Interreg CENTRAL EUROPE

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MISSION CE CLIMATE

CLIMATE DATA MANAGEMENT

DIGITAL SOLUTION FOR LOCAL CLIMATE MONITORING IN OUTDOOR AREAS TO SUPPORT DECISION-MAKING, AWARENESS, AND CLIMATE RESILIENCE.

INNOVATIVENESS

The solution presents high integration of digital technologies. Its innovativeness lies in combining:

- **open data** principles,
- participatory and **data-driven education**,
- a functional link between technical monitoring and **community engagement**.
- **multifactorial comparison** of combined and individual cooling effects of different surfaces and shading in urban environments

OBJECTIVE

To improve data governance for climate adaptation in the municipalities through systematic data collection, processing, and visualization of local climate data with the aim to gain insights into the potential of nature-based solutions in improving urban microclimate, enabling infirmed decisionmaking, and raising public awareness and educate citizens.

GEOGRAPHICAL COVERAGE:

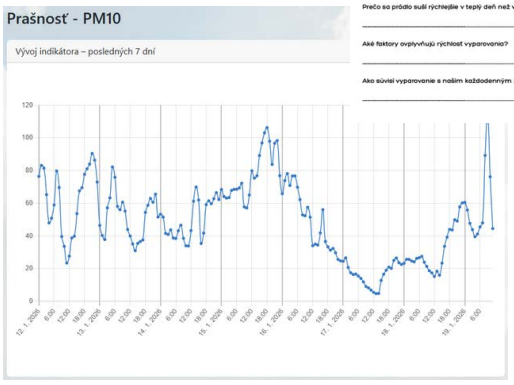
OUTDOOR SCHOOL AREAS OF THE CITY OF KOŠICE AND PARK AREAS OF THE CITY OF DORNBIRN

CLIMATE RESILIENCE SOLUTION IN MUNICIPALITY OF KOŠICE

The Košice school-based climate resilience pilot provides a controlled, real-world testbed for the full digital data lifecycle–from sensor readings to public interpretation.

The solution implemented by pilot project in the geographical area of City of Košice consists of:

- a network of IoT climate sensors installed in seven outdoor school areas.
- an open digital dashboard for visualization and interpretation of climate indicators published on www.klimatickedata.sk
- integration of collected data into the existing Open Data Platform of the City of Košice (See here)
- an Educational programme for participating schools and school communities based on real, locally measured data.



Climate sensors installed on rooftops of school buldings
Graphical visualization of measured climate indicator's values
Example of worksheet for studens of elementary schools

IMPLEMENTATION STEPS

The development of the digital solution within the City of Košice followed a structured, phased approach:

1. ANALYTICAL PHASE

- Identification of priority climate indicators based on Risk and Vulnerability Assessment (See here)
- Selection of suitable school locations for sensor installation based on local GISspatial analyses and local temperature maps (See here)
- Definition of technical specifications for sensors (in the case of pilot project on Košice following indicators were selected:

  Meteorological conditions: temperature, humidity, atmospheric pressure

  Wind dynamics: wind speed, wind gusts, wind direction

  Air quality – particulate matter: PM10, PM4, PM1

  Air quality – gases: CO, NO_2

2. TECHNICAL IMPLEMENTATION PHASE

Public procurement and installation of sensors

A public procurement process was conducted to acquire IoT climate stations, ensuring compliance with technical specifications and long-term warranty conditions. The sensors were installed in schoolyards and rooftops in early 2025, each measuring eleven indicators of air quality and meteorological conditions. The stations were connected to the Microsoft Azure IoT Central platform, enabling secure data transfer, cloud storage, and integration with visualization tools.

Establishment of data infrastructure

The solution generates continuous timeseries data with precise timestamps. These data allow both real-time analysis and longterm evaluation of local climate conditions. IoT devices are integrated into the Microsoft Azure IoT Central platform, supporting standard protocols (MQTT, AMQP, HTTPS). Data are stored in Azure Blob Storage and Azure Data Lake, while access and security are managed through Azure Active Directory (Entra ID). System monitoring and stability are supported by Azure Log Analytics, Azure Monitor, and Azure Security Center for IoT.

Preparation of dashboard visualization logic

Data are further processed and visualized in Microsoft Power BI dashboards dedicated for visualization of data and education purposes in schools and one integrated dashboard into the OPEN DATA KOŠICE platform for research, municipal governance, and transparency.

Testing and Fine-Tuning

Testing of the digital dashboard, resolution of technical issues and documentation of technical solution sustainability and maintenance.

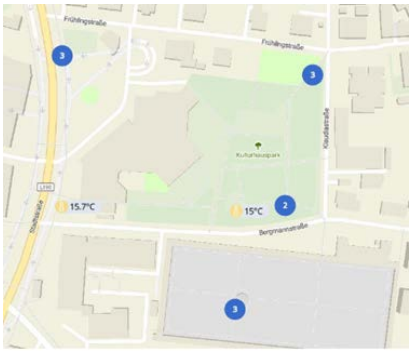
3. PARTICIPATORY EDUCATION AND COMMUNITY AWARENESS RAISING PHASE

Involvement of seven schools as active partners & joint development of educational worksheets and teaching instructions:

- Active collaboration with school representatives and educational experts in creation of curriculum for elementary schools consisting of educational worksheets for 4 school subjects and the implementation of the education program in schools.
- Awareness raising of school communities is ensured by presentation of climate monitoring dashboards at school premises via LED screens.

