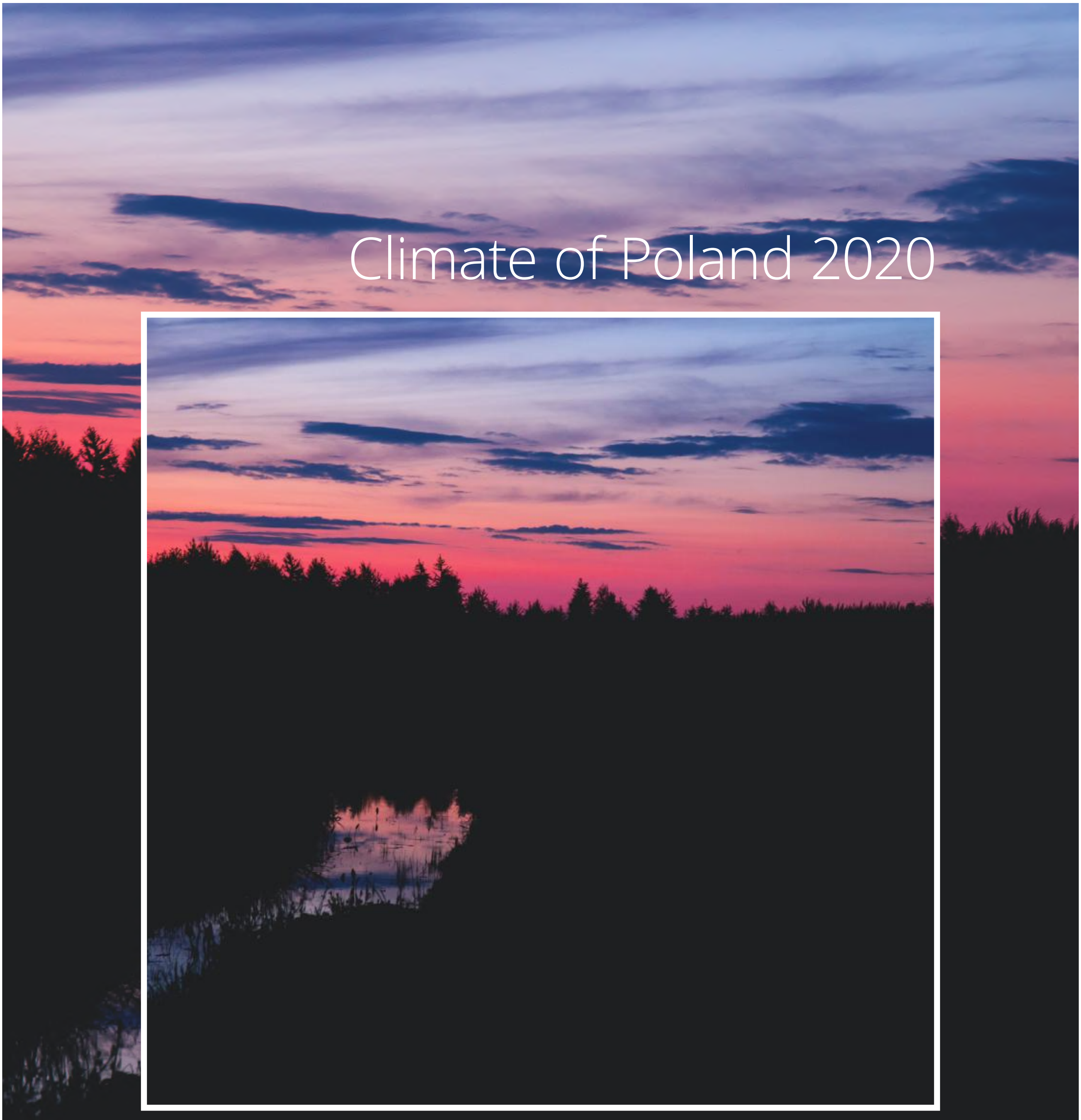
Climate of Poland 2020



Institute of Meteorology and Water Management
– National Research Institute

The climate is a natural resource significantly affecting civilization development. Spatial variability of climate zones on Earth clearly indicates areas of prosperity and poverty, where climatic factors play a key role and either contribute to further progress or limit it.

Contemporary climate change that has been observed for around 170 years, as a consequence of human activity, undoubtedly reaches magnitude that had not been observed before on Earth since the human species inhabited it. This is linked to the pace of change as it has never before been happening so fast. Moreover, never before has any climate change threatened such a large human population, that now stands at 7.8 billion people. At the beginning of the 20th century, the size of the Earth's population was estimated at 1.45 billion, but around 1750, when the industrial era began, it was only 750 million.

Since the observed climate change may lead to the exhaustion of civilization's climate resources, it is necessary to monitor the climate system regularly, take actions to slow down or even eliminate the causes of present climate change, as well as forecast the future evolution of the climate system. It should be accompanied by the development of adaptation strategies, i.e., taking adaptation measures.

The Institute of Meteorology and Water Management – National Research Institute has been monitoring Poland's climate for over 100 years on an ongoing basis, conducting observations and measurements of all relevant climatic variables. We inform the society and public administration about the climate system condition and the threats resulting from climate variability and change. We are the National Service, the meaning of which was well understood by the fathers of independent Poland, including the first president of the Republic of Poland, Gabriel Narutowicz.

We present the study "Climate of Poland 2020". It is a synthetic description of the Poland's climate in the last year, presented in relation to the long-term climate characteristics and from the perspective of global warming.

Prof. Mirosław Miętus
Deputy Director of IMGW-PIB
Director of the Research and Development Center

The presentation was prepared on the basis of the POLISH CLIMATE MONITORING BULLETIN developed by the team consisting of: Prof. ZBIGNIEW USTRNUL, AGNIESZKA WYPYCH, Ph.D., EWA JAKUSIK, Ph.D., DAWID BIERNACIK, DANUTA CZEKIERDA, ANNA CHODUBSKA.

Supplementary materials were prepared by the team: Prof. MIROSŁAW MIĘTUS, MICHAŁ MAROSZ, Ph.D., JANUSZ FILIPIAK, ,Ph.D., MICHAŁ KITOWSKI, MICHAŁ KOWALEWSKI, GRZEGORZ URBAN, Ph.D., EDWARD ŁASZYCA,Ph.D., BEATA KOWALSKA. Comments: Prof. MIROSŁAW MIĘTUS.

POLISH CLIMATE MONITORING BULLETIN was created as part of the CLIMATE project and has been published since 2010. The multi-annual series data were used in the presentation: Warsaw (Halina Lorenc, 2010), Poznań (Leszek Kolendowicz et al., 2019), Gdańsk (Mirosław Miętus, 1996) and Wrocław (Krystyna and Tadeusz Bryś, 2010) extended by Janusz Filipiak.

IMGW-PIB own study 2021. Design: Michał Seredin (IMWM-PIB).

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The animation of climate change in Poland is also available on the IMGW-PIB YouTube channel (https://www.youtube.com/c/IMGWMETEO).

CLIMATE OF POLAND IN 2020

The area average air temperature in 2020 in Poland reached 9.9°C and was higher by 1.6°C than the average long-term temperature value for the climatological normal period 1981-2010. The year 2020 should be classified as extremely warm if you consider the average temperature for Poland.

Poland's warmest region was the western part of the lowlands belt, with an average annual temperature of 10.6°C. Another extremely warm region was the western part of the lake districts, with the value of the average annual temperature of 10.4°C.

Last year February and August were especially warm, however May was very cold. The highest temperature value (35.3°C) was recorded on August 8 in Słubice. The lowest temperature at 2 m (–13.0°C) was recorded on March 25 at the station in Zakopane.

2020 was the second warmest year from the beginning of regular instrumental measurements in Poland. Only 2019 was warmer. Winter 2019/2020, i.e., the period from December 2019 to the end of February 2020 was the warmest winter season in the history of temperature measurements.

The temperature in Poland has increased by slightly more than 2.0°C since 1951. In the lake district belt and lowlands, Podkarpacie and the Carpathians temperature over the last 70 years has increased by 2.1°C. Slowest temperature rise occurred in the Sudetes (1.8°C). From the beginning of the second half of the 20th century, winter temperatures have increased by 2.5°C, and summer temperatures by 1.9°C.

An analysis of the historical series shows that the temperature in selected large Polish cities has increased from 1.4°C to 2.3°C since 1851. It is important to underline that the rate of temperature rise in large agglomerations municipalities increased significantly in the last 40 years.

In 2020, precipitation was characterized by a strong spatial variability and annual precipitation totals ranged from 80% to 140% of the long-term normal. In the warm season there have been numerous heavy and extremely efficient precipitation events, causing river surges and flooding. Heavy rainfall occurred also in October. In 2020, the area average precipitation total in Poland reached 645.4 mm and was 6% higher than the climatological normal.

A strong rainfall deficit appeared in Poland's north-west, the Coast, and South Baltic Coastlands. Interannual variability was characterized by several prolonged period with lack of any precipitation, heralding forecasting the atmospheric drought and the initiating phenomenon of soil drought.

The rainfall deficit was significant in isolated areas within the country. Evapotranspiration prevailed over rainfall.

Annual value of sunshine duration ranged from 1585 hours in Mława up to 2202 hours in Jelenia Góra. It was higher than the long-term normal from 100 hours to almost 600 hours.

CLIMATE IS A NATURAL RESOURCE SIGNIFICANTLY AFFECTING CIVILIZATION DEVELOPMENT. THE SPATIAL VARIABILITY OF CLIMATE ZONES ON EARTH CLEARLY SHOWS WHICH OF THEM PROMOTE CIVILIZATION DEVELOPMENT, IN WHICH IT IS LIMITED, AMONG OTHERS, FOR CLIMATE REASONS AND IN WHICH IT IS PRACTICALLY IMPOSSIBLE AT THIS STAGE OF DEVELOPMENT.

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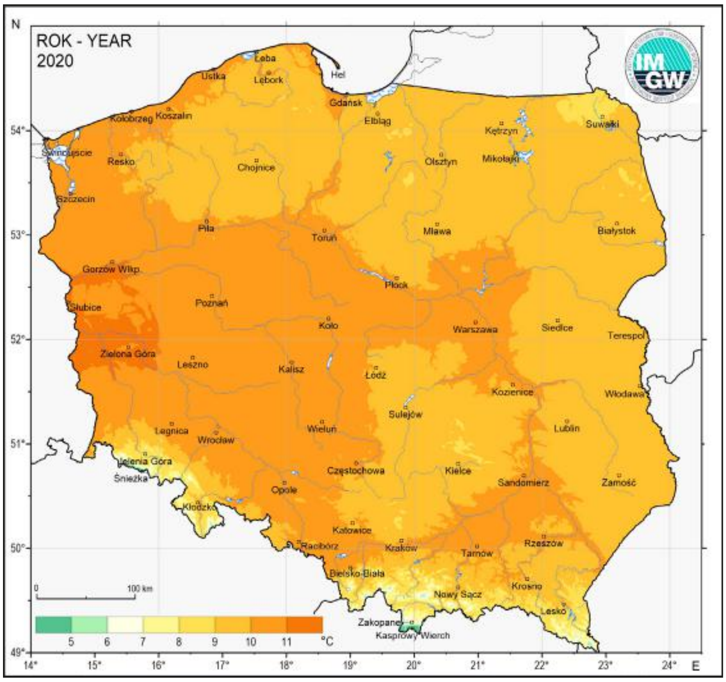
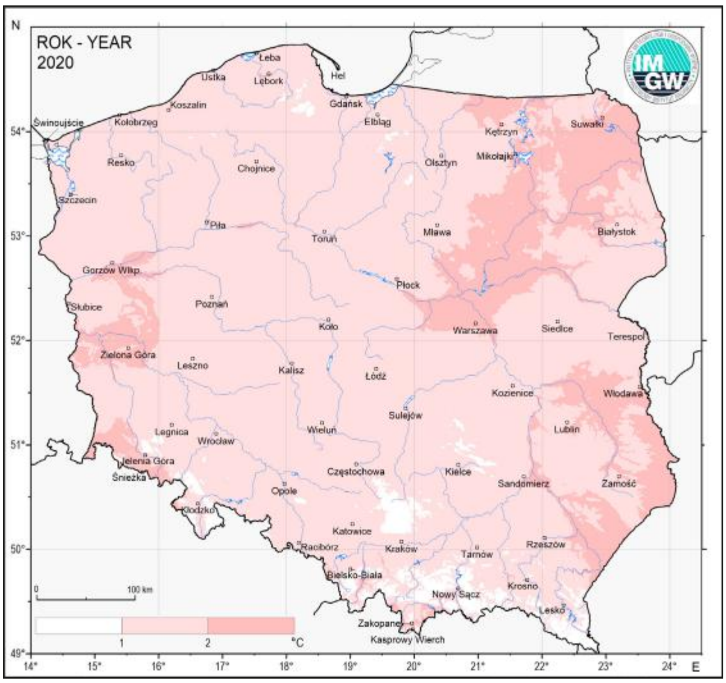
AIR TEMPERATURE

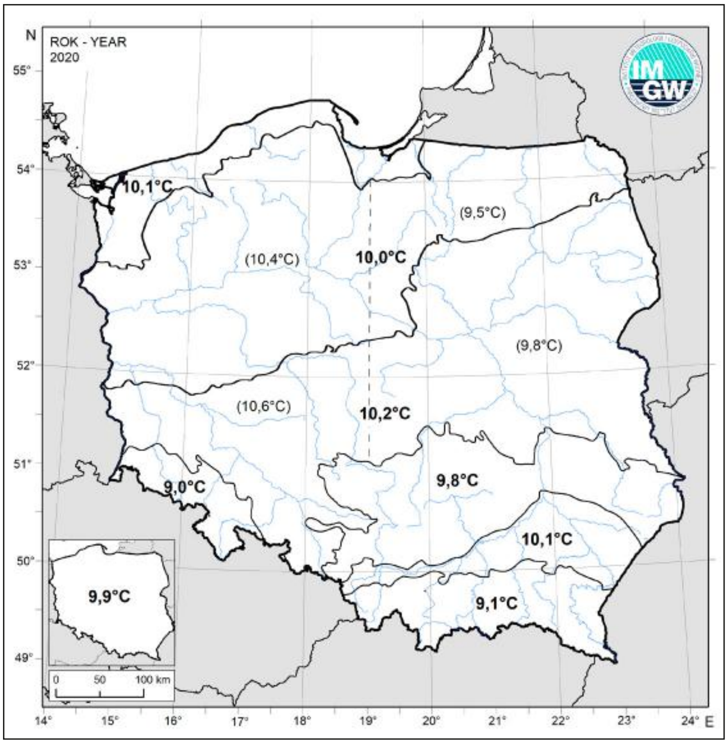
Spatial variability of air temperature in 2020 is a consequence of the quantity of solar radiation energy (partially described by the sunshine duration) reaching the area of Poland, the advection of warm air masses from the southern sector, and the influence of local factors. In 2020, the warmest region was the area between Zielona Góra, Słubice and Gorzów Wielkopolski. However, the coldest part was, except for the higher parts of the Sudetes and the Carpathians, in north-eastern Poland in the vicinity of Suwałki. Location of warmest and coldest areas on an annual basis is practically the exact reflection of the spatial temperature variability in the long-term period.



Spatial variability of average temperature anomalies referring to so-called the climatological standard normals, i.e., the average value for the period 1981-2010, shows that the highest anomalies, between 2°C and 3°C, occurred in the region, which was the warmest in 2020, and in the northern and central part of the Masovia Lowland, in the Podlaska Lowland, in the north-eastern part of the Mazurian Lakeland, the Polesie, in the north-eastern part of the Lublin Upland, on the Roztocze, and in the north-eastern part of Sandomierz Basin. Minimum anomalies not exceeding 1°C occurred in some parts of the Sudetes and the Carpathians, and also in Jura Krakowsko-Częstochowska, and the area of the Świętokrzyskie Mountains.



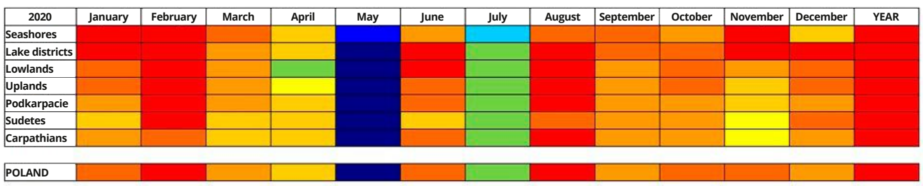
The area average temperature is an indicator that allows the description of the thermal conditions synthetically in a given area and, moreover, it allows comparison between regions, and provides reference to values determinating temperature on the regional or global scale. For this purpose, uniform temperature values are calculated for the basic physio-geographical units of Poland. They are (from the north): the Coast belt and the Southern-Baltic Coastlands belt, the lake districts belt, lowlands belt, the uplands belt, the Podkarpacie, the Carpathians, and the Sudetes. In addition, to reflect the impact of Atlantic Ocean's and the Asian continent, the lowlands and the lakes districts were divided into western and eastern parts along the 19°E meridian. Such a division allows showing possible differences related to the thermal regionalization of Poland. In 2020, the warmest region of the country was the lowlands belt, where the temperature was 10.2°C (more precisely, its western part, when the average annual temperature was 10.6°C). The coldest region in 2020 was the Sudetes (9.0°C). The division of the lake districts belt and the lowlands belt into western and eastern parts shows strong thermal differentiation between these subregions.



