Interreg
Danube Region

Co-funded by
the European Union

Be Ready

Urban heat islands vulnerability and risk assessment

Ratiboř, Czech Republic

Specific objective 1	Provide assessment and operational instruments to cities to better understand UHI drivers & effects
Activity 1.3.	Testing the methodology and tools: conducting vulnerability and UHI risk assessments in the partner cities
Deliverable 1.3.1	City reports from UHI risk assessment
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Place and date	Ratiboř, February 2025

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History

Version	Author(s)	Status	Comment	Date
01	As above	1.		February 2025

Version: 03

Status: Final

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List of Abbreviations

AR – Assessment Report
AUHI – Atmospheric Urban Heat Island
ASP – Adaptive Social Protection
BCR – Building Coverage Ratio
CCKP – Climate Change Knowledge Portal
ČHMU – Český hydrometeorologický ústav (Czech Hydrometeorological Institute)
EU – European Union
FAR – Floor Area Ratio
GDP – Gross Domestic Product
GIS – Geographic Information System
IPCC – Intergovernmental Panel on Climate Change
STUBA – Slovak University of Technology in Bratislava
SUHI – Surface Urban Heat Island
UHI – Urban Heat Island
VI – Vulnerability Index

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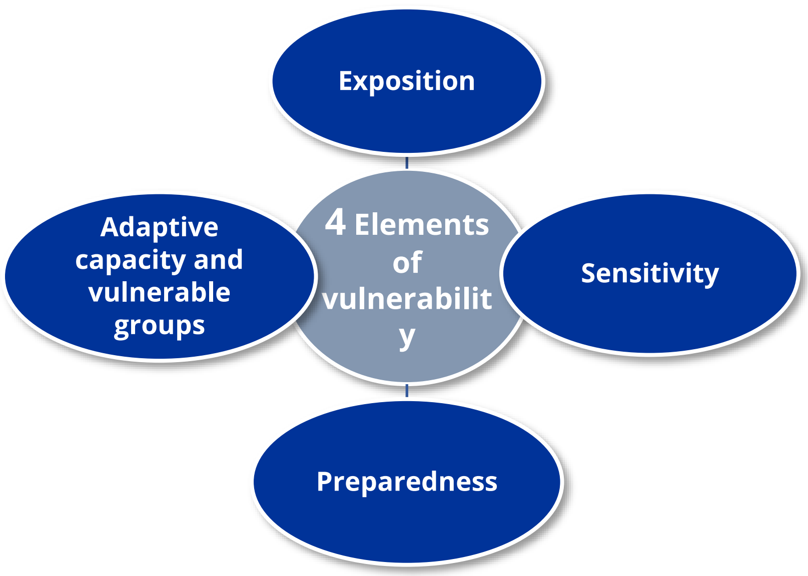
1. Introduction

ABOUT THE PROJECT

Urban heat islands (UHI) are the common challenge of the project that 19 partners and 9 ASPs from 12 countries will tackle with the aim to strengthen the preparedness and adaptive capacity of the society to cope with impacts of climate change and foster resilience at city level. The project approach will allow partners, to take targeted, small powerful, context-based measures to deal with UHI in critical urban areas. City pilots will test solutions in three areas: “green acupuncture” (vegetation-based interventions); “white acupuncture” (based on innovative surfaces and materials); and “blue acupuncture” (novel uses of water resources). The approach of jointly developing, testing and evaluating solutions contributes to most effective use of shared expertise for better understanding the effects of UHI in and building institutional capacity at local/regional level, for policy development and practical interventions.

ABOUT THE REPORT

The main aim of the document Deliverable 1.3.1 City reports from UHI risk assessment is to test the join methodology and tools developed for 4 vulnerability elements (figure 1): exposure, sensitivity, preparedness and adaptive capacity and risk groups (Deliverable 1.1.1. Shared methodology and tools for UHI vulnerability and risk assessment).



Four UHI vulnerability elements

Project partner cities will carry out UHI risk assessment for their cities as a preparatory activity for the implementation of the pilot actions as part of the Specific objective 2 Co-creating, testing, and validating jointly developed solutions to mitigate UHI effects in cities. The assessments will draw upon historical data and statistics, and other information and data from different sources. The risk assessment will be carried out with the support of the local coalitions (Activity 1.3), which will enable community engagement and raising awareness city-wide about the project objectives and expected results. The partner cities will choose which city zones to be included in the risk assessment, but to ensure comparability of the results and of the applicability and usability of the tools, we expect the UHI assessment to cover an area with high density of construction; an industrial zone; a densely populated area with mid- to low-income residents. Task leaders are the partner cities (conducting the risk assessment and drafting the resulting report; knowledge partners provide consultation and feedback.).

Each city will develop one city report supported by knowledge partners. The city report will include analysis of the usability of the tools and recommendations for adjustment of the methodology, where needed. The reports feed into the City Climate Sandbox concept and pilots.

AREA OF THE INTERVENTION

Territorial context

Village	Ratiboř
Municipality	Ratiboř
Region	Zlín
State	Czech Republic
Country	Czech Republic

Statistical data City Municipality of Kranj

Surface Area (km2)	18,75 km^2
Population	1 835 (1.1.2024)
Density	97,12 residents per km^2
GDP per capita (€)	22 616,12 €
Minimum Wage (€/month)	805,80 €

ABOUT RATIBOŘ

Ratiboř is wallachian village which is situated approximately 7 km west of the town of Vsetín in Zlín Region (Fig. 2) in the valley of the Ratibořka stream on the eastern edge of the Hostýn Hills. The altitude of the village is 343 m above sea level; the highest peak is Drastihlava with a height of 695 m. The cadastre of the village is very rugged and almost 57% consists of forests (Fig. 3). The village is built along a second-class road (Fig. 4) which connects to the expressway connecting the city of Vsetín. The surrounding hills and forests have given this village an unmistakable character, several smaller valleys that are a popular place for building family houses.

Figure 1: Location of the municipality of Ratiboř within the Czech Republic (Source: https://ags.cuzk.gov.cz/ and www.gobec.cz)

The village, with its location and natural beauty, attracts both active tourists and lovers of walks, who can use a number of hiking and cycling trails; in winter, good conditions are created here for cross-country skiing along the ridges of the local hills.

Figure 2: View of the village of Ratibor in the Zlín Region (Source: www.ratibor.cz)

The first written mention of Ratiboř can be found from 1306 which announces the establishment of a Cistercian monastery at the confluence of the Bečva and Ratibořka rivers. In the middle Ages, the village was part of the Vsetín manor and, as elsewhere in Wallachia, a pastoral way of life developed here. In addition to herding, the inhabitants lived by farming, and later also by small crafts, or daily work and labour was obligatory.

The centre of the village is dominated by the Evangelical church, which underwent extensive reconstruction in 2015. The area around the church forms the historic core of Ratiboř. There is a primary school, a parish garden and a local cemetery. In 2018, on the occasion of the 100th anniversary of Czechoslovakia, a Freedom Park was established in part of the parish garden. A bust of Thomas G. Masaryk and the Liberty Linden was planted.

Ratibor is renowned for its social life and the involvement of its citizens in cultural and social life. During the year, many social events are organised, such as the Ratiboř Feast Fair, the Gulášový král (Goulash King) and the Municipal Ball. In order to further support the development of social and social activities, was developed Multifunctional Community Centre Ratiboř which offers facilities for municipal associations, the possibility of organising social and cultural events and it is also house a day care centre for the elderly and premises for field service and personal assistance.

Respect for traditions, development of village community and modern technology are the basic features of this Wallachian village. A number of associations are involved in the cultural and sporting activities in the village, including the Kosiska men's and children's ensemble and the unique group Zvonky Dobré zprávy (Bells of Good News), which operates within the active Evangelical Church of Czech Brethren. Traditional crafts are not forgotten either, which are presented on various occasions in the historic farmhouse purchased by the municipality for this purpose.

Figure 3: Village Ratiboř (Source: Archive of the village)

For its systematic strategic development and social life, Ratiboř was awarded a gold ribbon in the regional round and a silver place in the national round of the Village of the Year 2019 competition.

And in 2022 she represented the Czech Republic in the European round of the "European Rural Renewal Award".

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2. Methodology of the assessment

SUMMARY OF THE PROCESS

The UHI risk assessment in Sofia is a preparatory activity for the implementation of the pilot project to co-create, test and validate jointly developed solutions to mitigate the effects of UHI. The assessment is based on historical data and statistics as well as other information and data from various sources. The risk assessment was conducted with the support of a local coalition of stakeholders and citizens, enabling community engagement and raising citywide awareness of the project goals and expected outcomes. The development of the city report was also supported by the Be Ready project's research partners.

The process consisted of 4 phases: preparatory, starting, active and final phase. The preparatory phase consisted of a review of the Methodology and a preliminary assessment of the internal capabilities to perform the analysis. The starting phase consisted of conducting a workshop, collecting information and data and cooperation with other cities to exchange ideas, experiences and issues. Active phase consisted of processing the gathered information and data, cooperation with the scientific partner for preparation the data for urban climate part of the report and drafting the report.

PREPARATORY PHASE

In the initial phase, a review of all available sources of information was carried out, along with the identification of local stakeholders and their input, as well as ways to involve civil society in the process. Missing data were identified, as well as methods to collect the necessary data through citizen participation. Areas where Ratiboř Municipality needs to increase its risk assessment capacity were also identified, as well as ways to address the issues.

In the preparatory phase, representatives of the scientific partner held a meeting regarding the preparation of locations also and the selection of weather stations and discussed issues related to the technical support of measuring devices and the transmission of climate data (Fig. 5).

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EVENTS/ ACTIVITIES

Several events/activities were organised to aid the assessment:

- The meeting of representatives of the scientific partner (STUBA) and stakeholders from Ratiboř regarding the preparation of sites for weather stations in Ratiboř and also regarding of selection of weather stations and during the meeting was discussed issues related to the technical support of measuring devices and the transmission of climate data (Fig. 4).
- The installation of local weather stations in Ratiboř was carried out in August 2024. The scientific partner Slovak University of Technology together with representatives of the municipality of Ratiboř selected 2 sites (in Kindergarten campus and in the centre of village – see Fig. 5) where climate data on temperature and humidity of air are continuously collected online at 10 minute intervals and precipitation is also monitored.

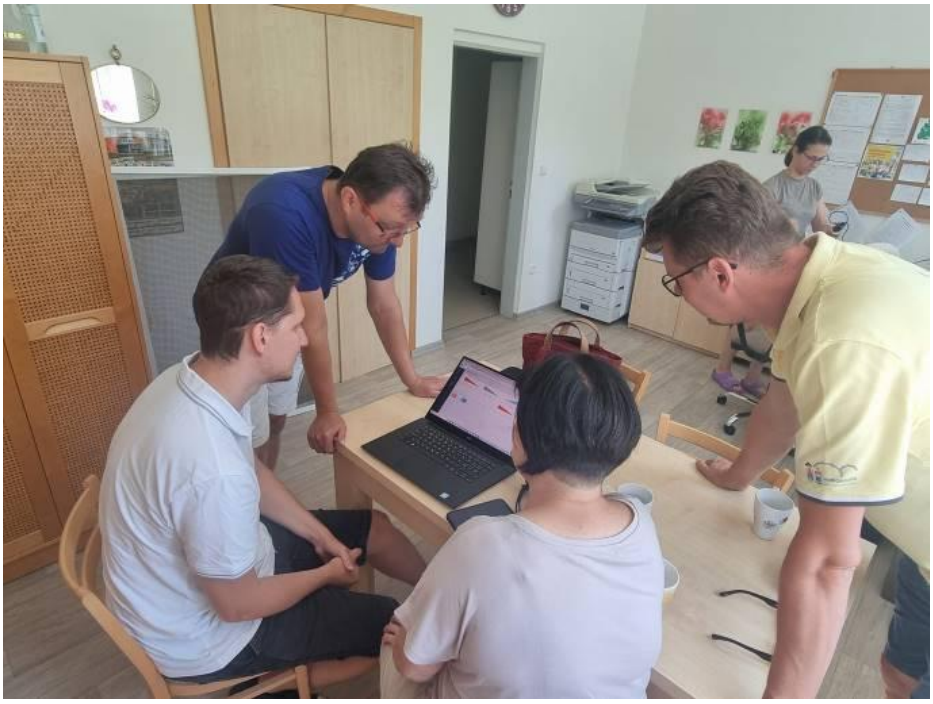

Figure 4: Meeting of the project team in Ratiboř (Kindergarten schol) in August 2024 (Author of photo: E. Škurlová, 2024)

Figure 5: Instalation of weather stations in Ratiboř, left: the campus of the Kindergarten; right: the village center (Author of photo. E. Pauditšová, 2024)

- Local UHI Methodology workshop that took place on 31. of October 2024 in Ratiboř. We hosted 25 stakeholders from different organisations, such as Municipality of Ratiboř, local entrepreneurs, Kindergarten director, local architect – urban planner, local forester, representative of the Regional Office, and other public and private interest groups. A fruitful discussion took place during the workshop, which brought many perspectives on solutions to the UHI problem. The participants presented via the Mentimeter application that the exchange of knowledge between different interested groups is very desirable and necessary.
- Signing the Local Coalition Agreement. The agreement was signed by 15 institutions including public, civil and business sector. The goal of this agreement was to establish strong and strategic cooperation in efforts to mitigate the effects of UHI.
- A focus group with representatives of Ratiboř Municipality and scientific partner to contribute to the assessment of Tool 4: Adaptive capacity of municipalities to cope with and mitigate climate risks.
- Online discussions between representatives of Ratiboř municipality and the scientific partner of the project, exchange of data.

