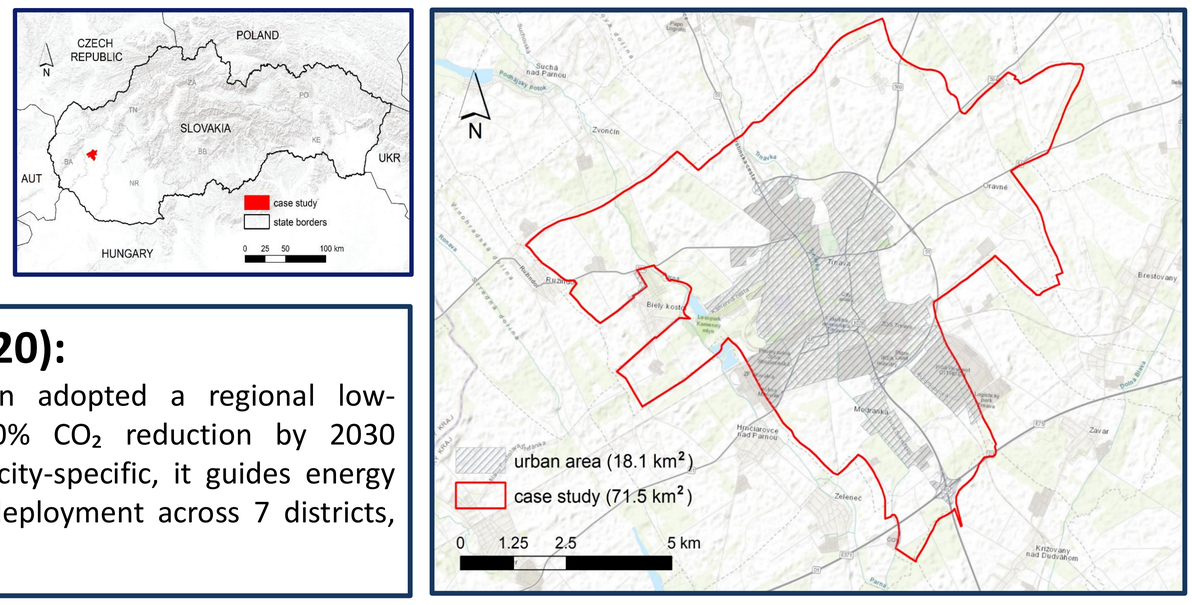
APPLICATION OF THE CLIMAAX TOOLBOX FOR CLIMATE RISK ASSESSMENT OF HEATWAVE–DROUGHT EVENTS IN TRNAVA (SLOVAKIA)

1 STUDY AREA TRNAVA CITY

- Trnava, a regional center in western Slovakia (65,000 inhabitants), is located in one of the country's warmest and driest lowlands, making it highly exposed to heatwaves and droughts
- Average temperature in July (the warmest month): 21 °C, mean annual precipitation: 660 mm.

▼ **Fig. 1** Position of Trnava city in western part of Slovakia.



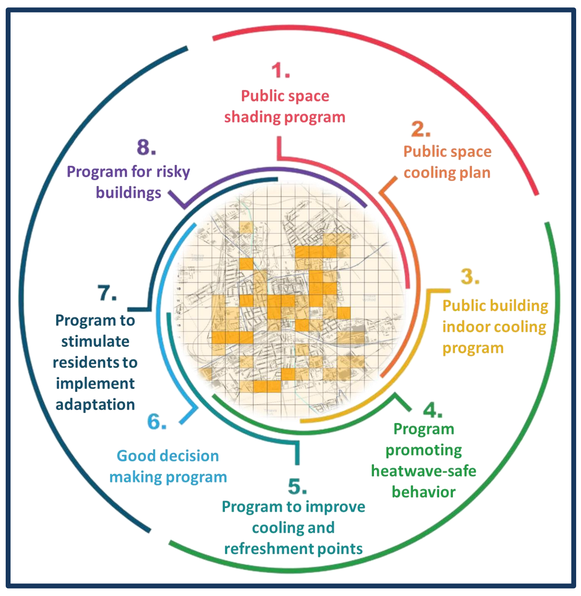
2 PREVIOUS CLIMATE STRATEGIES

Adaptation Strategy (2015-2017):

- Trnava's first climate adaptation strategy focused on heatwave risks. While it was pioneering at the time, the strategy now requires updating due to its relatively coarse spatial resolution and limited use of high-resolution datasets.