AIR TEMPERATURE
Thermal conditions classification

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Winter	Spring	Summer	Autumn	YEAR
2020	2.2	4.0	4.5	8.7	11.0	17.7	18.2	**19.8**	15.1	10.5	5.6	**1.9**	3.1	8.1	18.6	10.4	9.9
Anomaly, 1980-2010	3.7	4.6	1.7	0.6	–2.3	1.7	–0.1	2.0	1.8	1.9	2.2	2.2	3.9	0.0	1.2	1.9	1.6

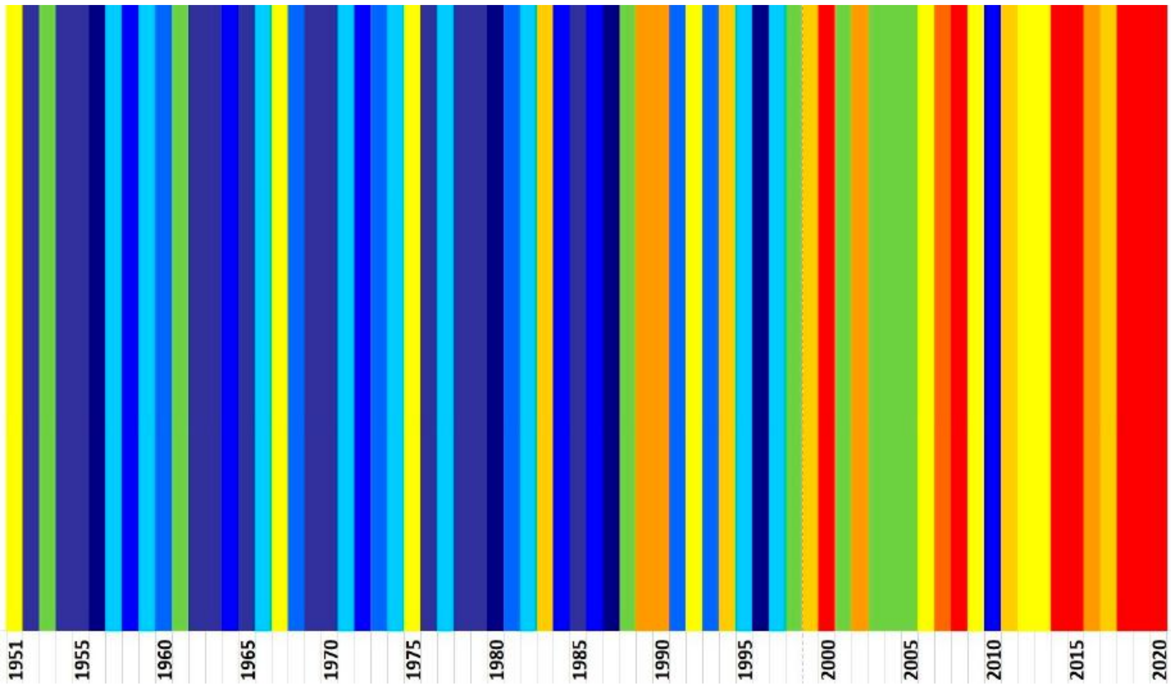
The air temperature is characterized by interannual variability. The warmest month in 2020 was August. The average temperature this month reached 19.8°C. It was 2.0°C higher than the average long-term temperature for this month. In turn, the coldest month was December. The average monthly temperature reached 1.9°C and was 2.2°C higher than the climatological standard normal. The beginning of the year was particularly warm, the temperature in January (usually the coldest month of the year) was higher than the climatological standard normal by 3.7°C, and in February up to 4.6°C. May 2020 was particularly cold. The average temperature this month reached 11.0°C and was 2.3°C below normal. May in Poland is one of the most erratic months (in terms of thermal conditions). The temperature may be as high, as in 2018 (16.4°C, enough to qualify May as the summer month), but also very low (9.3°C in 1980). On the other hand, July was a month close to normal. The anomaly was only –0.1°C. Due to the fact that the winter months were extremely warm, the air temperature in winter, i.e., between December 2019 and February 2020, was 3.1°C and was 3.9°C higher than the climatological standard normal. It was the warmest winter since the middle of the 20th century and since the beginning of instrumental measurements in Poland.



quantiles [%]	thermal conditions of the month	quantiles [%]	thermal conditions of the month
> 0,95	extremely warm	0,30-0,40	slightly cold
0,90-0,95	anomaly warm	0,20-0,30	cold
0,80-0,90	very warm	0,10-0,20	very cold
0,70-0,80	warm	0,05-0,10	anomaly cold
0,60-0,70	slightly warm	< 0,05	extremely cold
0,40-0,60	normal		

Descriptive classifications are often used to determine to what extent thermal conditions of the month, the climatic season, or the year differed from the typical conditions. One such qualification is based on an empirical cumulative distribution function of average air temperature values for each month, season, or year in the normal period 1981-2010, allowing the determination of threshold values of the classes based on a certain probability. Each class is given descriptive names, as shown above.

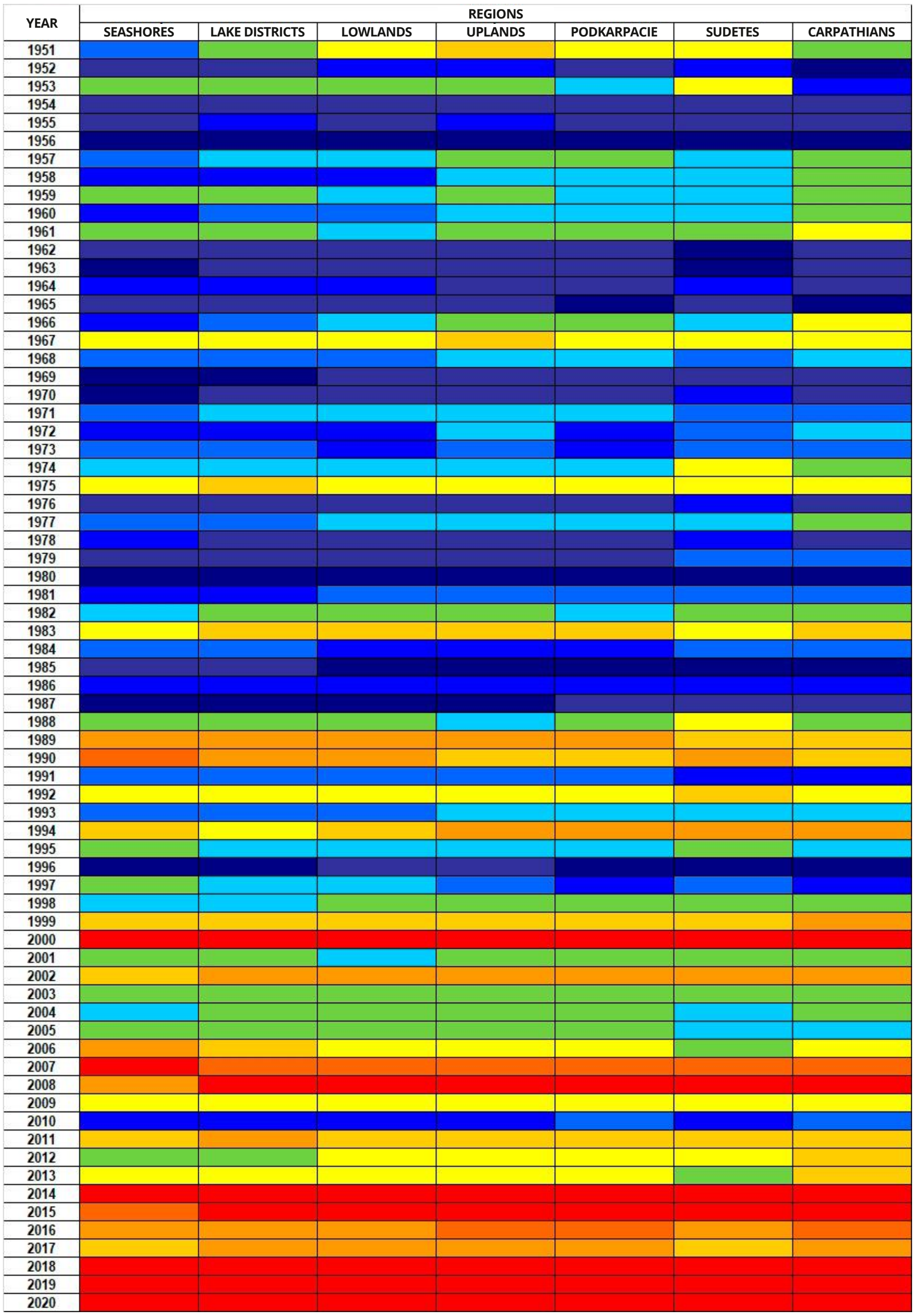
On the basis of this classification, thermal conditions in all months except May and July 2020 can be classified as at least slightly warm in all physio-geographical regions. February and August were almost everywhere extremely warm months, May was extremely cold, and July thermally normal.



It is possible to illustrate how thermal conditions have changed in Poland, year by year, since the beginning of the second half of the 20th century by using a descriptive classification of thermal conditions. It is visible that thermal conditions until the mid-1980s in each year were classified in the group of cold and cool conditions. In turn, from the second half of the 1980s, there were more often conditions known as normal or warmer. The last decade has seen conditions ranging from very warm to extremely warm. The years 1996 and 2010 clearly stand out as colder in the warm period. The year 1996 was extremely cold, with an average temperature of 6.6°C, and the year 2010 was very cold, with an average temperature of 7.5°C. In 1996, it was determined by very cool winter months, both in the period from January to February and in December. In the case of 2010, January, February, and December were cool, while July was very warm (20.8°C).

In individual years, the physio-geographic regions differ in terms of thermal conditions. These differences are not significant, however, there are some differences in the analyzed periods. There have been years when thermal conditions variability in the regions was significant (e.g., 1951, 1966, and 1997).

The warming process is clearly visible. As you move along the timeline, the cool colours are replaced by warm ones. This colour change reflects the warming process of the climate in all regions. The temperatures are rising!



AIR TEMPERATURE
Thermal conditions variability, 1951-2020

Average air temperature values in the individual decades of the 1951-2020 period are between 7,1°C (more precisely 7.08°C in the decade 1961-1970) and 9.3°C (more precisely 9.33°C in the last decade 2011-2020). The table showing those values illustrates the progressive increase of air temperature from decade to decade. The situation analyzed from the point of view of average values for 30-year periods (the so-called normal climatological periods) is similar. In this case, the increase is unambiguous, from 7.2°C in 1951-1980 to 8.7°C for the last 30-year period, i.e., 1991-2020. It represents an increase of 1.5°C in terms of 30-year normals.

As mentioned before, the last 20 years was the warmest period from the mid-20th century. During this period, the warmest winter was in the season December 2019 - February 2020 (season temperature 3.1°C), the warmest spring (March-May) occurred in 2007 (10.0°C), the warmest summer (June-August) in 2019 (19.9°C), and the warmest autumn (September-November) in 2006 (11.0°C). With regard to the year, the warmest was in 2019 (10.2°C).

DECADE	AVERAGE AIR TEMPERATURE (°C)		NORMAL PERIOD
1951-1960	7.25		
1961-1970	7.08		
1971-1980	7.25	7.19	1951-1980
1981-1990	7.61	7.31	1961-1990
1991-2000	7.91	7.59	1971-2000
2001-2010	8.22	7.91	1981-2010
2011-2020	**9.33**	**8.73**	1991-2020

YEAR	AVERAGE AIR TEMPERATURE (°C)				
	WINTER	SPRING	SUMMER	AUTUMN	YEAR
2000	0.5	9.9	16.9	10.2	9.5
2001	0.5	7.9	17.6	8.7	8.3
2002	0.2	9.7	19.0	8.3	9.1
2003	–3.8	8.2	18.6	8.3	8.3
2004	–0.9	7.9	17.1	9.1	8.3
2005	–0.1	7.3	17.2	9.3	8.3
2006	–3.2	7.0	18.7	**11.0**	8.7
2007	2.7	**10.0**	18.3	7.6	9.4
2008	1.7	8.4	18.0	9.1	9.4
2009	–0.7	8.8	17.5	9.3	8.5
2010	–3.2	7.9	18.7	8.0	7.5
2011	–3.0	8.9	17.9	9.0	8.9
2012	–1.2	9.3	18.0	9.4	8.5
2013	–1.8	6.8	18.3	9.2	8.5
2014	1.3	9.8	17.9	10.0	9.6
2015	1.1	8.5	18.9	9.3	9.7
2016	1.8	9.0	18.2	8.9	9.2
2017	–0.9	8.8	18.2	9.4	9.0
2018	0.1	9.8	19.5	10.2	9.8
2019	1.0	9.2	**19.9**	10.4	**10.2**
2020	**3.1**	8.1	18.6	10.4	9.9

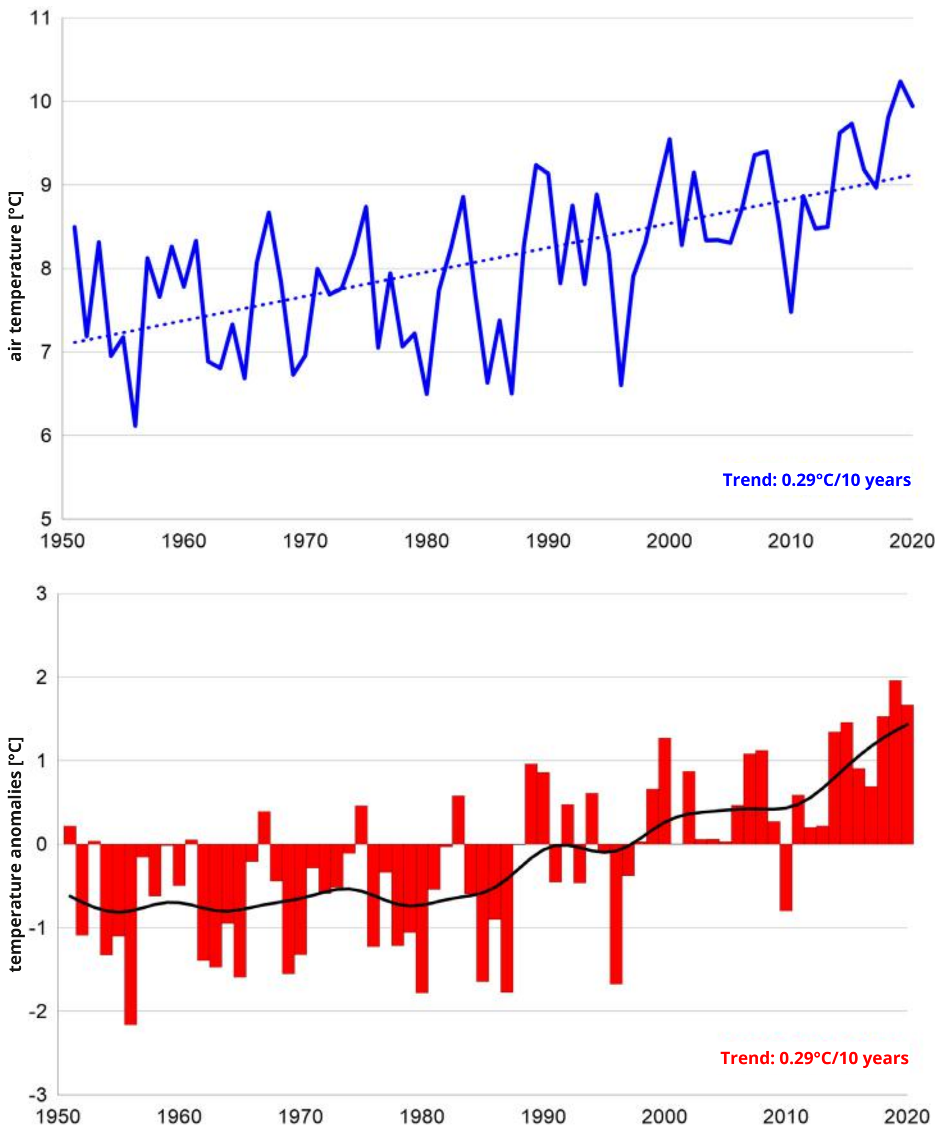
In the last 20 years, only in 2010, the annual average air temperature was below the long-term average for the period 1981-2010. The anomaly reached –0.8°C and was a consequence of the extremely cold beginning of the year (January-February) and the cold December.

YEAR	AIR TEMPERATURE (°C)	
	YEAR	ANOMALY RELATIVE TO 1981-2010
2019	**10.2**	**1.9**
2020	9.9	1.6
2018	9.8	1.5
2015	9.7	1.4
2014	9.6	1.3
2008	9.4	1.1
2007	9.4	1.1
2016	9.2	0.9
2002	9.1	0.8
2017	9.0	0.7
2011	8.9	0.6
2006	8.7	0.4
2009	8.5	0.2
2013	8.5	0.2
2012	8.5	0.2
2004	8.3	0.0
2003	8.3	0.0
2005	8.3	0.0
2001	8.3	0.0
2010	**7.5**	**–0.8**

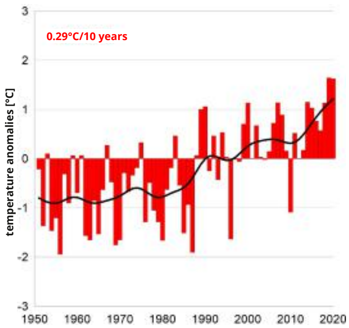
STATION	Kołobrzeg (12100)		Warsaw (12375)		Włodawa (12497)		Śnieżka (12510)		Kasprowy Wierch (12650)	
	Average air temperature	Anomaly relative to	Average air temperature	Anomaly relative to	Average air temperature	Anomaly relative to	Average air temperature	Anomaly relative to	Average air temperature	Anomaly relative to
DECADE	(°C)	1971-2000 (°C)	(°C)	1971-2000 (°C)	(°C)	1971-2000 (°C)	(°C)	1971-2000 (°C)	(°C)	1971-2000 (°C)
1951–1960	7.52	–0.74	7.79	–0.26	7.49	0.01	0.42	–0.20	–0.76	–0.12
1961–1970	7.43	–0.83	7.52	–0.53	7.15	–0.33	0.42	–0.20	–0.81	–0.16
1971–1980	7.89	–0.37	7.73	–0.32	7.11	–0.36	0.30	–0.31	–0.98	–0.33
1981–1990	8.35	0.09	8.14	0.09	7.48	0.01	0.57	–0.05	–0.66	–0.01
1991–2000	8.49	0.23	8.30	0.26	7.80	0.32	1.00	0.38	–0.34	0.31
2001–2010	8.71	0.46	8.80	0.75	8.18	0.70	1.32	0.70	–0.08	0.57
2011–2020	**9.75**	**1.50**	**9.85**	**1.80**	**9.35**	**1.87**	**2.20**	**1.58**	**0.85**	**1.50**

Progressive warming is also seen at individual meteorological stations located in various physio-geographic regions of Poland and characterized by different location features (coastal station, metropolitan station, high-mountain station, station in a small town).