The scientific partner became familiar with the possibilities of using GIS data processed within the national system ZABAGED® – Basic geographic data base. For the municipality, he processed satellite thematic images from publicly available EU sources (https://land.copernicus.eu), processed documents on urban morphology using sources from professional and scientific literature, the Czech Climate Atlas (Tolasz 2007), and data from the Statistical Office of the Czech Republic.

General information and urban climate trends in the Czech Republic and Ratiboř were obtained using the Czech Hydrometeorological Institute - outputs of the renowned Czech climatologist Michal Žák and information on climate scenarios in the municipality of Ratiboř was taken from the Institute for Global Change Research of the Academy of Sciences of the Czech Republic v. v. i. (www.climrisk.cz).

In addition, we used data from local weather stations installed in the municipality for the Be Ready project. Data from these weather stations were processed by the scientific partner of the project.

The work for tool 1 consisted of collecting data, consulting with various stakeholders, finding solutions, processing and displaying data. This stage was supported by the scientific partner of the project – the Slovak University of Technology.

The analysis for tool 2 began with a review of available information online. This part was prepared by an expert from the scientific partner Slovak University of Technology who focused on the emissivity of materials and UHI as part of his research work.

To obtain the data needed for analysis for tool 3 we reviewed in more detail the document Strategic Development Document of Ratiboř Municipality (2019) from which we extracted data on the population structure. We checked the data on the official website of the Statistical Office of the Czech Republic (https://csu.gov.cz).

For the analysis for tool 4 we used Tool application guide in the UHI Vulnerability and Risk Assessment methodology and proposed checklist to identify factors that influence a municipality's preparedness and adaptive capacity.

TIMELINE OF THE PROCESS

The UHI report preparation scheme shown in figure 6 presents four basic phases that followed each other in the report preparation process. Individual phases included specific steps in which representatives of the municipality of Ratiboř, stakeholders, partners of the Be Ready project including scientific partner of the Slovak University of Technology and experts in the field of climate science had an important position.

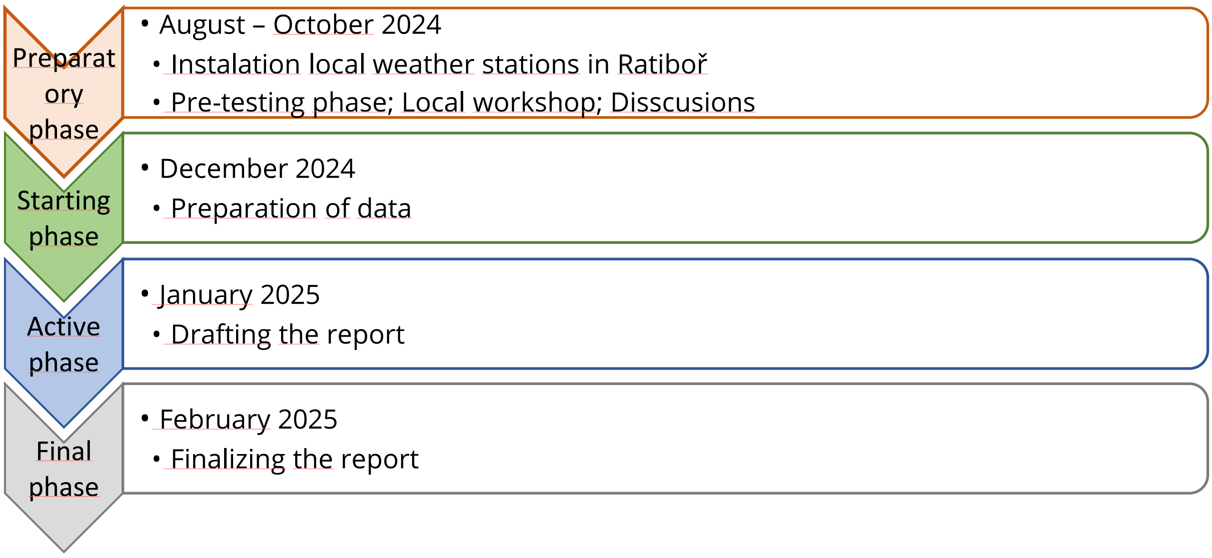

Figure 6: UHI report preparation scheme

In the preparatory phase, representatives of the scientific partner held a meeting regarding the preparation of locations also and the selection of weather stations and discussed issues related to the technical support of measuring devices and the transmission of climate data this step was identified as a key for obtaining the local climatic data (Fig. 7).

Figure 7: UHI report preparation scheme (Author of photo: L. Žabčíková, 2024)

3. Urban climate

GENERAL INFORMATION ABOUT URBAN CLIMATE TRENDS

Throughout historical epochs, the development of the Earth's global climate system has been influenced primarily by natural factors and has been related mainly to tectonic movements of the Earth's crust, volcanic activity, changes in the Earth's orbital parameters, or long-term (slow) changes in the chemistry of the Earth's atmosphere.

However, from time to time, sudden, catastrophic changes have also occurred, for example, after an asteroid impact or a major volcanic eruption. In the last century, the climate has been changing relatively rapidly, although we do not observe any of the aforementioned causes. It seems that at present, the global climate is influenced by human activity and the associated air pollution and the environment in general. Climate change, its consequences, and the need to respond to these changes represent one of the key topics of current environmental policy.

Scientific knowledge from recent years (including the comprehensive IPCC reports) shows that the increase in the concentration of greenhouse gases has a very fundamental impact on the Earth's climate system. The latter reacts to changes in greenhouse gas concentrations in the form of global warming and rapid complex changes in the entire system.

Over the past 150 years, the global average temperature has increased by 1.1 °C (AR6 states +1.09 °C ± 0.11 °C), with warming accelerating especially in the last 30 years (especially after 1985). The level of the world's oceans has risen by almost 30 cm, there has been a significant retreat of sea ice in the Arctic, the retreat of mountain glaciers in the Alps, Andes, and Himalayas, the frequency and amplitude of temperature and precipitation extremes have changed, and there has also been a shift of climate zones closer to the Earth's poles.

The manifestations and impacts of climate change, or rather global warming, have already been quite significant in the Czech Republic. A very significant regional increase in air temperature is accompanied by rapid changes in other climatic elements in individual regions, especially changes in precipitation patterns and an increase in their extremes.

In recent years, the Czech Republic has seen an increase in heat waves, which will likely continue with increasing global warming. The frequency and duration of droughts are also expected to increase and so are the damages. In previous years, droughts alone costed the Czech Republic damages estimated at 500 million EUR. The combination of droughts and heat waves also result in extreme wildfires in the Czech Republic, and they are projected to worsen over time with climate change. Heavy precipitation is also projected to occur more frequently in the Czech Republic, with up to a 35% increase in winter precipitation projected for the period 2071-2100. The resulting more severe and frequent floods can pose a great threat to the country, particularly because they are expected in vulnerable areas around the Morava River (part of the Danube River Basin), where around 2.8 million people live. Moreover, the Czech Republic has a historically high death rate from flooding compared to other European countries. Climate change also affects food security in the Czech Republic.

Farming systems have already documented declines in crop productivity owing to rising temperatures and changes in precipitation. The arable land and land dedicated to permanent crops have already fallen drastically in the past years. The production of wheat, for example, the most important crop in the Czech Republic, is projected to decline by up to 100 000 tonnes by 2030 compared to 2000 and that of maize is expected to decrease by half at 1.5°C of global warming. Forests are no exception. Climate change affects the timing, intensity, rate and frequency of disturbances and its impact on forest ecosystems. The incidence of pests and diseases, such as the infestation of bark beetles that put 50% of Czech forests at risk, which are at least partly linked to climate change, will likely intensify.

There are also health-related climate change impacts. Between 1990-2016, up to 1000 fatalities in the Czech Republic were due to extremely high temperature. This will likely increase drastically and at 4°C global warming, extreme heat is projected to claim 3.6% of total deaths. And the repercussions will be more severe in urban areas with denser populations. The occurrence of vector-borne diseases, such as the West Nile virus infections, and respiratory diseases will become more common and widespread. In 2018, up to 1500 premature deaths were attributed to air pollution (specifically, particulate matter) in the Czech Republic. Finally, mental health is also at risk. Especially for young people, climate- or eco-anxiety poses a major threat at a crucial point in their physical and psychological development. Eco-anxiety can cause stress, anxiety, depression and may even lead to substance use and other disorders.

Climate change scenarios

For the UHI assessment, climate change scenarios related to air temperature are relevant. For the Czech Republic, climate change impact scenarios in the form of air temperature distribution are shown in Figure 8.

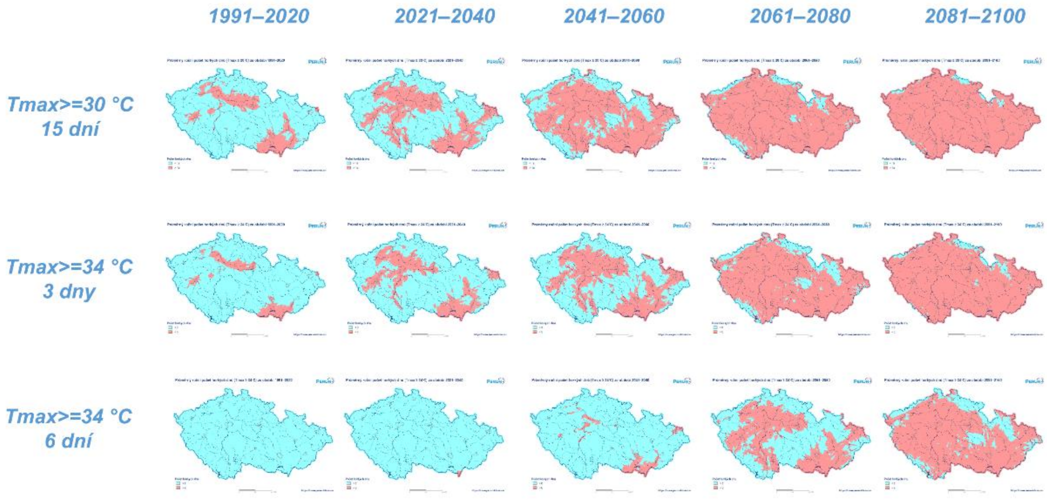

Figure 8: Models of scenarios (www.perun-klima.cz)

Table 1: Limits for heat (www.perun-klima.cz)

Definice	Limitní hodnota
Počet horkých dnů (Tmax>=30 ˚C)	15 dní / rok
Počet horkých dnů (Tmax>=34 ˚C)	3 dny / rok 6 dní / rok
Počet tropických nocí (Tmin>= 20 °C)	4 noci / rok
Počet dní s horkou vlnou (Tmax>=30 °C/3 dny)	10 dní / rok 15 dní / rok
Počet horkých vln (Tmax>=30 °C/3 dny)	2 vlny / rok 4 vlny / rok

In addition to increasing air and surface temperatures, many other climate phenomena are also expected in the prediction scenarios. Figure 9 shows the combination of various risks arising from climate phenomena recorded over the 30-year period (1991–2020) in the Czech Republic.

