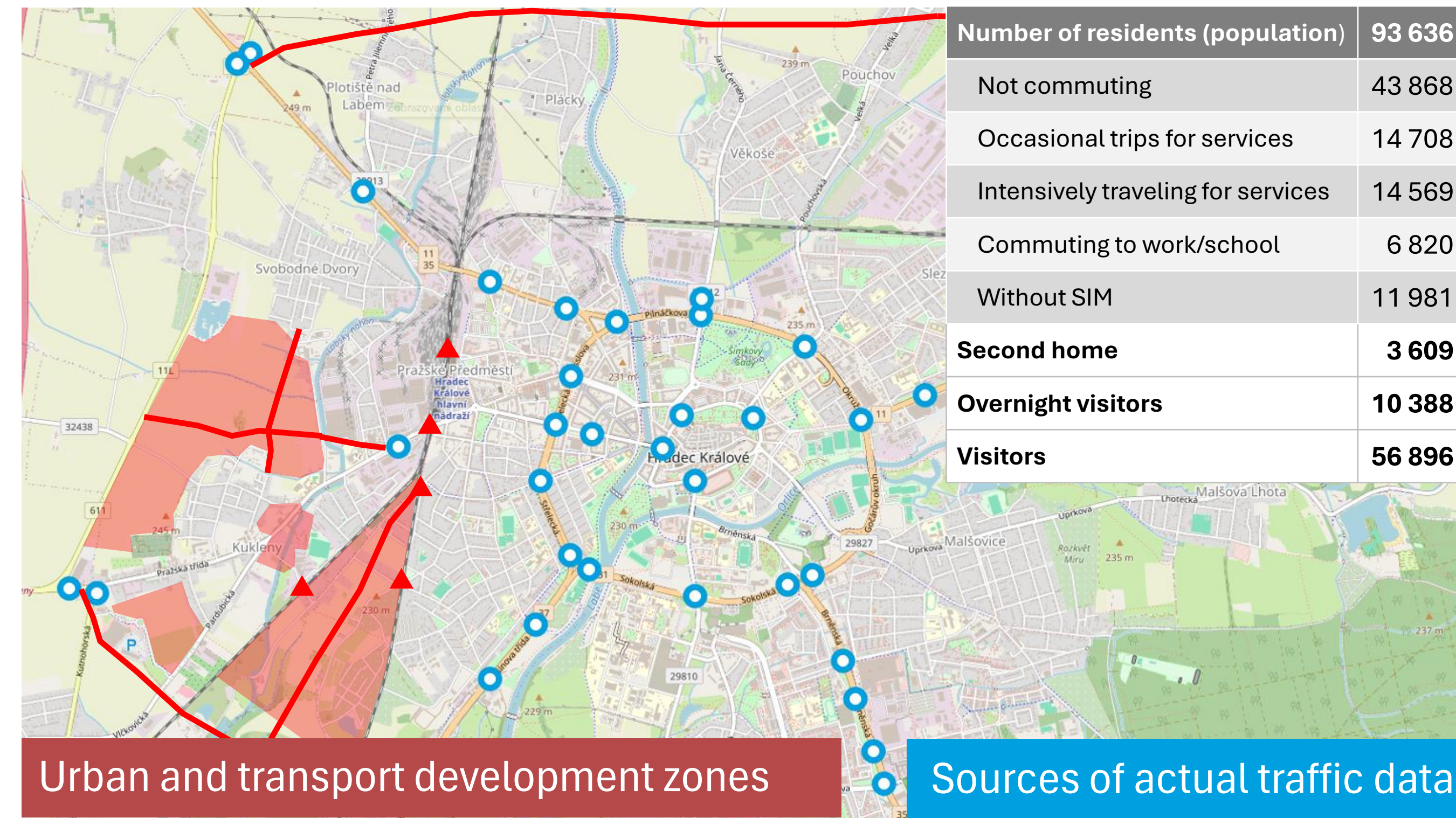
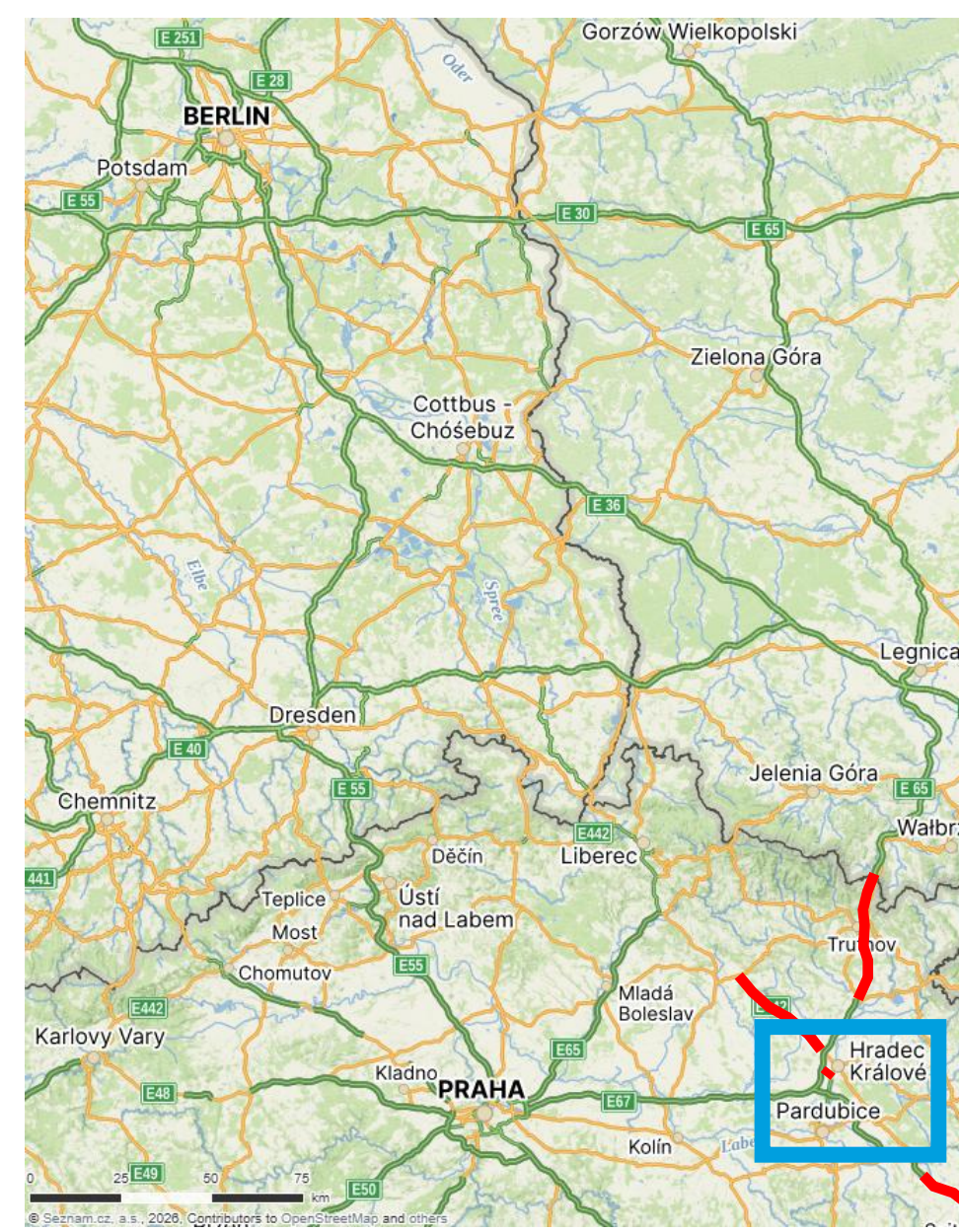




