0  | -6.9      | -6.7      | -8.2                | -7.1 |

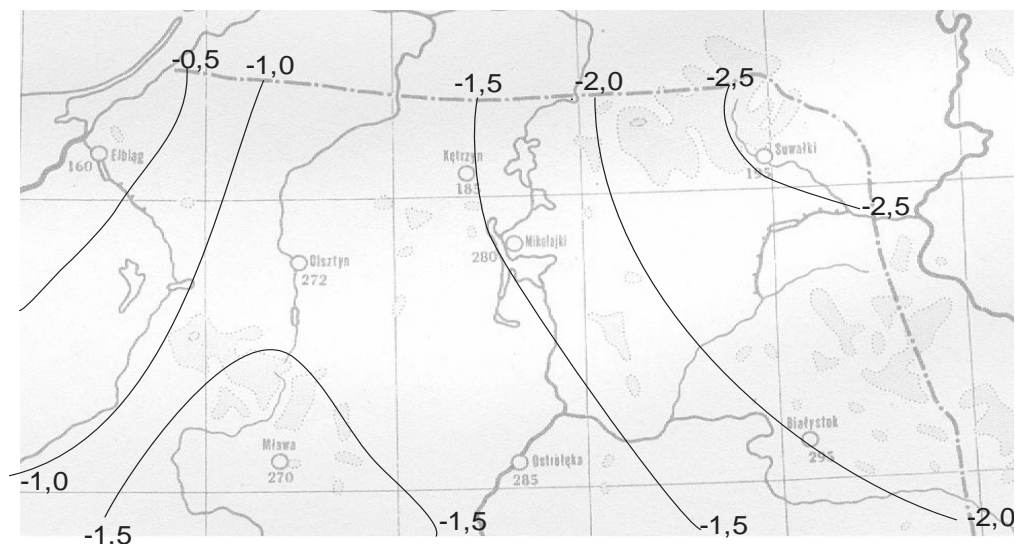


Fig. 14. Isotherms of mean monthly temperature of December (°C) in years 1966-2005

## Minimum air temperatures

The mean annual air temperature of the north-eastern part of Poland in the period under analysis was 3.4°C (Fig. 15).

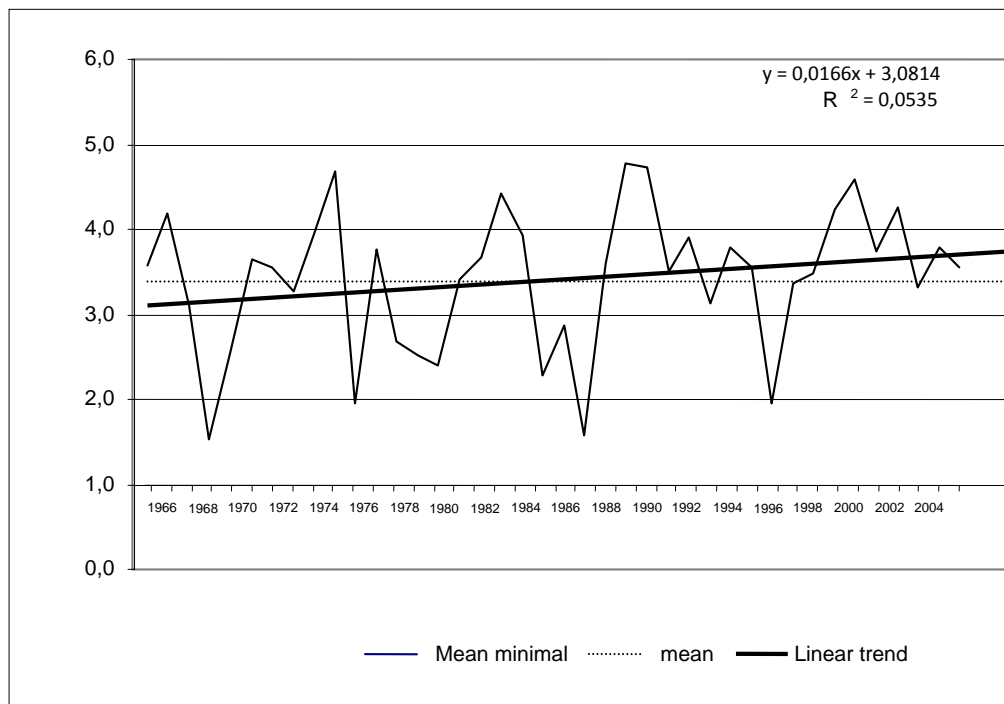


Fig. 15. Mean annual minimum temperature in years 1966-2005

A linear trend, although statistically significant (only at  $\alpha = 0.05$ ), demonstrated that in the examined multi-year period, the mean annual minimum air temperature was increasingly higher. In the distinguished time brackets, this value was subject to significant changes. The lowest mean annual air temperature in the region reached the value of 1.5°C and occurred in 1969. In five-year intervals of the forty-year period of 1966-2005, the value of the mean minimum five-year air temperature varied from 2.6 to 3.7°C. The coldest five-year period was the period between 1976 and 1980, with a mean five-year air temperature of 2.6°C. In ten-year periods, the value of the mean minimum air temperature in a decade ranged from 3.1 to 3.7°C, while the twenty-year intervals levelled out the difference to the range of 3.2-3.6°C. The lowest value of the mean annual minimum air temperature in the examined area occurred in 1969, reaching the value of 0.2°C.

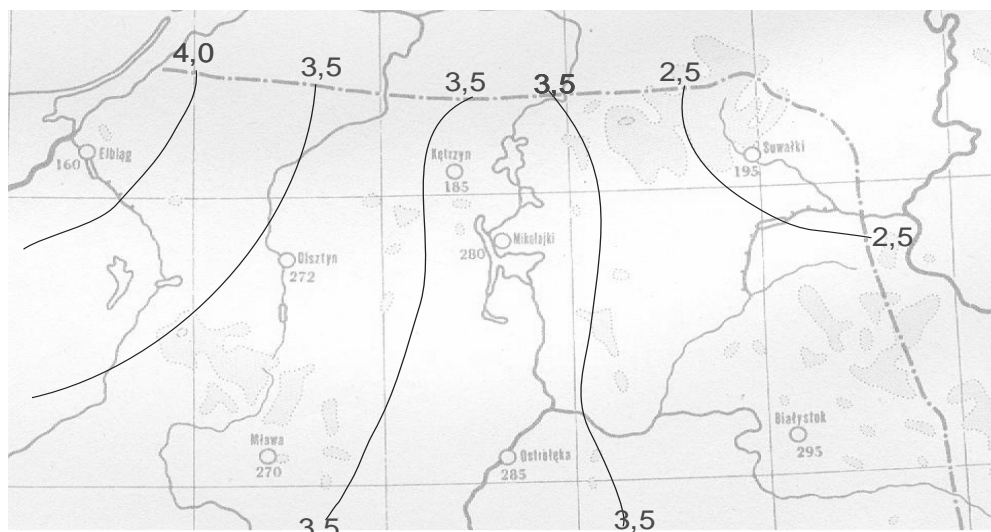


Fig. 16. Isotherms of mean monthly minimum temperature (°C) in years 1966-2005

Spatial distribution of the mean annual minimum air temperature in the examined area (Fig. 16) was characterized by the longitudinal pattern of isotherms. In the spatial distribution for the region, those values ranged from 2.4°C in the north-east of the analysed area to 4.4 °C in the north-west. The lowest mean monthly minimum temperature was recorded in January, while it reached the mean value for the region of -5.8°C, fluctuating from -4.4°C in Elbląg to -7.1°C in Suwałki. On the other hand, the highest values of the minimum temperature were recorded in July, and on average, in the research area during the examined period, they amounted to 12.7°C. The mean annual minimum temperature reached the lowest value in Suwałki (2.4°C) and the highest in Elbląg (4.4°C) (Table 16). The lowest values of the minimum air temperature recorded in the analysed territory are presented in Table 17.

Table 14

Absolute minimum temperatures (°C)

| Specification         | Locations  |            |            |            |            |                            |             |            |
|-----------------------|------------|------------|------------|------------|------------|----------------------------|-------------|------------|
|                       | Elbląg     | Kętrzyn    | Suwałki    | Olsztyn    | Mikołajki  | Mława                      | Ostrołęka   | Białystok  |
| Temperatures recorded | -31.1      | -30.1      | -30.7      | -30.4      | -31.2      | -30.2                      | -30.2       | -35.4      |
| Date of occurrence    | 1.02. 1987 | 4.01. 1979 | 8.01. 1987 | 2.02. 1970 | 8.01. 1987 | 8.01. 1987;<br>30.01. 1987 | 30.01. 1987 | 7.01. 2003 |

Table 15

Values of minimum temperature in periods

| Periods      |             | Minimum temperature(°C) |                |      |
|--------------|-------------|-------------------------|----------------|------|
|              |             | Average                 | Minimal values | Year |
| Five-years   | 1966 - 1970 | 3.0                     | 1.5            | 1969 |
|              | 1971 - 1975 | 3.7                     | 3.3            | 1973 |
|              | 1976 - 1980 | 2.6                     | 1.9            | 1976 |
|              | 1981 - 1985 | 3.5                     | 2.3            | 1985 |
|              | 1986 - 1990 | 3.5                     | 1.6            | 1987 |
|              | 1991 - 1995 | 3.6                     | 3.1            | 1993 |
|              | 1996 - 2000 | 3.5                     | 1.9            | 1996 |
| Ten-years    | 2001 - 2005 | 3.7                     | 3.3            | 2003 |
|              | 1966 -1975  | 3.4                     | 1.5            | 1969 |
|              | 1976 - 1985 | 3.1                     | 1.9            | 1976 |
|              | 1986 - 1995 | 3.6                     | 1.6            | 1987 |
| Twenty-tears | 1996 - 2005 | 3.7                     | 1.9            | 1996 |
|              | 1966 -1985  | 3.2                     | 1.5            | 1969 |
| Forty-years  | 1986 - 2005 | 3.6                     | 1.6            | 1987 |
|              | 1966 - 2005 | 3.4                     | 1.5            | 1969 |

Table 16

Mean monthly minimum temperatures in years 1966-2005 1966-2005

| Months      | Locations |         |         |          |           |       |           |           |                     |
|-------------|-----------|---------|---------|----------|-----------|-------|-----------|-----------|---------------------|
|             | Elbląg    | Kętrzyn | Suwałki | Olisztyn | Mikołajki | Mława | Ostrolęka | Białystok | Mean for the region |
| January     | -4.4      | -5.8    | -7.1    | -5.4     | -5.8      | -5.8  | -5.8      | -6.6      | -5.8                |
| February    | -3.7      | -5.0    | -6.6    | -4.8     | -5.3      | -4.9  | -4.9      | -5.9      | -5.1                |
| March       | -0.7      | -2.0    | -3.4    | -1.9     | -2.3      | -1.8  | -1.8      | -2.9      | -2.1                |
| April       | 3.2       | 2.3     | 1.6     | 1.9      | 2.4       | 2.5   | 2.6       | 1.8       | 2.3                 |
| May         | 8.0       | 7.2     | 6.6     | 6.8      | 7.9       | 7.6   | 7.6       | 6.8       | 7.3                 |
| June        | 11.1      | 10.4    | 9.8     | 10.2     | 11.5      | 10.5  | 10.8      | 10.0      | 10.5                |
| July        | 13.0      | 12.4    | 11.7    | 12.2     | 13.5      | 12.3  | 12.3      | 11.9      | 12.4                |
| August      | 12.7      | 12.0    | 11.0    | 11.7     | 13.1      | 11.8  | 11.7      | 11.0      | 11.9                |
| September   | 9.3       | 8.5     | 7.3     | 8.2      | 9.3       | 8.1   | 8.3       | 7.3       | 8.3                 |
| October     | 5.5       | 4.7     | 3.4     | 4.6      | 5.2       | 4.2   | 4.2       | 3.5       | 4.4                 |
| November    | 1.2       | 0.3     | -0.7    | 0.4      | 0.7       | 0.0   | 0.1       | -0.4      | 0.2                 |
| December    | -2.6      | -3.7    | -5.1    | -3.5     | -3.4      | -3.9  | -3.6      | -4.6      | -3.8                |
| Mean annual | 4.4       | 3.5     | 2.4     | 3.4      | 3.9       | 3.4   | 3.5       | 2.7       | 3.4                 |

## Maximum air temperature

The mean annual maximum air temperature in north-eastern Poland in the analysed period was 11.3°C. A statistically significant linear trend indicated its growth (Fig. 17). A spatial profile of the mean annual maximum temperature is presented by isotherms, showing a longitudinal pattern in the northern part of the analysed territory, gradually changing into the latitudinal arrangement towards the south. The highest mean annual maximum air temperature of 13.0°C was observed three times in this area, in 1989, 2000 and 2002 (Fig. 17). The highest mean annual values of the maximum temperature were observed in the south (the Kurpie Plain), north-west (the Warmia Plain) and in the western part of the region (the Iława Lake District).

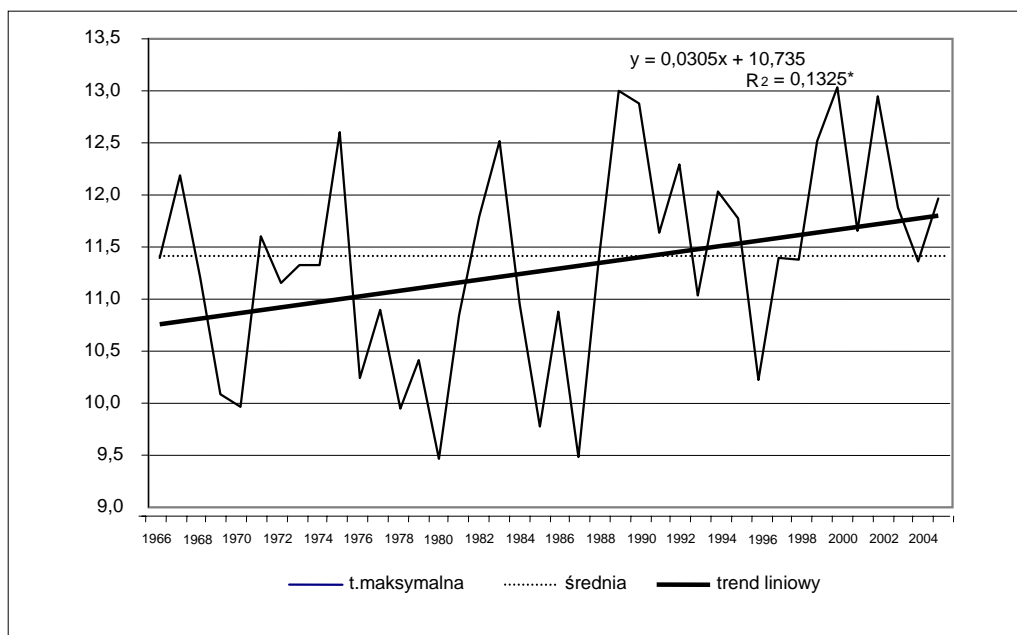


Fig. 17. Mean maximum temperature (°C) in years 1966-2006.



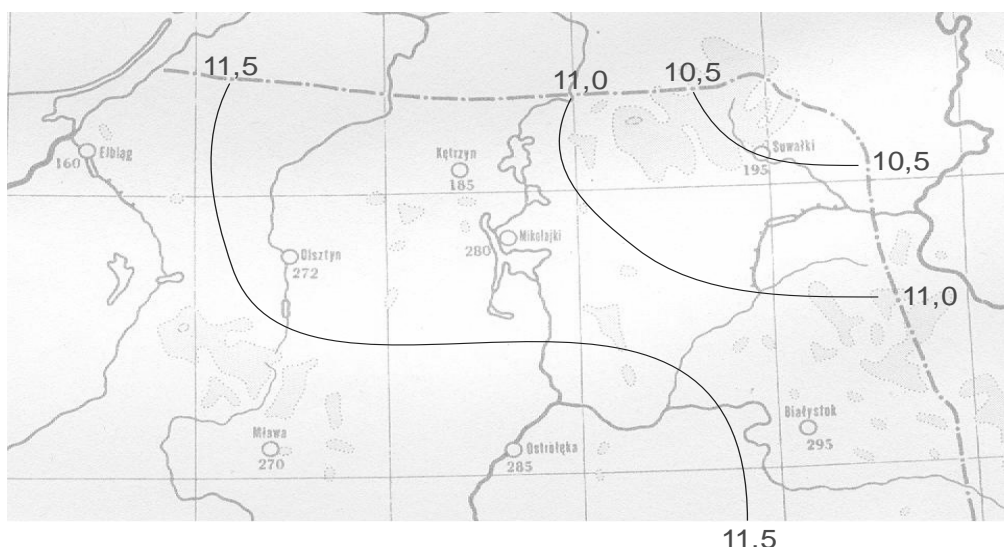


Fig. 18. Isotherms of mean monthly maximum temperature temperature (°C) in years 1966-2005

The highest annual maximum air temperature was observed in 1987 in Ostrołęka, when it reached the value of 13.7°C. In distinguished time brackets, its value was subject to significant changes (Table 17). In five-year intervals, the mean maximum air temperature varied from 10.8 to 12.0°C.

Table 17

Values of maximum temperature in periods

| Periods      |             | Maximum temperature (°C) |         |                  |
|--------------|-------------|--------------------------|---------|------------------|
|              |             | Average                  | Minimum | Year             |
| Five-years   | 1966 - 1970 | 10.8                     | 12.2    | 1967             |
|              | 1971 - 1975 | 11.5                     | 12.6    | 1975             |
|              | 1976 - 1980 | 10.1                     | 10.9    | 1977             |
|              | 1981 - 1985 | 11.1                     | 12.5    | 1985             |
|              | 1986 - 1990 | 11.4                     | 13.0    | 1989             |
|              | 1991 - 1995 | 11.7                     | 12.3    | 1992             |
|              | 1996 - 2000 | 11.7                     | 13.0    | 2000             |
| Ten-years    | 2001 - 2005 | 12.0                     | 13.0    | 2002             |
|              | 1966 - 1975 | 11.2                     | 12.6    | 1975             |
|              | 1976 - 1985 | 10.6                     | 12.5    | 1985             |
|              | 1986 - 1995 | 11.6                     | 13.0    | 1989             |
| Twenty-years | 1996 - 2005 | 11.8                     | 13.0    | 2000; 2002       |
|              | 1966 - 1985 | 10.9                     | 12.6    | 1975             |
| Forty-years  | 1986 - 2005 | 11.7                     | 13.0    | 1989; 2000; 2002 |
|              | 1966 - 2005 | 11.3                     | 13.0    | 1989; 2000; 2002 |

Table 18

Absolute maximum temperatures (°C)

| Specification         | Locations  |            |            |            |            |            |            |            |
|-----------------------|------------|------------|------------|------------|------------|------------|------------|------------|
|                       | Elbląg     | Kętrzyn    | Suwałki    | Olsztyn    | Mikołajki  | Mława      | Ostrołęka  | Białystok  |
| Temperatures recorded | 36.5       | 36.1       | 35.2       | 36.2       | 34.9       | 36.6       | 36.6       | 35.5       |
| Date of occurrence    | 31.07.1994 | 29.07.1992 | 31.07.1994 | 10.08.1992 | 31.07.1994 | 31.07.1994 | 31.07.1994 | 31.07.1994 |

The warmest five-year period was the period between 2001 and 2005, with the mean five-year air temperature of 12.0°C. In ten-year time brackets, the value of the mean air temperature for decades ranged from 10.6 to 11.8°C, while twenty-year intervals ranged from the value of 10.9 to 11.7°C. Monthly means of the maximum air temperature for the examined area reached the values from -0.8°C in January to 22.7°C in July, giving the mean annual for the research area of 11.3°C (Table 23). The highest air temperatures for the region (36.6°C) were recorded on 31 July in 1994 in Mława and Ostrołęka.