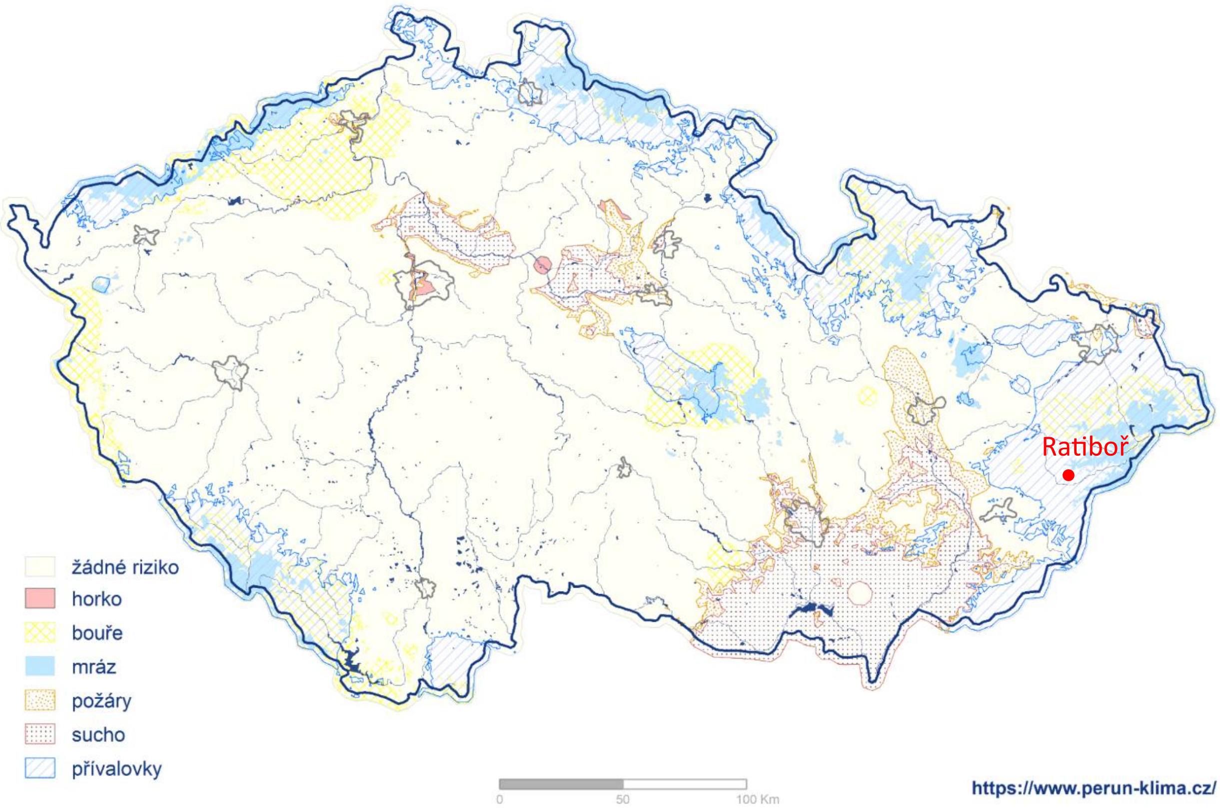

Figure 9: Combination of climate risk events recorded in the Czech Republic in the period 1991-2020 (www.perun-klima.cz)

Climate Change Knowledge Portal (CCKP) provides global data on historical and future climate, vulnerabilities, and impacts. The CCKP is a web-based platform built to enhance the understanding of our changing climate across different level of detail. Using the latest climate data and scientific research available, CCKP provides resources to explore, evaluate, synthesize, and learn about future climate scenarios, projected risks, and climate-related vulnerabilities at multiple levels of details.

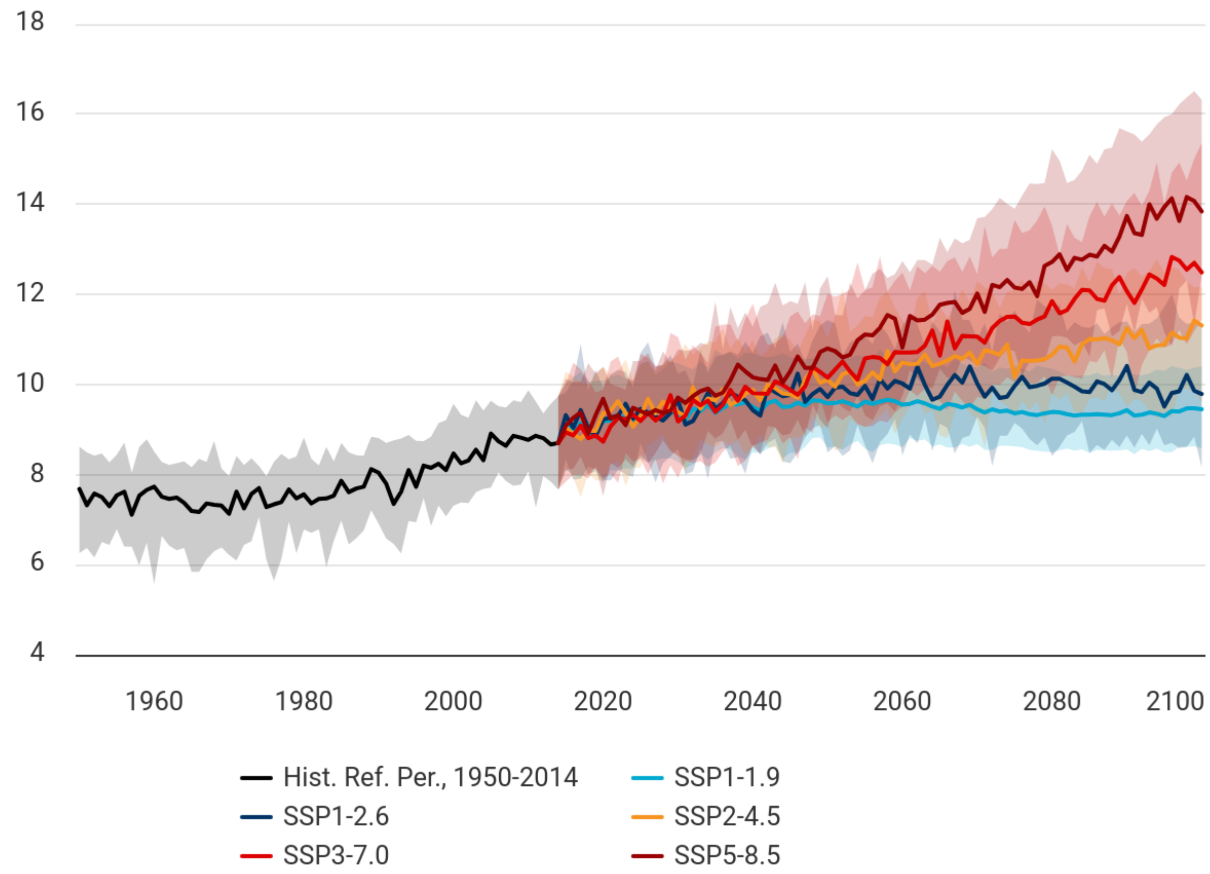

Figure 10: Projected average mean surface air temperature, Czech Republic, ref. period 1995-2014 (https://climateknowledgeportal.worldbank.org/)

Main characteristics of climate change in the period 1961–2023

Air temperature

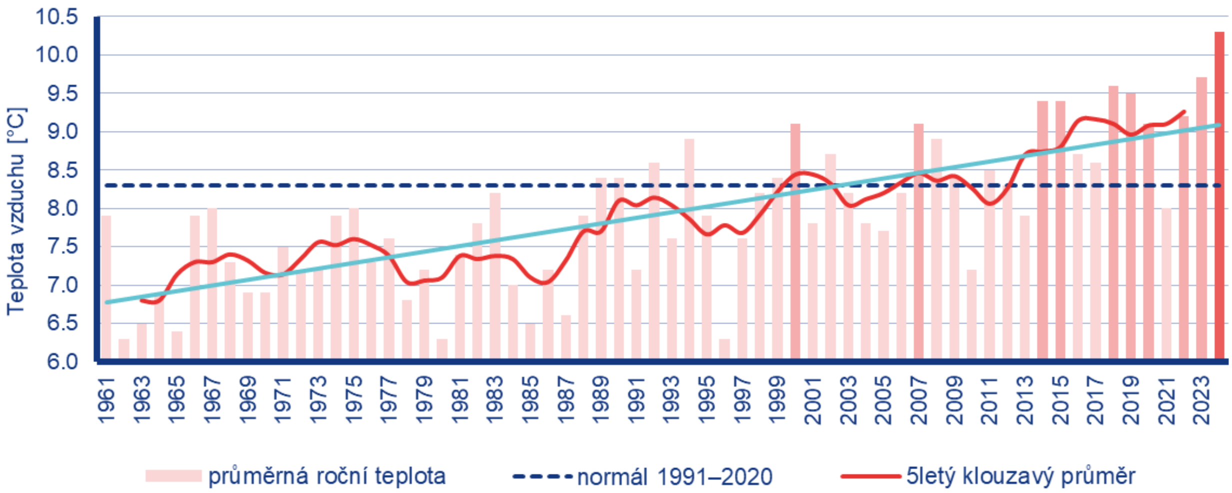

Figure 11: Average annual air temperature in the Czech Republic compared to the 1991–2020 normal and plotted with a linear line (blue) in the period 1961–2024. Years with an average temperature above 9.0 °C are highlighted. (ČHMÚ 2024)

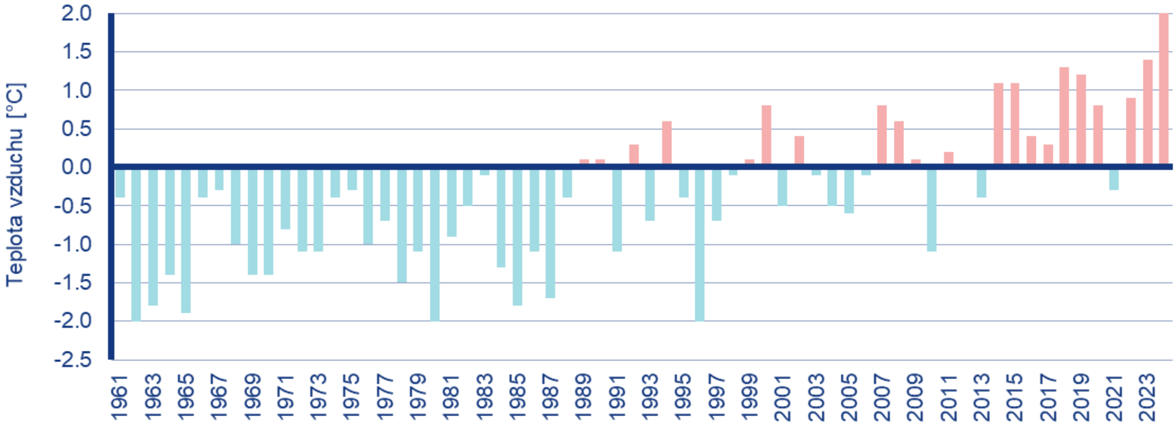

Figure 12: Deviation of the average annual air temperature in the Czech Republic from the 1991–2020 normal in the period 1961–2023. (ČHMÚ 2024)

Precipitation

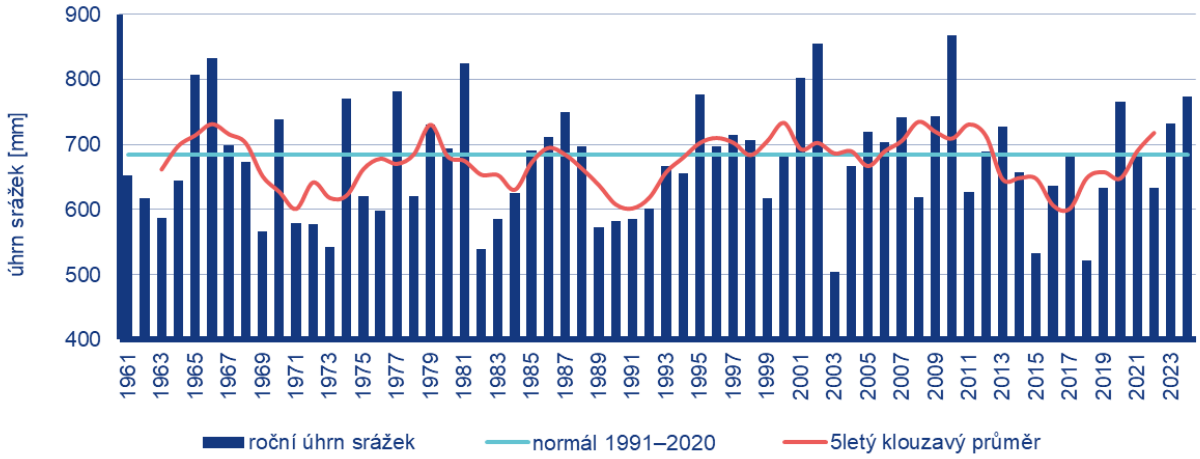

Figure 13: Annual precipitation totals in the Czech Republic [mm] compared to the 1991–2024 normal and 5-year moving average. (ČHMÚ 2024)

Main characteristics of climate change in 2024

The year 2024 was a record warm year in the Czech Republic, with extreme months in terms of temperature and precipitation. The average annual air temperature of 10.3 °C was 2.0 °C higher than the 1991–2020 normal. The year 2024 is therefore assessed as exceptionally above-normal in terms of temperature and has become the warmest year in the Czech Republic in a row since 1961. The average air temperature of the warmest year so far, 2023 (9.7 °C), was exceeded very significantly, followed by 2018 (9.6 °C), 2019 (9.5 °C), 2014 and 2015 (9.4 °C).