Agent-based traffic micro simulation driven by population model and socio-economic factors with use of open data and intelligent transport system data.

Smart Urban Mobility Simulation: A Case Study of Hradec Králové

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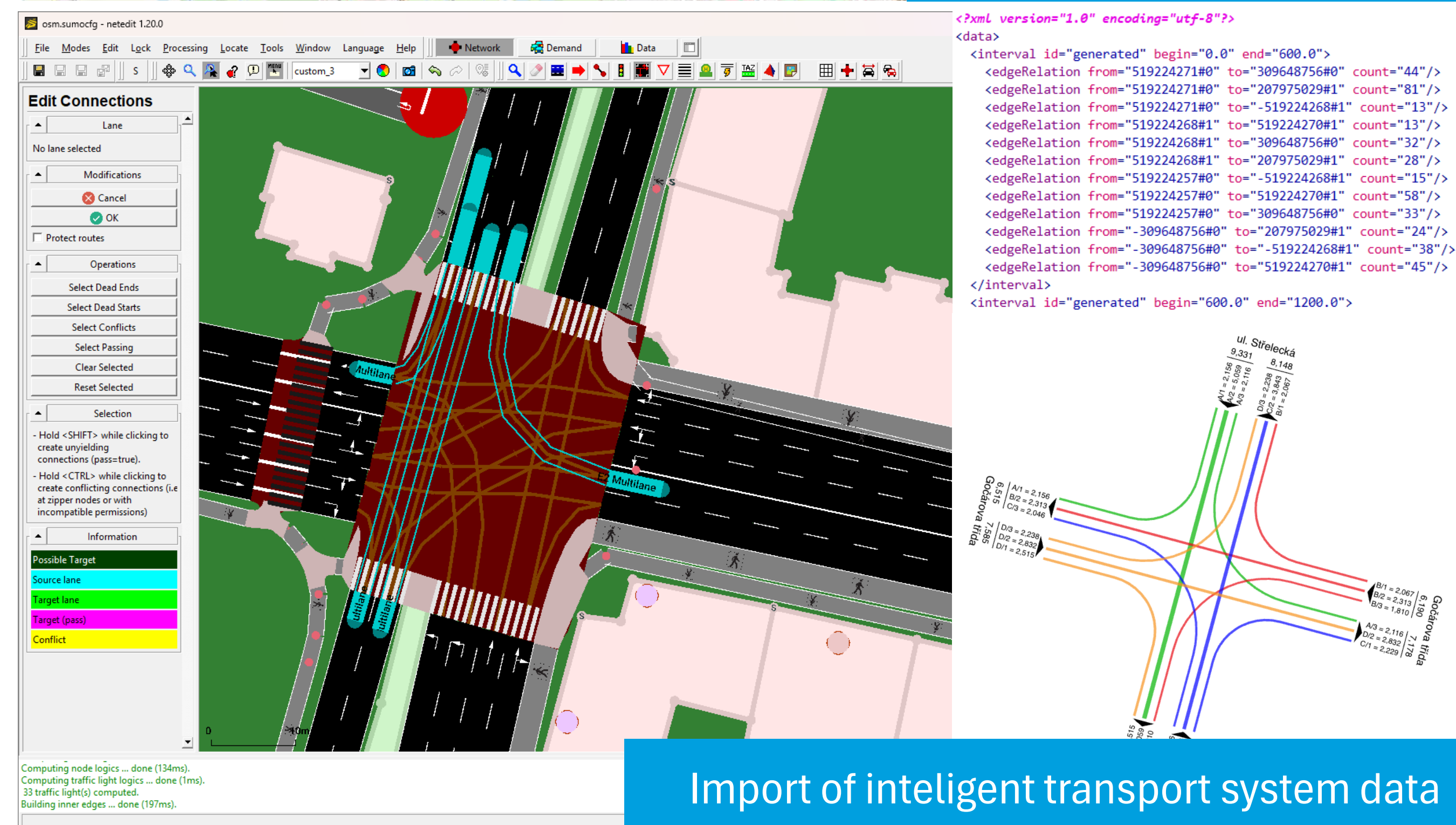