Table 19

Mean monthly maximum temperatures in years 1966-2005

| Months      | Locations |         |         |         |           |       |           |           |                     |
|-------------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|
|             | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok | Mean for the region |
| January     | 0.4       | -0.8    | -2.1    | -0.5    | -1.0      | -0.7  | -0.6      | -1.3      | -0.8                |
| February    | 1.7       | 0.5     | -0.9    | 0.9     | 0.3       | 0.8   | 1.0       | 0.3       | 0.6                 |
| March       | 5.9       | 5.0     | 3.8     | 5.4     | 4.9       | 5.4   | 5.9       | 5.1       | 5.2                 |
| April       | 11.8      | 11.7    | 11.1    | 11.8    | 11.4      | 12.2  | 12.6      | 12.4      | 11.8                |
| May         | 17.9      | 18.1    | 17.8    | 18.2    | 17.9      | 18.6  | 19.2      | 18.7      | 18.2                |
| June        | 20.5      | 20.7    | 20.5    | 20.8    | 20.7      | 21.2  | 22.1      | 21.4      | 20.9                |
| July        | 22.3      | 22.6    | 22.3    | 22.6    | 22.5      | 23.1  | 23.6      | 23.1      | 22.7                |
| August      | 22.3      | 22.4    | 22.1    | 22.4    | 22.2      | 23.0  | 23.1      | 22.6      | 22.5                |
| September   | 17.5      | 17.1    | 16.6    | 17.2    | 17.0      | 17.6  | 17.8      | 17.2      | 17.3                |
| October     | 12.1      | 11.4    | 10.5    | 11.6    | 11.3      | 11.7  | 11.9      | 11.4      | 11.5                |
| November    | 5.7       | 4.8     | 3.7     | 4.9     | 4.8       | 4.8   | 5.0       | 4.5       | 4.8                 |
| December    | 1.8       | 0.8     | -0.4    | 1.0     | 0.7       | 0.7   | 1.0       | 0.3       | 0.8                 |
| Mean annual | 11.7      | 11.2    | 10.4    | 11.4    | 11.1      | 11.5  | 11.9      | 11.3      | 11.3                |

### Days with the minimum daily temperature below 0°C

The number of days with temperatures within specified ranges or thresholds is the information illustrating the quality of the climate and its character, which is commonly referred to as mild, moderate, acute or unfriendly [WOŚ, 1999].

Table 20

Number of days with minimum daily temperature below 0°C in years 1966-2005

| Months    | Locations |         |         |         |           |       |           |           |                     |
|-----------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|
|           | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikolajki | Mława | Ostrołęka | Białystok | Mean for the region |
| January   | 21.6      | 24.1    | 26.0    | 23.9    | 25.0      | 24.1  | 24.2      | 25.3      | 24.3                |
| February  | 20.2      | 22.0    | 23.7    | 21.8    | 23.0      | 22.1  | 21.7      | 23.2      | 22.2                |
| March     | 15.8      | 19.0    | 22.0    | 19.0    | 19.5      | 19.4  | 18.4      | 21.4      | 19.3                |
| April     | 6.1       | 8.0     | 10.4    | 9.8     | 7.9       | 7.9   | 7.7       | 10.4      | 8.5                 |
| May       | 0.5       | 1.1     | 1.5     | 1.5     | 0.9       | 0.4   | 1.1       | 1.8       | 1.1                 |
| June      | 0.0       | 0.0     | 0.1     | 0.0     | 0.0       | 0.0   | 0.0       | 0.0       | 0.0                 |
| July      | 0.0       | 0.0     | 0.0     | 0.0     | 0.0       | 0.0   | 0.0       | 0.0       | 0.0                 |
| August    | 0.0       | 0.0     | 0.0     | 0.0     | 0.0       | 0.0   | 0.0       | 0.0       | 0.0                 |
| September | 0.2       | 0.3     | 1.0     | 0.7     | 0.5       | 0.1   | 0.5       | 1.1       | 0.6                 |
| October   | 3.0       | 4.1     | 6.6     | 4.6     | 5.2       | 3.0   | 5.3       | 6.9       | 4.8                 |
| November  | 10.0      | 12.0    | 14.8    | 12.0    | 13.4      | 11.3  | 12.9      | 14.2      | 12.6                |
| December  | 20.0      | 22.1    | 24.7    | 21.7    | 23.2      | 22.0  | 21.8      | 23.5      | 22.4                |

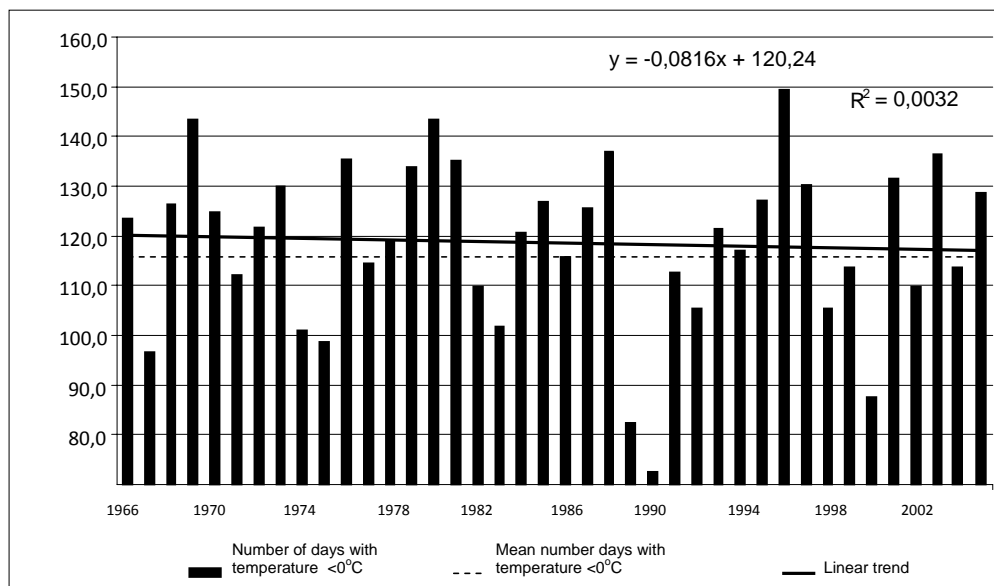


Fig. 19. Days with minimum daily temperature below 0°C

In the north-eastern Poland, there were on average 116 days with the minimum temperature below 0°C in the multi-year period (Fig. 19, Table 20). Their distribution, both as regards time and space, was diverse. The highest number of such days were recorded in the east (128-131), and the lowest in the north-west of the region (97). In the examined area, days with the minimum temperature below zero were not recorded only in July. In 1996, the highest number of days with minimum temperature below 0°C was observed (146 days), with regional differentiation between 138 and 156 days. A large number of such days was also recorded in 1969 (141 days – between 126 and 153 in the region) and 1980-143 days (132-151). A lower number of the discussed days was found in 1990 (72), in the spatial distribution between 56 and 88 days in 2000, when 86 cases were observed, on average. A trend line indicates a decreasing number of such days in a year (a statistically insignificant trend).

### Days with a maximum daily temperatures below 0°C

Days with the daily maximum temperature below 0°C are described as frosty. In the north-eastern area of Poland, there were on average 46 such days in a year.

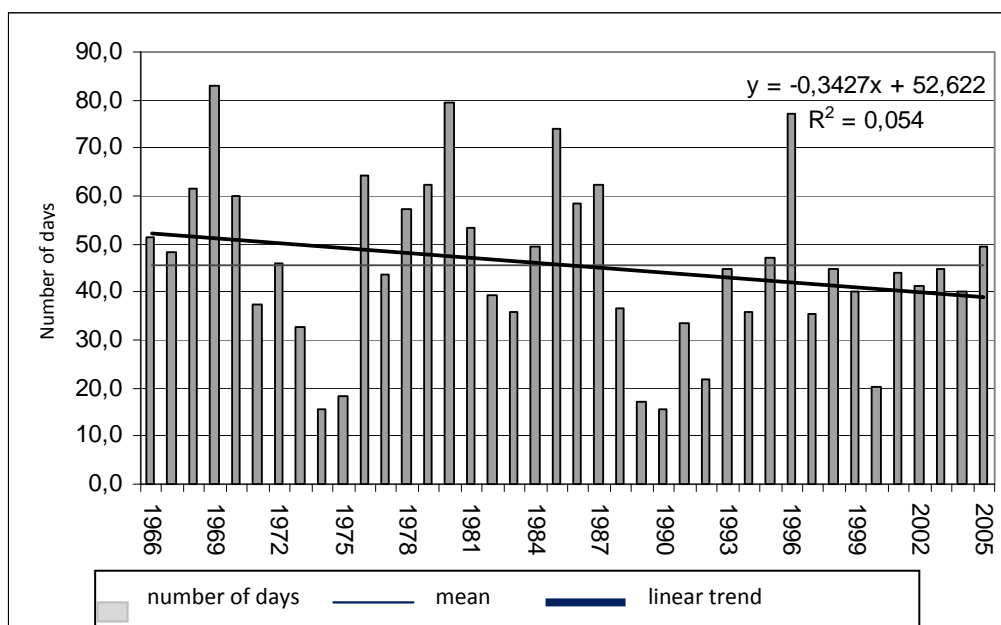


Fig. 20. Number of days with maximum daily temperature below 0°C in years 1996-2005

In the area under analysis, the greatest number of frosty days, with the maximum temperature below zero, was recorded in the Suwałki Lake District and in the region of the Romnicka Primeval Forest (58 days). In the eastern and south-eastern part of the area (the Augustów Plain and the North Podlasie Lowland) there were 50 days recorded on average in a year. On a time scale, most frosty days were observed in January (15 days), February (12 days) and in December (11 days). The largest

number of frosty days was recorded in 1969, when there were on average 83 such days with spatial variability ranging from 71 to 99 days. In 1980, there were on average 79 frosty days (54-98 days in the region), and in 1996 – 77 days (65-85). A linear (statistically insignificant) trend indicated a decreasing number of such days per year. In 1974, there were recorded only 16 such days, in 1989 – 17 days, in 1975 – 18 days, and in 2000 – 20 days.

### Days with the maximum daily temperature below -10°C

A day with the maximum daily temperature below -10°C is referred to as a very frosty day. Although the north-eastern Poland is considered to be the coldest region of the entire country (apart from the mountains), the average number of very frosty days in a year was only 3 (Table 22, Fig. 21). Also, a trend line (statistically insignificant) indicated a decrease in the number of such cases per year.

Table 21

Number of days with a maximum daily temperature below 0°C in years 1966-2005

| Months    | Locations |         |         |         |           |       |           |           |                     |
|-----------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|
|           | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok | Mean for the region |
| January   | 12.2      | 14.7    | 17.0    | 14.3    | 15.1      | 14.7  | 14.5      | 16.075    | 14.8                |
| February  | 9.2       | 12.0    | 14.7    | 11.0    | 12.1      | 11.2  | 10.7      | 12.5      | 11.7                |
| March     | 2.3       | 3.7     | 6.0     | 3.4     | 4.0       | 3.5   | 2.9       | 4.0       | 3.7                 |
| April     | 0.0       | 0.0     | 0.1     | 0.1     | 0.1       | 0.0   | 0.0       | 0.1       | 0.1                 |
| May       | 0.0       | 0.0     | 0.0     | 0.0     | 0.0       | 0.0   | 0.0       | 0.0       | 0.0                 |
| June      | 0.0       | 0.0     | 0.0     | 0.0     | 0.0       | 0.0   | 0.0       | 0.0       | 0.0                 |
| July      | 0.0       | 0.0     | 0.0     | 0.0     | 0.0       | 0.0   | 0.0       | 0.0       | 0.0                 |
| August    | 0.0       | 0.0     | 0.0     | 0.0     | 0.0       | 0.0   | 0.0       | 0.0       | 0.0                 |
| September | 0.0       | 0.0     | 0.0     | 0.0     | 0.0       | 0.0   | 0.0       | 0.0       | 0.0                 |
| October   | 0.0       | 0.1     | 0.2     | 0.1     | 0.1       | 0.1   | 0.0       | 0.2       | 0.1                 |
| November  | 2.5       | 3.9     | 5.6     | 3.8     | 3.9       | 4.0   | 4.0       | 4.5       | 4.0                 |
| December  | 8.5       | 11.2    | 14.3    | 11.1    | 11.5      | 11.5  | 10.6      | 12.2      | 11.4                |

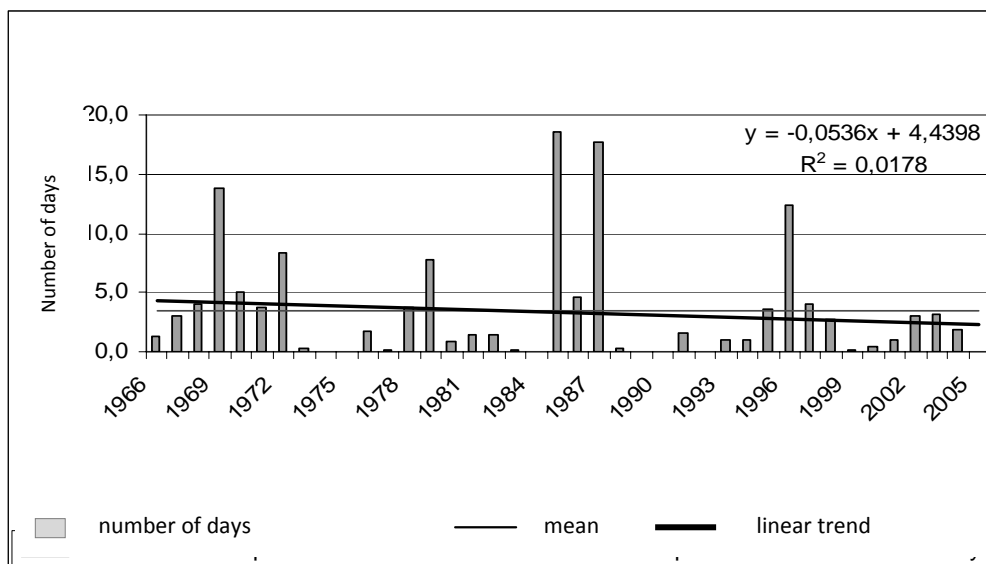


Fig. 21. Number of days with a maximum temperature below -10°C in years 1966-2005

Table 22

Number of days with a maximum daily temperature below -10°C in years 1966-2005

| Months   | Locations |         |         |         |           |       |           |           |                     |
|----------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|
|          | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok | Mean for the region |
| January  | 0.8       | 2.0     | 3.0     | 1.4     | 2.0       | 1.6   | 1.7       | 2.2       | 1.8                 |
| February | 0.3       | 0.7     | 1.2     | 0.4     | 0.8       | 0.5   | 0.5       | 0.7       | 0.6                 |
| March    | 0.1       | 0.1     | 0.2     | 0.1     | 0.1       | 0.1   | 0.1       | 0.1       | 0.1                 |
| -----    |           |         |         |         |           |       |           |           |                     |
| November | 0.0       | 0.0     | 0.0     | 0.0     | 0.0       | 0.0   | 0.1       | 0.0       | 0.0                 |
| December | 0.4       | 0.9     | 1.1     | 0.6     | 0.9       | 0.7   | 0.9       | 1.0       | 0.8                 |

### The number of days with a maximum daily temperature above 25°C

A day with the maximum temperature above 25°C is referred to as a hot day. In north-eastern Poland, the number of such days in the multi-year period under analysis was 29, on average (Fig. 22). A linear trend indicated their growing number per year. The years with the highest number of days characterized by the daily maximum temperature above 25 were: 2002 – with 62 days (ranging from 56 to 68),

1992 – with 43 days (ranging from 37 to 54), 1975 and 1983 with 42 days each (in the range of 36-61 and 35-58, respectively) and 1999 –with 41 days (25 to 52 in the research area). In the spatial arrangement of the region, it meant 24 days in the centre and in the north-east, 26 days in the north-west and 31-37 days in the south of the area. Hot days occurred in the area under analysis between April and October. Most of them were recorded in July and August, 9 days in each month (ranging from 7 to 11 and from 8 to 10, respectively) (Table 23).

### Days with the maximum daily temperature above 30°C

The number of days with the maximum daily temperature exceeding 30°C in the examined area varied from 2 days in the centre (Great Mazurian Lakes) and in the north-east of the area (the Suwałki Lake District), 3 days west of the centre (the Olsztyn Lake District, the Mrągowo Lake District and the Sepopol Lowland) and the south-east of the area, to 5 days in the North-Mazovian Lowland. Very hot days were recorded only from May to September, while September cases were observed only in the south of the region (the North Mazovian Lowland). The highest number of very hot days was recorded in 1994 – 15.3 days on average (13 to 18 days for the area under discussion) and in 1971 – 9.6 days (7 to 16 days in the examined area). In 1970, 1978 and 1980, very hot days did not occur in the north-eastern area of Poland (Fig. 23). A linear trend (statistically insignificant) indicated the growth in the number of such cases.