In the year 2024 a positive deviation of the average monthly air temperature in the Czech Republic from the 1991–2020 normal was recorded for all months, except November. The months of February (deviation +6.1 °C) and March (deviation +3.8 °C) were exceptionally warm. These months were the warmest February and March ever recorded in the Czech Republic since 1961, and in February there was a record high deviation of the average monthly temperature from the 1991–2020 normal. The following months, April to October, were assessed as above-normal to strongly above-normal in terms of temperature (deviation +1.4 to 2.3 °C). The final months of the year, November and December, are assessed as normal in terms of temperature.

In terms of precipitation, 2024 was above-normal in the Czech Republic. The preliminary average annual precipitation in our territory of 776 mm represents 113% of the 1991–2020 normal. This is the 9th highest annual total recorded since 1961. (ČHMU, 2025)

In September 2024, Ratiboř was also exceptionally rainy (Fig. 14). In the period 15.-17. September 2024, an extreme flow was recorded in the Ratibořka stream, Q_{1000} (Fig. 15).

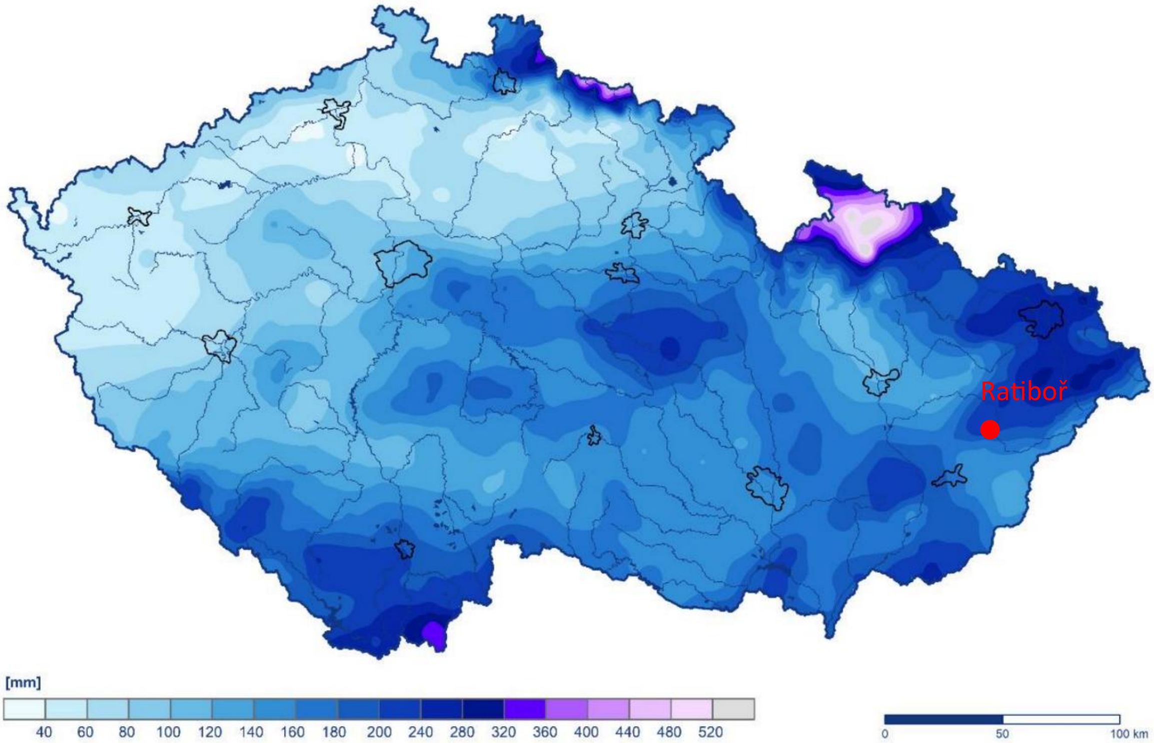

Figure 14: Total precipitation in the Czech Republic for the period 11–16 September 2024 (ČHMÚ, 2024)

Figure 15: The bed of the Ratibořanka stream, designed for a flow of Q1000, was almost full on September 15-17, 2024 (Source: Archive of Ratiboř, 2024)

Meteorological causes of the flood

According to information processed by the Czech Hydrometeorological Institute (ČHMÚ 2025), the flood in September 2024 was preceded by a very warm and precipitation-poor period which led to a significant decrease in the water content in the soil and an increase in the free retention capacity of the soil before subsequent precipitation. On Tuesday, September 10, a low pressure area formed between Iceland and the British Isles on a frontal wave. As a result of its circulation, cold Arctic air penetrated over the western Mediterranean. In the Gulf of Genoa, an intensive cyclogenesis process began on September 12, above the very warm surface of the Mediterranean Sea, and a low pressure area named Boris was formed. At the same time, a separate low pressure area formed in the higher layers of the atmosphere from a low pressure wake moving south.

This low began to deepen in the interaction between the polar jet stream and the subtropical jet stream. At that time, the front located over Central Europe began to undulate and its progress slowed down. The precipitation zone associated with it thus only slowly moved from Bohemia through Moravia and Silesia to Slovakia where its progress stopped. At the same time, wind shear began to play a significant role in precipitation-forming processes, and near the ground, cold air from the north also brought snowfall (September 13). On Friday, September 13, the low pressure began to advance east to northeast. As it advanced, it began to pick up a large amount of moisture from the surrounding seas on its front side. There was intense precipitation activity at the frontal interface, which persisted over the territory of the Czech Republic due to the blocking of the downward advance by the pressure high over Eastern Europe. On the northern windward side of the mountains, a significant intensification of the precipitation windward effect was applied due to very strong winds. In addition, nested convection occurred inside the precipitation cloud, which was manifested by a further intensification of permanent precipitation. Thanks to the combination of these factors, extreme precipitation totals were achieved, including the absolute record for daily precipitation in the Czech Republic for the entire observation period - in the Jeseníky Mountains at the Loučná nad Desnou, Švýcárna station, a daily precipitation total of 386 mm per day was measured on September 14, 2024. From September 15, the depression began to slowly fill in, the precipitation zone advanced from the eastern half of the republic to the west, but it stopped only from Tuesday, September 17, 2024. Over the six-day period from September 11 to 16, precipitation totals reached extreme values. The recurrence period of these totals, according to statistical evaluation at a number of stations, exceeded 200 years. The total average precipitation in September 2024 in the Czech Republic reached 179 mm (which is 298% of the 1991–2020 normal). This is the highest value of precipitation for September and the second highest monthly precipitation in the Czech Republic since 1961. A higher monthly precipitation (204 mm) was recorded only in July 1997. (ČHMÚ 2025)

Table 2: List of municipalities in the Zlín Region in whose territory, according to operational data, a flood or heavy rainfall was recorded in one of the measuring profiles in September 2024. (ČHMÚ 2024)

City/village	Flood Level	Climatic Phenomenon
Bystřice pod Hostýnem	Flood (3rd degree of flood activity)	Heavy rains and local flooding
Holešov	Flood (3rd degree of flood activity)	Heavy rains and local flooding
Kroměříž	Significant flood	Heavy rains and local flooding
Luhačovice	Flood (3rd degree of flood activity)	Heavy rains and local flooding
Otrokovice	Significant flood	Heavy rains and local flooding
Rožnov pod Radhoštěm	Significant flood	Heavy rains and local flooding
Uherské Hradiště	Significant flood	Heavy rains and local flooding
Uherský Brod	Flood (3rd degree of flood activity)	Heavy rains and local flooding
Valašské Klobouky	-	Heavy rains and local flooding
Valašské Meziříčí	Significant flood	Heavy rains and local flooding
Vizovice	-	Heavy rains and local flooding
Vsetín	Flood (3rd degree of flood activity)	Heavy rains and local flooding

Air Temperature

Table 3: Temperature characteristics of the climatic region of the municipality of Ratiboř and their comparison with the area averages in the Czech Republic (according to Quitt 1971)

Parameter	**Climatic characteristics of the area**	
	MT2	**Area average of the Czech Republic**
Number of summer days	20 - 30	35,2
Number of days with average temperature ≤10°C	140 - 160	155,2
Number of frost days	110 - 130	121,5
Number of ice days	40 - 50	37,5
Average January temperature	-3 - 4	-2,5
Average July temperature	16 - 17	17

Parameter	Climatic characteristics of the area	
	MT2	Area average of the Czech Republic
Average April temperature	6 - 7	7,3
Average October temperature	6 - 7	7,9

Table 4: Average monthly and annual air temperature (°C) in the municipality of Ratiboř according to the Climate Atlas of the Czech Republic (Tolasz et al. 2007)

Period	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
1901-1950	-3,1	-1,7	2,8	8,0	13,4	16,3	18,1	17,1	13,6	8,5	3,5	-0,5	8,0
1961-2000	-2,8	-1,4	2,3	7,3	12,6	15,7	17,1	16,5	12,7	8,3	3,4	-0,8	7,7
The difference	0,3	0,3	-0,5	-0,7	-0,8	-0,6	-0,7	-0,6	-0,9	-0,2	-0,1	-0,3	-0,3

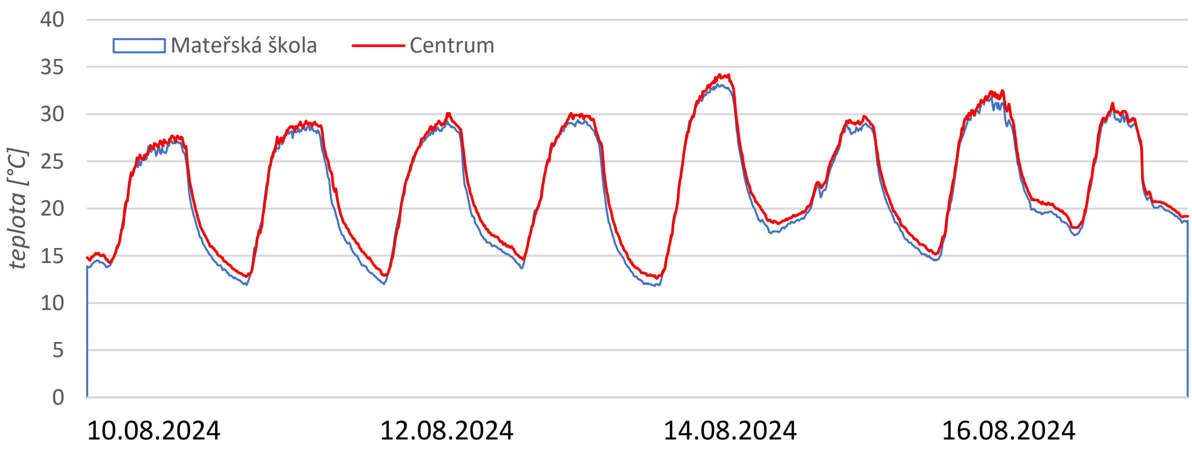

Figure 16: Selected air temperature trends in Ratiboř during heat wave in August 2024 recorded by local weather stations installed in the village for the purposes of the Be Ready project; the graph shows the differences in air temperature measurements at 2 weather stations in Ratiboř; blue = Kindergarten area, permeable area vegetation covered; red = UHI in the centre of Ratiboř – impermeable asphalt area

Solar Radiation

Reference evapotranspiration

Precipitation

Table 5: Climatic characteristics of the area CZ (according to Quitt 1971)

Parameter	**Climatic characteristics of the area**	
	MT2	**Area average of the Czech Republic**
Average number of days with precipitation ≤1 mm	120 - 130	109,5
Precipitation total in the growing season (mm)	450 - 500	409,1
Precipitation total in the winter season (mm)	250 - 300	257,3
Number of days with snow cover	80 - 100	65,3
Number of cloudy days	150 - 160	150,2
Number of clear days	40 - 50	45,1

Height of new snow and height of snow cover

Greenhouse gas emission scenarios

Temperature

Average air temperature at ground level

Extreme temperature conditions

Extreme temperature conditions are monitored with temperature indicators, for conditions when the air temperature becomes unfavorable for living beings.