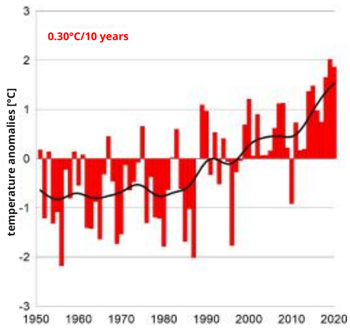
An increase of the average annual temperature during the period 1951-2020 is characterized by positive, statistically significant (at level 1–α = 0.95) trend of 0.29°C /10 years. It corresponds to an increase of temperature in a given period from 1951 up to 2.0°C. To illustrate the variability of temperatures, series are often presented in the form of anomalies from the climatological standard normal (i.e., the average for the last normal period), instead of series of absolute values. Such series presents a positive value when a given year was warmer than normal, and negative when it was colder. Using a series of anomalies (deviations) from the normal allows for quick visual identification of colder and warmer periods. In addition to a series of anomalies, the graph presents a curve showing the course of a series of anomalies after smoothing it with a Gaussian filter with a 10-year window, i.e., after filtering out short-term temperature fluctuations.



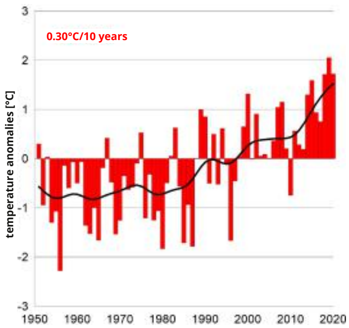
The series of deviations show the temperature variability in particular physio-geographical regions in the period 1951-2020. Differences in variability between regions can be compared, and regions where temperature changes are the strongest (lake districts, lowlands, Podkarpacie and the Carpathians, temperature increase of 2.1°C) and those where they are the weakest (the Sudetes, 1.9°C), can be identified.



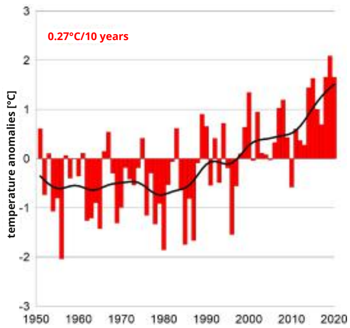
SEASHORES



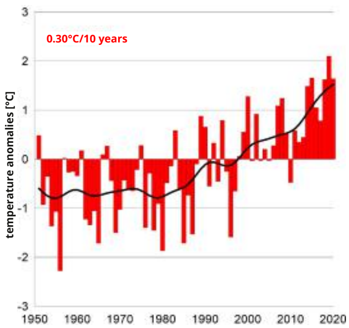
LAKE DISTRICTS



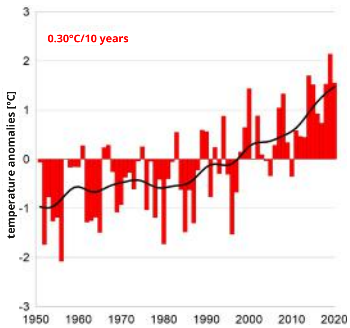
LOWLANDS



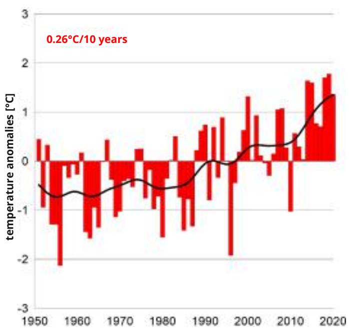
UPLANDS



PODKARPACIE



CARPATHIANS



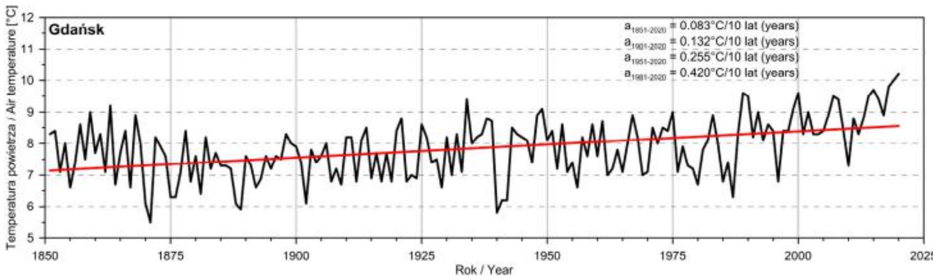
SUDETES

AIR TEMPERATURE
Thermal conditions variability, 1851-2020

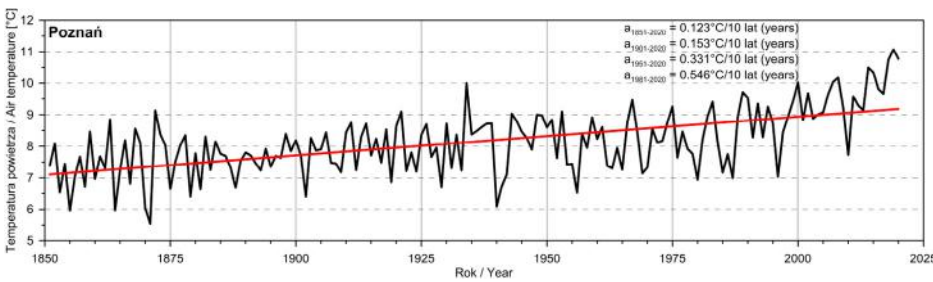
Regular instrumental temperature measurements began in Poland in the 18th century, including Warsaw (in 1779), Wrocław (in 1791), and Kraków (in 1792). However, at the earliest, they commenced in Gdańsk since 1739. In the first half of the 19th century, regular meteorological measurements were launched in other Polish cities.

Intergovernmental Panel on Climate Change (IPCC) has been systematically publishing temperature variability analyses for the global and regional series since 1851. For this reason, we present the temperature variability in Gdańsk, Poznań, Warsaw, and Wrocław in the period 1851-2020.

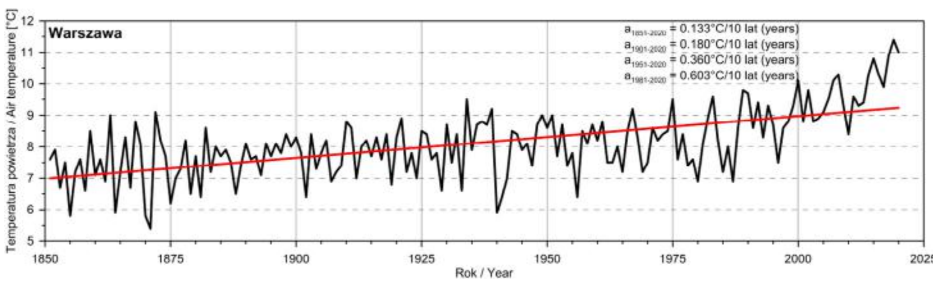
Each series documents an increase in air temperature, although the pace of change varies. The weakest temperature rise, reaching 1.4°C, occurs in Gdańsk, and the strongest, reaching 2.3°C, in Warsaw. Shown series clearly illustrate that the rate of warming is steadily increasing. Trend coefficients calculated for the period 1901-2020 are higher than those for 1851-2020, and these calculated for the period from 1951 - even higher. The values of the trend coefficients increased sharply in the period after 1980.



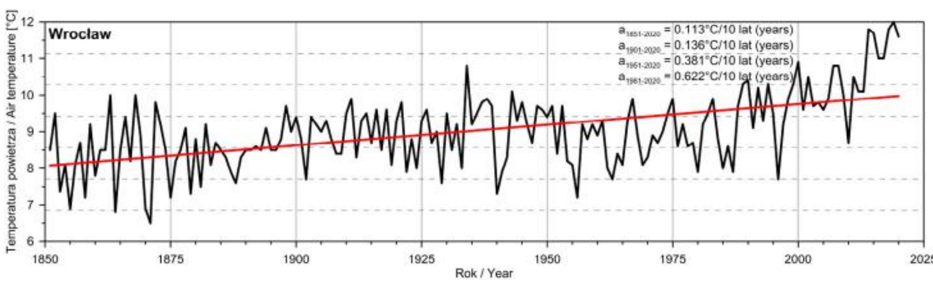
M. Miętus, 1996; rozszerzone J. Filipiak



L. Kolendowicz, B. Czernecki, M. Półrolniczak et.al. 2019. https://doi.org/10.1007/s00704-018-2560-z; rozszerzone J. Filipiak



H. Lorenc, 2010; rozszerzone J. Filipiak

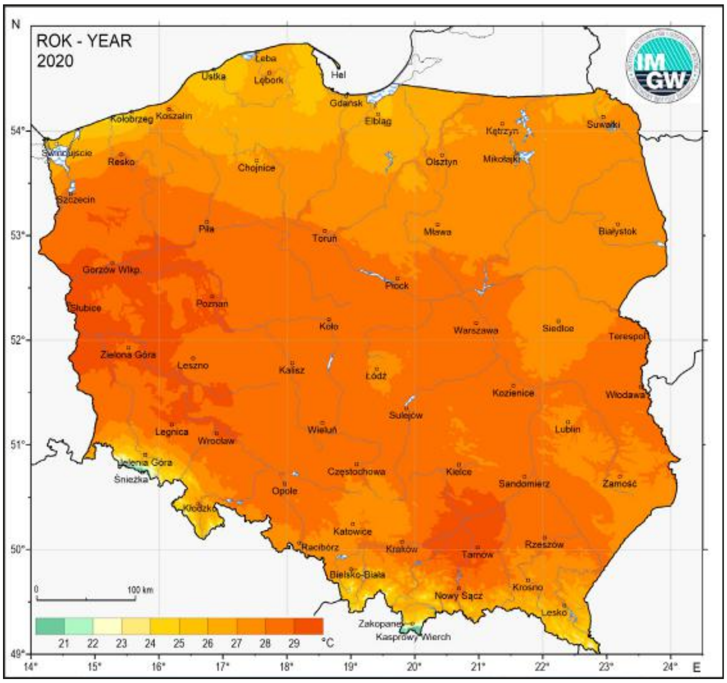


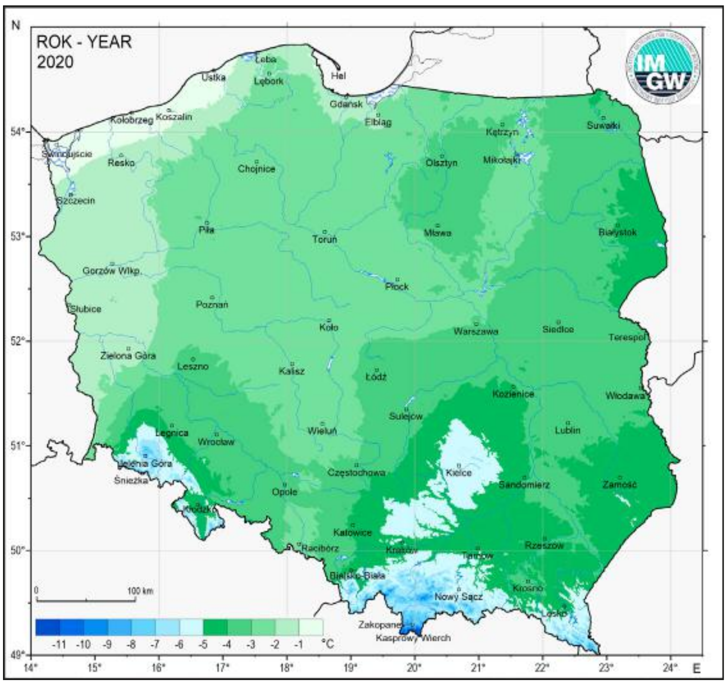
K. Bryś, T. Bryś, 2010; rozszerzone J. Filipiak

AIR TEMPERATURE
Extreme temperatures – quantiles

Spatial variability of the 95% percentile of the maximum air temperature identifies the areas where the occurrence probability of the higher temperature than the map shows is lower or equal to 5%. The map shows, in a generalized view, a clear gradient directed from the southwestern areas of Poland (the warmest) to northern Poland (the coldest). The influence of the southern Baltic's cold water masses, responsible for the „flattening" of the highest temperature values, is clearly visible in late spring and summer.

In turn, the warming influence of the Baltic Sea is reflected in the spatial distribution of the 5% percentile of the minimum air temperature. Its values are clearly higher in the western and central part of the Polish coast and the coastlands belt. For this element, the gradient is towards the southeast. However, the highest temperature drops occur in the Sudetes, the Carpathians, and the Świętokrzyskie Mountains.

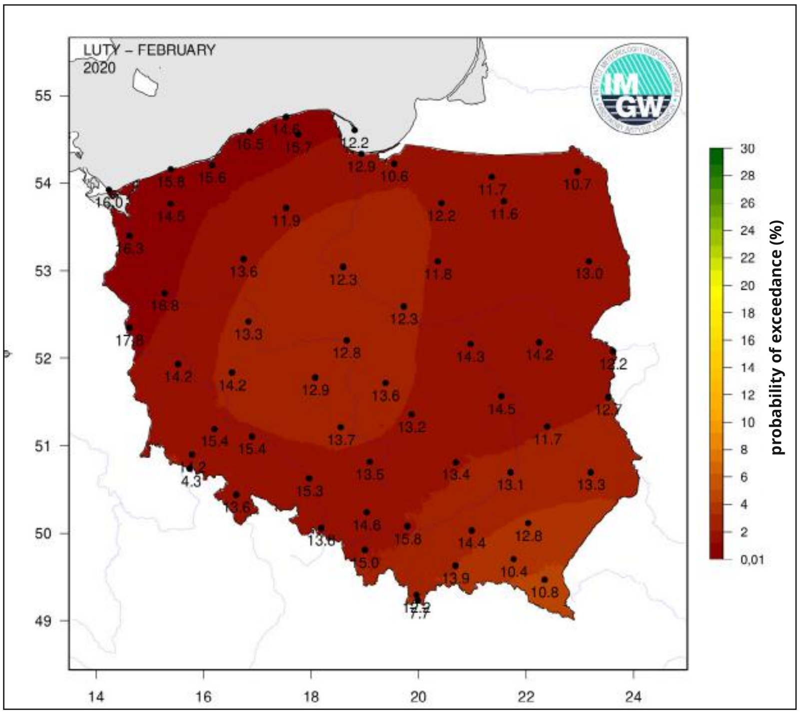


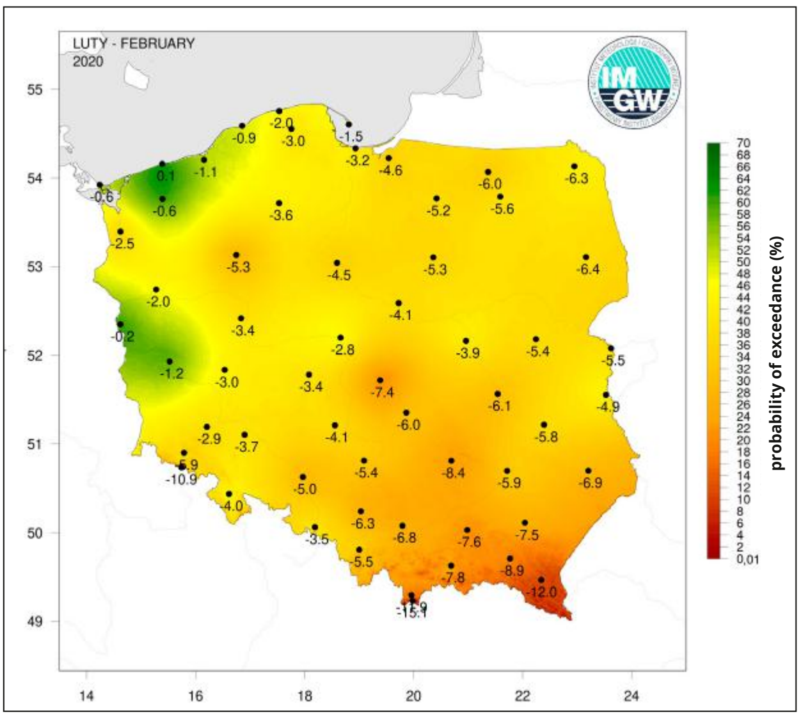


AIR TEMPERATURE
Extreme temperatures in February – thermal hazards risk

February was a particularly warm month in 2020. A strong thermal anomaly at this time is illustrated by the map of probability of exceedance of maximum daily air temperature registered in February at individual stations and the map of probability of not exceeding the lowest values of minimum temperature recorded at the concerned stations. The probabilities were determined by fitting of the theoretical probability density functions to empirical distributions for the data from 1981-2010.