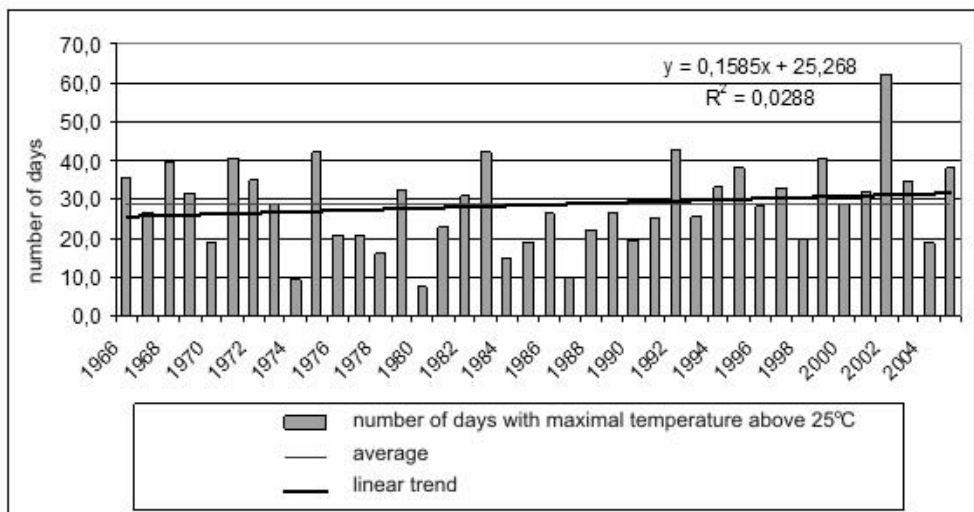


Fig. 22. Mean annual number of days with daily maximal temperature above 25°C in years 1966-2005

Table 23

Number of days with a maximum daily temperature above 25°C in years 1966-2005

| Months    | Locations |         |         |         |           |       |           |           |                     |
|-----------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|
|           | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok | Mean for the region |
| April     | 0.5       | 0.5     | 0.4     | 0.5     | 0.3       | 0.6   | 0.5       | 0.5       | 0.4                 |
| May       | 3.2       | 2.8     | 2.6     | 3.4     | 2.1       | 3.2   | 4.3       | 3.4       | 3.1                 |
| June      | 5.3       | 5.1     | 4.3     | 5.8     | 4.8       | 6.4   | 8.6       | 6.6       | 5.8                 |
| July      | 7.4       | 8.6     | 7.9     | 8.9     | 8.1       | 10.0  | 11.3      | 10.0      | 9.0                 |
| August    | 7.8       | 8.0     | 7.8     | 8.6     | 7.7       | 10.1  | 10.1      | 9.0       | 8.6                 |
| September | 1.5       | 1.2     | 1.3     | 1.4     | 1.1       | 1.7   | 2.1       | 1.7       | 1.5                 |
| October   | 0.0       | 0.0     | 0.0     | 0.0     | 0.0       | 0.1   | 0.1       | 0.0       | 0.0                 |

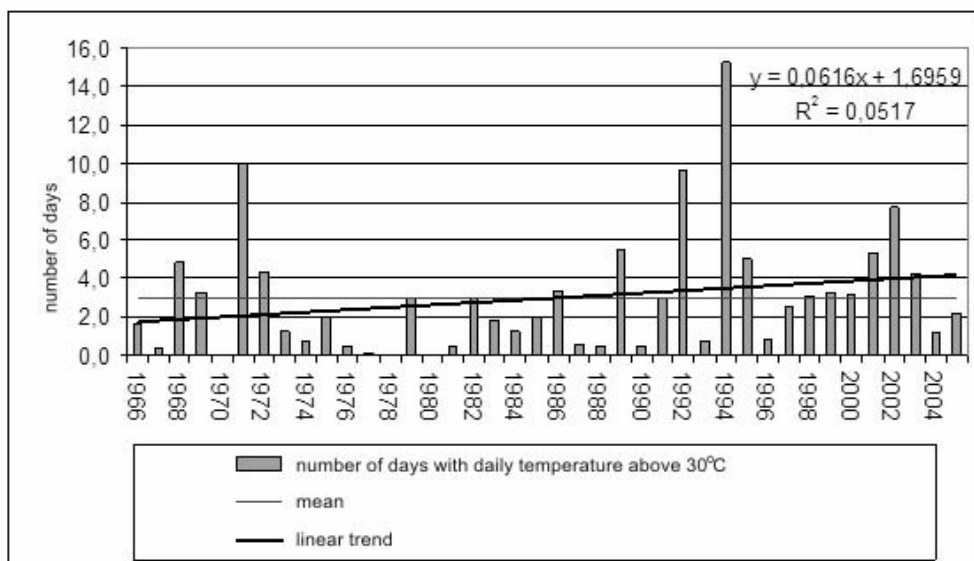


Fig. 23. Mean annual number of days with daily temperature above 30°C



Table 24

Number of days with a maximum daily temperature above 30°C in years 1966-2005

| Months    | Locations |         |         |         |           |       |           |           |                     |
|-----------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|
|           | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok | Mean for the region |
| April     | 0.0       | 0.0     | 0.0     | 0.0     | 0.0       | 0.0   | 0.0       | 0.0       | 0.0                 |
| May       | 0.1       | 0.1     | 0.1     | 0.1     | 0.1       | 0.1   | 0.1       | 0.1       | 0.1                 |
| June      | 0.5       | 0.4     | 0.2     | 0.5     | 0.3       | 0.6   | 0.7       | 0.5       | 0.4                 |
| July      | 1.2       | 1.3     | 1.1     | 1.4     | 1.0       | 1.5   | 2.1       | 1.4       | 1.4                 |
| August    | 0.8       | 1.0     | 0.7     | 1.2     | 0.7       | 1.3   | 1.6       | 1.1       | 1.0                 |
| September | 0.0       | 0.0     | 0.0     | 0.0     | 0.0       | 0.0   | 0.1       | 0.0       | 0.0                 |

### Extreme temperatures of the Winter and Summer periods

Air temperature measurements also include recording of extreme values in the assumed time interval. In weather services, a basic time range for which extreme values are determined is the period conventionally referred to as day and night. This means the following time ranges: day: from 6 a.m. to 6 p.m. GMT, and night: from 6 p.m. to 6 a.m. on the following day. These two time intervals provide the basis to determine the daily extreme values which further on are used for determining extreme values for any indicated time periods. In the analysed time range of 1966-2005, the values of extreme temperatures, both in winter and in summer period, were subject to changes both in year-to-year relations and in multi-year ranges. A trend illustrating the mean minimum temperature of the winter period indicates its statistically insignificant growth.

The winter period was characterized by values of temperatures from the three coldest months: December, January and February. The lowest mean minimum temperature (-13.8°C) for the research area was observed in winter of 1969-1970 (Fig. 24). The lowest absolute air temperature (-35.4°C) in the examined area was recorded on 1 February 1987 in Białystok (Table 25). Significantly lower minimum temperatures were found near the surface of the ground. They are presented in Table 28.

The summer period was characterized with the values of temperatures observed in the hottest months of the year, (June, July and August). The mean maximum summer temperature in north-eastern region of Poland in 1966-2005 reached 22.0°C. The highest mean of this type (25.0°C) was observed in 1992.

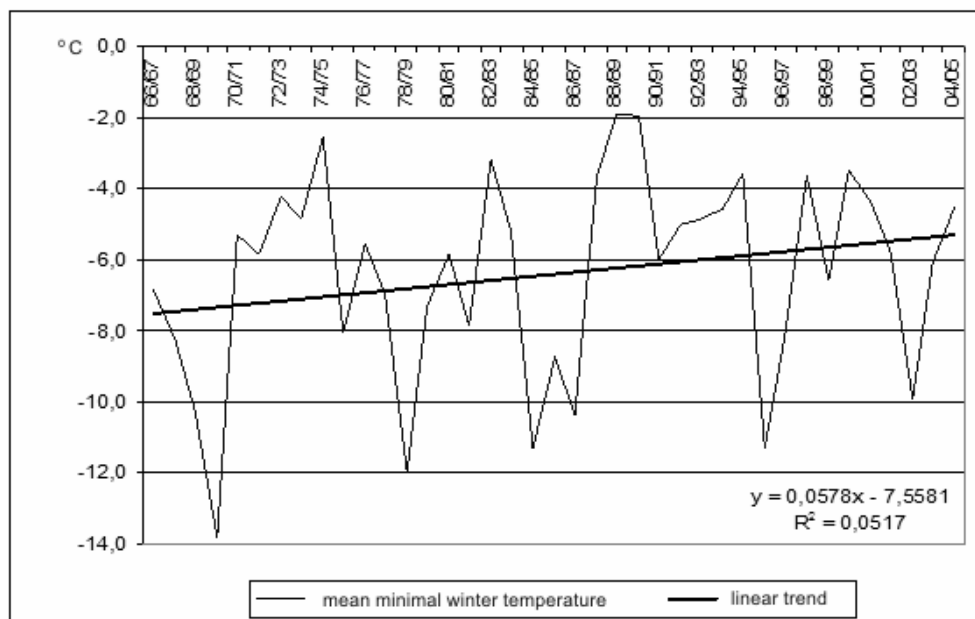


Fig. 24. Mean annual temperature of winter period in years 1966-2005.

The analysis of the trend illustrating the mean maximum temperature in the summer period shows, just like in majority of such cases, a statistically insignificant growth. The hottest summer pentad was the period of 2001-2005, in which the mean maximum temperature reached 23.0°C. During the period under analysis, the mean maximum summer temperature in the research area varied between 20.3 and 25.0°C (Fig. 26). The highest air temperatures recorded in the examined area by meteorological stations were from the range of values between 34.9°C in Mikołajki and 36.6°C in Mława and Ostrołęka (Table 26).

Table 25

Absolute minimum temperatures of winter period (°C)

| Specification         | Locations   |             |             |             |             |                  |             |             |
|-----------------------|-------------|-------------|-------------|-------------|-------------|------------------|-------------|-------------|
|                       | Elbląg      | Kętrzyn     | Suwałki     | Olštyn      | Mikołajki   | Mława            | Ostrołęka   | Białystok   |
| Temperatures recorded | -30.1       | -30.7       | -31.1       | -30.2       | -30.4       | -31.2            | -30.2       | -35.4       |
| Date of occurrence    | 04.01. 1979 | 08.01. 1987 | 07.01. 2003 | 08.01. 1987 | 02.02. 1970 | 08 i 30.01. 1987 | 30.01. 1987 | 01.02. 1987 |

Table 26

Absolute minimum temperatures near the surface (°C)

|                    | Locations   |            |             |            |             |             |            |             |
|--------------------|-------------|------------|-------------|------------|-------------|-------------|------------|-------------|
|                    | Elbląg      | Kętrzyn    | Suwałki     | Olsztyn    | Mikołajki   | Mława       | Ostrołęka  | Białystok   |
| Values             | -36.5       | -32.9      | -36.1       | -38.2      | -39.1       | -36.6       | -36.4      | -39.8       |
| Date of occurrence | 29.01. 1987 | 8.01. 1987 | 30.01. 1987 | 8.01. 1987 | 30.01. 1987 | 30.01. 1987 | 1.02. 1970 | 30.01. 1987 |

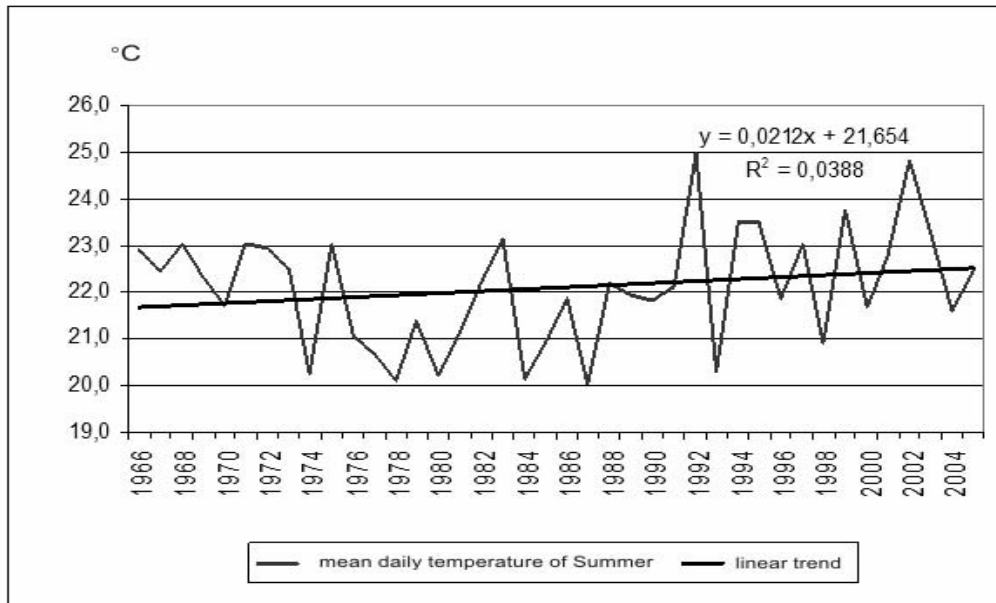


Fig. 25. Mean annual daily temperature in Summer period in years 1966-2005.

Table 27

Absolute maximum temperatures in Summer period (°C) in years 1966-2005

|                    | Locations   |             |             |             |             |             |             |             |
|--------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                    | Elbląg      | Kętrzyn     | Suwałki     | Olsztyn     | Mikołajki   | Mława       | Ostrołęka   | Białystok   |
| Values             | 36.5        | 36.1        | 35.2        | 36.2        | 34.9        | 36.6        | 36.6        | 35.5        |
| Date of occurrence | 31.07. 1994 | 29.07. 1992 | 31.07. 1994 | 10.08. 1992 | 31.07. 1994 | 31.07. 1994 | 31.07. 1994 | 31.07. 1994 |

Table 28

Mean minimum air temperature of Winter period

| Winter    | December | January | February | Mean  |
|-----------|----------|---------|----------|-------|
| 1966/1967 | -4.4     | -11.3   | -4.8     | -6.8  |
| 1967/1968 | -6.9     | -10.9   | -7.0     | -8.3  |
| 1968/1969 | -7.5     | -12.4   | -10.9    | -10.2 |
| 1969/1970 | -14.7    | -13.2   | -13.5    | -13.8 |
| 1970/1971 | -3.4     | -8.1    | -4.5     | -5.3  |
| 1971/1972 | 0.0      | -12.7   | -4.9     | -5.8  |
| 1972/1973 | -3.7     | -6.2    | -2.8     | -4.2  |
| 1973/1974 | -6.4     | -5.1    | -3.1     | -4.9  |
| 1974/1975 | -1.4     | -1.7    | -4.5     | -2.5  |
| 1975/1976 | -3.5     | -9.5    | -11.1    | -8.0  |
| 1976/1977 | -5.7     | -6.0    | -5.0     | -5.6  |
| 1977/1978 | -5.2     | -5.9    | -9.9     | -7.0  |
| 1978/1979 | -11.3    | -12.8   | -11.9    | -12.0 |
| 1979/1980 | -4.0     | -10.5   | -7.5     | -7.3  |
| 1980/1981 | -4.3     | -7.6    | -5.6     | -5.8  |
| 1981/1982 | -8.3     | -8.7    | -6.5     | -7.9  |
| 1982/1983 | -1.9     | -0.4    | -7.3     | -3.2  |
| 1983/1984 | -5.8     | -3.5    | -6.4     | -5.2  |
| 1984/1985 | -4.0     | -14.4   | -15.5    | -11.3 |
| 1985/1986 | -4.2     | -6.0    | -16.0    | -8.7  |
| 1986/1987 | -4.4     | -20.0   | -6.7     | -10.4 |
| 1987/1988 | -3.0     | -3.5    | -4.3     | -3.6  |
| 1988/1989 | -5.1     | -0.4    | -0.2     | -1.9  |
| 1989/1990 | -4.9     | -2.2    | 1.2      | -2.0  |
| 1990/1991 | -3.8     | -5.2    | -9.1     | -6.0  |
| 1991/1992 | -5.9     | -5.4    | -3.6     | -5.0  |
| 1992/1993 | -4.3     | -5.0    | -5.2     | -4.9  |
| 1993/1994 | -2.4     | -1.6    | -9.7     | -4.6  |
| 1994/1995 | -3.3     | -6.2    | -1.2     | -3.6  |
| 1995/1996 | -10.5    | -10.9   | -12.4    | -11.3 |
| 1996/1997 | -11.2    | -10.0   | -3.3     | -8.2  |
| 1997/1998 | -5.1     | -3.5    | -2.3     | -3.6  |
| 1998/1999 | -7.7     | -5.4    | -6.6     | -6.6  |
| 1999/2000 | -2.6     | -6.1    | -1.8     | -3.5  |
| 2000/2001 | -1.8     | -4.1    | -7.3     | -4.4  |
| 2001/2002 | -8.8     | -6.3    | -2.3     | -5.8  |
| 2002/2003 | -10.4    | -9.6    | -9.7     | -9.9  |
| 2003/2004 | -2.6     | -10.0   | -5.7     | -6.1  |
| 2004/2005 | -2.1     | -3.3    | -8.2     | -4.5  |

Table 29

Mean maximum temperature of Summer period (°C) years 1966-2005

| Year | June | July | August | Mean |
|------|------|------|--------|------|
| 1966 | 23.0 | 23.5 | 22.2   | 22.9 |
| 1967 | 21.1 | 24.0 | 22.2   | 22.4 |
| 1968 | 23.5 | 21.9 | 23.8   | 23.0 |
| 1969 | 21.3 | 23.9 | 21.8   | 22.3 |
| 1970 | 21.9 | 21.4 | 21.8   | 21.7 |
| 1971 | 20.3 | 23.7 | 25.1   | 23.0 |
| 1972 | 22.1 | 25.5 | 21.3   | 22.9 |
| 1973 | 21.4 | 23.1 | 22.9   | 22.5 |
| 1974 | 18.9 | 19.4 | 22.4   | 20.2 |
| 1975 | 20.9 | 24.1 | 24.1   | 23.0 |
| 1976 | 19.1 | 23.1 | 21.0   | 21.1 |
| 1977 | 21.9 | 19.8 | 20.3   | 20.7 |
| 1978 | 19.7 | 20.5 | 20.1   | 20.1 |
| 1979 | 24.9 | 18.6 | 20.7   | 21.4 |
| 1980 | 20.4 | 20.3 | 19.9   | 20.2 |
| 1981 | 21.0 | 22.1 | 20.4   | 21.1 |
| 1982 | 19.6 | 23.3 | 23.7   | 22.2 |
| 1983 | 21.4 | 23.9 | 24.1   | 23.1 |
| 1984 | 17.9 | 19.6 | 22.8   | 20.1 |
| 1985 | 19.1 | 21.2 | 22.4   | 20.9 |
| 1986 | 21.4 | 22.7 | 21.5   | 21.9 |
| 1987 | 19.6 | 21.4 | 19.1   | 20.0 |
| 1988 | 21.0 | 23.8 | 21.7   | 22.2 |
| 1989 | 20.2 | 23.3 | 22.2   | 21.9 |
| 1990 | 21.5 | 21.2 | 22.7   | 21.8 |
| 1991 | 19.7 | 23.5 | 23.1   | 22.1 |
| 1992 | 23.3 | 25.4 | 26.2   | 25.0 |
| 1993 | 19.5 | 20.9 | 20.5   | 20.3 |
| 1994 | 19.7 | 27.3 | 23.5   | 23.5 |
| 1995 | 21.9 | 24.8 | 23.8   | 23.5 |
| 1996 | 21.2 | 20.5 | 23.9   | 21.9 |
| 1997 | 21.2 | 22.6 | 25.3   | 23.0 |
| 1998 | 21.5 | 21.3 | 19.9   | 20.9 |
| 1999 | 23.0 | 25.5 | 22.8   | 23.8 |
| 2000 | 22.0 | 20.6 | 22.4   | 21.7 |
| 2001 | 19.1 | 25.6 | 23.7   | 22.8 |
| 2002 | 21.9 | 25.7 | 27.0   | 24.8 |
| 2003 | 21.8 | 25.1 | 23.0   | 23.3 |
| 2004 | 19.4 | 21.4 | 23.9   | 21.6 |
| 2005 | 20.3 | 25.1 | 22.0   | 22.5 |

## Precipitation

### Annual sums of precipitation

Precipitation is a liquid or solid product of water vapour condensation that falls on the earth surface. This the most differentiated (on a spatial scale) element of the climate, and determination of the distribution of its value in the scale of the region is a considerable simplification and generalization.