Tropical nights, when the temperature does not drop below 20 °C even at night, indicate conditions when it does not cool down enough even at night for people and other living beings to be able to take a break from the heat load. Tropical nights are not recorded in areas of higher altitudes and, it seems, will not be recorded on average in the future either. The number is expected to increase by approximately 5 days elsewhere in the country (southwestern, northeastern and central regions) in the first period, and by up to 20 days in the second period, depending on the region. In the last period, the number of tropical nights will stabilize under the RCP4.5 emissions scenario, while in some areas, according to the RCP8.5 emissions scenario, we will have up to 60 more tropical nights than in today's climate. When several such days follow each other in succession, living organisms can experience major problems due to increased heat stress.

In the most sensitive groups of people (chronic patients, infants and the elderly), heat stress occurs when the air temperature exceeds 25 °C. Days when the maximum temperature exceeds 25 °C are called warm days. There will be approximately 10 more warm days in the near future than in the comparison period, regardless of the emission scenario. The change for the second period already depends somewhat on the emission scenario. Under the moderately optimistic RCP4.5 emission scenario, we can expect slightly less than 20 more warm days, and under the pessimistic RCP8.5 emission scenario, up to 25 more warm days than in today's climate. At the end of the century, the change in the number of warm days will depend very much on the emission scenario. Under the RCP4.5 emissions scenario, there will be up to 25 more such days in most regions, while under the RCP8.5 emissions scenario, we can expect 55 to 60 more warm days compared to today's climate. When the air temperature exceeds 30 °C, temperature conditions become burdensome for the entire population, not only for the most vulnerable groups. The indicator of the number of hot days, when the maximum temperature exceeds 30 °C, also indicates a gradual increase in the number of such days. In the near future, there will be 5 to 10 more hot days in the lowland part of the country (central, north-eastern and south-western regions) than in the comparison period. A slightly higher estimate (up to 30 more days) applies to a larger part of the country in the second and, according to the RCP4.5 emissions scenario, also in the third period. By the end of the century, according to the most pessimistic scenario, we can expect up to 60 more hot days in the lowland part than in the comparison period.

Very low temperatures also pose a burden on living things, but this will decrease in the future. The number of cold and icy days depends strongly on the relief of the surface and the altitude. The number of cold days will gradually decrease in the future. In the first period, according to the RCP4.5 scenario, the number of cold days is expected to decrease by approximately 10 days, and in the second and last period by approximately 20 days per year. Both the changes, as well as the differences between the changes according to the altitude, are somewhat more pronounced in the RCP8.5 scenario. According to the pessimistic scenario, approximately 40 fewer cold days are expected in most parts of Slovenia by the end of the century, and in the highlands, there will be up to 60 fewer such days than in the comparative period. (IPCC….)

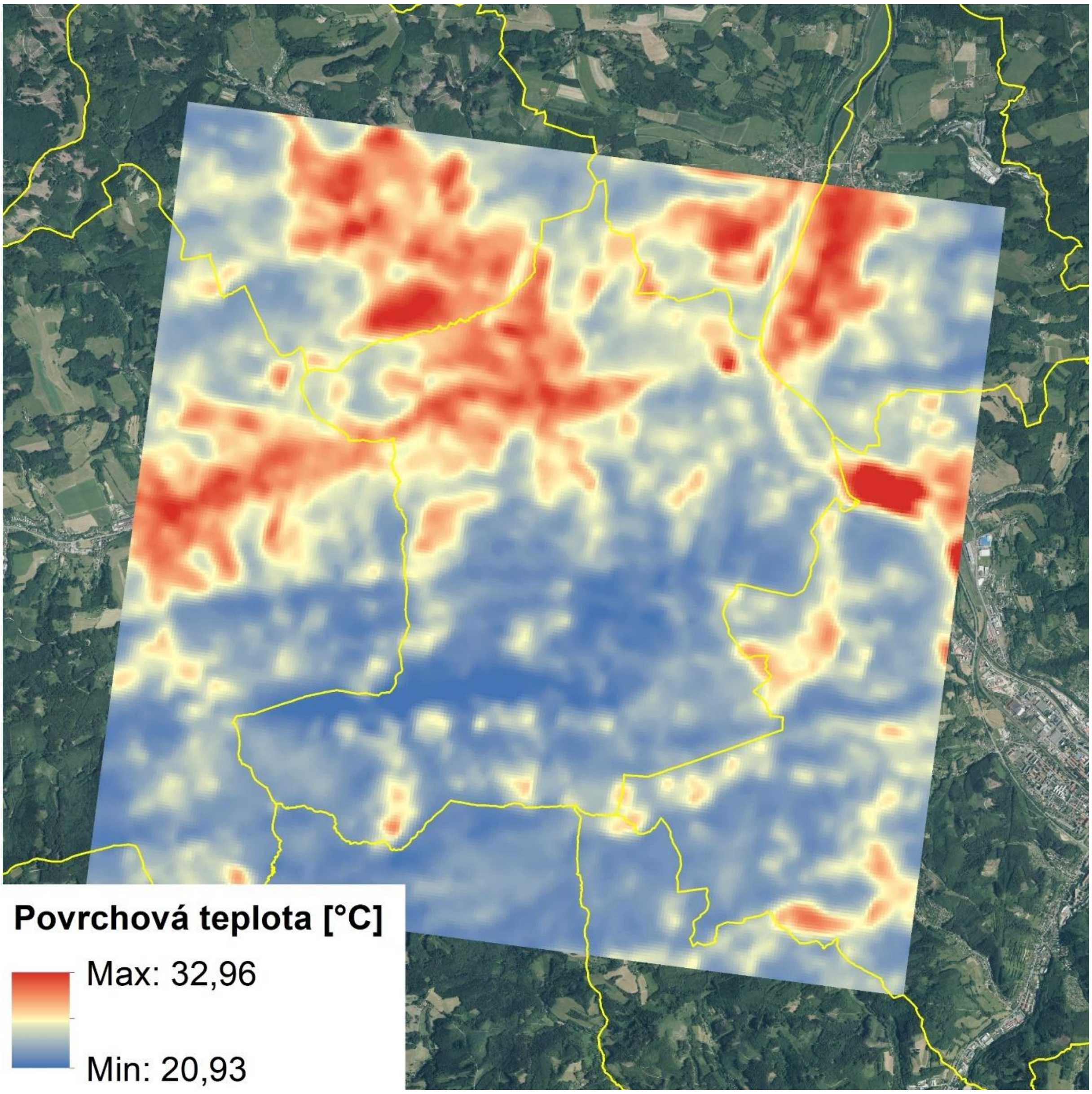

Figure 17: Satellite thermal image showing the cadastre of Ratiboř, 12.8.2024 11:38 SELČ

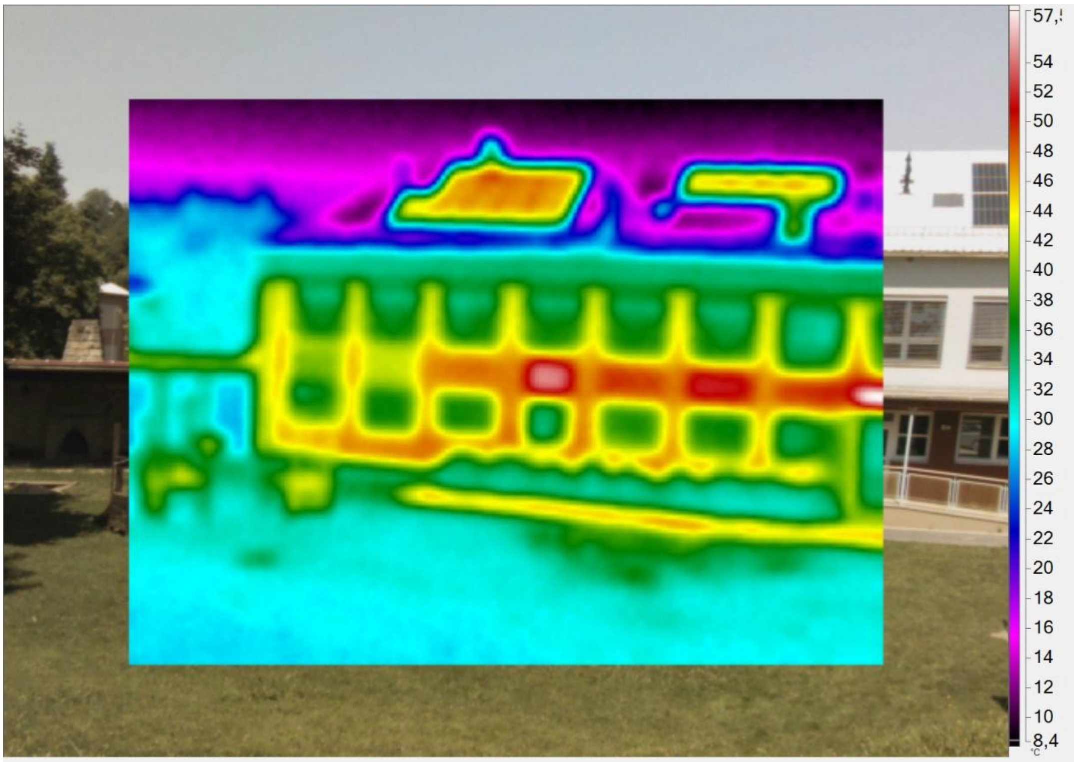

Figure 18: *Demonstration of the diversity of surface temperatures on the facade of the Kindergarten building in Ratiboř (August 2024)*