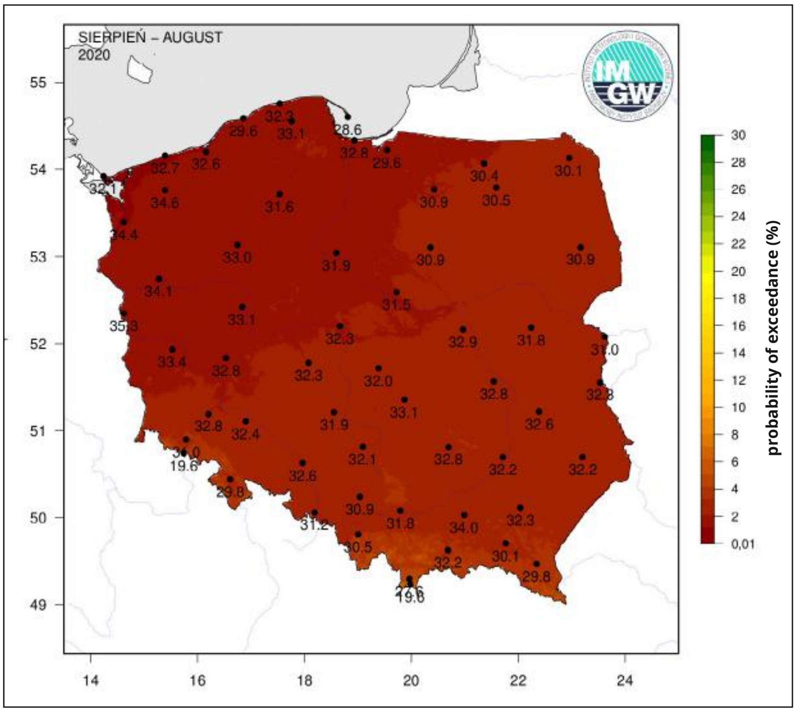
Since the probability of exceeding of the absolute values of maximum temperature in February is between 0.001 and 0.05 throughout the country, this proves that in February 2020, we had extremely rare temperatures in this month. Simultaneously, the probability distribution map for the lowest values of minimum temperature shows that the probability of occurrence of lower temperatures than those actually recorded, is relatively high. In most of the country area, the probability is 0.4 and higher, and in the western part of the coast and seashore, and the area between Słubice, Zielona Góra, and Gorzów Wielkopolski it reaches 0.7. It means that the lowest values of minimum temperature were often much lower in the reference period.

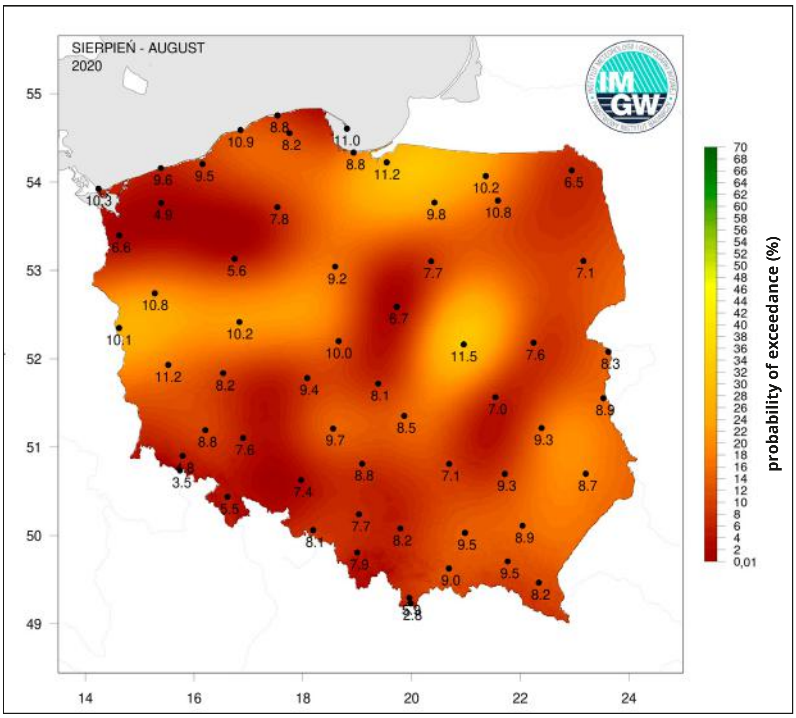




AIR TEMPERATURE
Extreme temperature in August – thermal hazards risk

In August 2020, the probability of occurrence of the maximum temperature higher than those given (on the order of 30°C) was within the range of 0.001 to 0.04. In the case of the lowest temperature, the probability of their occurrence ranged between 0.02 and 0.3. This confirms that in a large area of Poland, the days were hot and the nights were warm.



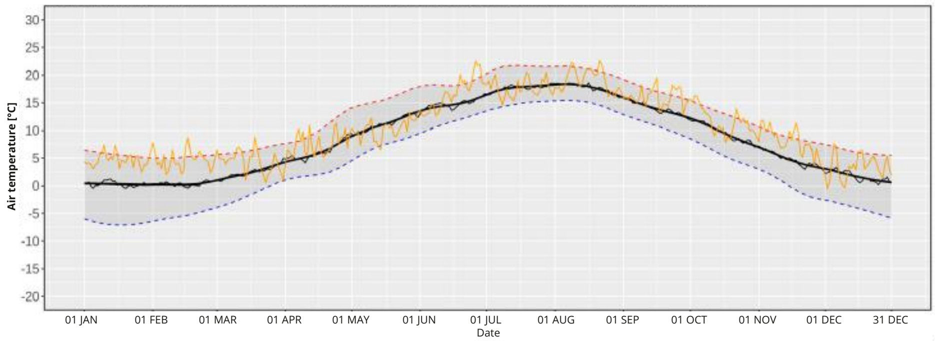


AIR TEMPERATURE
Interannual variability

The daily mean temperature at individual stations was higher than the so-called normal from the beginning of the year to mid-March and then from the beginning of August to the end of the year (except for rare cases at the beginning of December). The value of the daily mean temperature repeatedly exceeded 95% quantile value for this element derived from multi-annual period 1981-2010.

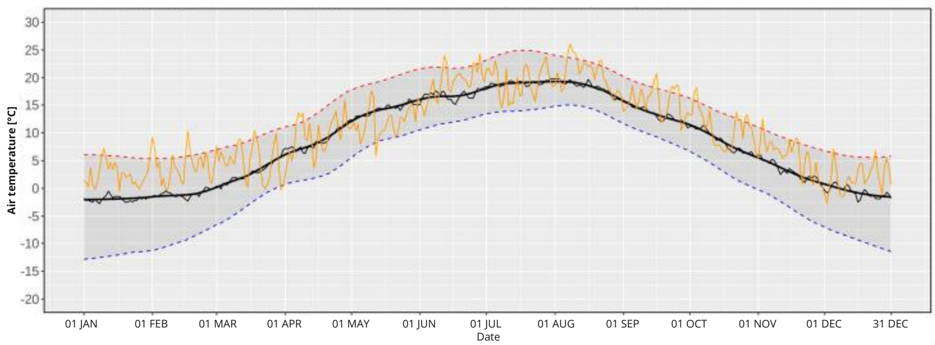
In a few cases, the period during which it occurred lasted for several days without interruption. There were practically no days with daily mean temperature values lower than the 5% quantile value for this element in the years 1981-2010. A very similar mid-year variability occurred at most stations in Poland.

HEL – variability of the daily mean air temperature (TSRD) in 2020 with reference to long-term characteristics 1981-2010
daily mean air temperature in 2020 (orange line), long-term average (black line),
quantiles: 95% (red line) and 5% (blue line) – smoothed with locally weighted polynomial regression



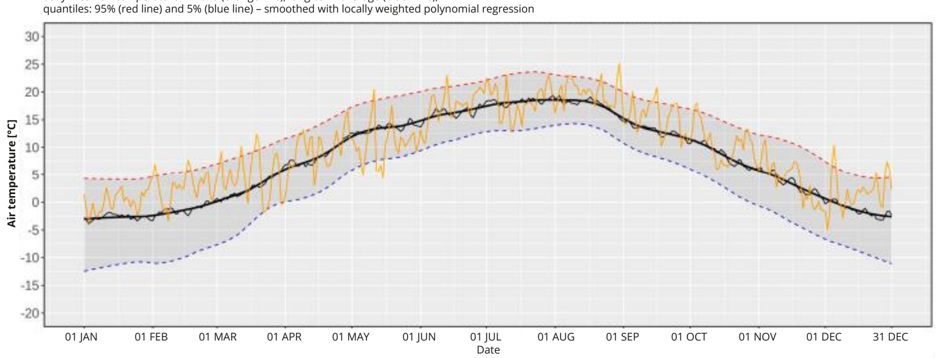
Source: IMGW-PIB: ZBM, KP

WARSAW-OKĘCIE – variability of the daily mean air temperature (TSRD) in 2020 with reference to long-term characteristics 1981-2010
daily mean air temperature in 2020 (orange line), long-term average (black line),
quantiles: 95% (red line) and 5% (blue line) – smoothed with locally weighted polynomial regression



Source: IMGW-PIB: ZBM, KP

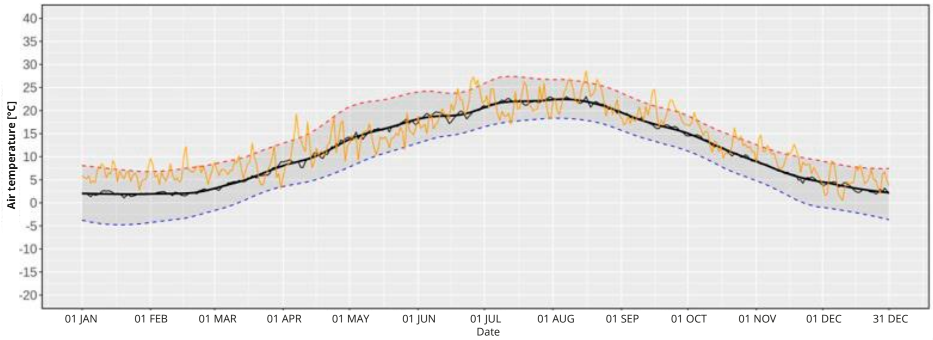
KROSNO – variability of the daily mean air temperature (TSRD) in 2020 with reference to long-term characteristics 1981-2010
daily mean air temperature in 2020 (orange line), long-term average (black line),
quantiles: 95% (red line) and 5% (blue line) – smoothed with locally weighted polynomial regression



Source: IMGW-PIB: ZBM, KP

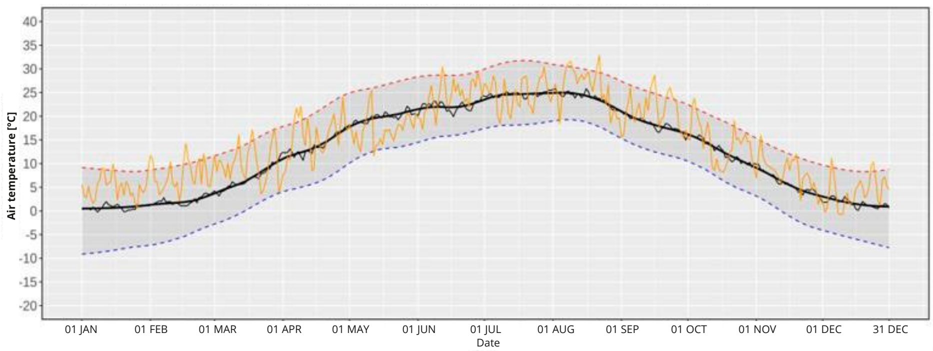
The interannual variability of the maximum daily air temperature was very similar to the variability of the daily mean temperature

HEL – variability of the maximum daily air temperature (TMAX) in 2020 with reference to long-term characteristics 1981-2010
maximum daily air temperature in 2020 (orange line), long-term average (black line),
quantiles: 95% (red line) and 5% (blue line) - smoothed with locally weighted polynomial regression



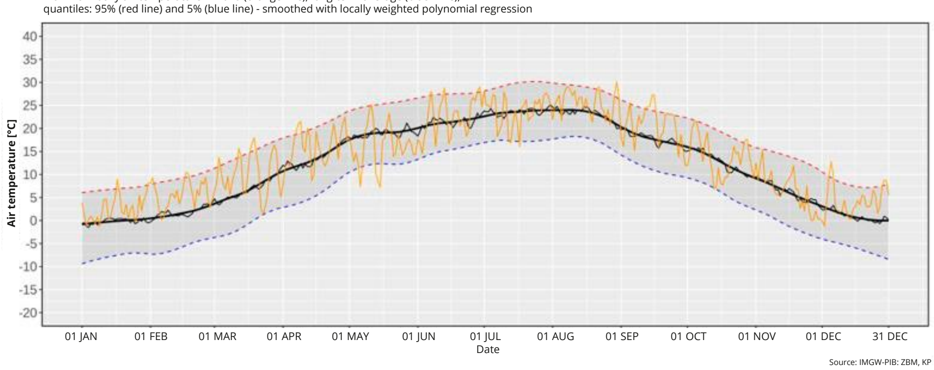
Source: IMGW-PIB: ZBM, KP

WARSAW-OKĘCIE – variability of the maximum daily air temperature (TMAX) in 2020 with reference to long-term characteristics 1981-2010
maximum daily air temperature in 2020 (orange line), long-term average (black line),
quantiles: 95% (red line) and 5% (blue line) - smoothed with locally weighted polynomial regression



Source: IMGW-PIB: ZBM, KP

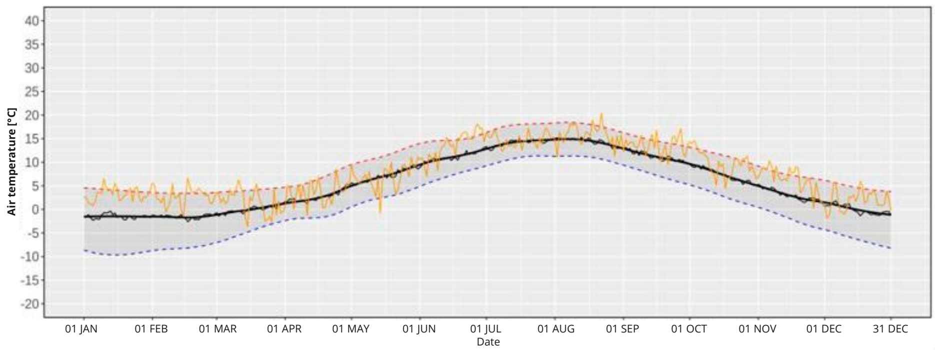
KROSNO – variability of the maximum daily air temperature (TMAX) in 2020 with reference to long-term characteristics 1981-2010
maximum daily air temperature in 2020 (orange line), long-term average (black line),
quantiles: 95% (red line) and 5% (blue line) - smoothed with locally weighted polynomial regression



Source: IMGW-PIB: ZBM, KP

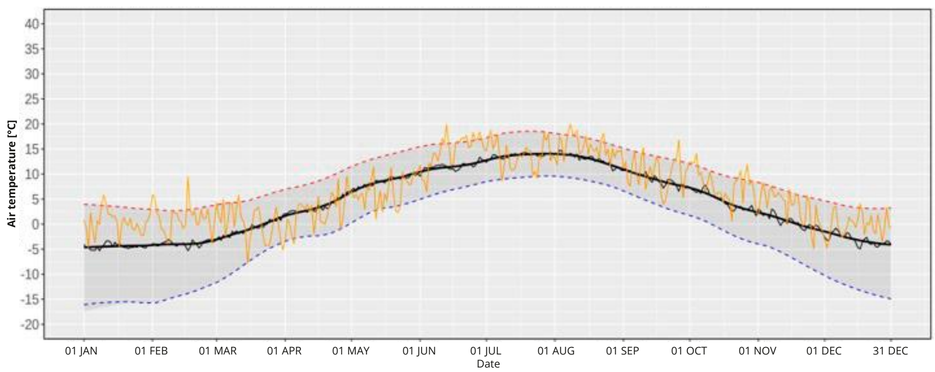
The interannual variability of the minimum daily temperature was similar to that of the daily mean temperature.