Low-Carbon Strategy (2020):

- The Trnava Self-Governing Region adopted a regional low-emission strategy targeting a 40% CO_2 reduction by 2030 (compared to 2010). Though not city-specific, it guides energy efficiency and renewable energy deployment across 7 districts, including Trnava.



3 TRACAP SPECIFIC OBJECTIVES

Update Trnava's Climate Adaptation Strategy
Replace the outdated strategy using the CLIMAAX methodology, enhanced with high-resolution local data and vulnerability assessments tailored to urban characteristics.

Focus on Heatwave and Drought Risks
Apply CLIMAAX toolboxes for heatwave and drought risk analysis, which are the most pressing hazards for Trnava.

Identify Priority Areas for Green Infrastructure
Use refined spatial analysis to target specific zones for urban greening, water management, and other adaptation interventions.

Strengthen Emergency Preparedness
Improve local risk management plans, early warning systems, and crisis communication, ensuring better response to extreme weather events.

Engage Stakeholders in a Collaborative Framework
Involve at least six stakeholder groups - including municipal departments, NGOs, academic institutions, and vulnerable populations - in all project phases.

Promote Knowledge Transfer and Policy Integration
Train city staff to use CLIMAAX tools, host workshops, and mainstream the results into urban planning and policy-making processes.

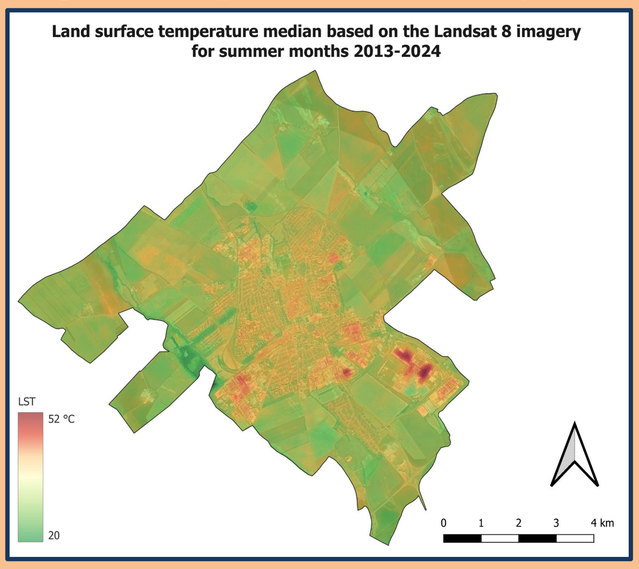
Build Long-Term Resilience
Reduce vulnerability to climate change by embedding adaptation into local governance and encouraging citizen participation and preparedness.

4 HEATWAVE AND DROUGHT IMPACTS

Heatwave Risk:

The CLIMAAX heatwave workflow integrated Land Surface Temperature (RSLab) and population vulnerability data (WorldPop) to identify critical zones of urban overheating. **Fig. 2** shows the median LST (2013–2024), confirming persistent heat accumulation in the city centre and industrial zones. **Fig. 3** highlights areas where vulnerable populations (elderly, children) face the highest exposure, mainly around the city centre, train station, and university area. Projections indicate an increase in heatwave days by more than **180 % under RCP 4.5** and up to **240 % under RCP 8.5** for 2036–2065. These results emphasize the need for targeted adaptation measures such as urban greening, reflective surfaces, and cooling shelters, especially in densely populated residential districts with limited vegetation.