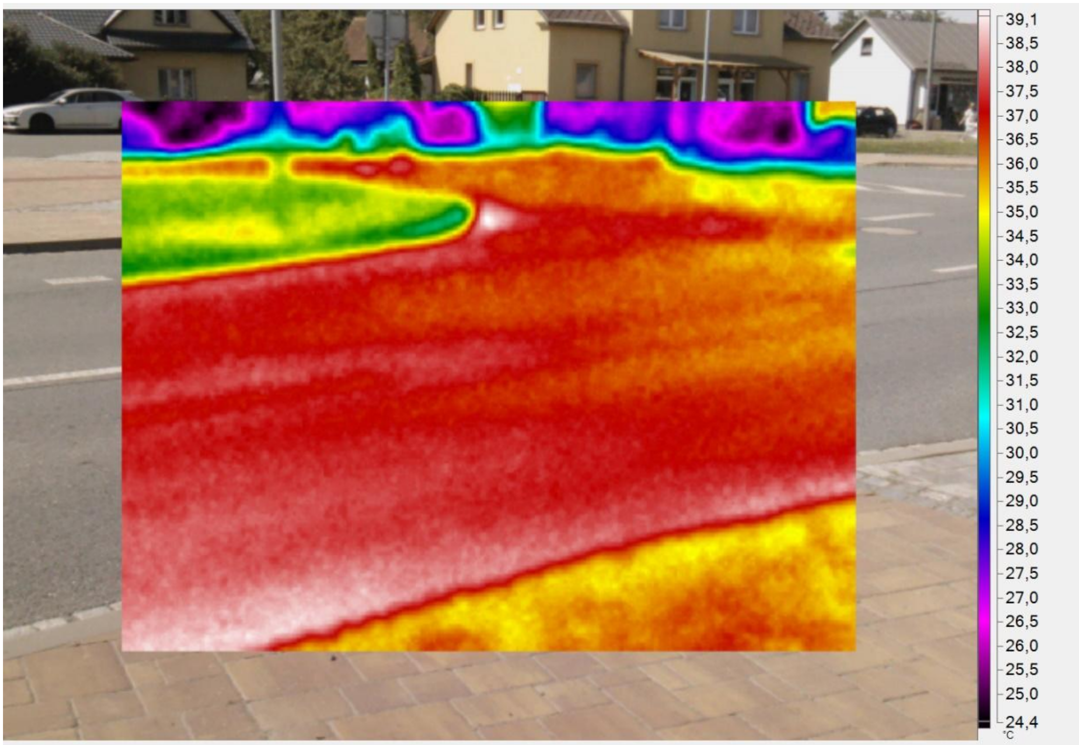

Figure 19: *UHI thermal image in the centre of Ratiboř (August 2024)*

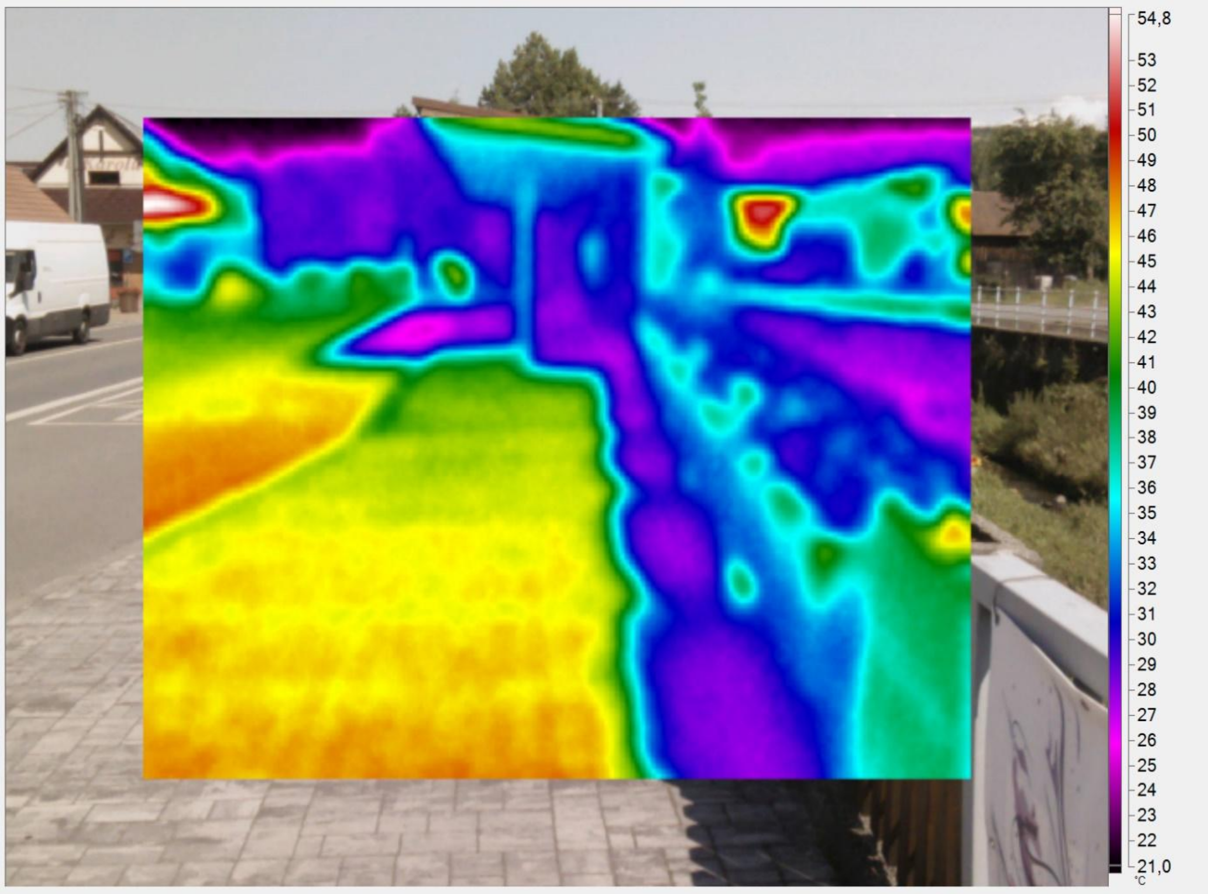

Figure 20: Thermal image showing the temperatures of various surfaces of a place where residents regularly gather (bus stop) (August 2024)

Precipitation

Average precipitation amount

Extreme rainfall

4. Assessment of the city based on 4 vulnerability elements, exposure, sensitivity, preparedness and adaptive capacity and risk groups

EXPOSURE OF BUILDINGS AND SURROUNDINGS

The analysis was prepared based on a survey of the area and a general description of urban forms.

Urban morphology/urban form

General description.

Limitation of the analysis.

Source of data for the assessment.

Building coverage ratio (BCR)

Building coverage ratio (BCR) reflects the relationship between the ratio of the site occupied by the building and the site area (plot/parcel or larger area). BCR is urban planning code which is defined in the implementation part of the Territorial plan.

Floor area ratio (FAR)

Floor area ratio (FAR) is a measure describing how much land is covered by a building. It is a relationship between the total floor area of land covered by buildings and the whole area where the building stands. FAR is urban planning code which is also defined in the Implementation part of the Territorial plan.

Street canyon aspect ratio

As input data, we took data from the Geodetic Administration of the Republic of Slovenia, from the real estate cadastre, which for each building records the number of floors and the highest elevation angle of the building given in altitude.

Green urban areas and water bodies

General description.

Limitation of the analysis.

Source of data for the assessment

Green coverage ratio

Tree canopy coverage

Tree canopy coverage is a ratio of tree canopy coverage at settlement level compared to a other territorial unit (neighborhood, district). In our case the main unit is settlement Ratiboř.

Ratiboř does not have a separate Document for recording greenery in the village. We used a Complex drawing (Fig. 21) from the Territorial plan (2014) or we can use data from the Copernicus online platform to display the tree tops.

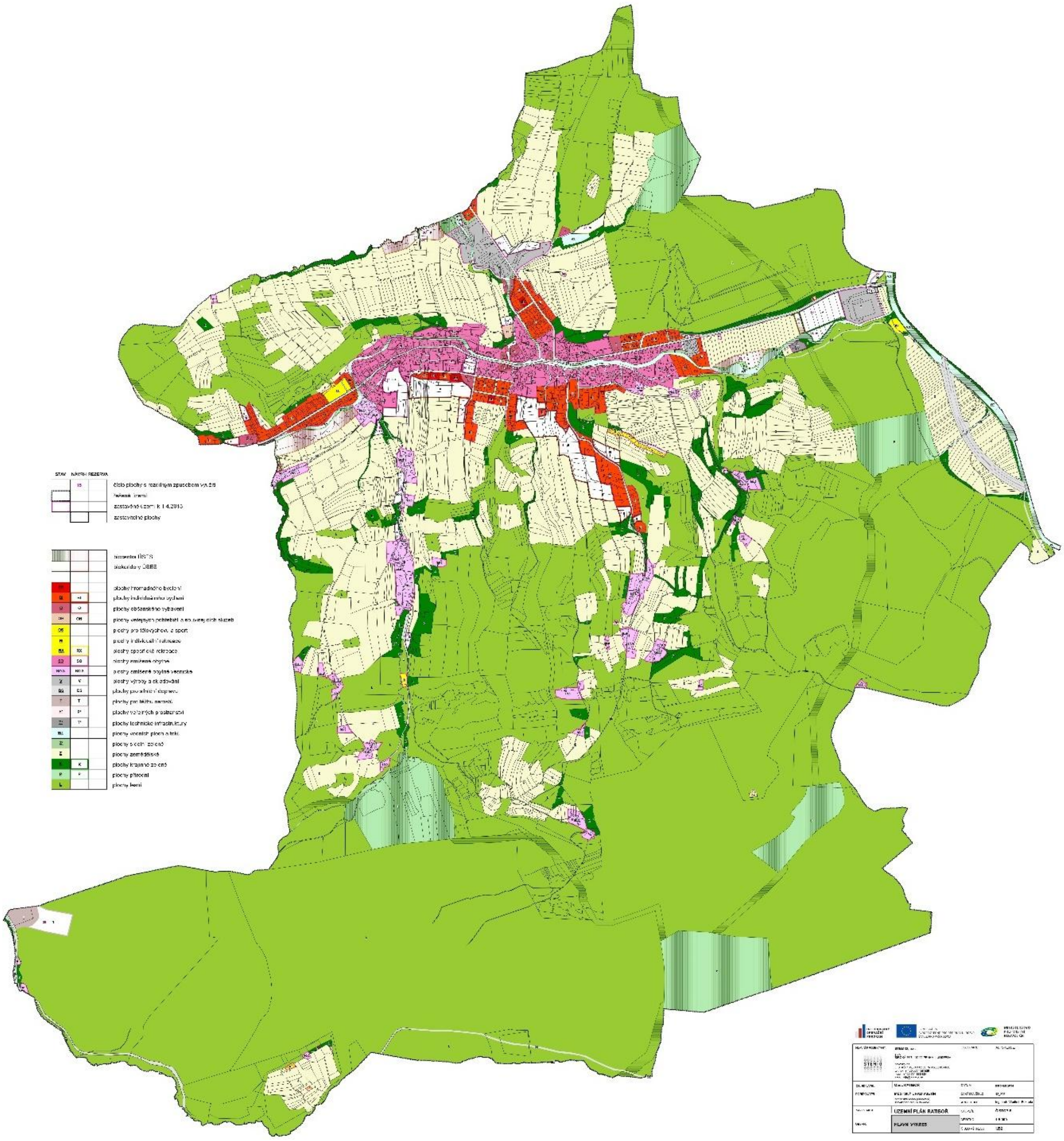

Figure 21: Greenery in Ratiboř (Territorial plan of Ratiboř, 2014)

Water coverage ratio

Water coverage ratio is a relationship between the size of the village and water bodies within the settlement. We obtained information on rivers/stremas and other water bodies from Territorial plan of Ratiboř (2014) (Fig. 22).

The Ratibořka stream flows through Ratiboř. This stream is a left-sided tributary of the Vsetínská Bečva in the Vsetín district of the Zlín region. The length of the stream is 11.0 km. It rises in the Hostýnské vrchy on the northern slope of the Kamenitá hill (600 m above sea level), flows through the valley with the villages of Hošťálková and Ratiboř. In the village of Ratiboř, the stream has reinforced banks (Fig. 23).