HEL – variability of the daily minimum air temperature (TMIN) in 2020 with reference to the long-term characteristics 1981-2010
daily minimum air temperature in 2020 (orange line), long-term average (black line),
quantiles: 95% (red line) and 5% (blue line) – smoothed with locally weighted polynomial regression



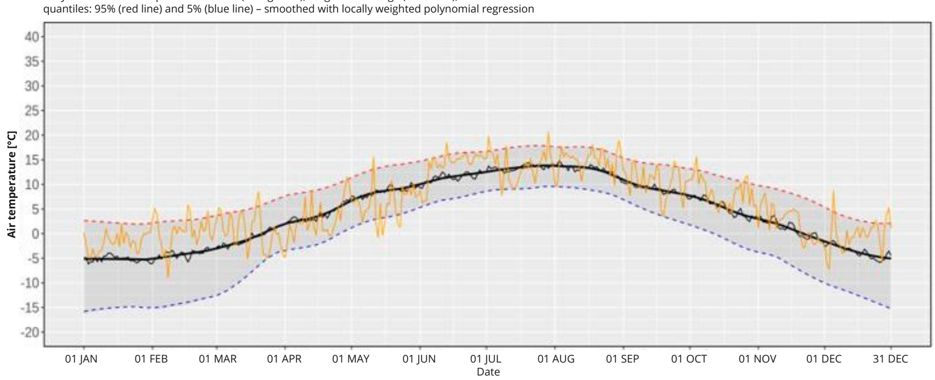
Source: IMGW-PIB: ZBM, KP

WARSAW-OKĘCIE – variability of the daily minimum air temperature (TMIN) in 2020 with reference to long-term characteristics 1981-2010
daily minimum air temperature in 2020 (orange line), long-term average (black line),
quantiles: 95% (red line) and 5% (blue line) – smoothed with locally weighted polynomial regression



Source: IMGW-PIB: ZBM, KP

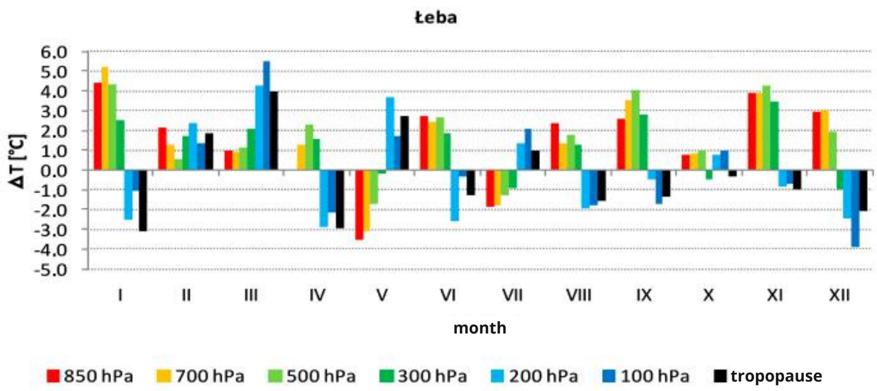
KROSNO – variability of the daily minimum air temperature (TMIN) in 2020 with reference to long-term characteristics 1981-2010
daily minimum air temperature in 2020 (orange line), long-term average (black line),
quantiles: 95% (red line) and 5% (blue line) – smoothed with locally weighted polynomial regression

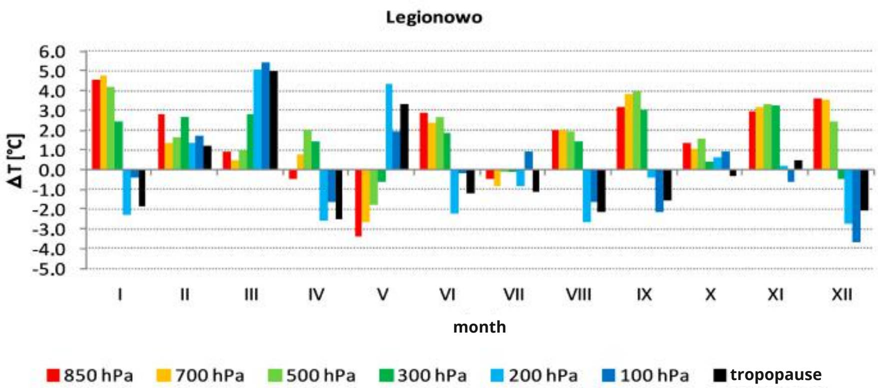


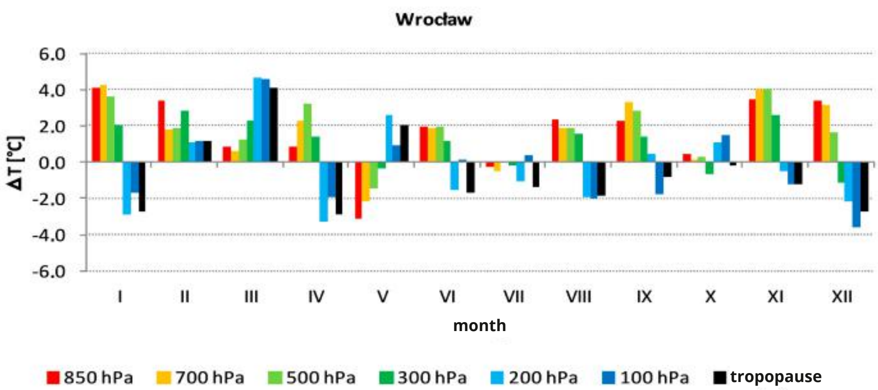
Source: IMGW-PIB: ZBM, KP

AIR TEMPERATURE
The upper layers of the atmosphere

Temperature anomalies that occurred at stations, are reflected in the variability of this element in the entire troposphere profile. In months that were warmer than normal at station level, the temperature recorded at main levels in the troposphere was also higher. In those that were cooler, it was also cooler in the troposphere.







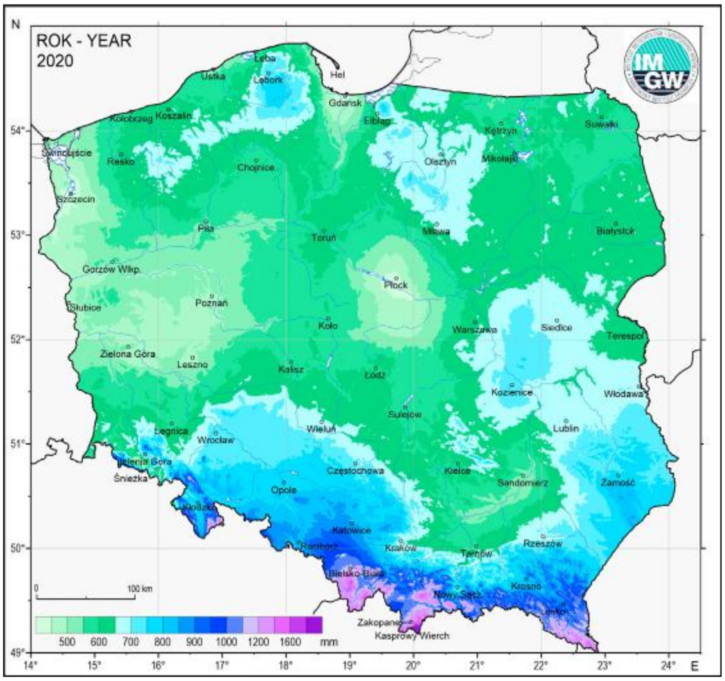
MODERN CLIMATE CHANGE THAT HAS BEEN OBSERVED FOR AROUND 170 YEARS, AS A CONSEQUENCE OF HUMAN ACTIVITY, UNDOUBTEDLY REACHES MAGNITUDE THAT HAD NOT BEEN OBSERVED BEFORE ON EARTH SINCE THE HUMAN SPECIES HAVE INHABITED IT. THIS IS LINKED TO THE PACE OF CHANGE AS IT HAS NEVER BEFORE BEEN HAPPENING SO FAST. MOREOVER, NEVER BEFORE HAS ANY CLIMATE CHANGE THREATENED SUCH A LARGE HUMAN POPULATION, WHICH NOW STANDS AT 7.8 BILLION PEOPLE. AT THE BEGINNING OF THE 20TH CENTURY, THE SIZE OF THE EARTH'S POPULATION WAS ESTIMATED AT 1.45 BILLION, BUT AROUND 1750, WHEN THE INDUSTRIAL ERA BEGAN, IT WAS ONLY 750 MILLION.

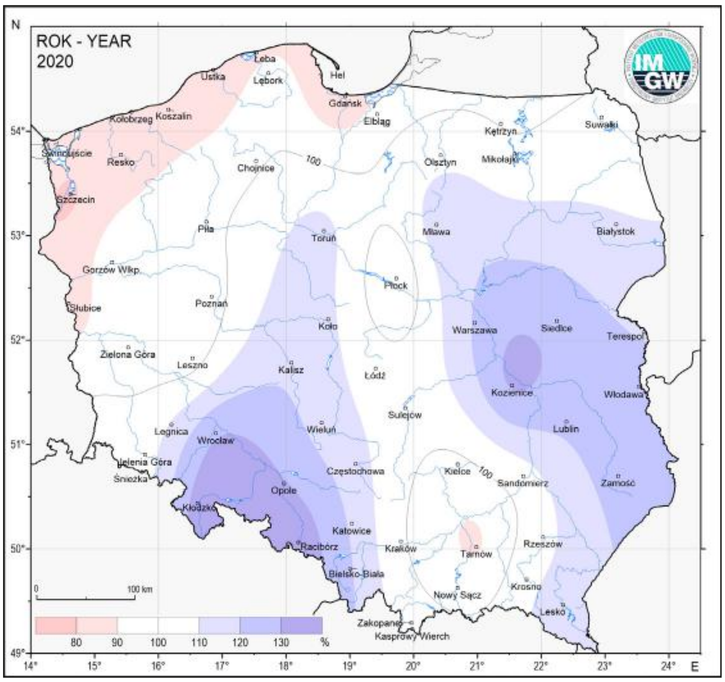
PRECIPITATION

In 2020, the area average of annual total precipitation in Poland was 645.4 mm. This value qualifies this year, in terms of precipitation, as the 3rd in the ending decade and as the 6th in the 21st century. Annual variability of precipitation was very high. April was the least abundant with rainfall, and turned out to be the driest April in the 21st century, and the second driest April in the last 55 years. The area average of total precipitation amounted to 8.3 mm, with no precipitation occurring for nearly 4 weeks in a significant part of the country. In turn, June was the wettest month in the year and the wettest June in the 21st century. Also, it was the second in terms of the total rainfall in the last 55 years. The average area of total precipitation was 120 mm.

The map of the spatial variability of precipitation totals in 2020 in Poland shows a significant variability. The highest totals , up to nearly 2,000 mm, were recorded in the higher parts of the Carpathians. The annual precipitation totals exceeded the national area average in the south of the country, except the western parts of the Sudetes, the Silesian Lowland, and the South Wielkopolska Lowland. Higher than average precipitation also occurred in the Lublin Upland, in the southern part of the Masovia Lowland, in the western part of the Masurian Lakeland and, on the Kashubian Lakeland. In turn, rainfall of annual totals of 450 mm and less occurred in the Baltic Sea coastal zone, in the central and western parts of the Wielkopolskie Lakeland, and the western part of the Masovia Lowland.

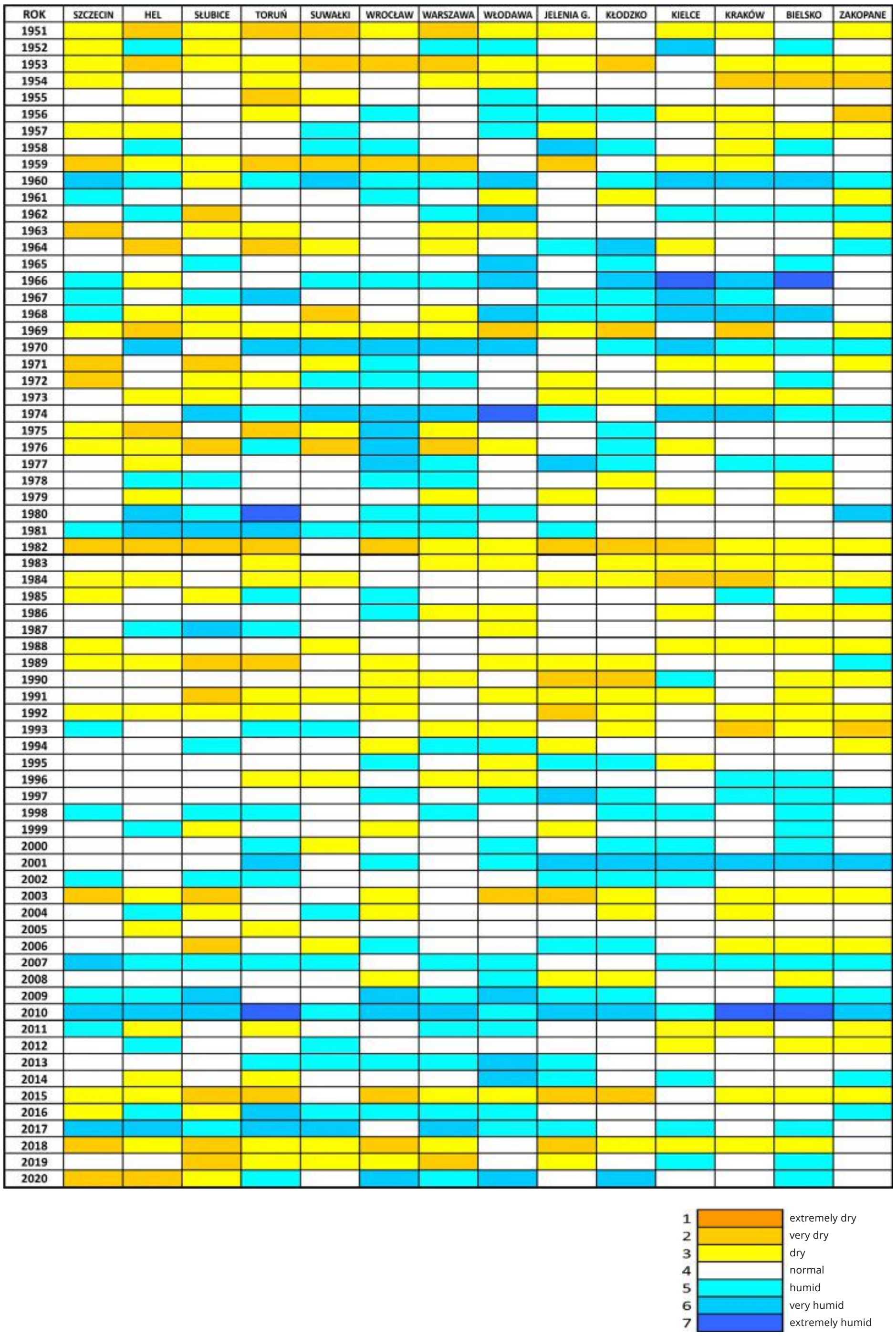
With reference to the spatial variability of precipitation totals in the normal period 1981-2010, above normal precipitation (in the range 110-140% of the norm) occurred in two wedge shaped areas with wider bases in the south of Poland. The first of these wedges covers the eastern part of the Silesian Lowland, the Silesian Upland, and the western parts of the Oświęcim Basin. The second wedge covers the eastern part of The Carpathians and the Sandomierska Basin, the Lublin Upland, the Poleska Lowland, the central and eastern part of the Masovia Lowland, and the southern part of the Podlaska Lowland. Rainfall below the long-term normal (ranging from 80% to 90% of the norm) occurred in 2020 in the area of the South Baltic Coastlands, in the north-western part of the Pomeranian Lakeland, and the western part of the Wielkopolskie Lakeland.





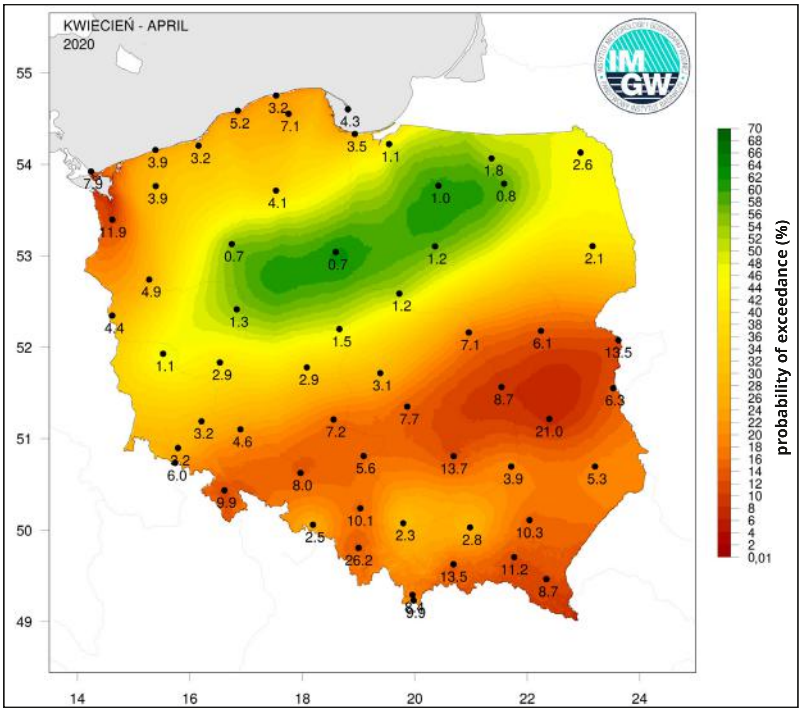
PRECIPITATION
Pluvial conditions classification

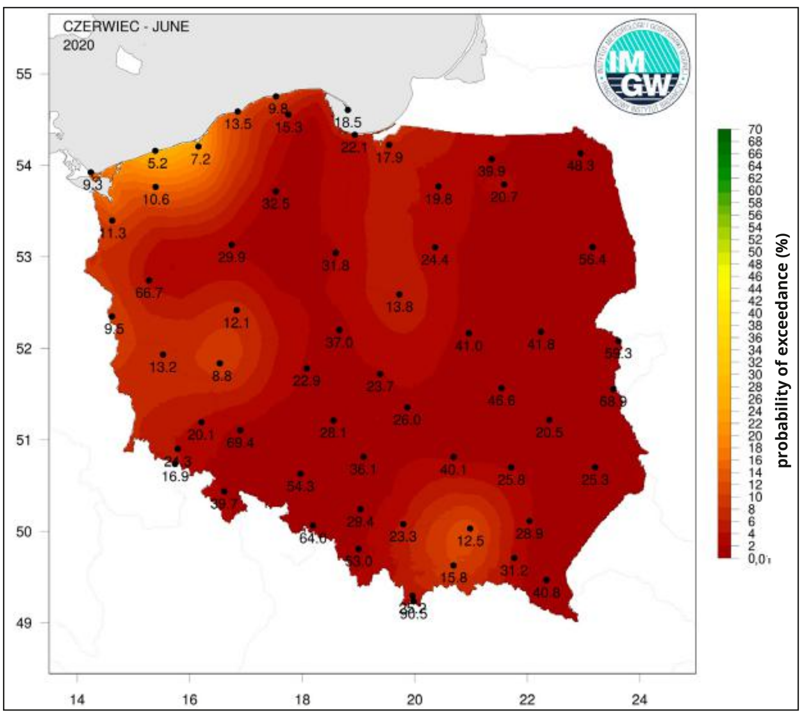
Presentation of the amount of precipitation in a given year as a percentage with reference to the amount of rainfall in the normal period permits the introduction of a classification that allows a descriptive presentation of the pluvial conditions prevailing at a given station or area of interest. Contrary to thermal conditions, precipitation characteristics are characterized by high spatial variability. With reference to the long-term period 1951-2020, we can say that spatial variability of precipitation was significant in 2020. At the same time, we can see that 2020 was another period in which many stations recorded below normal precipitation.