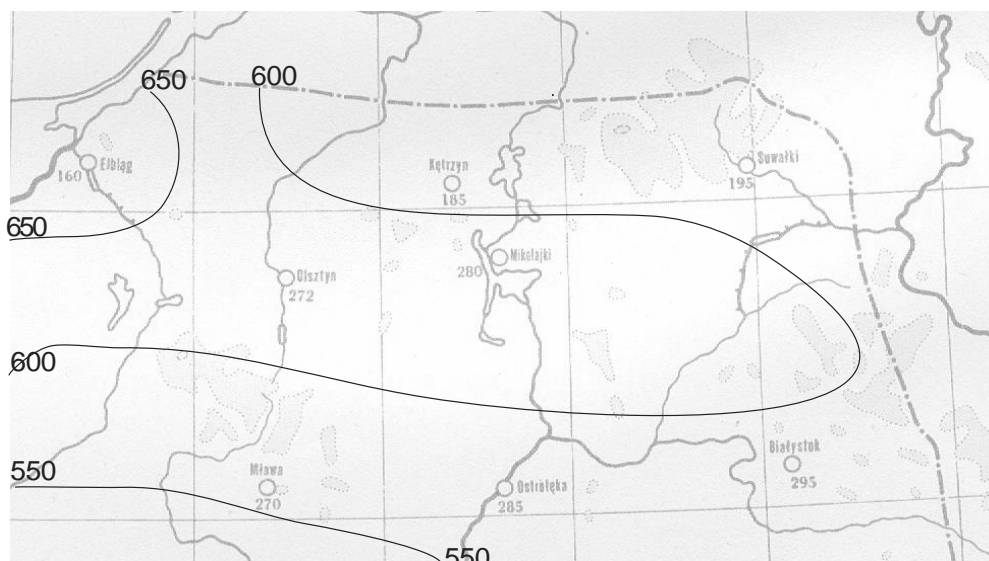


Fig. 26. Isohyets of mean annual sums of precipitation in years 1966-2005

A generalization, which provides a picture of characteristic regional distribution of precipitation, is given in the form of isohyets (Fig. 26). The highest annual sums of precipitation (670-650 mm) occurred in north-western part of the region (Żuławy Wiślane, the Warmia Plain and the Orneta Plain). An annual precipitation of 640-600 mm was recorded in the western and the central part of the analysed area (the Hława Lake District, the Olsztyn Lake District, the Mrągowo Lake District, the Great Mazurian Lakeland, and the Ełk Lake District). The northern, the eastern and the south-eastern area of the region (the Sępopol Lowland, the Węgorapa Land, the Suwałki Lake District, the Augustów Plain and the North Podlasie Lowland) received, on average, the annual sum of precipitation amounting to 580-600 mm. The lowest precipitation of 550-580 mm was recorded in the southern part (the North Mazovian Lowland, the Mazurian Plain). The distribution of annual means, from the multi-year period, of sums of precipitation in the region of north-eastern Poland was much differentiated in the analysed space and time (Fig. 27). Extreme high annual precipitation in the region occurred in 1970, amounting on average to 819 mm. Values higher than the average occurred particularly in the north-western part of the region – 936 mm (Żuławy Wiślane, the Warmia Plain, the

Orneta Plain, the Górowo Hills), its western and central part – 905 mm (the Iława Lake District and the Olsztyn Lake District) and the south-east – 585 mm (the North Podlasie Lowland). Years with high sums of precipitations in the region were also 1974 – 769 mm and 1981 – 704 mm. The lowest annual sums of precipitation in the region were recorded in: 1969 – 471 mm, 1971 – 458 mm, 1976 – 465 mm, 1982 – 446 mm, 1991 and 1996 – 488 mm. In the area under analysis, the annual sum of precipitation averaged from the multi-year period reached 600 mm. The area means for five-, ten- and twenty-year periods did not significantly differ (Table 30).

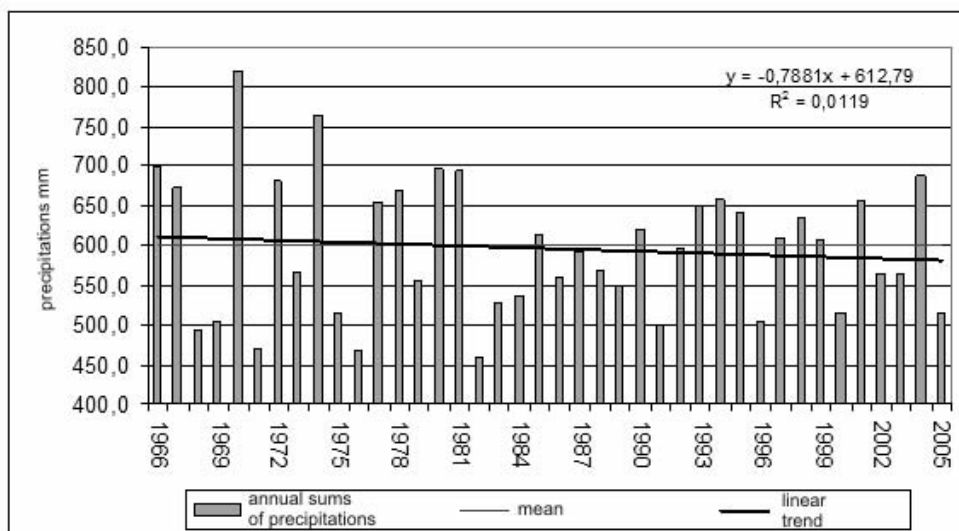


Fig. 27. Mean regional sums of annual precipitations (mm) in years 1966-2005

Peak monthly sums of precipitation in north-eastern area of Poland were recorded in October 1974, when the monthly sum of precipitation in Mikołajki amounted to 237.4 mm, in Olsztyn – 181.9 mm, in Kętrzyn – 195.8 mm and in Suwałki – 191.6 mm. Significant monthly sums of precipitation also occurred in other months: in August 1972: 234 mm in Białystok and 208.2 mm in Ostrołęka, and in September 1995: 207.4 mm in Mława. The highest daily sum of precipitation was recorded on 6 September 1992 in Olsztyn, with 98.9 mm rainfall (Table 31).

### Precipitation in periods

A description of precipitation for the region, showing the sum of precipitation, was extended by the number of days with typical sums of precipitation. This made it possible, by means of stemplots, to assess the distribution of the precipitation intensity over time. The number of days with precipitation of a daily value above 0.1 mm is the basic factor for days on which precipitation was recorded. In the research area, the mean number of days with precipitation was slightly varied, and ranged from 169 to 176 days, giving an average multi-year value for the region of 173 days with precipitation (Table 32). The maximum values of the number of

days with precipitation ranged from 195 days in Suwałki and Mława to 216 days in Elbląg.

The minimum number of days with precipitation observed in the period under analysis varied from 120 days in Kętrzyn to 137 days in Ostrołęka. 1970 had the highest average number of precipitation days in the region (Fig. 28). A linear trend (statistically insignificant) indicated the growth of the number of days with such precipitation.

Table 30

Values of annual sums of precipitations in periods

| Periods      |             | Average | Annual precipitation (mm) |                    |                |                    |
|--------------|-------------|---------|---------------------------|--------------------|----------------|--------------------|
|              |             |         | maximal values            | year of occurrence | minimal values | year of occurrence |
| Five-years   | 1966 - 1970 | 638     | 819                       | 1970               | 471            | 1969               |
|              | 1971 - 1975 | 598     | 769                       | 1974               | 458            | 1971               |
|              | 1976 - 1980 | 610     | 698                       | 1980               | 465            | 1976               |
|              | 1981 - 1985 | 568     | 704                       | 1981               | 446            | 1982               |
|              | 1986 - 1990 | 589     | 633                       | 1987               | 544            | 1989               |
|              | 1991 - 1995 | 610     | 673                       | 1994               | 487            | 1991               |
|              | 1996 - 2000 | 589     | 651                       | 1999               | 488            | 1996               |
|              | 2001 - 2005 | 591     | 682                       | 2004               | 521            | 1985               |
| Ten-years    | 1966 - 1975 | 618     | 819                       | 1970               | 458            | 1971               |
|              | 1976 - 1985 | 589     | 704                       | 1980               | 446            | 1982               |
|              | 1986 - 1995 | 600     | 673                       | 1994               | 487            | 1991               |
|              | 1996 - 2005 | 592     | 682                       | 2004               | 488            | 1996               |
| Twenty-years | 1966 - 1985 | 604     | 819                       | 1970               | 446            | 1982               |
|              | 1986 - 2005 | 596     | 682                       | 2004               | 487            | 1991               |
| Forty-years  | 1966 - 2005 | 600     | 819                       | 1970               | 446            | 1982               |



Table 31

Extremely falls (mm)

| Falls                        | Locations |           |           |           |           |           |           |            |
|------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
|                              | Elblag    | Kętrzyn   | Suwałki   | Olsztyn   | Mikołajki | Mława     | Ostrołęka | Białystok  |
| Annual max                   | 935.7     | 785.5     | 807       | 904.9     | 851.5     | 798.2     | 798.5     | 857.3      |
| Year of occurrence           | 1970      | 1981      | 1974      | 1970      | 1974      | 1970      | 1970      | 1970       |
| Annual min                   | 354.1     | 373.1     | 394.3     | 403.4     | 419.1     | 355.5     | 372.0     | 445.8      |
| Year of occurrence           | 1969      | 1971      | 1968      | 1982      | 1991      | 1971      | 1982      | 1971       |
| Monthly max                  | 214.3     | 195.8     | 191.6     | 181.9     | 237.4     | 207.4     | 208.2     | 234.3      |
| Month and year of occurrence | IX-1992   | X-1974    | X-1974    | X-1974    | X-1974    | IX-1995   | IX-1995   | VIII-1972  |
| Daily max                    | 83.8      | 72.0      | 64.0      | 98.9      | 72.0      | 78.5      | 94.9      | 90.6       |
| Date of occurrence           | 6.09.1992 | 6.09.1992 | 9.08.2005 | 6.09.1992 | 6.09.1992 | 3.03.1995 | 3.03.1995 | 26.06.1985 |

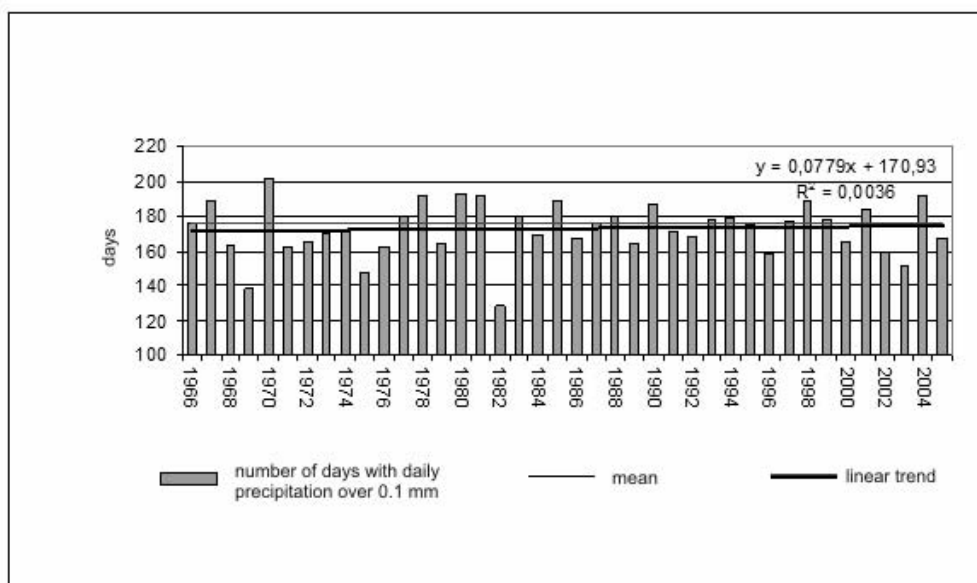


Fig. 28. Mean number of days with precipitation over 0.1 mm in years 1966-2005

Table 32

Number of days with precipitation over  $\geq 0,1$  mm in years 1966-2005

| Number of days | Locations |         |         |         |           |       |           |           | Mean for the region |
|----------------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|
|                | Elblag    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok |                     |
| Mean           | 176       | 176     | 170     | 174     | 173       | 170   | 173       | 169       | 173                 |
| Max            | 216       | 211     | 195     | 210     | 208       | 195   | 208       | 200       | 197                 |
| Min            | 122       | 120     | 129     | 131     | 127       | 129   | 137       | 135       | 128                 |

### Characteristics of precipitation in months

The precipitation distribution in a year for the area under analysis was characteristic for the moderate zone regions [TAMULEWICZ 1995]. The maximum mean sums occurred in the summer period (June, July and August) and the lowest in the winter period (Fig. 29). The lowest absolute monthly sums of precipitation were observed in August, September and October, while the lowest occurred in February. Information on precipitation in monthly ranges is of significant importance in the picture characterizing the region in both its environmental and economic aspects.

The mean multi-year sum of precipitation for the examined area amounted in January to 33.2 mm and took values from 40 mm, lowering its value eastwards and southwards (Fig. 30), reaching 30 mm in the North Mazovian Lowland and in the strip towards the south part of the Great Mazurian Lakeland, and 35 mm in the Sepopol Lowland, the Olsztyn Lake District and the Hława Lake District. In the remaining part of area the recorded precipitation amounted to 31-33 mm. The highest amounts of precipitation occurred in the third decade of January, although the number of days with precipitation equal or higher than 0.1 mm was the same in the first and the third decade (5.9 days). On the other hand, the number of days with precipitation equal to or exceeding 1.0 mm was higher in the third decade, amounting to 3.2 days (I – 3.0, II – 2.8 days). There were also more days with precipitation higher than 10.0 mm: I and II decade – 0.1 days, III decade – 0.2 days (Table 33).

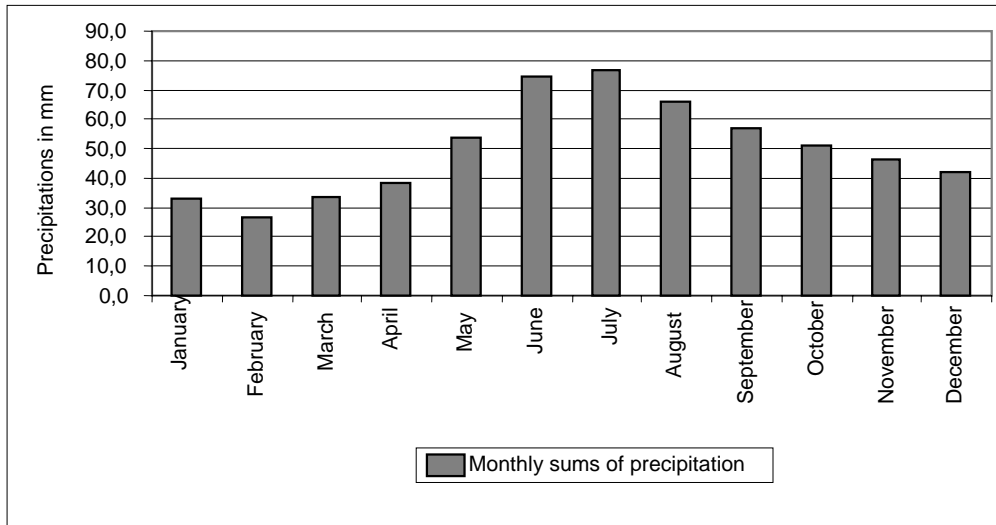


Fig. 29. Mean monthly sums of precipitation in years 1996-2005

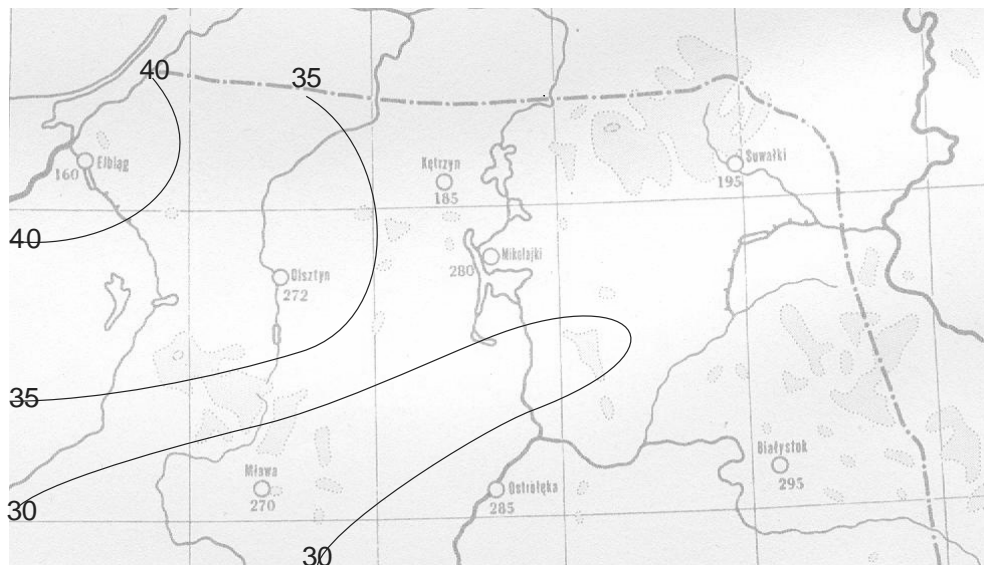


Fig. 30. Isohyets of mean monthly sums of precipitations in January (1966-2005)

In the spatial arrangement, the mean multi-year sums of precipitation in February ranged from 32 mm in the north-east to 24 – 25 in the south west and the centre of the region, and 26 to 29 mm in the remaining area of the region (Fig. 31). The average value of precipitation in February for the research area was 26.6 mm. While analysing precipitation in February in terms of time distribution, it was found that the second decade was standing out, with the lowest ten-day sum of precipitation recorded in a year – 7.9 mm, while slightly higher sums of precipitation were recorded in the first and the third decade – 10.0 and 8.7 mm,

respectively. The lowest monthly sums of precipitation in February did not mean the lowest number of days with precipitation. Quite contrary, there were on average as many as 14.6 such days in February (Table 34). Most days with precipitation occurred in the first decade of the month (5.6 days) with an even distribution over the area of the entire region (between 5.3 and 5.8 days).