CLIMATE RESILIENCE SOLUTION IN MUNICIPALITY OF DORNBIRN

Rather than relying on satellite data or city-wide averages, the study directly measures surface temperature, air temperature, and humidity on the ground capturing microclimatic conditions that most affect human thermal comfort. It introduces a scalable and replicable low-cost methodology for assessing urban heat island mitigation which enables easy adaptation to other areas and climatic context.



Area where sensors are installed in City of Dornbirn

Climate sensors installed on street lamps

The solution implemented by the pilot project in the City of Dornbirn consists of:

- A network of climate sensors to measure air temperature, surface temperature, as well as humidity to assess a heat index and the perceived temperature. The sensors are located in sealed/unsealed and shade/no shade areas.
- The data is collected and visualized on the CityMonitor dashboard to to enable transparency and informed decision-making on the city level.

IMPLEMENTATION STEPS

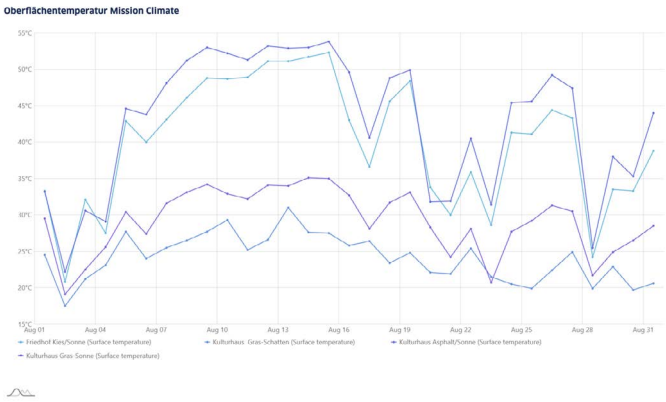
The development of the digital solution within the City of Dornbirn followed the following approach:

1. ANALYTICAL PHASE

- **Identification of climate indicators** based on the Risk and Vulnerability Assessment – heat and changes in the water cycle were the most relevant climate risks for the city of Dornbirn
- Selection of **suitable locations** for sensor installation in close cooperation with the relevant departments in the city of Dornbirn
- Definition of **technical specifications for sensors**. In the case of the pilot study in the city of Dornbirn, the following data is collected: air and surface temperature and humidity to calculate the heat index and the perceived temperature.
- To go beyond mere measurement of heat, a **multi-factor design** was chosen comparing temperatures between sealed and non-sealed and shade and non-shade to each other.

2. TECHNICAL IMPLEMENTATION PHASE

- **Public procurement and installation of sensors**
  A public procurement process was conducted to acquire the sensor network, ensuring compliance with technical specifications and long-term warranty conditions. The sensors were installed in the "Kulturhauspark" in 2025.
- **Establishment of data infrastructure**
  The solution generates continuous timeseries data with precise timestamps. The data allows both real-time analysis and longterm evaluation of local climate conditions. The data is used to assess the heat index.
- **Integration into the Dashboard**
  The Data is visualized in the already existing citymonitor dashboard dedicated for visualization of data and transparency within the city to enable informed decision-making.
- **Testing and Fine-Tuning**
  Testing of the digital dashboard, resolution of technical issues and documentation of technical solution sustainability and maintenance.



This graph shows the surface temperature of four locations within the time frame of a month, which highlights the temperature difference between shade and non-shade.

SCALE-UP OF THE PILOT STUDY IN DORNBIRN

Water, alongside heat, is one of the most significant climate risks in Vorarlberg in general, but also for the city of Dornbirn. Heavy rainfalls pose **a threat**.

In collaboration with the city's fire brigade, the pilot study is now being expanded to incorporate water into the climate monitoring system. This will include **tracking water levels of rivers and streams and monitor underground passageways for water**. This data will then be integrated into a dashboard to provide access to the data and the relevant **information in real-time** to enable the catastrophe response team to act swiftly and effectively in emergencies.

PILOTS SUMMARY

The Dornbirn pilot advances climate adaptation by proving a practical, city-ready pipeline for data acquisition, monitoring, analysis, and interpretation of urban heat. Using the heat index to compute perceived temperature, it translates raw sensor data into human-centric risk signals for planners. These insights are then published via the CityMonitor dashboard, which turns technical readings into clear visuals that support awareness, policymaking, and replication across new sites. In sum, the pilot operationalizes an end-to-end digital method– from robust sensing to meaningful public interpretation–that municipalities can reuse to target, validate, and prioritize nature-based cooling measures.

The Košice school-based climate resilience pilot provides a controlled, real-world testbed for the full digital data lifecycle–from sensor readings to public interpretation. Multi-parameter sensors installed on school grounds capture local air and weather conditions and transmit them to the city's Open Data platform. On top of this pipeline, a public "Climate data monitoring" dashboard transform raw streams into intelligible insights, linking values to health and environmental impacts and recommended behaviors. Thanks to cooperation with teachers, human-centered interpretation of data was ensured, and the solution was incorporated into the curriculum through prepared lesson plans and student projects, thereby promoting its lasting acceptance.