PRECIPITATION
Probabilities of exceedance of the maximum daily precipitation total in April and June 2020

The presented maps of exceedance probability of maximum daily rainfall in April and June 2020 both show the dissimilarity of pluvial conditions in these two months, as well as illustrate the significant deficit of rainfall on a large area of Poland in April and the risk of flooding in June last year.

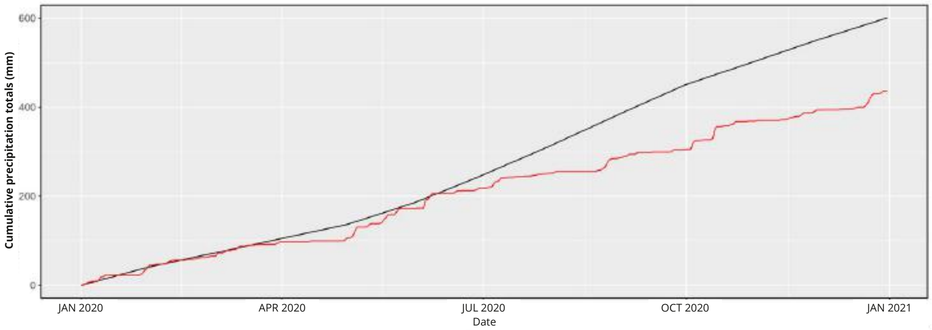




PRECIPITATION
Cumulative precipitation totals and days with precipitation

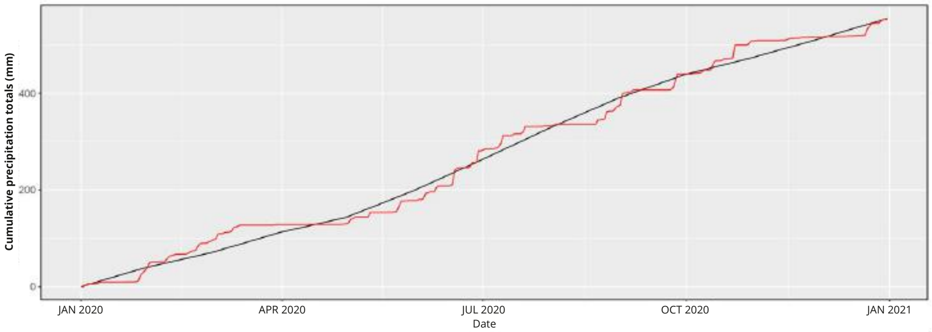
The annual variability of precipitation is presented in the form of cumulative daily precipitation totals with reference to multi-annual normals. This form of presentation makes it easy to identify the period when a deficit or excess of rainfall occurs in relation to a multiannual characteristics. In addition, it identifies periods without precipitation or with very little rainfall as well as cases of heavy rainfall. Data from three measurement stations were used to illustrate the variability of pluvial conditions in Poland in 2020. These are data from Hel, where precipitation was below normal, from Piła, where the rainfall was normal, and from Krosno, where the rainfall was above normal. In the course of the cumulative precipitation totals in the period from the beginning of the year to around the end of April, there is a strong similarity in each station. Precipitation was around normal until mid-March, and then a dry spell lasting over 30 days began. There was an atmospheric drought. After this period, the cumulative precipitation totals in the concerned stations started to differ. You can see the increasing lack of rainfall in Hel, rainfall practically in line with the longterm normals in Piła, and significantly above the normal precipitation in Krosno. In Krosno, two periods of strong precipitation totals increment are also visible, in June and October. As a result, the annual precipitation total in Hel was nearly 27% lower than the longterm 1981-2010 total, and in Krosno, it was almost 33% higher.

HEL – cumulative daily precipitation totals (2020/01/01-2020/12/31) – red line with reference to cumulative multi-annual normals 1981-2010 – red line



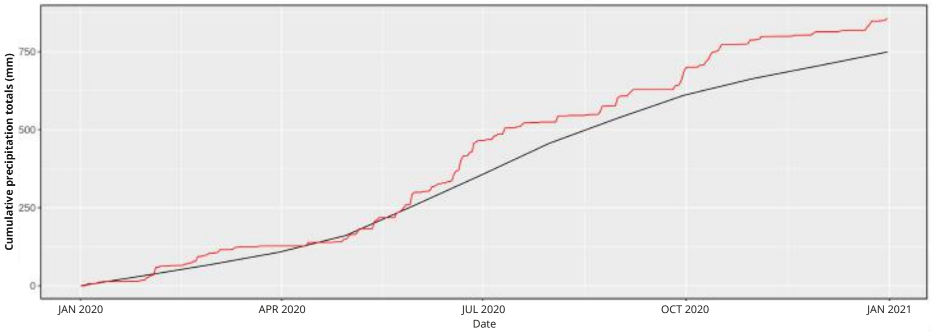
Source: IMGW-PIB: ZBM, KP

Piła – cumulative daily precipitation totals (2020/01/01-2020/12/31) – red line with reference to cumulative multi-annual normals 1981-2010 – red line



Source: IMGW-PIB: ZBM, KP

Krosno – cumulative daily precipitation totals (2020/01/01-2020/12/31) – red line with reference to cumulative multi-annual normals 1981-2010 – red line

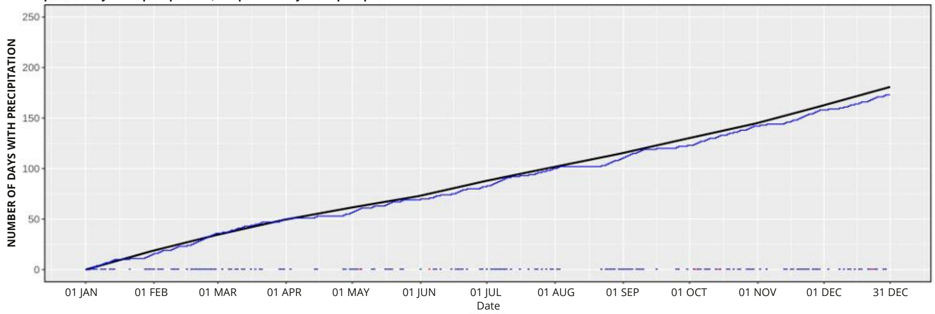


Source: IMGW-PIB: ZBM, KP

A graph showing the variability of the cumulative number of days with precipitation shows that in Hel, the variability of this characteristic was in high compliance with the longterm normals. It can be concluded when combined with a previous analysis regarding the cumulative daily precipitation totals that in Hel, precipitation was about as high as in longterm period, but they were less efficient. In Piła, although there were more than 20 less days with precipitation than in the longterm period, they were slightly more efficient, as the annual total of their was close to the longterm normal.

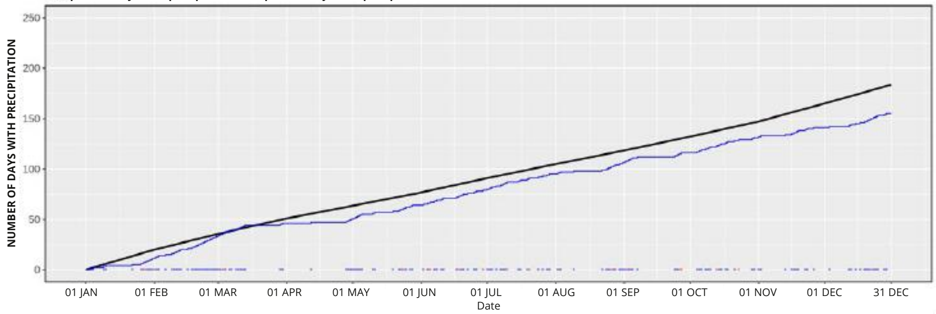
In Krosno, the number of days with precipitation was practically similar to normal. As the precipitation total during the year was significantly above the norm, it means that the precipitation in Krosno was more efficient.

HEL – cumulative number of days with precipitation (daily precipitation total > = 0.1 mm) in 2020 – blue line with reference to the cumulative mean monthly number of days with precipitation in the multi-annual period 1981-2010 – the bold black line blue points – days with precipitation, red points – days with precipitation > 10 mm



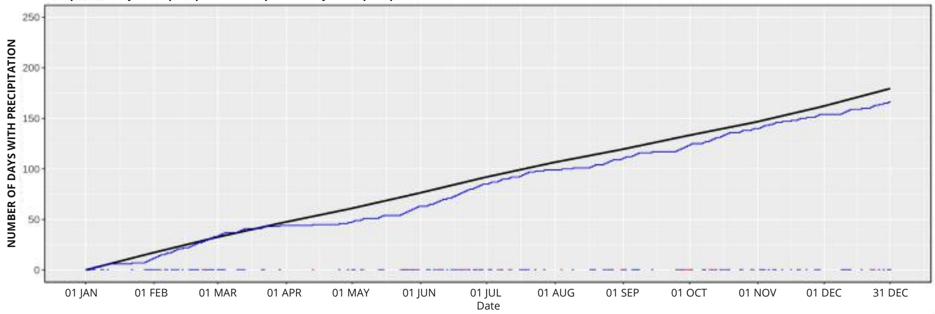
Source: IMGW-PIB: ZBM, KP

PIŁA – cumulative number of days with precipitation (daily precipitation total > = 0.1 mm) in 2020 – blue line with reference to the cumulative mean monthly number of days with precipitation in the multi-annual period 1981-2010 – the bold black line blue points – days with precipitation, red points – days with precipitation > 10 mm



Source: IMGW-PIB: ZBM, KP

KROSNO – cumulative number of days with precipitation (daily precipitation total > = 0.1 mm) in 2020 – blue line with reference to the cumulative mean monthly number of days with precipitation in the multi-annual period 1981-2010 – the bold black line blue points – days with precipitation, red points – days with precipitation > 10 mm



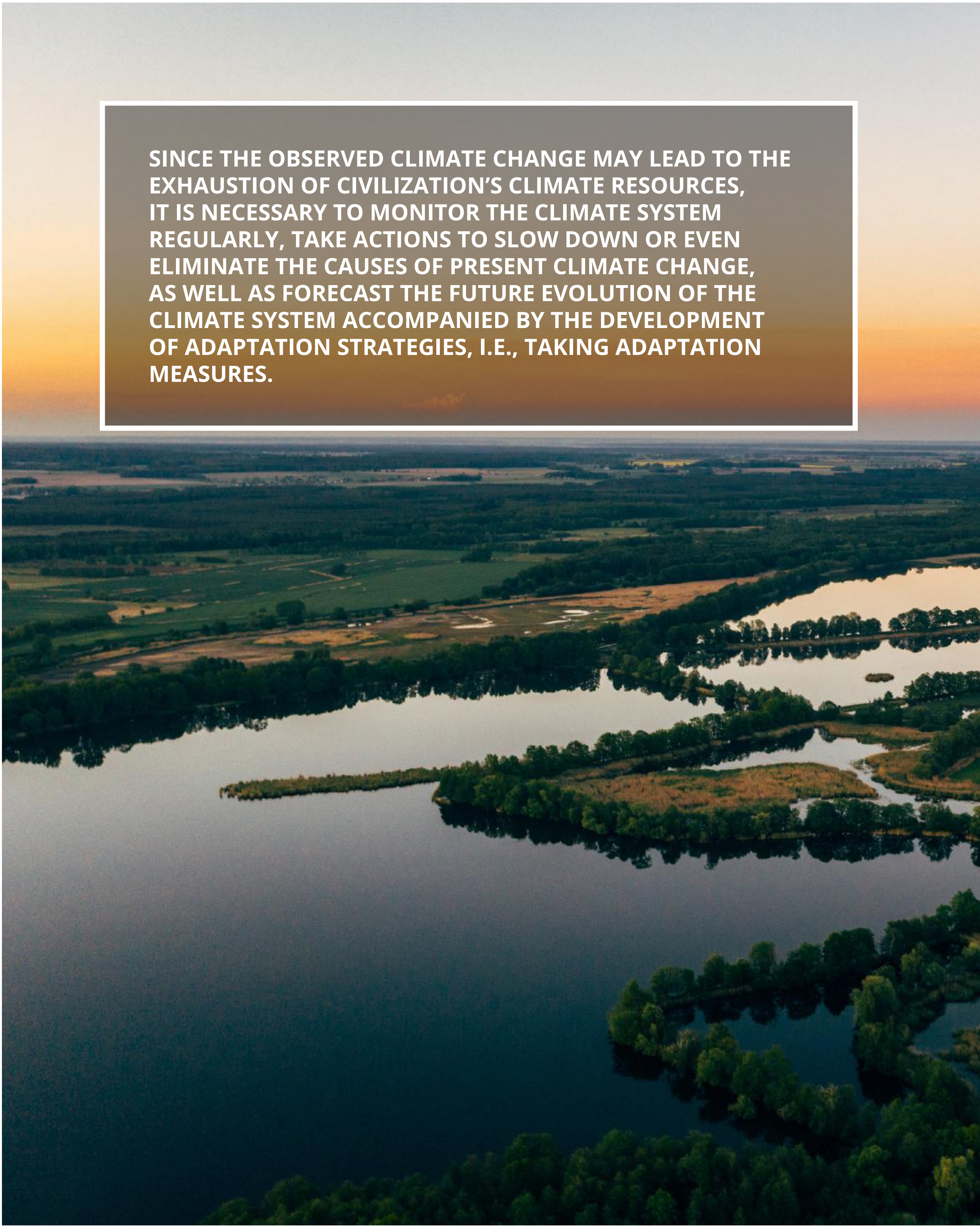
Source: IMGW-PIB: ZBM, KP

PRECIPITATION
Thunderstorms at selected stations

STATION	JUNE			JULY			AUGUST			YEAR
	Thunderstorm	Distant thunderstorm	Total	Thunderstorm	Distant thunderstorm	Total	Thunderstorm	Distant thunderstorm	Total	Razem
GDAŃSK-ŚWIBNO	4	10	14	2	4	6	0	2	2	26
HALA GĄSIENICOWA	4	14	18	4	6	10	1	4	5	38
HEL	0	4	4	0	5	5	1	2	3	15
JELENIA GÓRA	6	5	11	4	13	17	1	8	9	41
KASPROWY WIERCH	4	18	22	1	10	11	3	7	10	53
KIELCE-SUKÓW	12	21	33	0	10	10	3	18	21	83
KŁODZKO	6	24	30	4	15	19	3	14	17	75
KOZIENICE	13	34	47	6	16	22	8	18	26	111
KRAKÓW-BALICE	17	19	36	6	8	14	9	9	18	76
KROSNO	25	45	70	8	20	28	2	16	18	157
LEGNICA	2	5	7	5	12	17	1	4	5	35
LUBLIN-RADAWIEC	13	43	56	2	10	12	3	17	20	118
ŁEBA	0	3	3	2	12	14	0	4	4	27
ŁÓDŹ-LUBLINEK	9	10	19	4	10	14	5	11	16	60
OPOLE	9	24	33	3	13	16	1	8	9	63
PIŁA	2	12	14	1	7	8	0	5	5	32
POZNAŃ-ŁAWICA	5	5	10	7	5	12	5	2	7	32
RZESZÓW-JASIONKA	11	32	43	2	5	7	1	7	8	85
SUWAŁKI	3	19	22	0	2	2	0	4	4	33
SZCZECIN	3	1	4	0	4	4	3	9	12	21
ŚNIEŻKA	4	10	14	0	3	3	7	1	8	33
TORUŃ	2	12	14	2	11	13	2	8	10	41
WARSAW-OKĘCIE	13	19	32	7	7	14	6	5	11	76
WROCŁAW--STRACHOWICE	6	15	21	6	12	18	3	5	8	55
ZAKOPANE	3	23	26	2	12	14	2	12	14	78
ZAMOŚĆ	9	27	36	4	11	15	5	9	14	77
ZIELONA GÓRA	3	10	13	13	29	42	3	9	12	77
TOTAL	**367**	**976**	**1343**	**186**	**547**	**733**	**131**	**458**	**589**	**3234**

Thunderstorm is a dangerous phenomenon. The thunderstorm season in Poland culminates in the summer, from June to August. The number of thunderstorms at selected stations goes in hand with the precipitation. For earlier discussed precipitation in Hel, Piła, and Krosno – the number of thunderstorms throughout 2020 were: 15, 32 and 157, respectively. Krosno was the place where the most storms were recorded last year, and Hel the place with the lowest recorded cases of this phenomenon.

SINCE THE OBSERVED CLIMATE CHANGE MAY LEAD TO THE EXHAUSTION OF CIVILIZATION’S CLIMATE RESOURCES, IT IS NECESSARY TO MONITOR THE CLIMATE SYSTEM REGULARLY, TAKE ACTIONS TO SLOW DOWN OR EVEN ELIMINATE THE CAUSES OF PRESENT CLIMATE CHANGE, AS WELL AS FORECAST THE FUTURE EVOLUTION OF THE CLIMATE SYSTEM ACCOMPANIED BY THE DEVELOPMENT OF ADAPTATION STRATEGIES, I.E., TAKING ADAPTATION MEASURES.