Table 33

Precipitations in periods of January, means for years 1966-2005

| Precipitation (mm) |  | Period | Locations |         |         |         |           |       |           | Mean for the region |           |
|--------------------|--|--------|-----------|---------|---------|---------|-----------|-------|-----------|---------------------|-----------|
|                    |  |        | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka |                     | Białystok |
| month              |  |        | 40.1      | 31.0    | 32.9    | 37.8    | 30.2      | 29.4  | 31.0      | 32.8                | 33.2      |
| Ten-days periods   |  | I      | 13.9      | 10.0    | 11.7    | 12.4    | 9.8       | 9.6   | 10.3      | 11.0                | 11.1      |
|                    |  | II     | 11.5      | 9.1     | 9.3     | 11.5    | 9.3       | 9.2   | 9.1       | 10.3                | 9.9       |
|                    |  | III    | 14.8      | 11.8    | 12.0    | 14.0    | 11.1      | 10.6  | 11.6      | 11.5                | 12.2      |
| month              |  |        | 17.5      | 17.1    | 17.5    | 17.8    | 16.8      | 17.0  | 16.7      | 16.6                | 17.1      |
| $\geq 0,1$ mm      |  | I      | 5.9       | 5.8     | 6.2     | 5.9     | 5.9       | 5.8   | 5.9       | 5.9                 | 5.9       |
|                    |  | II     | 5.5       | 5.4     | 5.5     | 5.5     | 5.1       | 5.4   | 5.3       | 5.1                 | 5.3       |
|                    |  | III    | 6.2       | 5.9     | 5.9     | 6.3     | 5.9       | 5.8   | 5.9       | 5.6                 | 5.9       |
| month              |  |        | 9.9       | 8.7     | 8.9     | 10.0    | 8.6       | 8.7   | 8.6       | 8.7                 | 9.0       |
| $\geq 1,0$ mm      |  | I      | 3.4       | 2.8     | 3.1     | 3.1     | 2.8       | 2.8   | 3.0       | 3.0                 | 3.0       |
|                    |  | II     | 2.9       | 2.7     | 2.6     | 3.2     | 3.0       | 2.7   | 2.6       | 2.8                 | 2.8       |
|                    |  | III    | 3.6       | 3.1     | 3.2     | 3.7     | 2.9       | 3.2   | 2.8       | 2.9                 | 3.2       |
| month              |  |        | 2.2       | 1.4     | 1.4     | 2.0     | 1.3       | 1.4   | 1.4       | 1.8                 | 1.6       |
| $\geq 5,0$ mm      |  | I      | 0.8       | 0.5     | 0.6     | 0.7     | 0.5       | 0.4   | 0.6       | 0.6                 | 0.6       |
|                    |  | II     | 0.7       | 0.4     | 0.4     | 0.6     | 0.4       | 0.5   | 0.5       | 0.6                 | 0.5       |
|                    |  | III    | 0.7       | 0.5     | 0.4     | 0.7     | 0.5       | 0.5   | 0.6       | 0.6                 | 0.6       |
| month              |  |        | 0.5       | 0.4     | 0.3     | 0.4     | 0.3       | 0.2   | 0.4       | 0.4                 | 0.4       |
| $\geq 10,0$ mm     |  | I      | 0.2       | 0.1     | 0.1     | 0.1     | 0.1       | 0.1   | 0.1       | 0.1                 | 0.1       |
|                    |  | II     | 0.2       | 0.0     | 0.0     | 0.1     | 0.1       | 0.1   | 0.1       | 0.1                 | 0.1       |
|                    |  | III    | 0.2       | 0.2     | 0.2     | 0.2     | 0.2       | 0.1   | 0.2       | 0.1                 | 0.2       |

The distribution of isohyets in March was different than the isohyets representing January and February. The mean monthly precipitation in the region for March was 33 mm. At the same time, spatial distribution was slightly varied, from 32 to 38 mm (Fig. 32). The highest sums of precipitation were found in the Olsztyn Lake District (38 mm) and the Suwałki Lake District (35 mm). The lowest values were recorded in the North Mazovian Lowland and the Mazurian Plain (30 mm). The remaining area was characterized by values of 31 to 34 mm.

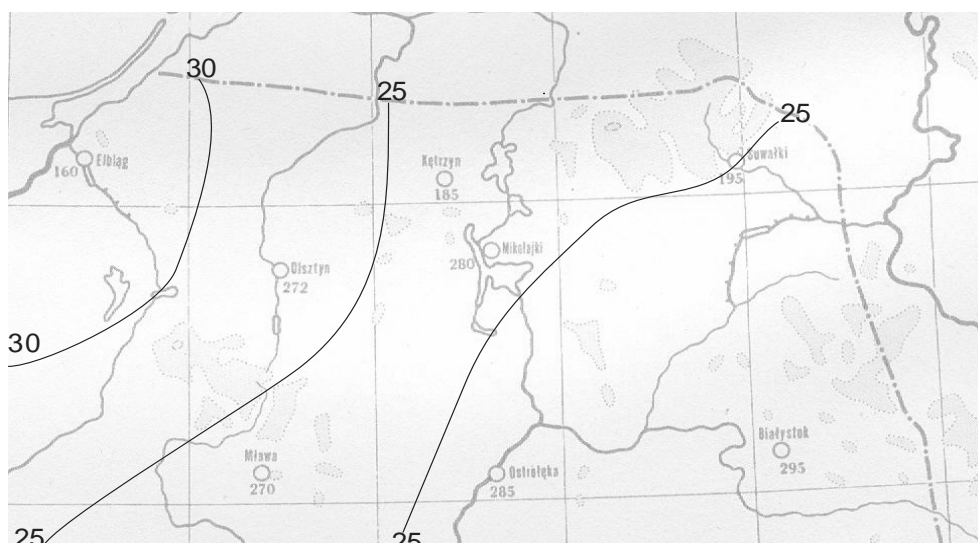


Fig. 31. Isohyets of mean monthly sums of precipitations in February (1966-2005)

Table 33

Precipitations in periods of February, means for years 1966-2005

| Precipitation (mm)   | Period           | Locations        |         |         |         |           |       |           |           | Mean for the region |      |     |
|----------------------|------------------|------------------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|------|-----|
|                      |                  | Elbląg           | Kętrzyn | Suwałki | Olsztyn | Mikolajki | Mława | Ostrołęka | Białystok |                     |      |     |
| month                |                  | 31.9             | 23.5    | 25.7    | 28.7    | 24.6      | 24.8  | 26.5      | 27.2      | 26.6                |      |     |
| Ten-days periods     | I                | 11.1             | 9.5     | 10.1    | 11.2    | 9.9       | 9.9   | 8.4       | 9.7       | 10.0                |      |     |
|                      | II               | 9.7              | 6.8     | 7.3     | 8.5     | 7.1       | 7.2   | 8.8       | 7.8       | 7.9                 |      |     |
|                      | III              | 11.1             | 7.1     | 8.2     | 9.0     | 7.6       | 7.7   | 9.3       | 9.7       | 8.7                 |      |     |
| Number of rainy days | ≥0,1 mm          | month            | 14.6    | 14.8    | 14.8    | 14.7      | 14.2  | 14.4      | 14.2      | 15.0                | 14.6 |     |
|                      |                  | Ten-days periods | I       | 5.3     | 5.6     | 5.8       | 5.8   | 5.5       | 5.7       | 5.6                 | 5.7  | 5.6 |
|                      |                  |                  | II      | 4.3     | 4.2     | 4.2       | 4.2   | 4.1       | 4.2       | 4.2                 | 4.5  | 4.2 |
|                      | III              |                  | 5.0     | 5.0     | 4.9     | 4.7       | 4.6   | 4.5       | 4.8       | 4.8                 | 4.8  |     |
|                      | ≥1,0 mm          | month            | 8.5     | 6.6     | 7.5     | 7.8       | 7.2   | 6.8       | 7.3       | 7.6                 | 7.4  |     |
|                      |                  | Ten-days periods | I       | 2.9     | 2.7     | 3.0       | 2.9   | 2.8       | 2.7       | 2.8                 | 2.9  | 2.8 |
|                      |                  |                  | II      | 2.8     | 1.8     | 2.0       | 2.3   | 2.1       | 1.9       | 2.2                 | 2.1  | 2.2 |
|                      | III              |                  | 2.8     | 2.1     | 2.6     | 2.7       | 2.2   | 2.2       | 2.5       | 2.6                 | 2.5  |     |
|                      | 5,0 mm           | month            | 1.8     | 1.1     | 1.1     | 1.6       | 1.2   | 1.1       | 1.3       | 1.5                 | 1.3  |     |
|                      |                  | Ten-days periods | I       | 0.6     | 0.5     | 0.5       | 0.7   | 0.5       | 0.5       | 0.5                 | 0.5  | 0.5 |
|                      |                  |                  | II      | 0.6     | 0.3     | 0.3       | 0.5   | 0.4       | 0.2       | 0.4                 | 0.4  | 0.4 |
|                      | III              |                  | 0.7     | 0.3     | 0.3     | 0.5       | 0.3   | 0.4       | 0.5       | 0.7                 | 0.5  |     |
| ≥10,0 mm             | month            | 0.3              | 0.1     | 0.2     | 0.1     | 0.1       | 0.1   | 0.1       | 0.1       | 0.1                 |      |     |
|                      | Ten-days periods | I                | 0.1     | 0.1     | 0.0     | 0.1       | 0.1   | 0.1       | 0.1       | 0.0                 | 0.1  |     |
|                      |                  | II               | 0.1     | 0.1     | 0.1     | 0.1       | 0.0   | 0.0       | 0.1       | 0.1                 | 0.1  |     |
| III                  |                  | 0.1              | 0.0     | 0.1     | 0.0     | 0.0       | 0.0   | 0.0       | 0.0       | 0.0                 |      |     |

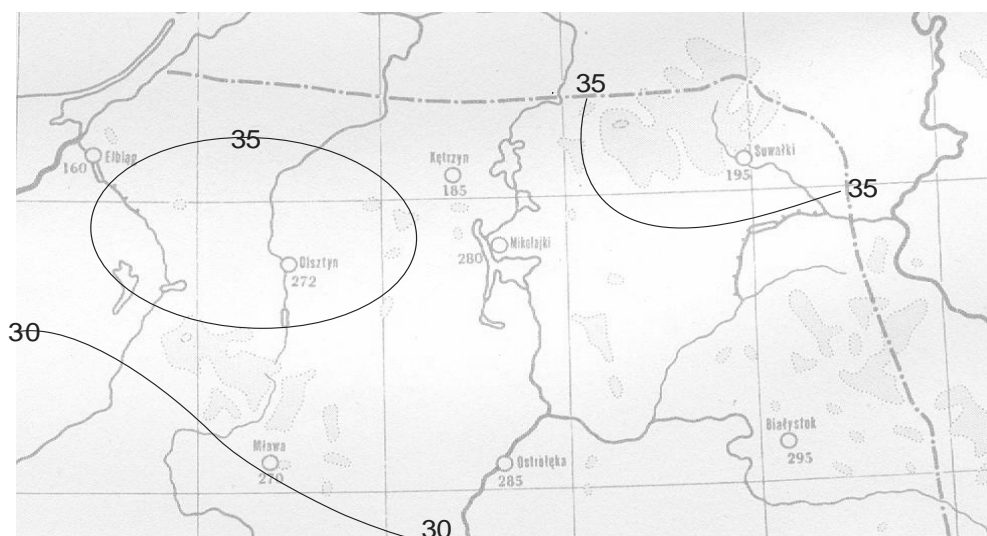


Fig. 32. Isohyets of mean monthly sums of precipitations in March (1966-2005)

Table 34

Precipitations in periods of March, means for years 1966-2005

| Precipitation (mm)   |                  | Locations        |         |         |         |           |       |           |           |                     |      |     |
|----------------------|------------------|------------------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|------|-----|
|                      |                  | Elbląg           | Kętrzyn | Suwałki | Olsztyn | Mikolajki | Mława | Ostrołęka | Białystok | Mean for the region |      |     |
| month                |                  | 33.8             | 31.5    | 34.8    | 37.5    | 33.8      | 30.8  | 32.2      | 32.1      | 33.3                |      |     |
| ten-days periods     | I                | 11.6             | 9.4     | 11.3    | 12.7    | 10.2      | 9.9   | 9.3       | 10.7      | 10.6                |      |     |
|                      | II               | 11.4             | 11.1    | 10.8    | 12.3    | 11.4      | 10.5  | 10.0      | 10.0      | 10.9                |      |     |
|                      | III              | 10.8             | 11.1    | 12.8    | 12.5    | 12.2      | 10.3  | 12.9      | 11.3      | 11.7                |      |     |
| Number of rainy days | ≥0,1 mm          | month            | 14.6    | 14.5    | 14.3    | 14.8      | 14.2  | 14.2      | 13.7      | 13.5                | 14.2 |     |
|                      |                  | ten-days periods | I       | 5.1     | 4.9     | 5.0       | 5.1   | 4.8       | 4.7       | 4.9                 | 4.7  | 4.9 |
|                      |                  |                  | II      | 5.3     | 5.1     | 5.1       | 5.3   | 5.1       | 5.3       | 4.7                 | 4.6  | 5.1 |
|                      | III              |                  | 4.2     | 4.5     | 4.2     | 4.4       | 4.3   | 4.3       | 4.4       | 4.2                 | 4.3  |     |
|                      | ≥1,0 mm          | month            | 8.9     | 8.1     | 8.5     | 8.6       | 7.9   | 7.7       | 7.7       | 7.8                 | 8.2  |     |
|                      |                  | ten-days periods | I       | 3.0     | 2.5     | 2.8       | 2.7   | 2.5       | 2.4       | 2.6                 | 2.5  | 2.6 |
|                      |                  |                  | II      | 3.2     | 3.2     | 3.0       | 3.1   | 3.0       | 2.8       | 3.0                 | 2.8  | 3.0 |
|                      | III              |                  | 2.8     | 2.4     | 2.8     | 2.8       | 2.4   | 2.5       | 2.6       | 2.5                 | 2.6  |     |
|                      | ≥5,0 mm          | month            | 2.0     | 1.8     | 2.2     | 2.3       | 2.0   | 1.8       | 2.0       | 2.0                 | 2.0  |     |
|                      |                  | ten-days periods | I       | 0.8     | 0.5     | 0.8       | 0.8   | 0.7       | 0.6       | 0.5                 | 0.8  | 0.7 |
|                      |                  |                  | II      | 0.7     | 0.6     | 0.6       | 0.7   | 0.5       | 0.5       | 0.6                 | 0.6  | 0.6 |
|                      | III              |                  | 0.6     | 0.8     | 0.8     | 0.8       | 0.8   | 0.7       | 0.8       | 0.7                 | 0.8  |     |
| ≥10,0 mm             | month            | 0.3              | 0.3     | 0.4     | 0.5     | 0.5       | 0.3   | 0.4       | 0.4       | 0.4                 |      |     |
|                      | ten-days periods | I                | 0.1     | 0.1     | 0.1     | 0.2       | 0.1   | 0.1       | 0.1       | 0.1                 | 0.1  |     |
|                      |                  | II               | 0.1     | 0.1     | 0.1     | 0.1       | 0.1   | 0.1       | 0.1       | 0.1                 | 0.1  |     |
| III                  |                  | 0.1              | 0.1     | 0.2     | 0.2     | 0.3       | 0.1   | 0.2       | 0.2       | 0.2                 |      |     |

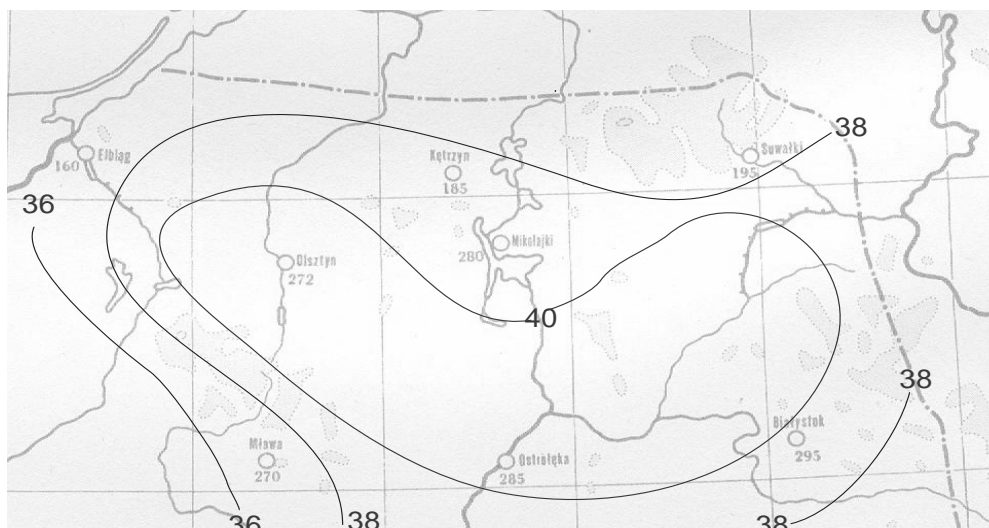


Fig. 33. Isohyets of mean monthly sums of precipitations in April (1966-2005)

Table 35

Precipitations in periods of April, means for years 1966-2005

| Precipitation (mm) | Period           | Locations |         |         |         |           |       |           |           | Mean for the region |      |
|--------------------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|------|
|                    |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka | Białystok |                     |      |
| month              |                  | 36.5      | 38.2    | 37.2    | 40.9    | 38.3      | 36.8  | 41.4      | 39.1      | 38.6                |      |
|                    | ten-days periods | I         | 13.2    | 12.5    | 12.6    | 14.6      | 14.0  | 13.1      | 14.4      | 13.3                | 13.5 |
|                    |                  | II        | 11.8    | 14.0    | 13.5    | 15.0      | 12.8  | 11.6      | 13.3      | 12.8                | 13.1 |
|                    |                  | III       | 11.5    | 11.7    | 11.2    | 11.4      | 11.5  | 12.1      | 13.7      | 13.1                | 12.0 |
| month              |                  | 12.3      | 13.0    | 12.5    | 13.1    | 12.4      | 12.5  | 13.4      | 12.5      | 12.7                |      |
|                    | ten-days periods | I         | 4.6     | 4.5     | 4.2     | 4.5       | 4.3   | 4.3       | 4.4       | 4.3                 | 4.4  |
|                    |                  | II        | 4.0     | 4.4     | 4.1     | 4.4       | 4.0   | 4.0       | 4.2       | 3.9                 | 4.2  |
|                    |                  | III       | 3.7     | 4.1     | 4.1     | 4.3       | 4.0   | 4.3       | 4.2       | 4.3                 | 4.2  |
| month              |                  | 7.5       | 7.7     | 8.2     | 8.0     | 8.0       | 7.4   | 8.4       | 7.9       | 7.9                 |      |
|                    | ten-days periods | I         | 2.7     | 2.6     | 2.9     | 2.8       | 2.8   | 2.3       | 2.7       | 2.7                 | 2.7  |
|                    |                  | II        | 2.5     | 2.8     | 2.7     | 2.9       | 2.8   | 2.5       | 2.7       | 2.6                 | 2.7  |
|                    |                  | III       | 2.3     | 2.4     | 2.6     | 2.3       | 2.4   | 2.6       | 2.5       | 2.6                 | 2.5  |
| month              |                  | 2.6       | 2.6     | 2.5     | 2.9     | 2.6       | 2.4   | 2.7       | 2.6       | 2.6                 |      |
|                    | ten-days periods | I         | 0.9     | 0.9     | 0.9     | 1.0       | 0.9   | 0.9       | 0.9       | 0.7                 | 0.9  |
|                    |                  | II        | 0.9     | 1.0     | 0.9     | 1.1       | 0.9   | 0.8       | 0.9       | 0.9                 | 0.9  |
|                    |                  | III       | 0.8     | 0.7     | 0.6     | 0.9       | 0.8   | 0.7       | 0.8       | 1.1                 | 0.8  |
| month              |                  | 0.8       | 0.7     | 0.6     | 1.0     | 0.7       | 0.7   | 0.9       | 0.8       | 0.8                 |      |
|                    | ten-days periods | I         | 0.3     | 0.4     | 0.2     | 0.5       | 0.3   | 0.3       | 0.3       | 0.3                 | 0.3  |
|                    |                  | II        | 0.3     | 0.2     | 0.3     | 0.2       | 0.2   | 0.2       | 0.3       | 0.3                 | 0.3  |
|                    |                  | III       | 0.3     | 0.2     | 0.1     | 0.3       | 0.2   | 0.2       | 0.2       | 0.2                 | 0.2  |

The highest monthly sums of precipitation in March were observed in 1994 in Kętrzyn (99.1 mm), Mikołajki (85.4 mm) and Olsztyn (82.5 mm). In decades, a growth of sums of precipitation can be observed from decade to decade (decade I: 10.6 mm, II: 10.9 mm and III: 11.7 mm).