Background

- ITS Implementation:** Hradec Králové recently deployed an Intelligent Transport System (ITS) designed to integrate traffic control, parking management, and municipal services into a unified ecosystem.
- The INVIPO Platform:** Powered by the Czech company INCINITY, this smart solution enables high adaptability to dynamic traffic conditions and evolving urban needs.
- Strategic Growth:** The city is on the brink of major development, including the expansion of the highway network and critical infrastructure projects such as railway capacity upgrades and new arterial roads.
- Research Collaboration:** In January 2026, UHK FIM and INCINITY launched a joint research project to enhance the INVIPO platform with advanced traffic prediction capabilities across various urban scenarios.
- Our methodology integrates** open-source solutions (**SUMO**, **MatSIM**, **ActivitySIM**) to develop, verify, and validate multi-modal traffic simulations based on a socio-economic population model.

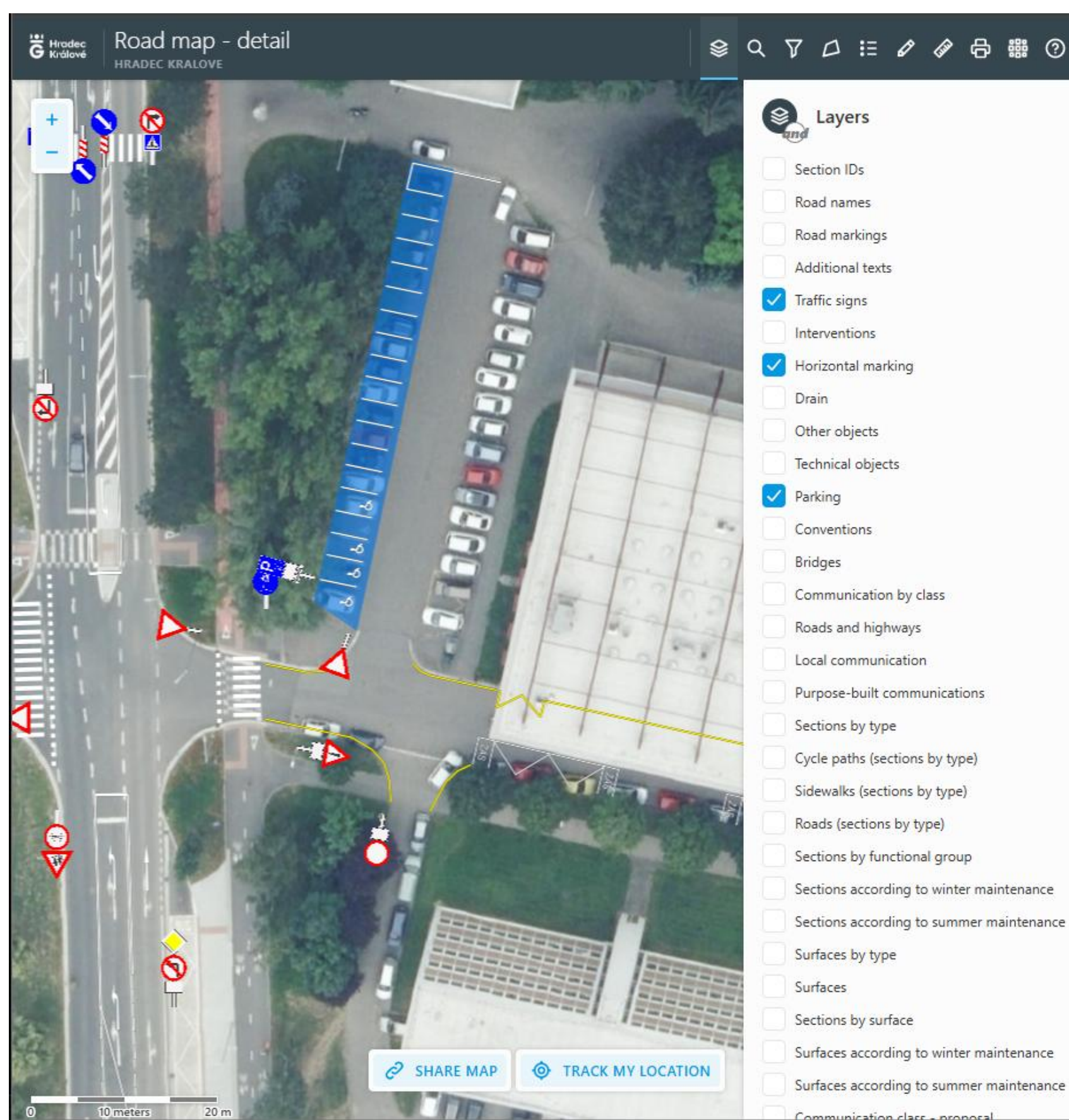
Motivation

- Data-Driven Case Study:** The project leverages open data sources in synergy with ITS data to create a comprehensive case study for Hradec Králové, establishing a framework transferable to other cities and regions.
- Strategic Applications**
 - Traffic Control Optimization:** Proposing and testing adaptive control strategies.
 - Public Transport Planning:** Evaluating changes in transit networks and schedules.
 - Event Management:** Analyzing traffic patterns during mass gathering events.
 - Logistics & Urban Planning:** Simulating freight scenarios and supporting informed urban development decisions.
- Industry Integration:** Resulting prototype will serve as a foundation for INCINITY to further enhance the capabilities of the INVIPO platform.