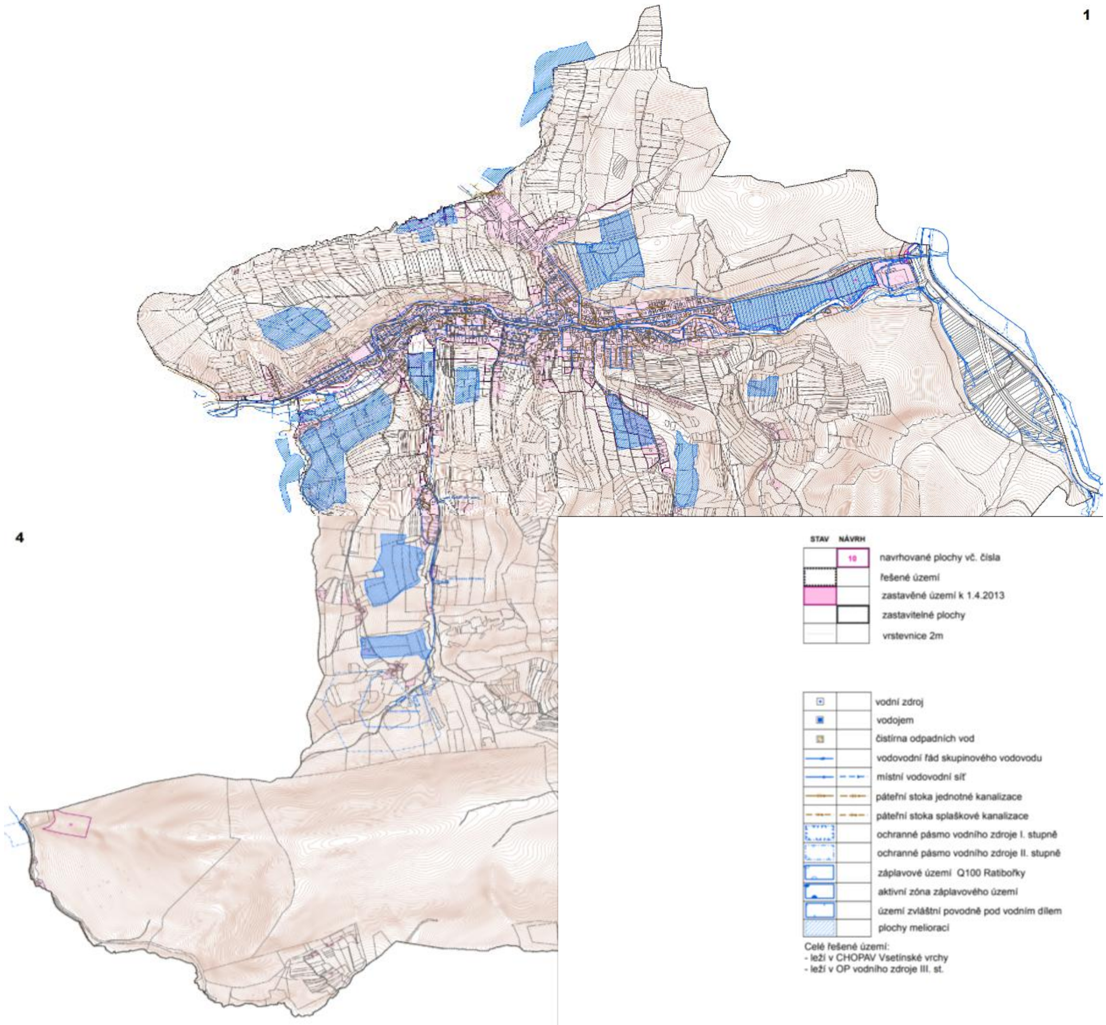

Figure 22: Water bodies in Ratiboř (Territorial plan of Ratiboř, 2014)

Figure 23: Stream of Ratibořka in center of Ratiboř (Author of photo: Archive of the village 2024)

Permeability of surfaces

General description.

Limitation of the analysis.

Source of data for the assessment.

Share of permeable surfaces related to impermeable surfaces

Human activities

General description.

Limitation of the analysis.

Source of data for the assessment

Interreg Danube Region
Co-funded by the European Union
Be Ready

Population density

According to historical data, it is clear that the population of the municipality of Ratiboř has been gradually increasing, with a partial decrease occurring mainly during and after World War II. In 2011 (according to data from the Census of Population, Houses and Apartments, 2011), there were 605 houses and 1,730 inhabitants registered in the municipality of Ratiboř, of which 259 were children under 15 years of age, 1,215 inhabitants aged 15–64 years and 252 aged 65 years and over. The municipality currently has 1,835 inhabitants.

Table 6: Number of inhabitants and housing stock – historical development (Sources: Czech Statistical Office; Population, House and Apartment Census, 2011)

Census year	Number of inhabitants	Number of houses
1869	1116	192
1880	1291	224
1890	1415	232
1900	1469	225
1910	1528	233
1921	1372	233
1930	1468	255
1950	1172	291
1961	1621	340
1970	1605	369
1980	1622	395
1991	1732	474
2001	1756	517
2011	1730	555
2022	1835	591

The increase in the number of inhabitants in the municipality between 2009 and 2022 occurred as a result of supporting, in particular, the development of rural areas through various subsidy mechanisms from European Union. This trend is related to the revival of the attractiveness of the countryside for housing, cultural and social life in the municipality and the increased interest of city residents in living in quieter locations with preserved natural potential. The municipality of Ratiboř is located in a convenient transport location, and at the same time it is a municipality with good basic amenities which increases its attractiveness for housing.

The municipality of Ratiboř regularly organizes a number of events that have a social, community, educational and entertainment character.

Table 7: Events in Ratiboř and number of visitors (Sourse: Internal resources of the municipality, 2024)

Name of event	Number of participants
Feast Fair	1500
Summer fun	600
Fairytale Journey	300
Goulash King	2000
Candles	300
Municipal slaughter	800
Lanternade	400
Municipal Ball	300
Christmas tree lighting	200
Maypole building	100
Welcoming spring	300
Singing Christmas carols	200
Wallachian Ball	200

Land use

In Ratiboř u Vsetína, agricultural land is mainly used by the MÍR Ratiboř Agricultural Cooperative. The cooperative manages a total area of 1320 hectares of agricultural land, of which 365 hectares are arable land. The main focus is cattle breeding, especially milk, meat and breeding animals. Crop production is adapted to the needs of livestock production and includes growing crops such as maize, winter wheat, triticale, oats, green peas, clover grass and grass seed.

According to the Ratiboř municipality's master plan, areas for housing are proposed in the Kobelné and Hološín valleys in order to complement and not disturb the existing urban structures of the characteristic dispersed development. Further areas for housing are proposed in direct connection with the built-up area of the village.

Table 8: Land use of Ratiboř cadastre (Source: Internal resources of the municipality, 2024)

Way of land use	Area (ha)	Area (%)
Arable land	180,3	9,62
Garden	27,8	1,48
Orchard	0,4	0,02
Permanent grassland	281,4	15,01
Forest	1260,9	67,26
Water area	15,5	0,83
Built-up area	19,4	1,03
Other area	89	4,75
Total	1874,7	100

SENSITIVITY OF EQUIPMENT AND MATERIALS

For each criteria provide results of the analysis of the assessment:

- *in general in text and graphic presentation (diagrams, charts, tables, maps)*
- *for each indicator of the criteria in text and graphic presentation (diagrams, charts, tables, maps)*

Source of data for the assessment.

Limitation of the analysis (missing data, outdated data, etc.).

Albedo (Reflectivity) Coefficient

Albedo is closely connected to the Urban Heat Island (UHI) effect, which refers to the phenomenon where urban areas experience significantly higher temperatures than their surrounding rural or natural areas. The connection between albedo and the UHI effect lies in the ability of different surfaces within a city to reflect or absorb solar radiation.

In cities, a significant portion of the surfaces, such as roads, buildings, parking lots, and rooftops, tend to have low albedo, meaning they absorb a large amount of solar radiation. These surfaces, often dark-colored like asphalt or concrete, convert the absorbed sunlight into heat. This absorbed heat increases the temperature of the urban environment, both during the day and night, because the heat is stored and gradually released back into the atmosphere. This can lead to uncomfortable living conditions and increased energy demand for cooling, such as air conditioning, which can lead to higher electricity consumption and increased greenhouse gas emissions, further contributing to global warming.

Table 9: Albedo of selected surface types (processed according to: Oke 1987; Ahrens 2006; Lapin 2007)

Surface type	Albedo value
bare soil	0,07 – 0,20
sand	0,15 – 0,45
lawn	0,16 – 0,26
field (crops)	0,18 – 0,25
tundra	0,18 – 0,25
deciduous forest	0,16 – 0,27
coniferous forest	0,86 – 0,19
water	0,03 – 1,0
snow	0,4 – 0,95
ice	0,2 – 0,45
clouds	0,3 – 0,9
asphalt	0,05 – 0,20
white facade plaster	0,93

At the microclimatic level, we can observe hot "spots" in settlements, referred to in the professional literature as "Hot Spots". Their occurrence is often related to impermeable material with a high absorption capacity to retain heat and mainly to the lack of shading of the given surface, usually in the residential environment it is the absence of vegetation elements. According to Oke (1987), hot "spots" in settlements can be divided into surface urban heat islands – SUHI (Surface Urban Heat Island) and atmospheric urban heat islands – AUHI (Atmospheric Urban Heat Island).

Thermal Conductivity and Heat Capacity

Soil thermal conductivity is a property of soil that determines how well it conducts heat. It is expressed in watts per meter Kelvin (W/m·K) and is crucial in geotechnical and civil engineering analyses, especially in the design of foundations, geothermal systems, and underground structures. Factors that affect soil thermal conductivity: soil composition; water content; soil density; soil temperature; mineralogical composition.

Typical values of soil thermal conductivity:

- Dry sandy soil: 0.15 – 0.25 W/m·K
- Moist sandy soil: 1.5 – 2.5 W/m·K

- Dry clay soil: 0.25 – 0.5 W/m·K
- Moist clay soil: 1.0 – 1.8 W/m·K
- Saturated soil: 2.0 – 3.5 W/m·K

The municipality of Ratiboř does not have information on thermal conductivity of soils in cadastre. This data is not publicly available even on the state administration's land portal.

Surface temperature and emissivity

At the microclimatic level, we can observe hot "spots" in settlements, referred to in the professional literature as "Hot Spots". Their occurrence is often related to impermeable material with a high absorption capacity to retain heat and mainly to the lack of shading of the given surface, usually in the residential environment it is the absence of vegetation elements. According to Oke (1987), hot "spots" in settlements can be divided into surface urban heat islands – SUHI (Surface Urban Heat Island) and atmospheric urban heat islands – AUHI (Atmospheric Urban Heat Island).

Urbanization involves the concentration of population and the replacement of natural landscapes with built structures such as buildings, roads and parking lots. This change in land cover also changes of the properties of the earth's surface temperature - the energy balance, or the amount of radiation that the surface reflects and absorbs, to how heat is dissipated from the surface (Kalnay, Cai, 2003). The energy balance is also changed by humans, who, through their activities in the city (heating, industry and transport), release energy into the atmosphere. They also release substances into the atmosphere, mainly in the form of pollutants, water vapor and dust particles, which modify the energy balance, as they reduce the share of direct and increase the share of diffuse solar radiation.

The cadastre of the municipality of Ratiboř has the following emissivity values:

- Agricultural land: arable land, meadows and pastures have an emissivity of approximately 0.986 to 0.99.
- Forests: deciduous and coniferous forests show an emissivity in the range of 0.972 to 0.99.
- Built-up areas: buildings and roads with various construction materials have an emissivity in the range of 0.986 to 0.99, depending on the specific material (e.g. concrete, asphalt, roofing).