In April, just like in March, the distribution of mean monthly sums of precipitation was slightly differentiated in the entire north-eastern region of Poland, oscillating around the value of 40 mm (Fig. 33), ranging from 36.5 mm in Elbląg to 41.4 mm in Ostrołęka (Table 36).

The peak monthly sums of precipitation in April for the analysed area occurred in 1999 in Olsztyn and Mława, reaching the value of 109.7 mm. Equally significant monthly sums of precipitation were observed in 1994 in Kętrzyn (99.5 mm) and Ostrołęka (98.2 mm). The distribution of April precipitation in decade arrangement was as follows: the first decade – 13.5 mm, the second decade – 13.1 and the third one – 12.0 mm. The highest precipitation in the first and the second decade was observed in the Olsztyn Lake District (14.6 and 15.0 mm, respectively), and in the third decade in the south of the area (13.7 mm). The number of days with precipitation above 0.1 mm was definitely higher than in the period from January to March, amounting on average to 12.7, and their number was evenly distributed in individual decades (4.4 days, 4.1 and 4.2 days, respectively) and in the examined area, from 4.0 to 4.6 days.

The distribution of mean multi-year sums of precipitation in the region ranged from 49.9 mm in Mława to 57.4 mm in Białystok. The 50 mm isohyetal line cuts the south-western part of the region with the lowest precipitation. The 55 mm isohyetal line marks the southern and south-eastern areas (Fig. 33) with the highest sums of precipitation (56-57 mm) leaving the other part of the region with monthly sums of precipitation of 52 to 54 mm. A ten-day distribution of precipitation ranges from 16.2 to 20 mm. May is the month in which the lowest number of days with precipitation occurred in the western and the central part of the region (11.9-12.4 days), with up to 13.5 days recorded in the other parts of the area. In May, the number of days with precipitation exceeding 10.0 mm grew, amounting in the first decade to the mean of 0.6 days, in the second: 0.5 and in the third: 0.6 days.

In June, the highest sums of precipitation occurred in the centre of the described area (Fig. 35, Table 38). The highest monthly means (78-81 mm) occurred in its central and northern part (the Olsztyn Lake District, the Mrągowo Lake District, the Great Mazurian Lakeland, the Sępopol Lowland and the Węgorapa Land). In the first decade, precipitation of 28.0 mm was recorded, in the second one: 26.8 mm, and in the third one: 26.6 mm. The second decade of June was characterized by the highest sums of precipitation in the year in the Great Mazurian Lakeland. The third decade of June was a peak one in the Olsztyn Lake District and the Mrągowo Lake District. The numbers of days with precipitation in characteristic ranges above 1.0 mm, 5.0 mm and 10.0 mm were also the highest in the central part.





Fig. 34. Isohyets of mean monthly sums of precipitations in May (1966-2005)

Table 36

Precipitations in periods of May, means for years 1966-2005

| Precipitation (mm)                  | Period           | Locations |         |         |         |           |       |           |           | Mean for the region |     |
|-------------------------------------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|-----|
|                                     |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikolajki | Mława | Ostrołęka | Białystok |                     |     |
| month                               |                  | 52.3      | 51.9    | 53.4    | 54.3    | 56.4      | 49.9  | 56.0      | 57.4      | 54.0                |     |
| ten-days periods                    | I                | 16.7      | 15.1    | 15.3    | 14.9    | 16.9      | 13.8  | 14.5      | 18.3      | 15.7                |     |
|                                     | II               | 16.9      | 18.9    | 20.3    | 19.9    | 22.8      | 18.6  | 22.2      | 22.9      | 20.3                |     |
|                                     | III              | 18.7      | 17.9    | 17.8    | 19.6    | 16.8      | 17.5  | 19.3      | 16.2      | 18.0                |     |
| Number of rainy days $\geq 0,1$ mm  | month            | 11.9      | 12.3    | 12.8    | 12.4    | 12.5      | 11.9  | 13.5      | 12.4      | 12.5                |     |
|                                     | ten-days periods | I         | 3.6     | 3.9     | 4.0     | 3.6       | 3.7   | 3.6       | 4.2       | 3.9                 | 3.8 |
|                                     |                  | II        | 4.2     | 4.2     | 4.7     | 4.6       | 4.7   | 4.2       | 4.8       | 4.6                 | 4.5 |
| III                                 |                  | 4.2       | 4.2     | 4.2     | 4.2     | 4.2       | 4.2   | 4.5       | 4.0       | 4.2                 |     |
| Number of rainy days $\geq 1,0$ mm  | month            | 8.5       | 8.5     | 8.8     | 8.5     | 8.9       | 7.9   | 9.3       | 9.0       | 8.7                 |     |
|                                     | ten-days periods | I         | 2.7     | 2.9     | 2.7     | 2.5       | 2.6   | 2.3       | 2.7       | 2.8                 | 2.7 |
|                                     |                  | II        | 2.9     | 2.9     | 3.0     | 3.0       | 3.2   | 2.9       | 3.2       | 3.1                 | 3.0 |
| III                                 |                  | 2.9       | 2.8     | 3.1     | 3.0     | 3.1       | 2.7   | 3.4       | 3.2       | 3.0                 |     |
| Number of rainy days $\geq 5,0$ mm  | month            | 3.7       | 3.8     | 3.3     | 3.6     | 4.0       | 3.4   | 3.8       | 3.8       | 3.7                 |     |
|                                     | ten-days periods | I         | 1.2     | 1.1     | 0.9     | 1.1       | 1.4   | 1.0       | 1.1       | 1.2                 | 1.1 |
|                                     |                  | II        | 1.2     | 1.6     | 1.3     | 1.4       | 1.5   | 1.2       | 1.4       | 1.4                 | 1.4 |
| III                                 |                  | 1.4       | 1.2     | 1.1     | 1.2     | 1.1       | 1.2   | 1.3       | 1.2       | 1.2                 |     |
| Number of rainy days $\geq 10,0$ mm | month            | 1.6       | 1.5     | 1.6     | 1.6     | 1.6       | 1.3   | 1.5       | 1.8       | 1.6                 |     |
|                                     | ten-days periods | I         | 0.5     | 0.4     | 0.4     | 0.3       | 0.5   | 0.4       | 0.3       | 0.6                 | 0.4 |
|                                     |                  | II        | 0.6     | 0.6     | 0.7     | 0.6       | 0.7   | 0.6       | 0.6       | 0.7                 | 0.6 |
| III                                 |                  | 0.5       | 0.6     | 0.6     | 0.6     | 0.4       | 0.4   | 0.6       | 0.5       | 0.5                 |     |

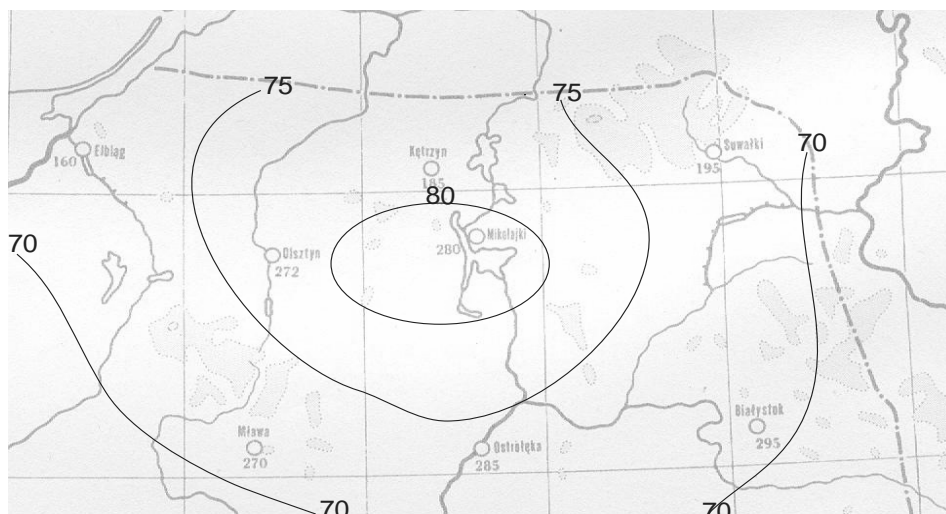


Fig. 35. Isohyets of mean monthly sums of precipitations in June (1966-2005)

Table 37

Precipitations in periods of June, means for years 1966-2005

| Precipitation (mm) |     | Period | Locations |         |         |         |           |       |           | Mean for the region |           |
|--------------------|-----|--------|-----------|---------|---------|---------|-----------|-------|-----------|---------------------|-----------|
|                    |     |        | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikolajki | Mława | Ostrołęka |                     | Białystok |
| month              |     |        | 73.4      | 78.1    | 70.9    | 77.7    | 80.5      | 71.7  | 74.4      | 70.5                | 74.7      |
| ten-days periods   | I   |        | 20.1      | 20.1    | 19.4    | 18.7    | 21.8      | 18.9  | 20.2      | 19.6                | 19.9      |
|                    | II  |        | 24.7      | 30.3    | 26.4    | 29.1    | 31.1      | 26.2  | 31.5      | 24.5                | 28.0      |
|                    | III |        | 28.6      | 27.6    | 25.0    | 29.9    | 27.7      | 26.6  | 22.7      | 26.5                | 26.8      |
| month              |     |        | 13.3      | 14.1    | 13.9    | 13.6    | 14.5      | 13.8  | 13.6      | 13.7                | 13.8      |
| ten-days periods   | I   |        | 3.7       | 3.9     | 4.0     | 3.8     | 3.9       | 3.5   | 4.0       | 3.9                 | 3.8       |
|                    | II  |        | 4.7       | 5.0     | 5.1     | 4.8     | 5.3       | 4.9   | 5.0       | 4.9                 | 5.0       |
|                    | III |        | 5.0       | 5.3     | 4.9     | 5.1     | 5.3       | 5.4   | 4.6       | 4.9                 | 5.1       |
| month              |     |        | 10.0      | 10.4    | 10.5    | 10.0    | 10.4      | 9.6   | 9.9       | 10.0                | 10.1      |
| ten-days periods   | I   |        | 2.7       | 2.9     | 3.0     | 2.8     | 2.7       | 2.5   | 2.6       | 2.7                 | 2.7       |
|                    | II  |        | 3.4       | 3.9     | 3.7     | 3.7     | 4.0       | 3.5   | 3.7       | 3.5                 | 3.7       |
|                    | III |        | 3.9       | 3.7     | 3.8     | 3.5     | 3.7       | 3.7   | 3.5       | 3.8                 | 3.7       |
| month              |     |        | 4.8       | 5.1     | 5.0     | 4.9     | 5.0       | 4.5   | 4.6       | 4.5                 | 4.8       |
| ten-days periods   | I   |        | 1.3       | 1.3     | 1.3     | 1.1     | 1.3       | 1.2   | 1.2       | 1.3                 | 1.3       |
|                    | II  |        | 1.5       | 2.0     | 1.9     | 2.0     | 1.9       | 1.6   | 1.9       | 1.7                 | 1.8       |
|                    | III |        | 2.0       | 1.8     | 1.9     | 1.8     | 1.8       | 1.7   | 1.5       | 1.6                 | 1.8       |
| month              |     |        | 2.3       | 2.4     | 2.2     | 2.6     | 2.4       | 2.2   | 2.3       | 2.0                 | 2.3       |
| ten-days periods   | I   |        | 0.6       | 0.5     | 0.5     | 0.6     | 0.7       | 0.6   | 0.7       | 0.6                 | 0.6       |
|                    | II  |        | 0.8       | 0.9     | 0.9     | 1.1     | 1.0       | 0.8   | 0.9       | 0.7                 | 0.9       |
|                    | III |        | 0.9       | 1.1     | 0.8     | 1.0     | 0.8       | 0.8   | 0.7       | 0.8                 | 0.9       |

The distribution of mean monthly sums of precipitation in July was different than in June. The highest sums of precipitation were observed in the east and the west of the region, while the centre was characterized by their lowest amount (Fig. 36, Table 39). The distribution of mean monthly values ranged from 69 mm in the North Mazovian Lowland (the Kurpie Plain), through 74-76 mm in the Great Mazurian Lakeland, to 80 mm in the North Podlasie Lowland, 81 mm in the Suwałki Lake District and 83 mm in Żuławy Wiślane and the Warmia Plain. In the west and the east of the area, the precipitation reached the highest monthly values in the year. The mean monthly precipitation of July was 77 mm. The peak monthly sums of precipitation was recorded in Elbląg and Białystok in 1980, with 198.5 and 180.1 mm of rain, respectively. Equally high precipitation, of 181.2 mm, occurred in 1997 in Olsztyn. In the first decade of that month, spatial distribution ranged from 22 mm in the Kurpie Plain to 28 mm in the Suwałki Lake District, and 30 mm in Żuławy Wiślane and the Warmia Plain. The second decade was characterized by the highest mean sums of precipitation, while the highest ten-day sums in a year occurred in the west (30-33 mm) and the east of the area (29-30 mm). In the third decade, the sum of precipitation was definitely lower (the mean of 22 mm), in the area cross-section, from 19 mm in the North Mazovian Lowland to 26 mm in the Great Mazurian Lakeland. The total number of days of July with precipitation of 0.1 mm and higher (14) was distributed in individual decades as follows: the first decade: 4.4 days, the second: 5.5 and the third one: 4.1 days. In July, most days with sums of precipitation of 10.0 mm and more occurred from 1.9 days in the North Mazovian Lowlands to 2.5 in the Suwałki Lake District and 2.6 in Żuławy Wiślane and the Warmia Plain.