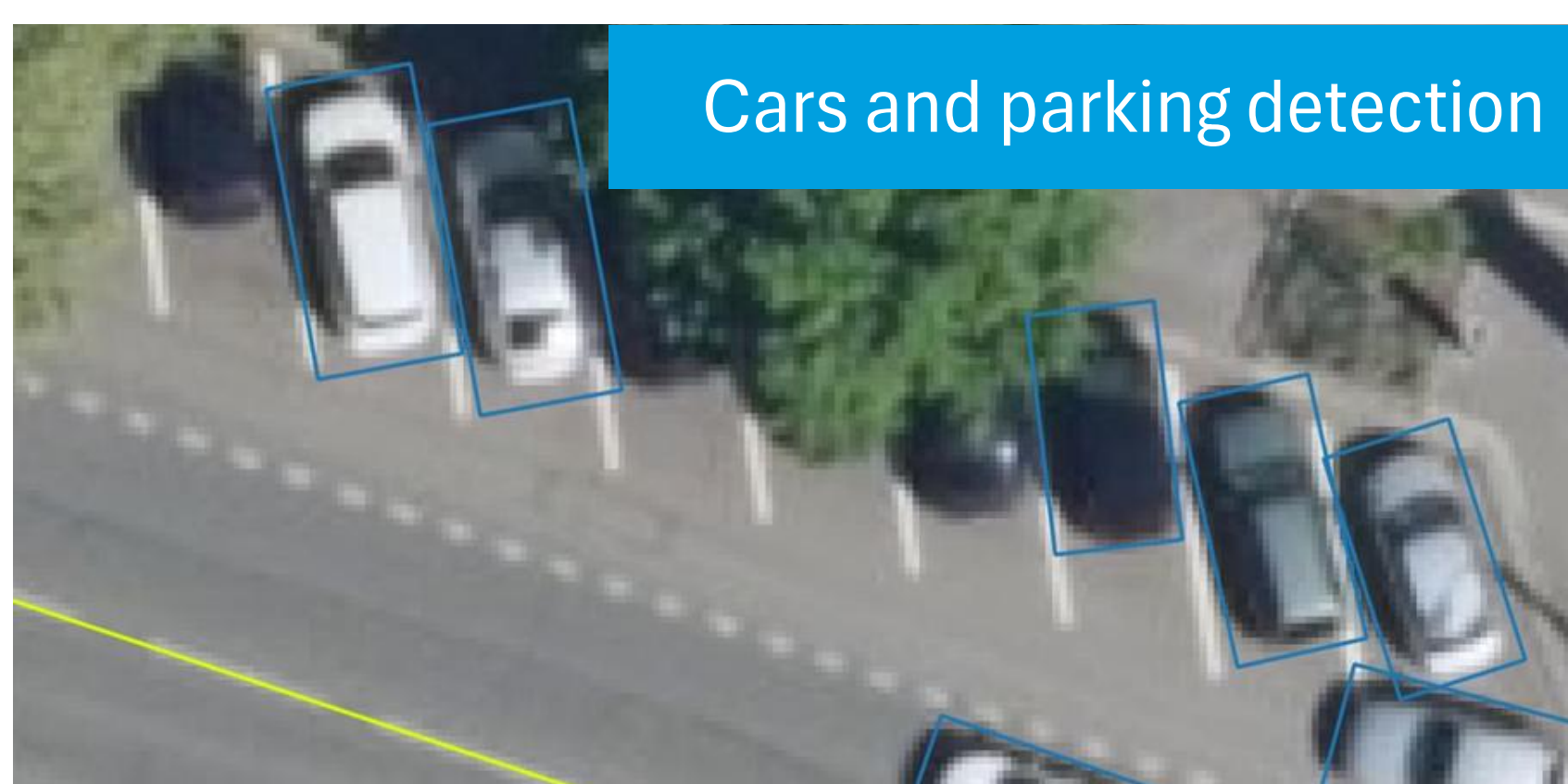


Data sources

- Default option: openstreetmap.org
- Census surveys: geodata.csu.gov.cz
- Traveling behavior: kamdojzidime.cz
- Infrastructure data: geoportal.mmhk.cz
- We apply deep learning techniques (YOLO26) to detect cars and parking places from aerial orthophoto maps for validation.