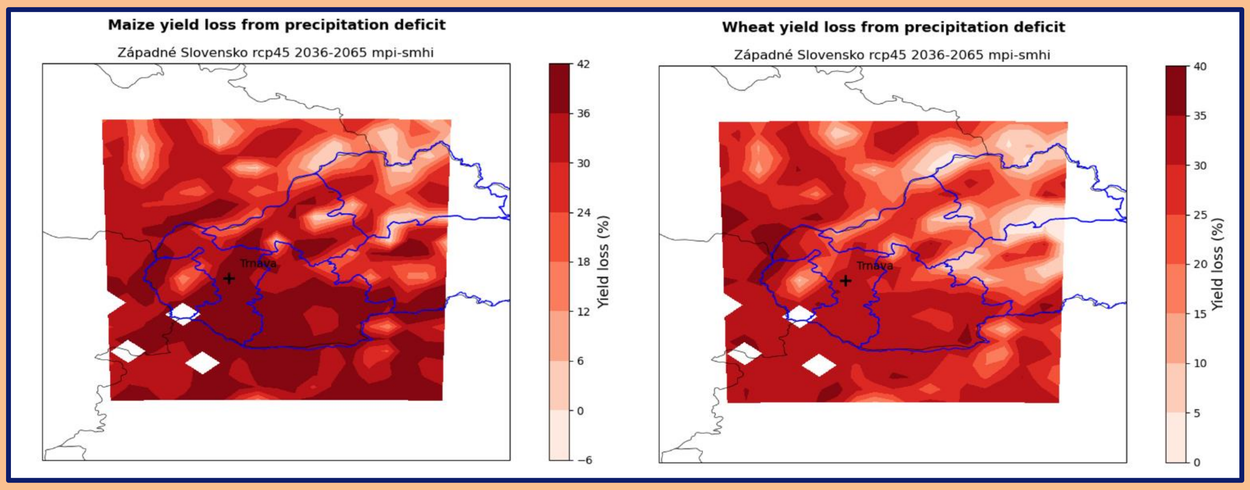
▼ **Fig. 2** Trnava LST (median for summer months).



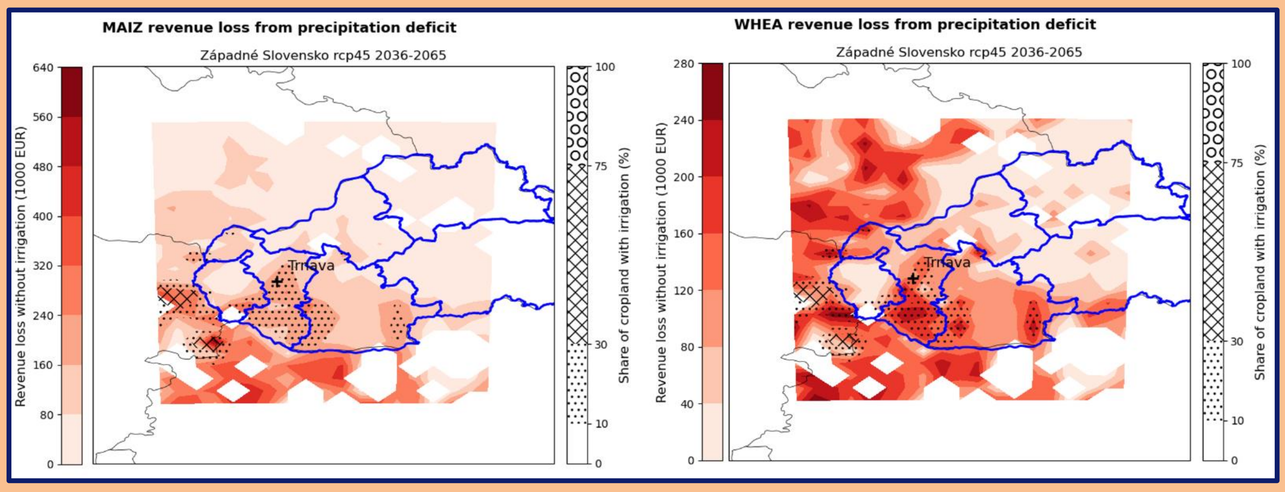
▼ **Fig. 3** Possible heat risk areas to vulnerable population.

Drought Risk:

The CLIMAAX drought workflow applied the agricultural drought module using Euro-CORDEX projections and crop-specific parameters to estimate yield reductions for maize and wheat. **Fig. 4** show projected yield losses under RCP 4.5 (2036–2065), reaching **30–42 %** across the Trnava region. These spatial patterns indicate severe impacts on both crops, especially in lowland agricultural zones with limited irrigation capacity. **Fig. 5** translate these yield losses into potential economic damages, illustrating that maize revenue losses could exceed **€320 000 per grid cell**, while wheat losses remain substantial but lower. Without improved irrigation and soil-moisture management, such drought-induced yield reductions could significantly threaten local food security and farm income. The results highlight the need to integrate agricultural adaptation, water-management, and ecosystem-based measures into Trnava's updated climate strategy.



▲ **Fig.4** Maize (left) wheat (right) yield loss from precipitation deficit.



▲ **Fig. 5** Maiz (left) wheat (right) revenue loss from precipitation deficit.

TRNAVA

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CLIMAAX climate ready regions