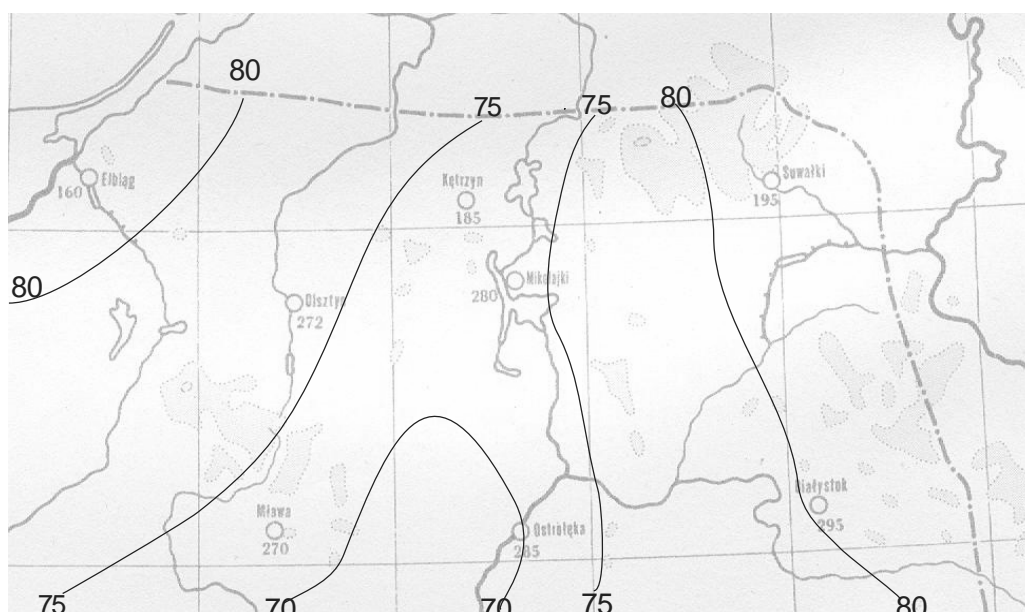


Fig. 36. Isohyets of mean monthly sums of precipitations in July (1966-2005)

Table 38

Precipitations in periods of July, means for years 1966-2005

| Precipitation (mm)   |     | Period           | Locations |                  |         |         |           |       |           | Mean for the region |           |      |      |     |     |
|----------------------|-----|------------------|-----------|------------------|---------|---------|-----------|-------|-----------|---------------------|-----------|------|------|-----|-----|
|                      |     |                  | Elblag    | Ketrzyn          | Suwalki | Olsztyn | Mikołajki | Mława | Ostrołęka |                     | Białystok |      |      |     |     |
| month                |     |                  | 82.5      | 74.3             | 81.3    | 78.3    | 76.0      | 74.0  | 68.9      | 80.0                | 76.9      |      |      |     |     |
| ten-days periods     |     | I                | 29.6      | 27.3             | 28.3    | 27.8    | 22.9      | 27.2  | 22.0      | 28.1                | 26.7      |      |      |     |     |
|                      |     | II               | 32.7      | 26.0             | 30.3    | 29.9    | 27.0      | 27.7  | 27.2      | 29.4                | 28.8      |      |      |     |     |
|                      |     | III              | 20.2      | 21.1             | 22.6    | 20.7    | 26.1      | 19.1  | 19.7      | 22.5                | 25.1      |      |      |     |     |
| Number of rainy days |     | ≥0,1 mm          |           | month            | 14.0    | 14.1    | 14.1      | 14.3  | 14.3      | 14.0                | 13.4      | 14.0 | 14.0 |     |     |
|                      |     | ten-days periods |           | I                | 4.4     | 4.4     | 4.5       | 4.6   | 4.4       | 4.5                 | 4.1       | 4.7  | 4.5  |     |     |
|                      |     |                  |           | II               | 5.6     | 5.7     | 5.5       | 5.7   | 5.8       | 5.4                 | 5.3       | 5.3  | 5.5  |     |     |
|                      |     |                  |           | III              | 4.0     | 4.0     | 4.1       | 4.1   | 4.1       | 4.0                 | 4.1       | 4.1  | 4.1  |     |     |
|                      |     | ≥1,0 mm          |           | month            | 10.2    | 10.7    | 10.3      | 10.8  | 10.3      | 9.5                 | 9.7       | 10.1 | 10.2 |     |     |
|                      |     |                  |           | ten-days periods |         | I       | 3.3       | 3.4   | 3.3       | 3.5                 | 3.1       | 3.1  | 3.0  | 3.5 | 3.3 |
|                      |     |                  |           |                  |         | II      | 4.1       | 4.2   | 3.9       | 4.4                 | 4.2       | 3.7  | 3.9  | 3.9 | 4.0 |
|                      |     | III              | 2.9       |                  |         | 3.2     | 3.1       | 2.9   | 3.0       | 2.7                 | 2.9       | 2.7  | 2.9  |     |     |
|                      |     | ≥5,0 mm          |           | month            | 5.2     | 4.9     | 4.8       | 5.0   | 4.9       | 4.5                 | 4.0       | 5.0  | 4.8  |     |     |
|                      |     |                  |           | ten-days periods |         | I       | 1.8       | 1.8   | 1.7       | 1.7                 | 1.5       | 1.5  | 1.1  | 1.7 | 1.6 |
| II                   | 2.1 |                  |           |                  |         | 1.8     | 1.9       | 2.1   | 1.8       | 1.8                 | 1.7       | 1.9  | 1.9  |     |     |
| III                  | 1.3 | 1.3              | 1.2       |                  |         | 1.3     | 1.6       | 1.2   | 1.1       | 1.4                 | 1.3       |      |      |     |     |
| ≥10,0 mm             |     | month            | 2.6       | 2.1              | 2.5     | 2.2     | 2.3       | 2.3   | 1.9       | 2.2                 | 2.3       |      |      |     |     |
|                      |     | ten-days periods |           | I                | 1.0     | 0.8     | 0.9       | 0.9   | 0.7       | 0.9                 | 0.5       | 0.8  | 0.8  |     |     |
|                      |     |                  |           | II               | 1.1     | 0.7     | 0.9       | 0.8   | 0.8       | 0.8                 | 0.9       | 0.8  | 0.9  |     |     |
| III                  | 0.6 |                  |           | 0.6              | 0.8     | 0.6     | 0.8       | 0.6   | 0.6       | 0.7                 | 0.7       |      |      |     |     |

The monthly mean sum of precipitation for the examined area reached the value of 64 mm in August. The highest value, of as much as 76 mm, was found in the north-western and in the western part of the region (Żuławy Wiślane, the Warmia Plain and the Hława Lakeland). In the centre and in the south of the region (the Olsztyn Lake District, the Mrągowo Lake District, the Great Mazurian Lakeland and the Kurpie Plain), there was recorded 68-69 mm, while 64 mm of precipitation was observed in the east of the region and the lowest value – of 58 mm – was in the south-west of the region. The highest monthly sum of precipitation – 234.3 mm, was recorded in Białystok in 1972. The distribution of sums of precipitation was even: the first decade: 22 mm, the second one: 23 mm and the third one: 22 mm. Spatial distributions in decades proved almost identical as in July. The average number of days with precipitation of 0.1 mm and more (12.4) was the lowest monthly value in a year. The lowest monthly number of days with precipitation in a year was also

found for the Kurpie Plain (12.0 days), the Suwałki Lake District (12.2 days), the Augustów Plain and the North Podlasie Lowland (11.8 days). The lowest number of days with precipitation in a year occurred in the first decade of August (3.8 days). In the remaining part of the area, the number of days with precipitation in the first decade ranged from 3.6 to 4.1. In the second decade of this month, there were on average 4.5 days, ranging from 4.2 days in the east to 4.9 days in the west of the area. In the third decade, there were found on average 4.2 days, from 3.8 to 4.6 days.

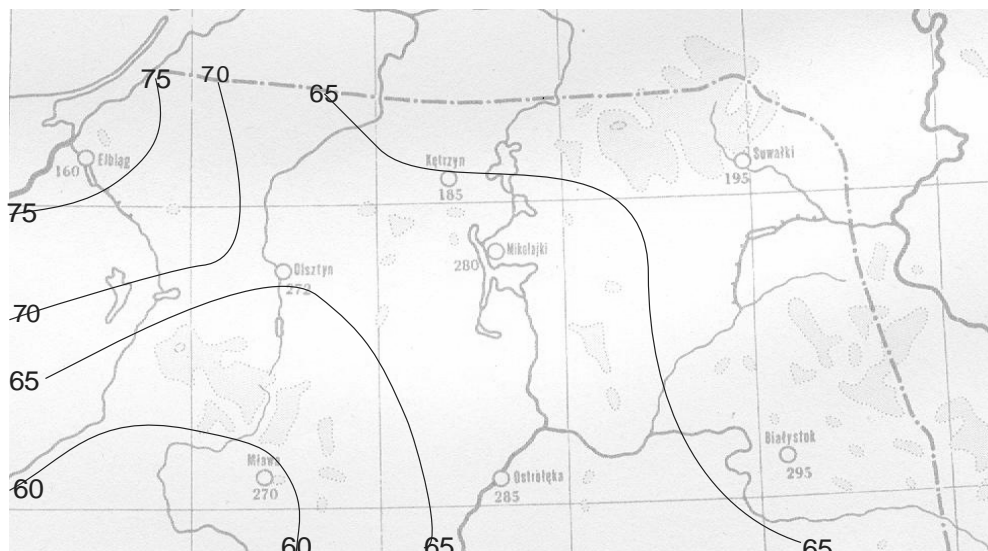


Fig. 37. Isohyets of mean monthly sums of precipitations in August (1966-2005)

The distribution of mean monthly sums of precipitation in September (Fig. 38) was even in the eastern part of the area (52-55 mm) with a gradual increase of monthly precipitation from the centre to the west and the north-west (55-72 mm). The highest monthly sums of precipitation occurred in 1992, with 214.3 mm in Elbląg and in 1995 in Ostrołęka (208.2 mm) and Mława (207.4 mm). The sums of precipitation were reduced decade after decade: 22 mm – 18 mm – 17 mm, with a spatial distribution similar to the monthly distribution. In addition, the number of days with precipitation of 0.1 mm and more grew: there were 13.5 such days, on average, in the region, ranging between 12.8 and 14.4 (Table 41). In the decade arrangement, an even distribution of days with precipitation of 0.1 mm and more was observed, with the following average values in consecutive decades, respectively: 4.4 – 4.5 – 4.5 days. In the spatial arrangement of the region, there were 4.0 such days recorded in the first decade in the North Podlasie Lowland, 4.2 days in the Suwałki Lake District and the Kurpie Plain, 4.5-4.6 days in the Great Mazurian Lakeland, the Mrągowo Lake District and the Sępopol Lowland, 4.8-4.9 days in the Olsztyn Lake District, the Iława Lake District, the Warmia Plain and Żuławy Wiślane. In the second decade, the number of days with precipitation was between 4.1 and 4.9 days, and in the third one – between 4.4 and 4.9 days, with a spatial distribution similar to the first decade. The number of days with

precipitation above 10.0 mm decreased in the area under examination; in individual decades, this number amounted to, on average: 0.6 – 0.5 – 0.4, in the first decade: 0.4-0.9, in the second one: 0.4-0.7 and in the third one: 0.3-0.5 days.

Table 39

Precipitations in periods of August, means for years 1966-2005

| Precipitation (mm)   |  | Period           | Locations |         |         |         |           |       |           | Mean for the region |           |      |      |
|----------------------|--|------------------|-----------|---------|---------|---------|-----------|-------|-----------|---------------------|-----------|------|------|
|                      |  |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka |                     | Białystok |      |      |
| month                |  |                  | 75.8      | 62.2    | 64.2    | 68.3    | 69.2      | 58.4  | 67.1      | 64.0                | 66.2      |      |      |
| ten-days periods     |  | I                | 18.8      | 21.2    | 21.9    | 22.0    | 24.1      | 18.1  | 23.5      | 25.0                | 21.8      |      |      |
|                      |  | II               | 27.8      | 20.7    | 19.9    | 25.0    | 22.0      | 22.0  | 23.5      | 21.2                | 22.8      |      |      |
|                      |  | III              | 29.2      | 20.3    | 22.4    | 21.3    | 23.1      | 18.3  | 20.1      | 17.8                | 21.6      |      |      |
| Number of rainy days |  | ≥0,1 mm          | month     |         | 12.9    | 13.0    | 12.2      | 12.7  | 12.6      | 12.4                | 12.0      | 11.6 | 12.4 |
|                      |  | ten-days periods |           | I       | 3.8     | 3.9     | 3.7       | 3.6   | 3.8       | 4.1                 | 3.8       | 3.6  | 3.8  |
|                      |  |                  |           | II      | 4.9     | 4.5     | 4.3       | 4.9   | 4.3       | 4.3                 | 4.4       | 4.2  | 4.5  |
|                      |  |                  |           | III     | 4.3     | 4.6     | 4.3       | 4.2   | 4.4       | 4.0                 | 3.9       | 3.8  | 4.2  |
| ≥1,0 mm              |  | month            |           | 9.2     | 9.1     | 9.0     | 9.1       | 8.6   | 8.6       | 8.7                 | 8.3       | 8.8  |      |
|                      |  | ten-days periods |           | I       | 2.6     | 2.8     | 2.6       | 2.5   | 2.7       | 2.8                 | 2.6       | 2.8  | 2.7  |
|                      |  |                  |           | II      | 3.3     | 3.1     | 3.1       | 3.4   | 2.9       | 3.0                 | 3.3       | 3.0  | 3.1  |
|                      |  |                  |           | III     | 3.3     | 3.3     | 3.2       | 3.2   | 3.1       | 2.8                 | 2.8       | 2.5  | 3.0  |
| ≥5,0 mm              |  | month            |           | 4.9     | 4.1     | 4.2     | 4.3       | 4.1   | 3.8       | 3.9                 | 4.1       | 4.2  |      |
|                      |  | ten-days periods |           | I       | 1.2     | 1.4     | 1.4       | 1.2   | 1.4       | 1.2                 | 1.4       | 1.3  | 1.3  |
|                      |  |                  |           | II      | 1.9     | 1.3     | 1.3       | 1.5   | 1.4       | 1.4                 | 1.2       | 1.4  | 1.4  |
|                      |  |                  |           | III     | 1.8     | 1.4     | 1.5       | 1.6   | 1.3       | 1.2                 | 1.4       | 1.4  | 1.5  |
| ≥10,0 mm             |  | month            |           | 2.6     | 1.8     | 1.9     | 2.1       | 2.1   | 1.9       | 2.1                 | 1.9       | 2.1  |      |
|                      |  | ten-days periods |           | I       | 0.6     | 0.7     | 0.7       | 0.8   | 0.7       | 0.6                 | 0.7       | 0.8  | 0.7  |
|                      |  |                  |           | II      | 0.9     | 0.6     | 0.5       | 0.7   | 0.7       | 0.7                 | 0.7       | 0.6  | 0.7  |
|                      |  |                  |           | III     | 1.1     | 0.5     | 0.7       | 0.7   | 0.8       | 0.5                 | 0.6       | 0.5  | 0.7  |

In October, the average precipitation value for the region was 51 mm. The highest monthly sums of precipitation were recorded in the north-western part of the area (Żuławy Wiślane and the Warmia Plain) – 63 mm, on average. The western part (the Iława Lake District and the Olsztyn Lake District) was supplied, on average, with 55 mm of precipitation. The northern and the southern part (the Sepopol Lowland and the Great Mazurian Lakeland) received 51-50 mm (Fig. 38). The eastern part of the analysed area was characterized by mean sums of precipitation, respectively: the Suwałki Lake District – 53 mm, the Augustów Plain and the North Podlasie Lowland – 49 mm.

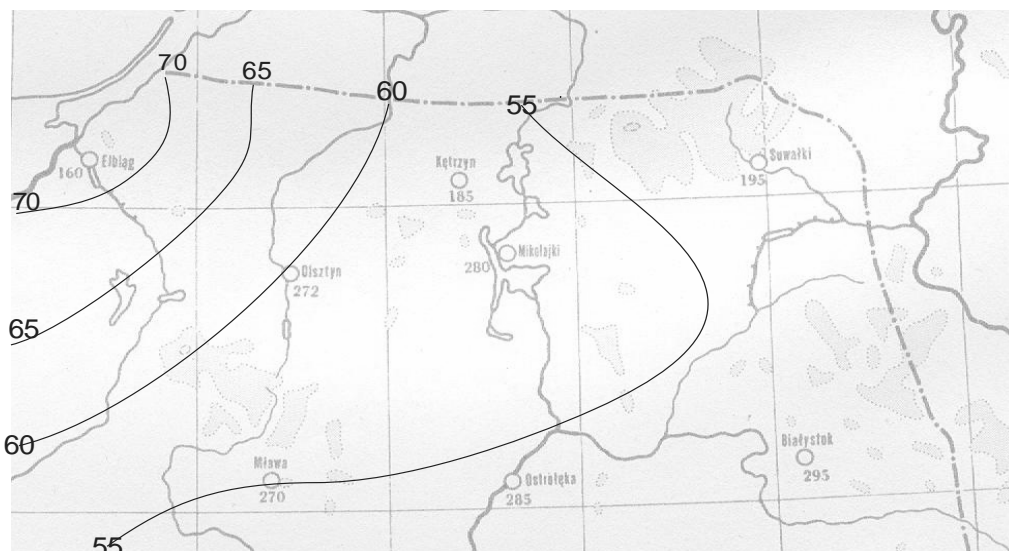


Fig. 38. Isohyets of mean monthly sums of precipitations in September (1966-2005)

Table 40

Precipitations in periods of September, means for years 1966-2005

| Precipitation (mm)   | Period           | Locations        |         |         |         |           |       |           |           | Mean for the region |      |      |
|----------------------|------------------|------------------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|------|------|
|                      |                  | Elbląg           | Kętrzyn | Suwałki | Olsztyn | Mikolajki | Mława | Ostrołęka | Białystok |                     |      |      |
|                      |                  | month            | 71.5    | 56.1    | 51.6    | 59.9      | 55.1  | 52.0      | 53.6      |                     | 54.8 | 56.8 |
| ten-days periods     | I                | 29.0             | 22.2    | 17.7    | 23.2    | 20.8      | 20.9  | 23.0      | 21.6      | 22.3                |      |      |
|                      | II               | 22.8             | 18.1    | 17.1    | 18.7    | 17.0      | 15.6  | 15.5      | 17.7      | 17.8                |      |      |
|                      | III              | 19.7             | 15.8    | 16.8    | 18.0    | 17.2      | 15.5  | 15.0      | 15.6      | 16.7                |      |      |
| Number of rainy days | ≥0,1 mm          | month            | 14.4    | 13.8    | 13.1    | 14.3      | 13.7  | 12.9      | 12.8      | 12.8                | 13.5 |      |
|                      |                  | ten-days periods | I       | 4.9     | 4.6     | 4.2       | 4.8   | 4.5       | 4.4       | 4.2                 | 4.0  | 4.5  |
|                      |                  |                  | II      | 4.9     | 4.7     | 4.3       | 4.6   | 4.5       | 4.2       | 4.1                 | 4.5  | 4.5  |
|                      | III              |                  | 4.6     | 4.5     | 4.6     | 4.9       | 4.7   | 4.3       | 4.5       | 4.4                 | 4.6  |      |
|                      | ≥1,0 mm          | month            | 10.3    | 9.6     | 9.3     | 9.9       | 9.2   | 7.8       | 8.4       | 8.8                 | 9.2  |      |
|                      |                  | ten-days periods | I       | 3.5     | 3.4     | 3.1       | 3.4   | 3.1       | 2.6       | 2.8                 | 2.8  | 3.1  |
|                      |                  |                  | II      | 3.4     | 3.1     | 3.0       | 3.3   | 2.8       | 2.4       | 2.7                 | 3.1  | 3.0  |
|                      | III              |                  | 3.5     | 3.1     | 3.3     | 3.3       | 3.3   | 2.8       | 2.9       | 2.9                 | 3.1  |      |
|                      | ≥5,0 mm          | month            | 5.0     | 3.7     | 3.5     | 3.5       | 3.7   | 3.3       | 3.3       | 4.1                 | 3.8  |      |
|                      |                  | ten-days periods | I       | 1.8     | 1.4     | 1.2       | 1.2   | 1.3       | 1.3       | 1.4                 | 1.5  | 1.4  |
|                      |                  |                  | II      | 1.7     | 1.3     | 1.1       | 1.2   | 1.1       | 1.0       | 1.0                 | 1.4  | 1.2  |
|                      | III              |                  | 1.5     | 1.1     | 1.2     | 1.0       | 1.3   | 1.0       | 0.9       | 1.1                 | 1.1  |      |
| ≥10,0 mm             | month            | 2.0              | 1.5     | 1.2     | 1.4     | 1.3       | 1.4   | 1.5       | 1.4       | 1.5                 |      |      |
|                      | ten-days periods | I                | 0.9     | 0.6     | 0.4     | 0.5       | 0.5   | 0.5       | 0.7       | 0.7                 | 0.6  |      |
|                      |                  | II               | 0.7     | 0.5     | 0.5     | 0.5       | 0.5   | 0.4       | 0.5       | 0.4                 | 0.5  |      |
| III                  |                  | 0.4              | 0.4     | 0.4     | 0.4     | 0.3       | 0.5   | 0.3       | 0.4       | 0.4                 |      |      |



Fig. 39. Isohyets of mean monthly sums of precipitations in October (1966-2005)