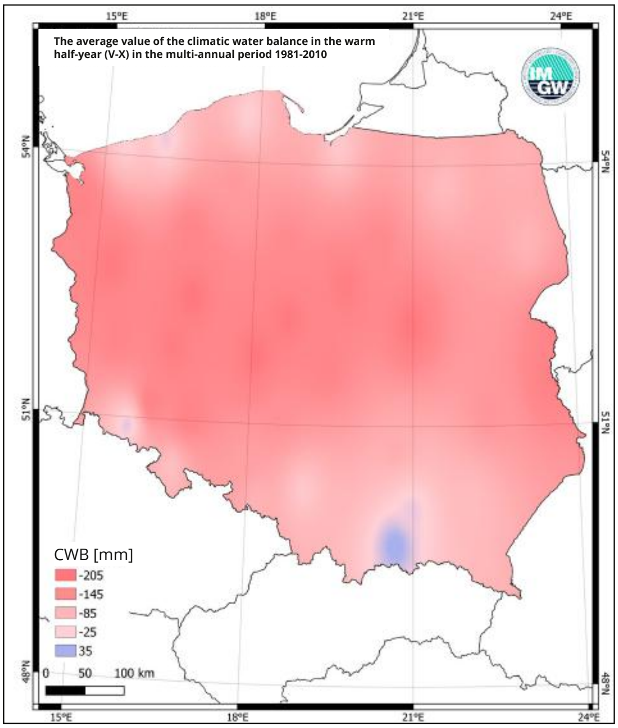


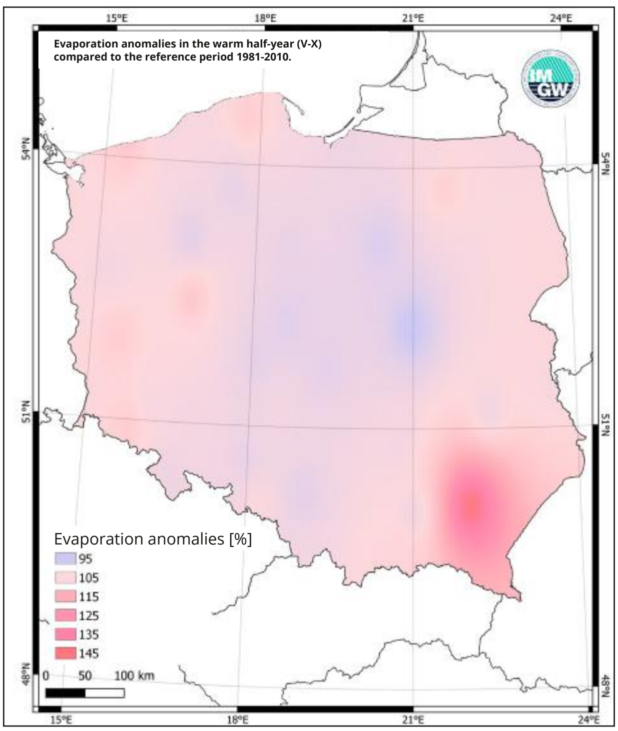
CLIMATIC WATER BALANCE – warm half-year

The climatic water balance (CWB) is the difference between the precipitation, i.e. precipitation total, and evapotranspitation, which can be determined based on measurements or using empirical formulas. Positive CWB value means that there was more precipitation than evaporation during the analysed period. In the case of negative CWB value, it is the opposite, evaporation prevails over precipitation.

From the economic point of view, information on CWB in the warm season, i.e., in the period when there is a high demand for water in such important sectors of the economy as agriculture, is of great significance. The evaporation values are high, they range between 475 mm to 750 mm, which is between 119% and 188% of the amount of precipitation.

Despite the relatively high rainfall in the warm half of the year (398.6 mm, which is 62% of the annual depth), positive CWB values were generally present in the western part of the Silesian Lowland, in the Silesian Upland, in the western part of the Sandomierska Valley and the western part of the Małopolska Upland.





Atmospheric circulation is one of the most important weather and climate factors. Because of atmosphere circulation, the weather in Poland changes from day to day, and even several times a day. There are many methods describing atmospheric circulation. One of the most popular is characterizing it by indicating the direction of advection of air masses over the area of interest and by defining the nature of the air movement (whether it is cyclonic or anti-cyclonic). In a given season of the year, these parameters determine the thermal and humidity characteristics of flowing air masses over the studied area.

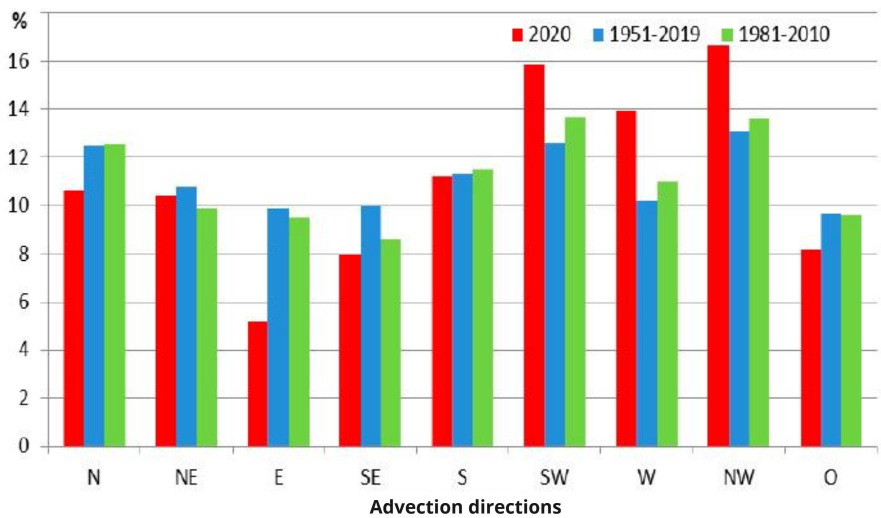
ATMOSPHERIC CIRCULATION
Indices and surface wind

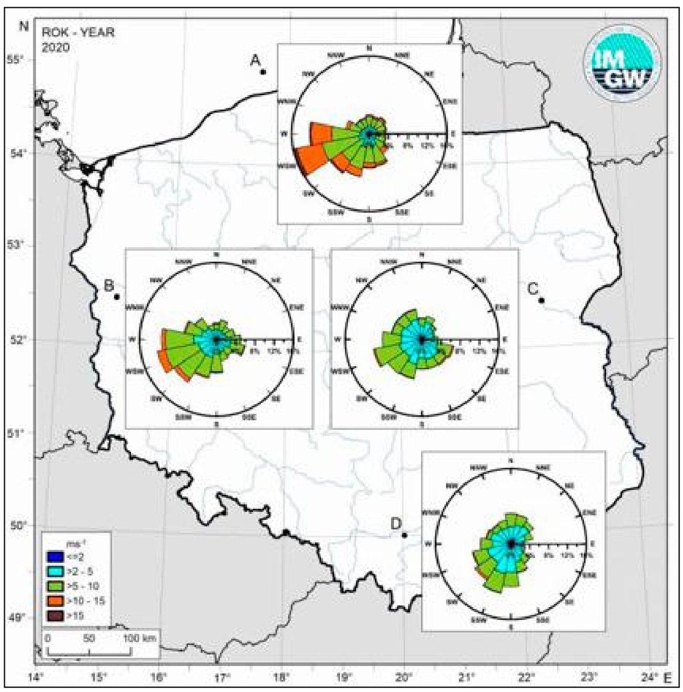
day \ month	I	I	II	III	IV	V	VI	VII	VIII	IX	XI	XII
1	NWa	SWc	SWc	NWa	Sc	NEa	Wc	Na	NEo	SEc	SWo	Oa
2	Wa	NWc	SWc	Wc	Oc	NEo	Wc	Oo	SEo	SEc	SWo	Sa
3	NWo	NWc	Sc	NWc	No	Ec	Wo	Wc	Sa	SEc	Wa	So
4	NWo	Nc	SEc	Oa	Na	Sc	Wa	Sc	Wa	SEc	NWa	SEc
5	Na	Na	Sc	SEa	No	SWc	Wc	Sa	Wo	Sc	NWa	SEc
6	Wa	No	Oc	Sa	No	SWc	NWc	SEa	NWo	Sc	NWa	SEo
7	SWa	Na	Oc	Wa	NWa	SWc	NWa	SEa	SWa	SWc	Wa	SEo
8	Wa	SWa	SWa	Wa	NWo	NEc	NWo	Ea	Wa	Wa	Na	SEo
9	Wo	SWo	Wo	NWa	Wo	NEo	Wa	NEa	NWa	Wo	Oa	SEo
10	NWo	SWc	Wc	Na	Oc	NEc	SWc	NEa	NWa	No	Ea	SEc
11	Wa	NWc	Wc	Oa	NWc	NEc	NWa	Ea	SWa	NEo	Sa	SEc
12	Wo	NWc	NWc	SWa	NWo	SEc	Na	Ea	SWo	NEo	Sa	SEc
13	Wo	Wo	NWc	NWc	Wo	Eo	Na	Oa	NWa	NEc	Sa	SEo
14	SWo	Oo	NWa	NWa	NWo	Eo	Oa	Oo	Na	NEc	Sa	SEo
15	SWo	SWa	SWa	NWa	NWo	NEo	Oo	Oa	Oa	NEc	SWo	So
16	Wa	SWo	Wa	NWo	NWa	Eo	No	NEa	NEo	NEo	SWo	Sa
17	SWa	SWo	Wa	Na	NWa	Ec	Oa	Oc	NEa	No	SWa	Sa
18	Wa	NWo	Wa	Na	NWa	Ec	Sa	Oc	Na	NWc	SWa	Sa
19	Na	NWo	NWa	NEa	No	NEc	Oa	Sc	Na	Na	NWo	SWa
20	NWa	SWa	NEa	NEa	NEa	Ec	No	So	Oa	Sa	Na	SWa
21	NWa	SWo	NEa	Ea	NEa	Eo	NWa	So	Wo	SWo	SWa	SWa
22	Na	SWo	Ea	NEa	Sa	No	NWa	SWc	SWo	SWo	Wo	SWc
23	NWa	NWc	Sa	Na	SWa	NEa	NWa	NWo	SWc	Wc	NWa	Wo
24	NWo	NWo	Sa	Nc	Wa	SEa	Wc	NWo	SWc	Wo	Wa	Nc
25	NWo	Wc	Oa	NWc	Na	SEa	So	SWc	Oc	SWo	SWa	No
26	SWo	NWc	SEa	Nc	NEa	Sa	So	NWc	Ec	SWc	Wo	Oo
27	SWo	Wc	Ea	Oc	Na	Sc	Sa	Nc	SEc	SWc	Oo	SWc
28	SWc	NWc	NEo	Oc	NEa	Sc	Sc	Ec	SEo	SWo	SEa	Sc
29	Wc	SWc	NEo	Oc	NEa	SWc	Wa	SEc	Ec	Wc	Ea	Sc
30	Wc		NEa	Sc	NEa	Wc	NWa	Nc	SEc	Oo	Oa	Sc
31	SWc		Na		NEo		NEa	NEc		Sa		Sc

Group of types	Symbols
north	Nc, No, Na
north-east	NEc, NEo, NEa
north-west	NWc, NWo, NWa
south	Sc, So, Sa
south-east	SEc, SEo, SEa
south-west	SWc, SWo, SWa
west	Wc, Wo, Wa
east	Ec, Eo, Ea
zero	Oc, Oo, Oa

The circulation index's calendar indicates that air masses coming from the west were prevailing (from SW to NW) in 2020. Their total share was nearly 47%. Relative to the normal period, the frequency of western air masses advection was almost 8% higher than in the longterm period 1981-2010 and nearly by the same amount greater than in the period from 1951. There was a significant share of air masses advection from the northern sectors (from NW to NE). It was 38%.

The frequency of advection from the south (SE to SW) was close to 35%. This characteristic of the flow direction of air masses is reflected in the wind directional structure at the surface.

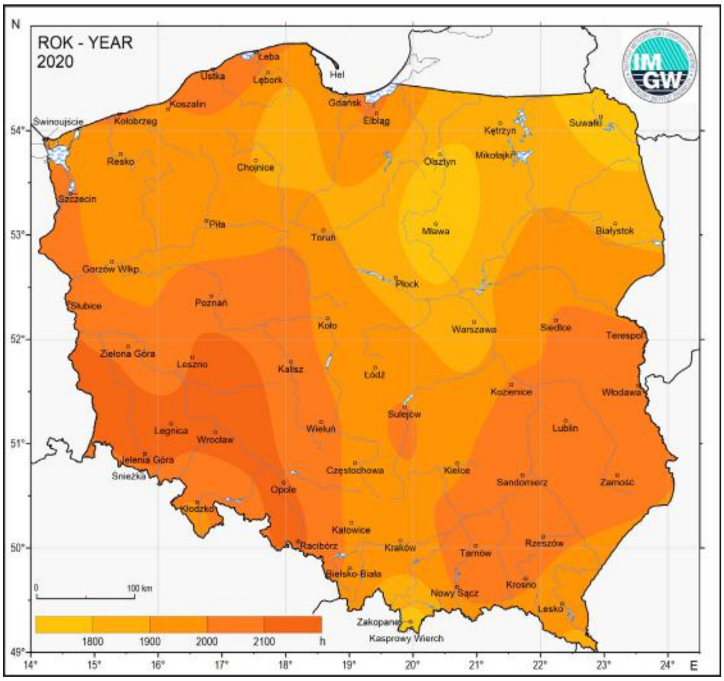


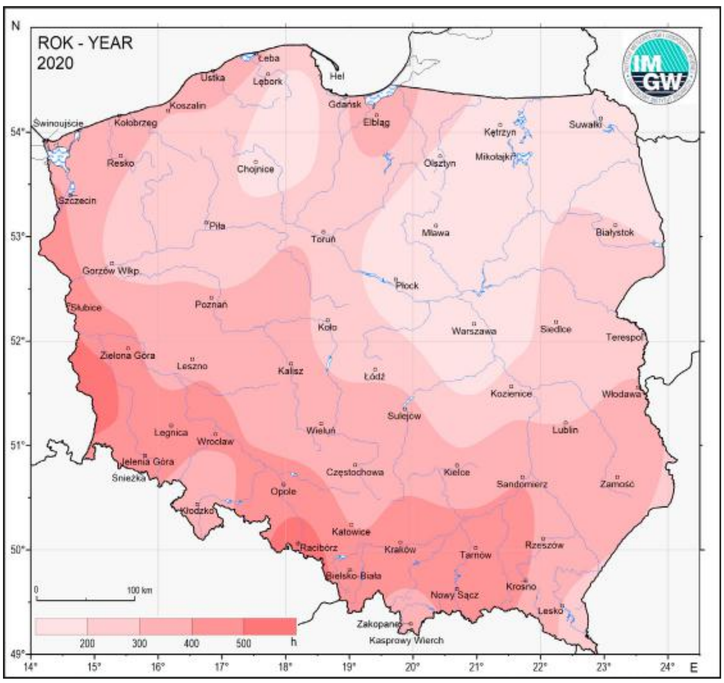


SUNSHINE DURATION

Sunshine duration, or the length of time when the solar disk is visible, depends on the location, topography and cloud cover – both the amount of cloud coverage and the cloud genera in the area concerned. Relative sunshine duration, that is the ratio of effective sunshine duration to the maximum possible, determined by the length of the day (i.e., from sunrise to sunset) in the area of northeast Poland was 35%, and in the rest of the country it reached 46-48%.

The annual total of sunshine duration in Poland was between 1700 and 2200 hours and was higher than the climatological normal from 100 up to 600 hours. The sun shone the longest over the southwest and south-eastern Poland and in the vicinity of the Central Coast.





THE INSTITUTE OF METEOROLOGY AND WATER MANAGEMENT – NATIONAL RESEARCH INSTITUTE HAS BEEN MONITORING POLAND'S CLIMATE FOR OVER 100 YEARS ON AN ONGOING BASIS, CONDUCTING OBSERVATIONS AND MEASUREMENTS OF ALL RELEVANT CLIMATIC VARIABLES. WE INFORM THE SOCIETY AND PUBLIC ADMINISTRATION ABOUT THE CLIMATE SYSTEM CONDITION AND THE THREATS RESULTING FROM CLIMATE VARIABILITY AND CHANGE. WE ARE THE NATIONAL SERVICE, THE MEANING OF WHICH WAS WELL UNDERSTOOD BY THE FATHERS OF INDEPENDENT POLAND, INCLUDING THE FIRST PRESIDENT OF THE REPUBLIC OF POLAND, GABRIEL NARUTOWICZ.

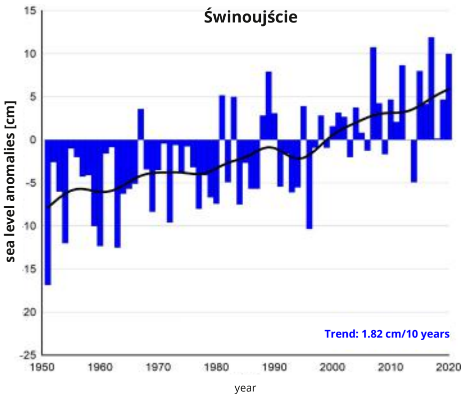
SEA LEVEL

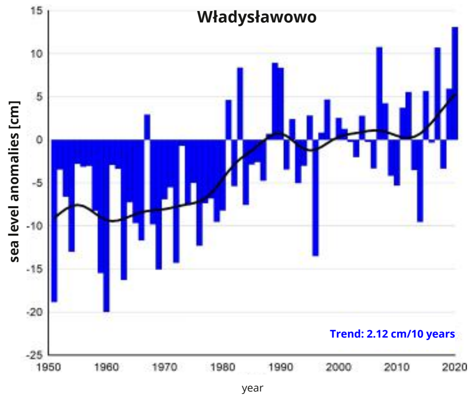
The sea level in the southern Baltic region is steadily increasing, which is the result of the increase of temperature on a global scale and domination of the western zonal circulation of the atmosphere in the Baltic area. The rate of sea increase varies. It is higher in the eastern part of the coast (mean sea level increase by nearly 13 cm in Świnoujście and by nearly 15 cm in Władysławowo).

This variability is a consequence of the above-mentioned dominance of western zonal circulation which causes maintenance of constant inclination of the Baltic sea surface increasing from western to east coast.

The sea level on the water gauge in Świnoujście in 2020 was never below the average low water SNW (416 cm), and only once it was above the warning level (560 cm) and once above the alarm level (580 cm). In the eastern part of the Polish coast, the sea level on the water gauge in Władysławowo in 2020 never reached the value below the mean low water (448 cm), 18 times was above the warning level (551 cm), and 3 times above the alarm level (570 cm).