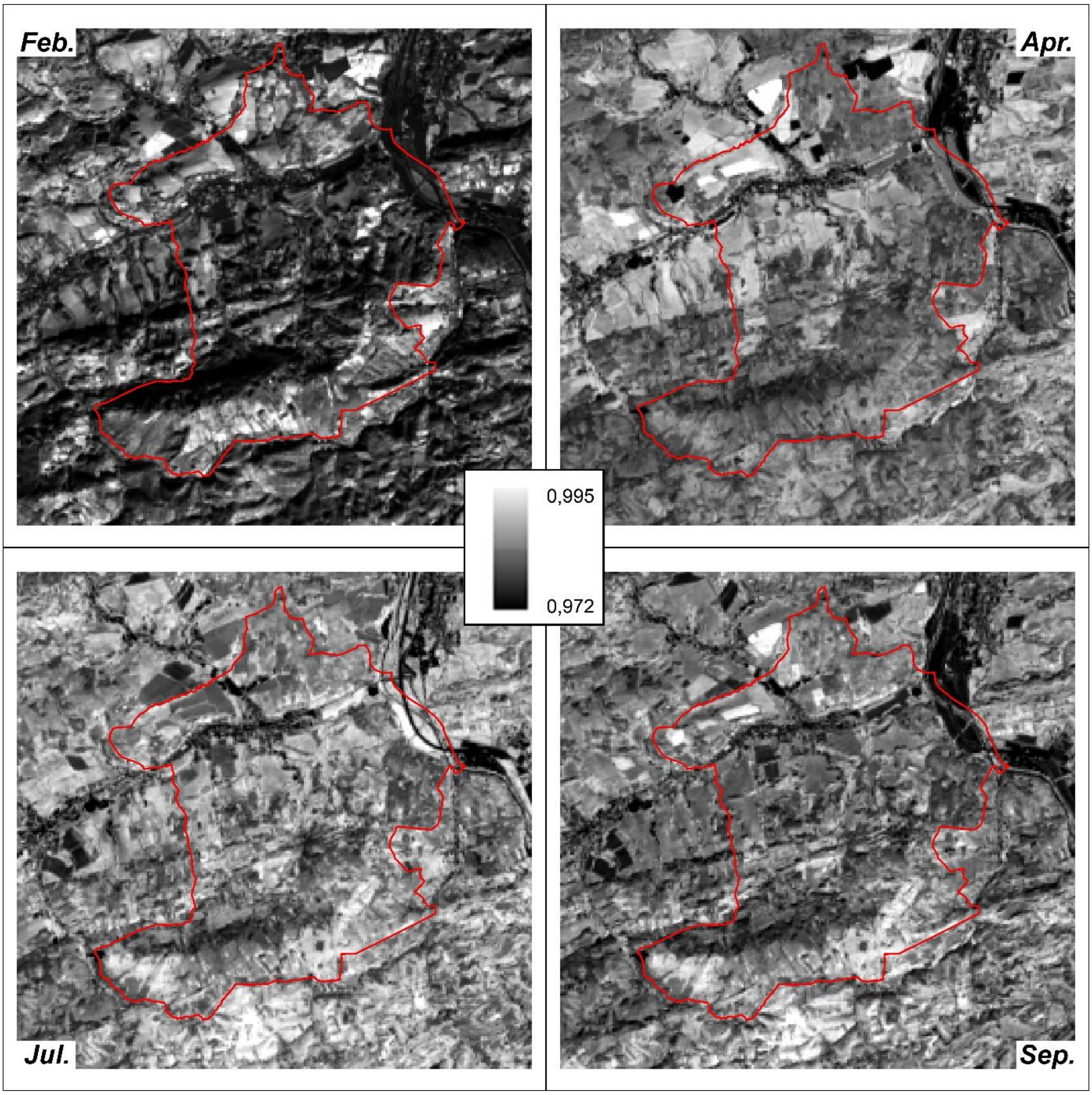

Figure 24: Emissivity of surfaces in the cadastre of the village of Ratiboř over the year (https://earthexplorer.usgs.gov)

There is a visible change in the emissivity of surfaces throughout the year. Emissivity is calculated from the wavelength of radiation captured by satellite sensors. The emissivity indicator also depends on the spectral range of radiation. For example, some materials have a different emissivity in the infrared spectrum and another in the visible spectrum.

Arable land shows a lower emissivity value in winter than in spring or summer.

Locations where the lowest emissivity value is throughout the year are built-up locations, especially buildings with aluminum or sheet metal roofs and paved industrial and transport areas. Areas with the highest emissivity values throughout the year are forests and permanent grasslands.

Material Condition

Coverage Area

Vegetative Cover

VULNERABLE GROUPS

Socio-economic indicators

The total population of Ratibor as of 1.1.2025 is 1837.

Young people, Elderly people

Under 15 years: 310 inhabitants

15-18 years: 67 inhabitants

Adult population aged 18 to 70 years: 1,202 inhabitants

Over 70 years: 258 inhabitants

Poverty rate

The national rate of Czech households at risk of income poverty is 9.8% (data for 2023).

Active working population

Gender

The total population of the village is 1837, of which 921 are women and 916 are men.

Immigrated people

The municipality records 19 foreigners as of 1 January 2025.

Low-skilled jobs

Undetectable data

Social housing

Undetectable data

Density of population

The population density in Ratiboř is 98 inhabitants per 1 km2.

Retired people

Health conditions

Ill people - Undetectable data

Disabled people - Undetectable data

Mentally ill people - Undetectable data

Newborn

In 2024, 15 newborns were born in the village.

Mortality rate

In 2024, 19 citizens residing in the village died.

Infrastructure

Hospitals capacity*

There is no hospital in the village.

Health centres*

There is a health centre in the village, which includes a general practitioner for children, a general practitioner for adults, a dentist's office and a female doctor's office (gynaecologist). There is also a pharmacy.

Retirement houses

There is no retirement home in the village, but there is a day care centre called Magnolia. This is for people over 65 who have reduced self-sufficiency due to age or health limitations and who need help and support from another person. The service allows you to combine a stay at home with a stay in a residential home.

Social housing

There are apartment buildings with social housing in the village. The first apartment house No. 337 has 10 housing units, the next apartment house No. 21 has 6 housing units, apartment house No. 572 has 2 housing units. In addition, the municipality has flats for crisis situations in houses No 89 and No 307.

PREPAREDNESS AND ADAPTIVE CAPACITY OF CITIES AND MUNICIPALITIES

For each criteria provide results of the analysis of the assessment:

- *in general in text and graphic presentation (diagrams, charts, tables, maps)*
- *for each indicator of the criteria in text and graphic presentation (diagrams, charts, tables, maps)*

Source of data for the assessment.

Limitation of the analysis (missing data, outdated data, etc.).

Institutional factors

The structure of the city administration

The basic body of the municipality is the council, which consists of 11 members (councillors). They are elected by the citizens of the municipality and then elect a mayor and a deputy mayor from among themselves. They are elected for 4 years. The municipality of Ratiboř does not have a council. Representatives are included as members of committees and commissions: audit and revision committee, finance committee, culture, youth and sports committee, social committee.

Legislative and regulatory regimes

The municipality is governed according to Act No. 128/2000 Coll.

Policies and plans

Institutions

There are 2 educational institutions in the village - a kindergarten and a primary school (for pupils of the first stage of primary school). There is also a cultural institution - the Multifunctional Community Centre (theatres and various cultural events of the village and the wider area are held here). There is also a religious institution - the Evangelical Church of Czech Brethren.

Social factors

Social connections and Community cohesion

In Ratiboř, social ties are strongly interconnected, creating a cohesive community where people often work together on local projects and events. Local associations, such as the fire department and cultural organizations, play a key role in maintaining patterns of mutual aid and tradition. There is a friendly atmosphere among residents, which promotes stability and mutual support in everyday life.

Self-learning/self-organizing capacities of communities and Available skills and knowledge

Ratiboř has a strong community capacity for self-organisation, which is reflected in the active participation of its residents in various initiatives and projects that make use of the available skills and knowledge of community members. Local people regularly organise cultural, sporting and volunteer events, thus promoting not only mutual cooperation but also the sharing of available skills and knowledge that contribute to the development of the community. This ability to learn and adapt to new challenges, while making use of available skills and knowledge, is also visible in the involvement of citizens in local decision-making, ensuring long-term development and strengthening mutual trust in the community.

Economic factors

Public financial resources

Public financial resources in the Czech Republic's municipalities are mainly made up of several main sources. Among the most important are the share of shared taxes, which form the main part of municipal revenues, including corporate and personal income tax, VAT and excise duties. Other important revenues are state subsidies and grants that municipalities receive for specific projects or development activities, both at national and European level.

Municipalities can also raise funds through their own activities, such as charges for services (e.g. waste, water, sewerage) or from income from municipal property (e.g. leases, property sales). Municipal revenues are therefore dependent not only on external sources, but also on the efficient management and administration of their assets, which is crucial for their financial stability and development.

Household income

Household income in the Czech Republic comes from several main sources. The largest part is income from work activities, i.e. wages and salaries, which are the main source of income for most households. In addition, households derive income from business activities, if members are self-employed, and from rental property or dividends from investments.

Other important incomes are various social transfers from the state, such as pensions, unemployment benefits, parental allowances or housing allowances. Household incomes can also be affected by various types of support, such as child allowances or social benefits for low-income earners. The total level of household income varies by economic status, education, age and region, with households in higher income areas often also benefiting from investments or other economic activities.

Access to financial resources and Insurance contracts

Access to financial resources and insurance can be affected by factors such as age, income, credit and insurance history, and regional differences. Lower-income people may have limited access to credit and may face higher interest rates or denial of loan applications. Similarly, in some areas, insurance options may be limited, particularly for specialized products or insurance in high-risk occupations.

Technological factors and scientific knowledge

Availability of technological, social, institutional, environmental and other innovations and Ability to use the innovations

The Czech Republic has seen growth in technological innovation in recent years, particularly in the IT sector, but smaller businesses face challenges in accessing these technologies. Social innovation focuses on improving the lives of the elderly, disadvantaged groups and promoting equality of opportunity, with some target groups still in need of more support. Institutional innovation includes simplifying administration and promoting the digitisation of public services, but bureaucracy and technology implementation in smaller municipalities remain challenges. Environmental innovation focuses on energy saving, renewable energy and nature conservation, while adaptation to green technologies is slower in industrial regions. Education and health care benefit from online learning and telemedicine, but digitisation and integration of new technologies face obstacles. Regional differences in the availability of innovation persist, with a higher concentration of innovation in cities and less availability in rural areas. Strategies such as the National Policy on Research, Development and Innovation 2021+

and the National Research and Innovation Strategy for Smart Specialisation aim to strengthen the innovation potential of the Czech Republic. Overall, the Czech Republic shows progress in different types of innovation, but closing regional gaps and supporting smaller players remain key challenges.

Availability of information on adaptation to climate change

In the Czech Republic, the availability of information on climate change adaptation is ensured through the Ministry of the Environment, which manages the Climate Change Adaptation Strategy for the Czech Republic. This strategy assesses the impacts of climate change and proposes adaptation measures in key areas such as agriculture and forestry.

Thanks to the BeReady project, the municipality of Ratiboř and its citizens are also learning about UHI issues.

5. Conclusions

The residential environment, largely formed by impermeable surfaces, has an impact on the formation of a specific climate, which is manifested by changes in hydrological conditions and the formation of an urban heat island. UHI is defined as an area of increased air temperature in the boundary and ground layers of the atmosphere above a city or industrial agglomeration compared to the rural surroundings (Streutker 2002). The magnitude of the UHI varies throughout the year, mainly due to changes in solar radiation intensity, changes in surface properties and also due to variability in weather conditions (Imhoff et al. 2010).

In particular, raising awareness among the residents and developing the skills of experts, planners, architects, urban planners and decision-makers will be essential for the successful planning and implementation of measures to reduce the impact of UHI in Ratiboř.

There are numerous measures to mitigate the effects of urban heat islands. The phenomenon of UHI represent a potential threat to the quality of life in the settlement which, especially in summer, can pose a health threat. Therefore, for detailed identification of UHI, it is important to monitor local climate indicators through certified local weather stations.

To mitigate the Urban Heat Island effect, one of the key strategies is to increase the albedo of urban surfaces. Here are some measures to do this:

1. Reflective or Cool Roofs:
    a. Cool roofing materials with high albedo (light colors or reflective coatings) can reduce the amount of heat absorbed by buildings. This helps lower both the air temperature and the cooling energy demand.
2. Light-Colored Pavements and Roads:
    a. Replacing traditional dark asphalt with lighter-colored or reflective pavement materials can significantly reduce heat absorption. This also lowers the surface temperatures of streets and other paved areas.
3. Urban Greening and Vegetation:
    a. Planting trees, grass, and creating green spaces in cities can help improve the albedo because vegetation typically has a higher albedo compared to urban infrastructure. Additionally, plants cool the air through evapotranspiration, which further helps mitigate the UHI effect.
4. Green Roofs and Walls:

   a. Installing green roofs or living walls with vegetation can both increase the albedo of buildings and reduce the amount of heat they absorb. These green spaces also contribute to cooling the immediate surroundings.
5. Water Features:
   a. Introducing water bodies (ponds, fountains, lakes) or using cooling techniques such as misting can lower temperatures and increase local humidity, helping to reduce the heat island effect.
   b. Albedo is directly linked to the Urban Heat Island effect because surfaces with low albedo in cities absorb more solar radiation and contribute to higher local temperatures. By increasing the albedo of urban surfaces through reflective materials, vegetation, and urban design strategies, cities can reduce the UHI effect, making urban areas cooler, more comfortable, and more sustainable for their inhabitants.

In conclusion, albedo plays a central role in shaping the microclimate by affecting temperature, humidity, and wind patterns. By manipulating albedo, cities and regions can manage their microclimates to reduce excessive heat and improve the comfort and sustainability of their environments.

Figure 25: View of the village of Ratibor in the Zlín Region (Source: www.ratibor.cz)

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Annexes