Table 41

Precipitations in periods of October, means for years 1966-2005

| Precipitation (mm) |      | Period | Locations |         |         |         |           |       |           | Mean for the region |           |
|--------------------|------|--------|-----------|---------|---------|---------|-----------|-------|-----------|---------------------|-----------|
|                    |      |        | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikolajki | Mława | Ostrołęka |                     | Białystok |
| month              |      |        | 63.3      | 50.4    | 53.1    | 54.9    | 51.0      | 42.8  | 44.4      | 48.7                | 51.1      |
| ten-days periods   | days | I      | 21.7      | 18.9    | 18.8    | 18.9    | 18.9      | 15.4  | 17.1      | 18.2                | 18.5      |
|                    |      | II     | 19.3      | 13.5    | 14.7    | 15.7    | 13.7      | 12.5  | 13.2      | 14.2                | 14.6      |
|                    |      | III    | 22.3      | 18.0    | 19.5    | 20.3    | 18.3      | 14.9  | 14.1      | 16.2                | 18.0      |
| month              |      |        | 15.3      | 14.1    | 13.8    | 13.7    | 14.2      | 13.5  | 12.8      | 13.3                | 13.8      |
| ten-days periods   | days | I      | 4.8       | 4.5     | 4.6     | 4.4     | 4.7       | 4.5   | 4.4       | 4.2                 | 4.5       |
|                    |      | II     | 5.4       | 4.6     | 4.3     | 4.7     | 4.9       | 4.7   | 4.3       | 4.5                 | 4.7       |
|                    |      | III    | 5.1       | 4.9     | 4.9     | 4.6     | 4.7       | 4.3   | 4.2       | 4.7                 | 4.7       |
| month              |      |        | 10.1      | 8.7     | 9.6     | 9.3     | 8.8       | 8.0   | 8.4       | 8.9                 | 9.0       |
| ten-days periods   | days | I      | 3.0       | 2.9     | 3.6     | 3.1     | 2.9       | 2.7   | 2.9       | 3.0                 | 3.0       |
|                    |      | II     | 3.6       | 2.8     | 2.9     | 3.1     | 2.9       | 2.8   | 2.7       | 3.0                 | 3.0       |
|                    |      | III    | 3.5       | 3.1     | 3.2     | 3.2     | 3.0       | 2.6   | 2.7       | 3.0                 | 3.0       |
| month              |      |        | 4.1       | 3.5     | 3.8     | 3.7     | 3.4       | 2.7   | 2.7       | 3.2                 | 3.4       |
| ten-days periods   | days | I      | 1.4       | 1.2     | 1.3     | 1.2     | 1.2       | 1.0   | 0.9       | 1.2                 | 1.2       |
|                    |      | II     | 1.2       | 1.0     | 1.1     | 1.0     | 0.9       | 0.6   | 0.7       | 1.0                 | 0.9       |
|                    |      | III    | 1.5       | 1.3     | 1.4     | 1.5     | 1.4       | 1.1   | 1.0       | 1.1                 | 1.3       |
| month              |      |        | 1.7       | 1.1     | 1.3     | 1.4     | 1.2       | 1.0   | 0.9       | 1.1                 | 1.2       |
| Ten-days period    | days | I      | 0.7       | 0.4     | 0.5     | 0.5     | 0.4       | 0.4   | 0.4       | 0.4                 | 0.5       |
|                    |      | II     | 0.4       | 0.2     | 0.2     | 0.3     | 0.3       | 0.2   | 0.2       | 0.3                 | 0.2       |
|                    |      | III    | 0.6       | 0.5     | 0.6     | 0.7     | 0.5       | 0.5   | 0.3       | 0.4                 | 0.5       |



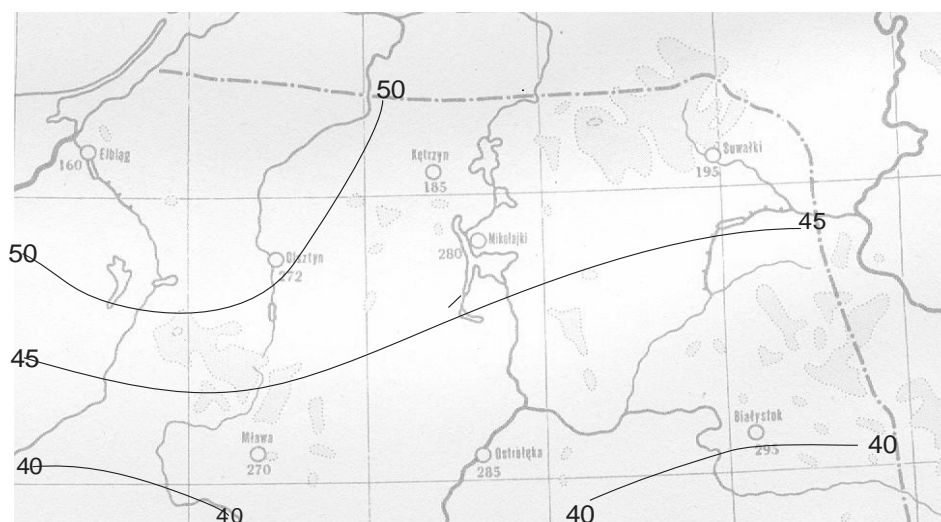


Fig. 40. Isohyets of mean monthly sums of precipitations in November (1966-2005)

Table 42

Precipitations in periods of November, means for years 1966-2005

| Precipitation (mm)   |                  | Period           | Locations |         |         |         |           |       |           |           | Mean for the region |      |
|----------------------|------------------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|-----------|---------------------|------|
|                      |                  |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikolajki | Mława | Ostrołęka | Białystok |                     |      |
| Number of rainy days | ≥0,1 mm          | month            | 53.7      | 46.6    | 46.8    | 50.4    | 46.6      | 41.6  | 43.5      | 40.9      | 46.3                |      |
|                      |                  | ten-days periods | I         | 16.2    | 14.2    | 17.1    | 15.1      | 15.2  | 13.7      | 12.4      | 14.6                | 14.8 |
|                      |                  |                  | II        | 20.7    | 17.7    | 15.9    | 19.9      | 16.8  | 15.7      | 16.5      | 15.0                | 17.3 |
|                      | III              |                  | 16.9      | 14.7    | 13.8    | 15.4    | 14.6      | 12.3  | 14.5      | 11.3      | 14.2                |      |
|                      | ≥1,0 mm          | month            | 16.3      | 16.0    | 16.0    | 16.2    | 16.0      | 15.8  | 15.2      | 15.7      | 15.9                |      |
|                      |                  | ten-days periods | I         | 5.0     | 4.9     | 4.9     | 4.7       | 5.0   | 4.6       | 4.5       | 4.7                 | 4.8  |
|                      |                  |                  | II        | 5.8     | 5.6     | 5.6     | 6.0       | 5.6   | 5.8       | 5.5       | 5.5                 | 5.7  |
|                      | III              |                  | 5.5       | 5.6     | 5.5     | 5.5     | 5.5       | 5.4   | 5.2       | 5.6       | 5.5                 |      |
|                      | ≥5,0 mm          | month            | 10.1      | 9.1     | 9.6     | 9.9     | 9.6       | 8.8   | 8.6       | 8.9       | 9.3                 |      |
|                      |                  | ten-days periods | I         | 3.2     | 2.9     | 3.1     | 3.0       | 3.2   | 2.8       | 2.4       | 2.8                 | 2.9  |
| II                   |                  |                  | 3.9       | 3.3     | 3.4     | 3.7     | 3.6       | 3.2   | 3.2       | 3.2       | 3.4                 |      |
| III                  | 3.1              |                  | 2.9       | 3.1     | 3.2     | 2.9     | 2.7       | 3.0   | 3.0       | 3.0       |                     |      |
| ≥10,0 mm             | month            | 3.7              | 3.1       | 3.0     | 3.3     | 3.2     | 2.6       | 2.7   | 2.5       | 3.0       |                     |      |
|                      | ten-days periods | I                | 1.2       | 1.0     | 1.2     | 1.0     | 1.1       | 0.9   | 0.9       | 1.1       | 1.1                 |      |
|                      |                  | II               | 1.5       | 1.1     | 1.1     | 1.4     | 1.1       | 0.9   | 1.1       | 0.9       | 1.1                 |      |
| III                  |                  | 1.1              | 1.0       | 0.8     | 1.0     | 1.0     | 0.8       | 0.8   | 0.5       | 0.9       |                     |      |
| ≥10,0 mm             | month            | 1.3              | 0.9       | 0.9     | 1.0     | 0.9     | 0.9       | 0.8   | 0.7       | 0.9       |                     |      |
|                      | ten-days periods | I                | 0.4       | 0.3     | 0.5     | 0.3     | 0.4       | 0.3   | 0.2       | 0.4       | 0.3                 |      |
|                      |                  | II               | 0.5       | 0.4     | 0.2     | 0.4     | 0.3       | 0.4   | 0.2       | 0.2       | 0.3                 |      |
| III                  |                  | 0.4              | 0.3       | 0.2     | 0.3     | 0.3     | 0.2       | 0.4   | 0.1       | 0.3       |                     |      |

The southern part of the region (the Kurpie Plain, the Mława Hills) was supplied by precipitation amounting on average to 43-44 mm. The mean number of days with sums of precipitation of 0.1 mm and more, amounting to 13.8 days, was distributed in the examined area in the range of values between 12.8 days in the Kurpie Plain to 15.3 days in Żuławy Wiślane. The ten-day distribution of days with precipitation in October, on average, was almost even, with, respectively: 4.5 – 4.7 – 4.7 days. However, different parts of the analysed area experienced more significant differences: in the first decade from 4.2 to 4.8 days, in the second one: between 4.3 and 5.4 days, and in the third one between 4.2 and 5.1 days.

In November, the mean monthly sum of precipitation decreased, in relation to October (the mean in the region: 46 mm), but the number of days with precipitation (days with precipitation of 0.1 mm and higher) grew – there were 16 such days, on average. The highest sums of precipitation occurred in the north-west of the region (Żuławy Wiślane, the Warmia Plain and the Orneta Plain), with average of 63 mm, in the Iława Lake District and the Olsztyn Lake District – average of 50 mm, in the Sępopol Plain, the Great Mazurian Lakeland, the Węgorapa Land and the Suwałki Lake District – average of 47 mm (Fig. 40, Table 43). The lowest monthly sums of precipitation were recorded in the North Podlasie Lowland (41 mm) and the North Mazovian Lowland (42 – 44 mm). The lowest monthly sum of precipitation in November occurred in 1969 in Suwałki, reaching the value of 106.6 mm.

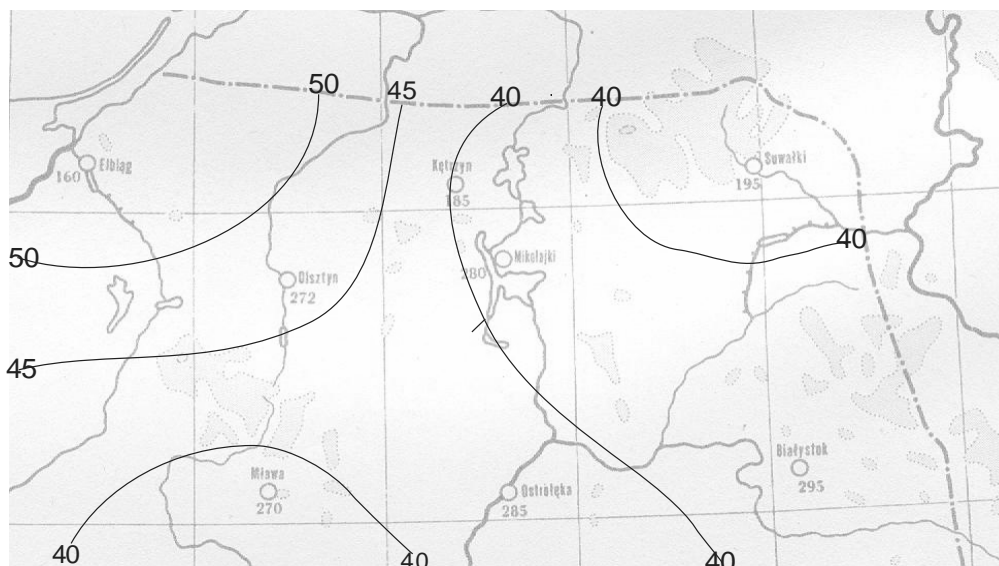


Fig. 41. Isohyets of mean monthly sums of precipitations in December (1966-2005)

Table 43

Precipitations in periods of December, means for years 1966-2005

| Precipitation (mm)   |                  | Period           | Locations |         |         |         |           |       |           | Mean for the region |           |      |
|----------------------|------------------|------------------|-----------|---------|---------|---------|-----------|-------|-----------|---------------------|-----------|------|
|                      |                  |                  | Elbląg    | Kętrzyn | Suwałki | Olsztyn | Mikołajki | Mława | Ostrołęka |                     | Białystok |      |
| Number of rainy days | ≥0,1 mm          | month            | 52.1      | 37.7    | 41.1    | 48.9    | 38.3      | 39.7  | 40.8      | 39.5                | 42.3      |      |
|                      |                  | ten-days periods | I         | 19.2    | 15.9    | 12.7    | 16.2      | 18.2  | 19.8      | 16.4                | 20.9      | 17.4 |
|                      |                  |                  | II        | 18.0    | 21.1    | 18.5    | 18.6      | 13.6  | 16.9      | 15.7                | 18.4      | 17.6 |
|                      |                  |                  | III       | 30.0    | 12.8    | 15.3    | 11.2      | 10.3  | 12.2      | 11.8                | 13.5      | 14.6 |
| ≥1,0 mm              | month            | 18.6             | 17.8      | 18.0    | 18.8    | 17.8    | 17.8      | 17.5  | 17.7      | 18.0                |           |      |
|                      | ten-days periods | I                | 5.8       | 5.4     | 5.6     | 5.8     | 5.4       | 5.6   | 5.6       | 5.5                 | 5.6       |      |
|                      |                  | II               | 7.0       | 6.7     | 6.8     | 7.0     | 6.8       | 6.7   | 6.6       | 6.6                 | 6.8       |      |
|                      |                  | III              | 5.8       | 5.6     | 5.6     | 6.0     | 5.6       | 5.5   | 5.3       | 5.6                 | 5.6       |      |
| ≥5,0 mm              | month            | 11.5             | 9.6       | 10.3    | 11.4    | 9.2     | 9.6       | 9.6   | 9.8       | 10.1                |           |      |
|                      | ten-days periods | I                | 3.5       | 3.2     | 3.5     | 3.5     | 3.0       | 3.0   | 3.3       | 3.3                 | 3.3       |      |
|                      |                  | II               | 4.2       | 3.7     | 3.7     | 4.1     | 3.5       | 3.4   | 3.4       | 3.6                 | 3.7       |      |
|                      |                  | III              | 3.8       | 2.8     | 3.2     | 3.8     | 2.8       | 3.2   | 2.9       | 3.0                 | 3.2       |      |
| ≥10,0 mm             | month            | 3.2              | 2.2       | 2.6     | 3.2     | 2.6     | 2.3       | 2.4   | 2.2       | 2.6                 |           |      |
|                      | ten-days periods | I                | 1.1       | 0.7     | 0.8     | 1.0     | 0.9       | 0.7   | 0.8       | 0.8                 | 0.9       |      |
|                      |                  | II               | 1.0       | 0.9     | 0.9     | 1.2     | 0.9       | 0.9   | 1.0       | 0.9                 | 1.0       |      |
|                      |                  | III              | 1.1       | 0.7     | 0.9     | 1.0     | 0.8       | 0.7   | 0.6       | 0.6                 | 0.8       |      |
| ≥10,0 mm             | month            | 0.9              | 0.4       | 0.5     | 0.7     | 0.3     | 0.4       | 0.6   | 0.6       | 0.6                 |           |      |
|                      | ten-days periods | I                | 0.2       | 0.2     | 0.2     | 0.2     | 0.2       | 0.1   | 0.2       | 0.3                 | 0.2       |      |
|                      |                  | II               | 0.4       | 0.1     | 0.2     | 0.4     | 0.1       | 0.3   | 0.2       | 0.2                 | 0.2       |      |
|                      |                  | III              | 0.3       | 0.1     | 0.1     | 0.2     | 0.1       | 0.1   | 0.1       | 0.1                 | 0.1       |      |

The mean monthly sum of precipitation in December was 42 mm. The distribution of precipitation in the examined area was little diversified (Fig. 41, Table 44). The highest monthly sums occurred in Żuławy Wiślane, the Warmia Plain and the Hawa Lake District (52 mm). Precipitation of 48-45 mm was recorded in the Sepopol Lowland and the Olsztyn Lake District, with 8 to 41 mm observed in the remaining area of north-eastern Poland. The highest monthly sum in December (98.4 mm) was recorded in Olsztyn, in 1966. Ten-day sums of precipitation were varied, both in time and space. In the first decade, precipitation of 13.6 mm was observed in the area under analysis (between 12.4 and 16.0 in the area of the region), in the second decade: 15.8 mm (for the area: 14.3-19.1), and in the third one: 12.9 mm (for the area: 11.0-16.9). December was characterized by the highest number of days with precipitation in a year, equal and higher than 0.1 mm, over the entire territory under analysis (18.0). In the research area, there were 17.5 such days in the Kurpie Plain and 18.8 days in the Olsztyn Lake District. For first decade, 5.6 such days were recorded, on average, ranging from 5.4 to 5.8. The second decade abounded in the highest number of days with precipitation in the year, with

average values of 6.8 days, from the 6.6 -7.0 range. In the third decade, there were recorded 5.6 days with precipitation (for the research area: between 5.3 and 6.0 days). In December, the recorded number of days with precipitation of 10.0 mm amounted on average to 0.5 day, ranging from 0.4 to 0.9 day in the area of the study.

## Conclusions

1. The mean annual temperature in the region in the forty-year period under analysis was 7.2°C. The statistical analysis revealed the existence of a temperature growth trend ( $\alpha=0.05$ ) of almost 0.026°C a year.
2. January was found to be the coldest month of the year (-3.3°C), and July – the warmest (17.5°C).
3. The minimum temperature decreased from the west (4.0°C) to the east of the region (2.5°C). The maximum temperature changed towards the same direction, from 11.5 to 10.5°C.
4. Annual sums of precipitation in the region were characterized by mean values ranging from 550 mm in the south west to 650 mm in the north west. The area mean for the forty-year period was 600 mm. The trend of changes of annual precipitation, although negative, was statistically insignificant ( $\alpha=0.05$ ). Trends in precipitation classes of 21-50 mm and above 50 mm proved statistically insignificant. In the examined period, a growing tendency was observed regarding the number of days with precipitation in the class between 1-10 mm and 11-20 mm.

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