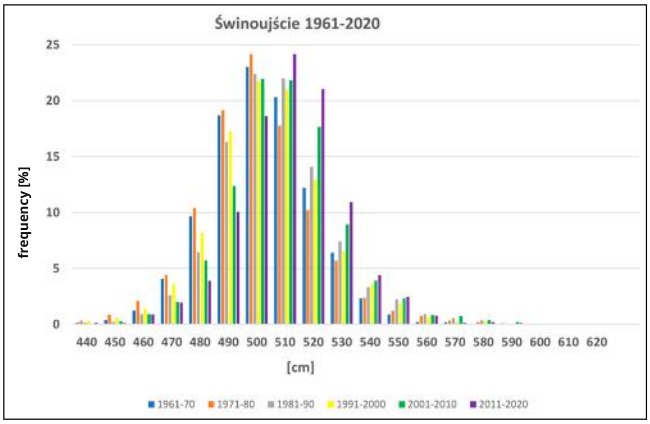
The change in the frequency of sea levels from a low range of values, below the so-called medium level, visibly stands-out from decade to decade. Both, in the western and eastern part of the coast, we can observe a decrease in the number of low levels (especially in Świnoujście). At the same time, we can observe an increasing trend in the number of cases of higher than mean levels, particularly the alarm levels from decade to decade.

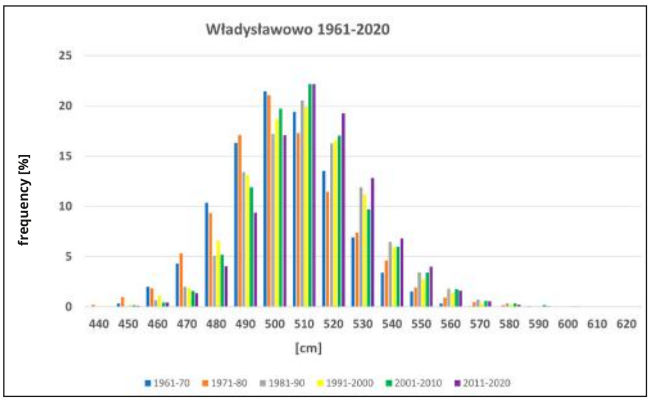




Świnoujście	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2020
below SNW [%]	0.000	0.028	0.000	0.027	0.000	0.082
above the alarm level [%]	0.137	0.386	0.084	0.055	0.493	0.520

Władysławowo	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2020
below SNW [%]	0.082	0.547	0.027	0.109	0.055	0.082
above the alarm level [%]	0.110	0.164	0.467	0.328	0.549	0.411





EXTREMES

VARIABLE			VARIABLE	DATE	STATION
TEMPERATURE*	(T°C)	max	35.3	08.08.2020	Słubice
		min	-13.0	25.03.2020	Zakopane
		min 5 cm**	-20.6	25.03.2020	Zakopane
PRECIPITATION	(RR mm)	Σ max 24 h	90.5	22.06.2020	Kasprowy Wierch
		Σ max	1809.9		Kasprowy Wierch
		Σ min	410.2		Szczecin
SUNSHINE DURATION	(U h)	Σ max 24 h	17.0	27.06.2020	Wieluń
		Σ max	2202.7		Jelenia Góra
		Σ min	1585.2		Mława

* temperature value without high mountain stations (Śnieżka and Kasprowy Wierch)

** temperature at a height of 5 cm above ground level

SUMMARY OF EXTREME WEATHER AND CLIMATE EVENTS IN POLAND IN 2020

OBSERVED EXTREME WEATHER OR CLIMATE EVENT	Event Start	Event End	Duration	Location/Area
Heat wave	2020–01–01	2020–01–31	31 days	Entire country: 52°03'N, 19°27'E
Heat wave	2020–02–01	2020–02–29	29 days	Entire country: 52°03'N, 19°27'E
Wind	2020–02–10	2020–02–11	2 days	Entire country: 52°03'N, 19°27'E (Especially south part)
Wind	2020–02–23	2020–02–24	2 days	Entire country: 52°03'N, 19°27'E (Especially south part)
Storm wave /coastal flood	2020–03–12	2020–03–13	2 days	Baltic Sea Coast: 54°10'N, 15°34'E
Drought/ dry period	2020–04–01	2020–04–30	30 days	Entire country: 52°03'N, 19°27'E
Rain/rainy period	2020–04–29	2020–04–29	1 day	Świdaysk (51°13'N, 22°41'E): Lubelskie voivodeship
Cold wave	2020–05–01	2020–05–31	31 days	Entire country: 52°03'N, 19°27'E
Rain/rainy period	2020–05–01	2020–05–31	31 days	South and south east part of the country
Frost	2020–05–12	2020–05–13	2 days	Entire country: 52°03'N, 19°27'E
Tornado	2020–06–07	2020–06–07	few minutes	Kaniów (49°56'N 19°03'E) – Silesian voivodeship
Rain/rainy period	2020–06–08	2020–06–08	1 day	Strzyżów (49°52'N 21°47'E) – Podkarpackie voivodeship
Rain/rainy period	2020–06–11	2020–06–11	1 day	Tenczyn (49°44'N 19°53'E) – Małopolska voivodeship
Rain/rainy period	2020–06–21	2020–06–21	1 day	Łapanów (49°52'N 20°17'E) – Małopolska voivodeship
Rain/rainy period	2020–06–21	2020–06–22	2 days	South part of the country
Hail	2020–06–26	2020–06–26	1 day	Jerzmanowice-Przeginia (50°12'N 19°45'E) – Małopolska voivodeship
Rain/rainy period	2020–06–26	2020–06–26	1 day	Zlewnia rzeki Mleczka – Podkarpackie voivodeship
Rain/rainy period	2020–06–27	2020–06–27	5 hours	Jasło (49°44'N 21°28'E) – Podkarpackie voivodeship
Rain/rainy period	2020–06–29	2020–06–29	1 day	Central part of the country
Hail	2020–07–10	2020–07–10	1 day	Gorzów Wielkopolski (52°44'N 15°14'E) – Lubuskie voivodeship
Tornado	2020–07–10	2020–07–10	few minutes	Ustronie Morskie (54°13'N 15°45'E) – West Pomeranian voivodeship
Rain/rainy period	2020–07–16	2020–07–16	few hours	Ciechanowiec (52°41'N 22°30'E) – Podlaskie voivodeship
Rain/rainy period	2020–07–18	2020–07–18	few hours	Dobczyce (49°53'N 20°06'E) – Małopolska voivodeship
Rain/rainy period	2020–07–19	2020–07–19	70 minutes	Starachowice (51°02'N 21°04'E) – Świętokrzyskie voivodeship
Heat wave	2020–08–07	2020–08–13	7 days	Entire country 52°03'N, 19°27'E Especially west, central and south part of the country
Rain/rainy period	2020–08–18	2020–08–19	2 days	West and south part of the country
Rain/rainy period	2020–08–31	2020–08–31	1 day	Central and south east part of the country
Rain/rainy period	2020–09–01	2020–09–01	1 day	Almost entire country – especially south west area
Heat wave	2020–09–14	2020–09–16	3 days	Entire country: 52°03'N, 19°27'E Especially west, central and south part of the country
Thunderstorm/squall line	2020–10–05	2020–10–05	1 day	South, east and central part of the country
Rain/rainy period	2020–10–12	2020–10–14	3 days	Entire country: 52°03'N, 19°27'E (especially central and south part of the country)
Drought/ dry period	2020–11–01	2020–11–30	30 days	Entire country: 52°03'N, 19°27'E
Heat wave	2020–11–01	2020–11–30	30 days	Seashore and the Lake District (the area of Masurian lakes)
Freezing rain	2020–12–10	2020–12–10	1 day	South part of the country (Podkarpackie voivodeship)
Wind	2020–12–27	2020–12–28	2 days	South part of the country (the Tatras area)

PHYSICAL CHARACTERISTICS OF EVENT	
Rarity	**Desciption of event**
Unusual	A very warm month in across the country; no permanent snow cover in most of the country. Daily maximum temperature exceeded 0°C every day at some meteorological stations (Meteorological Station – Rzeszów-Jasionka WMO 12580)
Unusual	A extremely warm month across the country; there was no snow cover in the western part of the country and on the Baltic Sea Coast
Unusual	Storm Sabine, also known as Ciara hit the country with winds of up to 100 km/h
Unusual	Strong wind caused by the movement of the Low Yulia, locally wind speed exceeds 110km/h
Unusual	Strong wind across the Baltic Sea Coast with a wind speed of 120 km/h (Meteorological Station – Rozewie)
Unusual	Monthly precipitation total did not exceed 10 mm in many stations in the country; the water level on the Vistula River dropped below 50 cm
Unusual	Thunderstorm with heavy rain and hail
Unprecedented	An extremely cold month across the country; the coldest May in the XXI century in Poland
Unprecedented	In many meteorological stations, monthly precipitation total exceeds 200 mm
Unusual	In many meteorological stations, daily minimum air temperature was below 0°C; there was a record height of snow cover at the meteorological stations located in the north-eastern part of the country (Kętrzyn WMO 12185 – 8 cm, Suwałki WMO 12195 – 8 cm)
Unprecedented	Supercell track from SW to NE across the Silesian Voivodeship
Unusual	Flash flood, caused by a strong storm with the heavy rainfall and hail – 45 mm /30 min (Rain GRS – product of the IMGW-PIB)
Unusual	Flash flood caused by quasi-stationary storm with the heavy rainfall (Meteorological Station Lubien – daily precipitation total exceeds 50 mm)
Unprecedented	Flash flood caused by quasi-stationary storm with the heavy rainfall (Meteorological Station Jodlownik – daily precipitation total exceeds 150 mm)
Unprecedented	Many flash floods caused by quasi-stationary storms with the heavy rainfall (three days precipitation total locally 100 on many meteorological stations)
Unprecedented	Thunderstorm with heavy rainfall and very strong heavy hailstorm
Unprecedented	Flash flood caused by few storms with heavy rainfall – daily precipitation total exceeds 100 mm (RainGRS – product of the IMGW-PIB)
Unprecedented	Flash flood caused by training storms with heavy rainfall (Meteorological Station Jaslo – 10 minutes precipitation total exceeds 20 mm and daily precipitation total exceeds 100 mm – the highest daily total since 1972)
Unprecedented	Thunderstorms with heavy rainfall and precipitation total exceeds 15mm/10 min (Meteorological Station Sielec); locally observed condensation funnel (Krakow city)
Unprecedented	Thunderstorms with hail (> 5 cm diameter) and heavy precipitation (13.7 mm/10minutes) Gorzów Wielkopolski (WMO12300)
unusual	Supercell track from SW to E/NE across the Baltic Sea Coast with heavy rainfall, hail, and very strong wind
Unprecedented	Thunderstorm with heavy rainfall – daily precipitation total exceeds locally 100 mm (RainGRS – product of the IMG-PIB)
Unprecedented	Thunderstorm with heavy rainfall (Meteorological Station Dobczyce – daily precipitation total exceeds 50 mm)
Unprecedented	Quasi-stationary thunderstorm with heavy rainfall (Meteorological Station Starachowice – 70-minutes precipitation total exceeds 40 mm, 30-minutes precipitation total exceeds 27 mm)
Unusual	A very warm period of 7 days with daily maximum air temperature exceeds 30°C (e.g. Słubice – WMO 12310, Zielona Góra – WMO 12400, Gorzów Wielkopolski – WMO 12300
Unusual	Active occluded front with intensive rainfall and storms (e.g. Meteorological Station Ustroń-Równica – daily precipitation total exceeds 90 mm)
Unusual	Active cold front with mesoscale convective system with bow echo (a characteristic radar image of an arc-shaped mesoscale convective system. Such a system can produce heavy winds, and sometimes tornadoes) (e.g. Meteorological Station Warsaw Bielany – precipitation 22 mm/10 min, wind velocity – 95 km / h)
Unusual	Movement of the warm front across the country with intensive rainfall (e.g. Meteorological Station Walim – daily precipitation total exceeds 58 mm)
Unprecedented	A very warm period of 3 days with the daily maximum air temperature exceeds 30°C (e.g. Meteorological Station Świebodzin – 31.3°C)
Unusual	Very strong thunderstorms formed on the line of convergence, locally with squall lines and heavy rainfall (e.g. Meteorological Station Ostrołęka – precipitation total 12.6 mm/10 minutes and gust wind 85 km/h)
Unusual	A low-pressure system along the Balkans moved over Poland with intensive rainfall; alarm and warning states exceeded on 30 rivers in the southern part of the country; on many meteorological stations daily precipitation total exceeds 70 mm (e.g. Meteorological Station Lądek Zdrój – 88.5 mm, Boguszów – 77.8 mm, Głuchołazy – 78.7 mm)
Unusual	Dry month across the country, particularly north, west, and central parts of the country; monthly precipitation total did not exceed 10 mm in many meteorological stations (e.g. Meteorological Station Szczecinek – 1 mm)
Unusual	Extremely warm month in the north part of the country; mean monthly temperature exceeds 6°C
Unusual	Freezing rain caused by occluded front movement from south east to the north east part of the country; icy road and sidewalk
Unprecedented	Very strong wind called "Halny" in the mountain and foothill areas of the Tatra range (e.g. Meteorological Station Kasprowy Wierch – wind speed exceeds 170 km/h

CLIMATE DATA: **https://klimat.imgw.pl/**

WEATHER SERVICE: **https://meteo.imgw.pl/**

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WE RECOMMEND AND INVITE YOU TO DOWNLOAD THE APPLICATION FOR MOBILE DEVICES: **http://aplikacjameteo.imgw.pl/**

ADDITIONAL SERVICES:

IMGW-PIB website: **https://www.imgw.pl/**

Mobile application (Android): **http://aplikacjameteo.imgw.pl/**

Weather widget: **http://widgetmeteo.imgw.pl/**

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Hydro data: **https://hydro.imgw.pl/**

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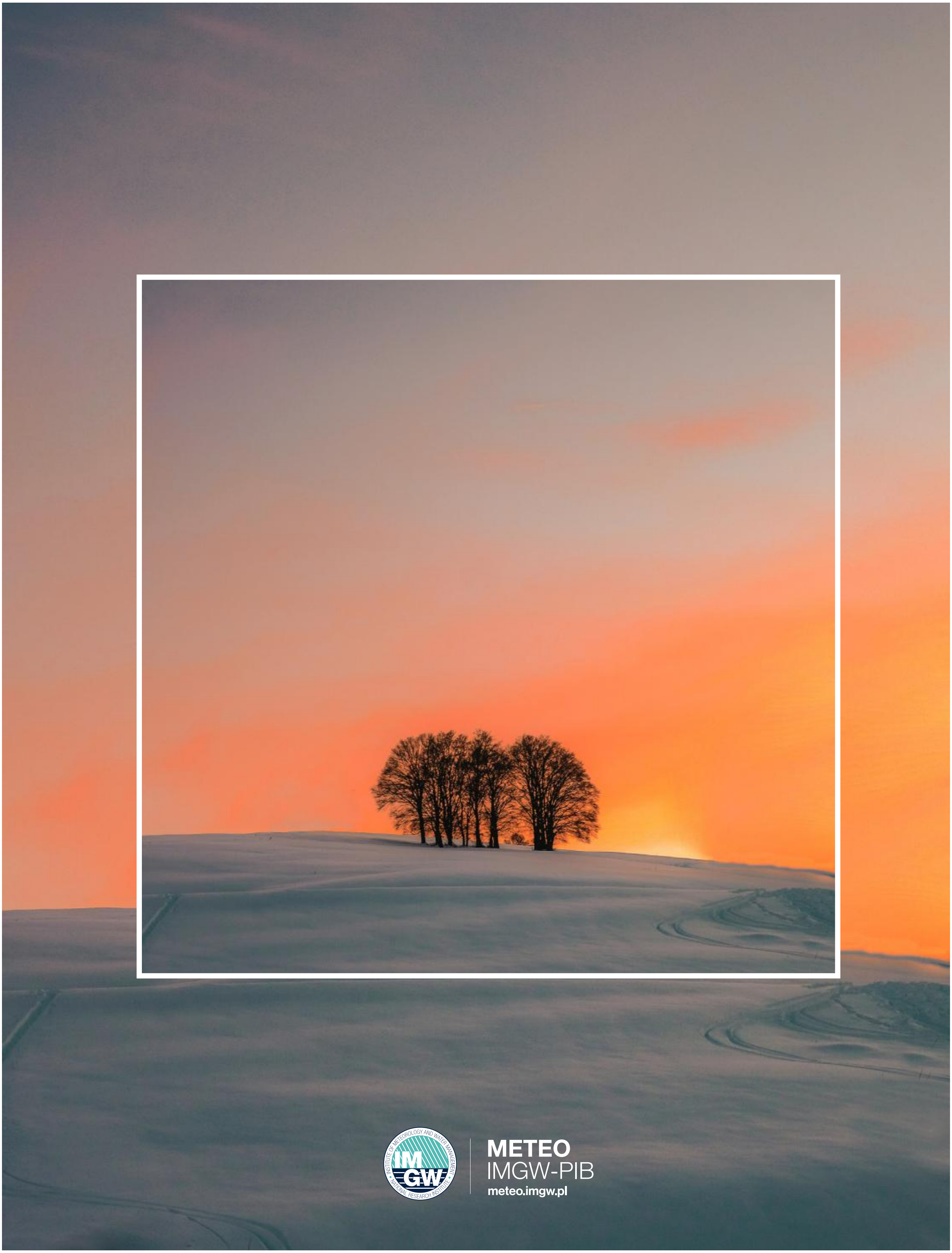
Biometeo data: **https://biometeo.imgw.pl/**

We represent Poland in the World Meteorological Organization (WMO)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