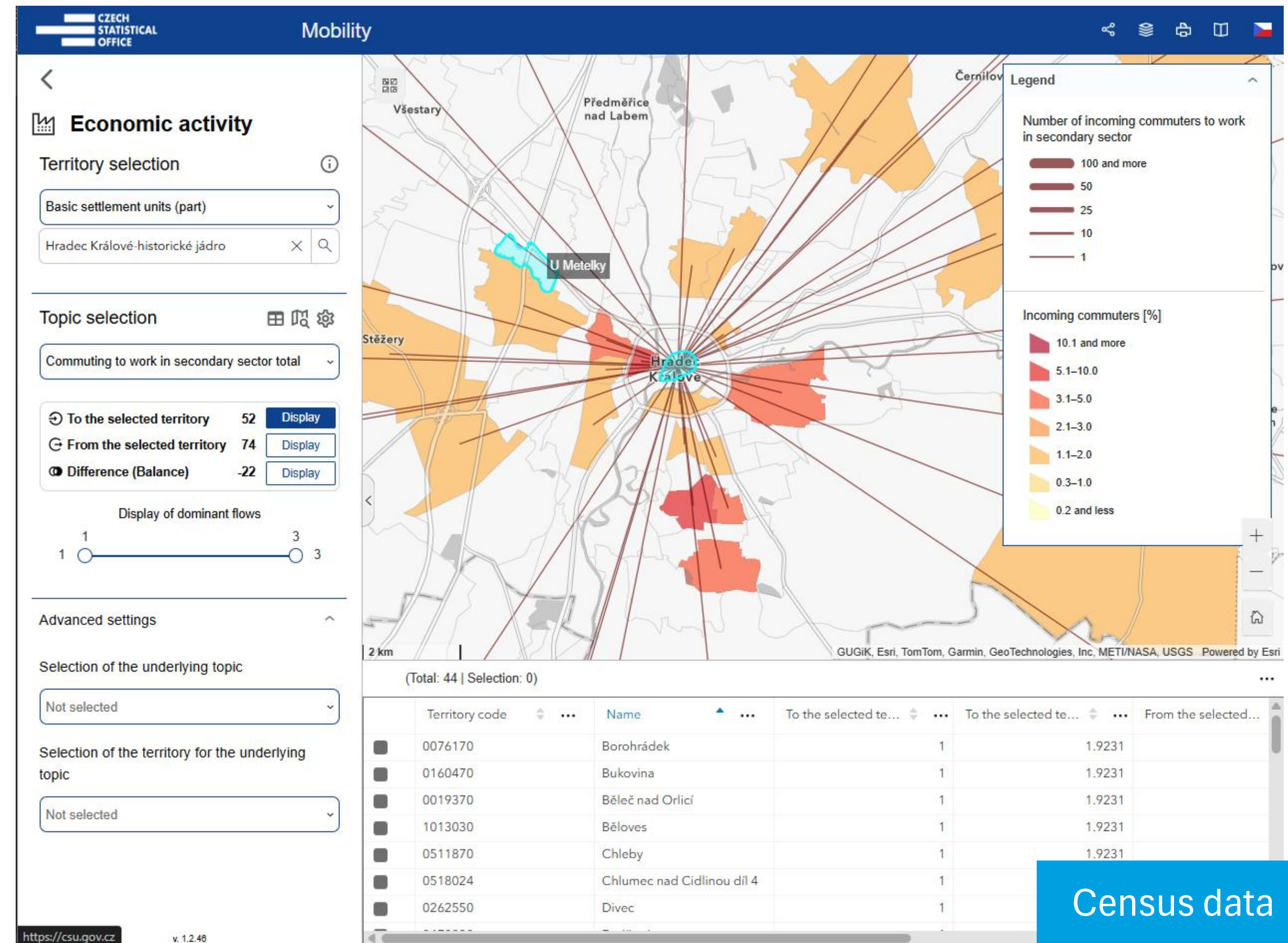
source: <https://geoportal.mmhk.cz/>



Cars and parking detection

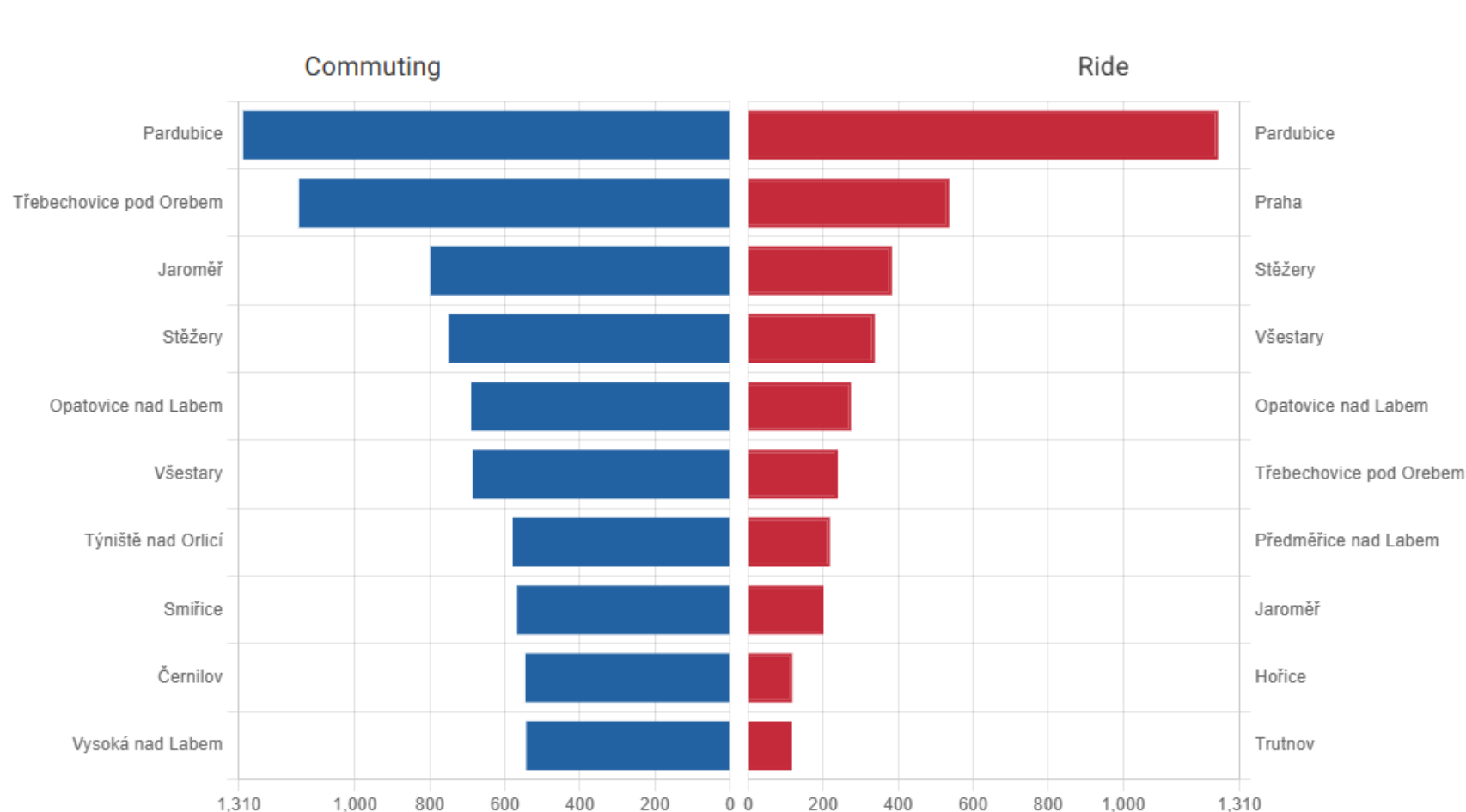
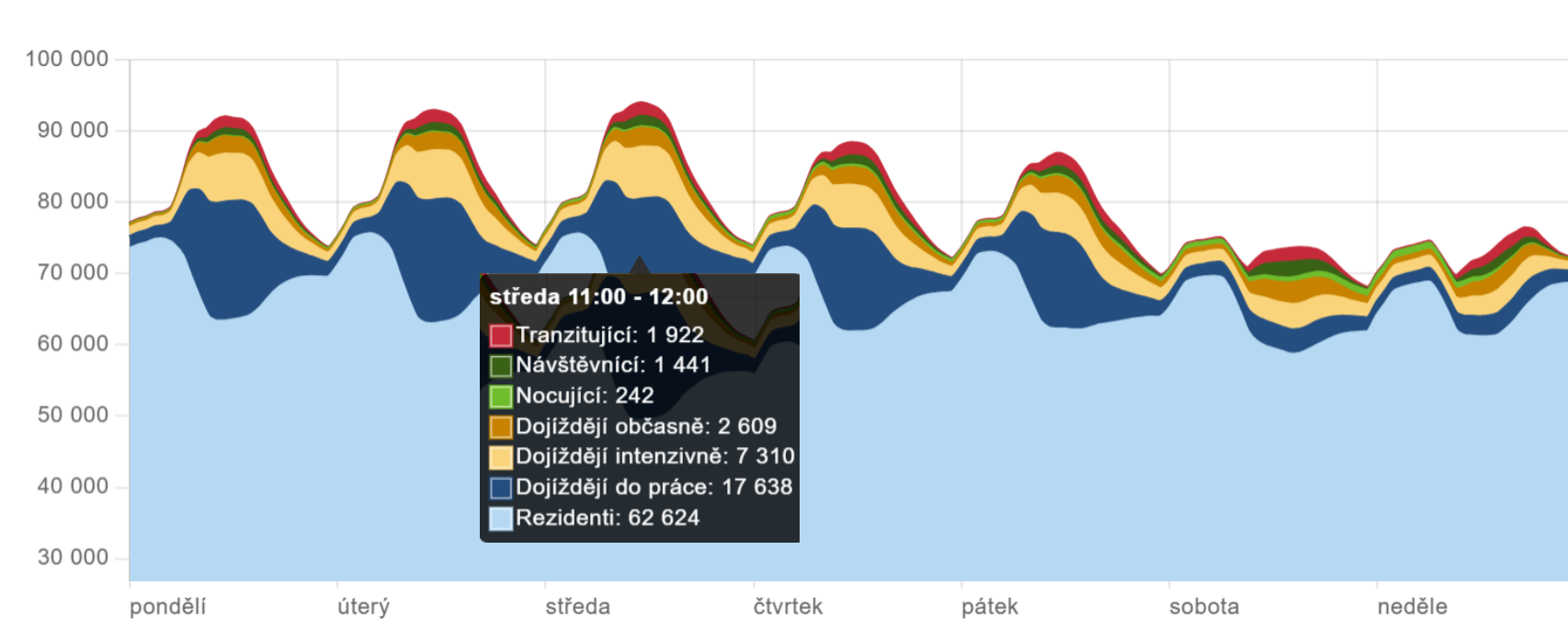
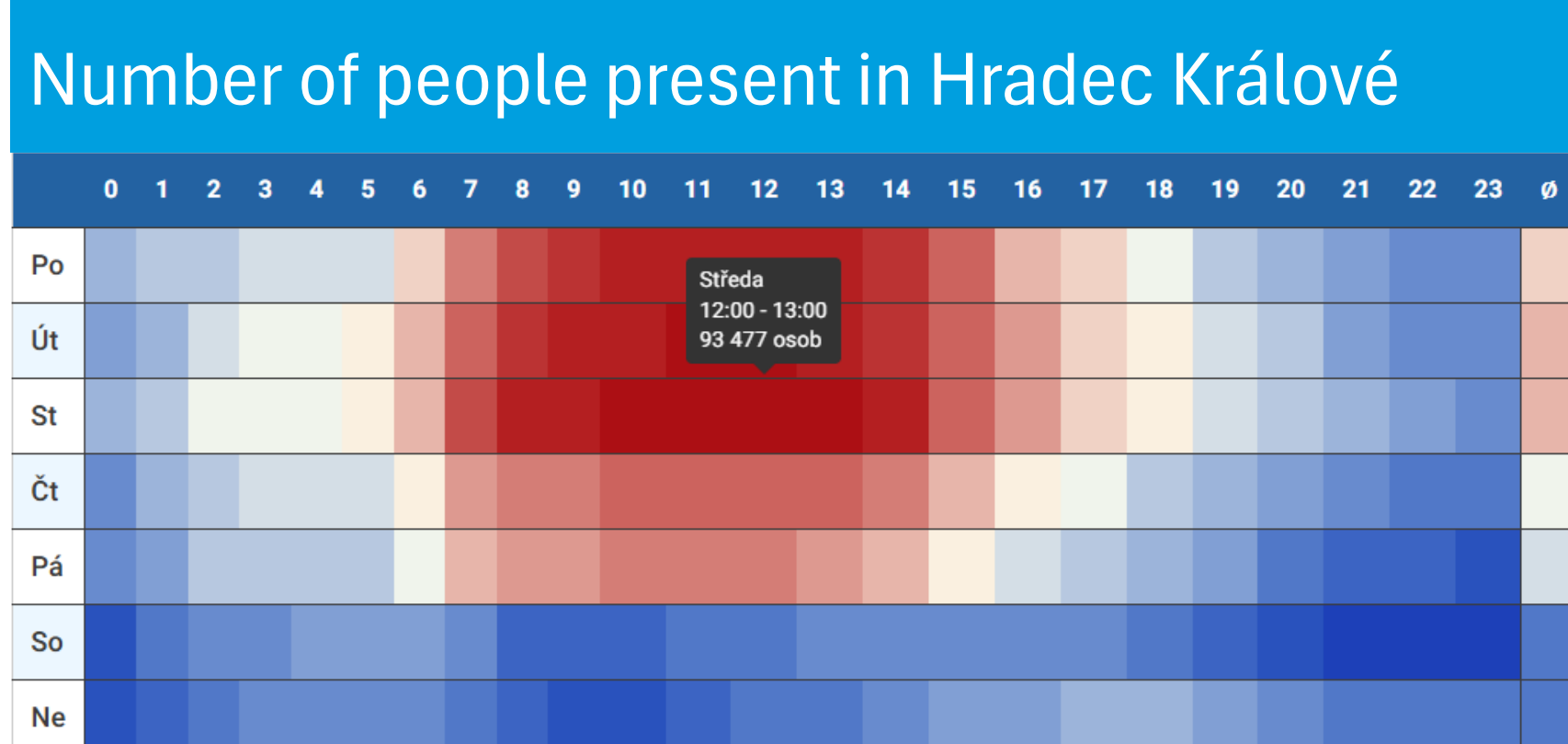


source: Archleb, Z. (2026), master thesis



Census data

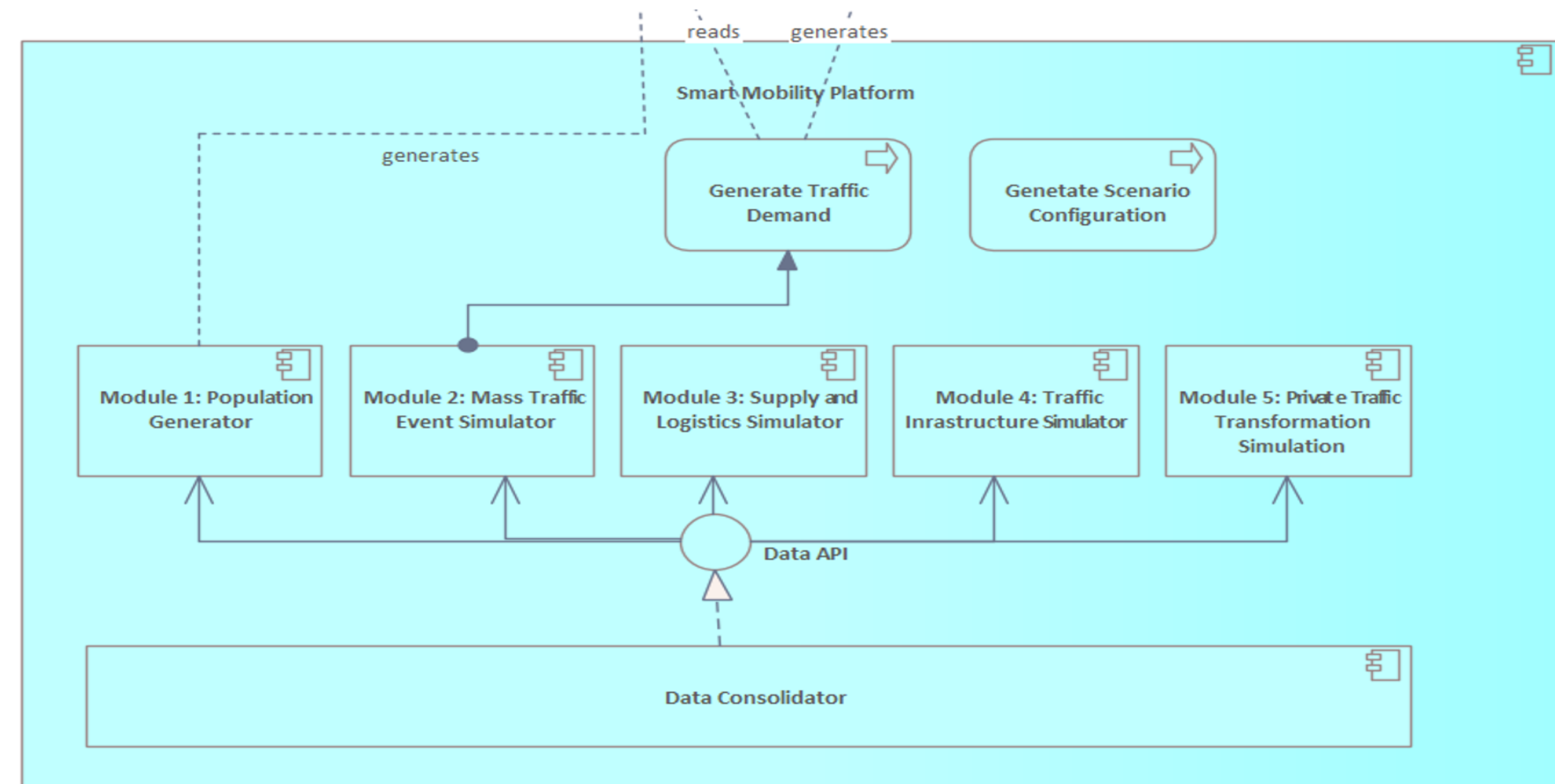
source: <https://geodata.csu.gov.cz/as/mobilita>



source: <https://www.kamdojzidime.cz>

Platform architecture

- Module 1:** Developing a high-fidelity population model, cross-referenced and validated against official census data to ensure demographic accuracy.
- Module 2:** Generating dynamic traffic demand patterns specifically tailored to mass gathering events and their impact on urban mobility.
- Module 3:** Designing and implementing logistics-specific scenarios within the simulation to evaluate freight movement and delivery networks.
- Module 4:** Simulating and quantifying the effects of various infrastructure modifications and traffic control changes on overall city throughput.
- Module 5:** Analyzing how varying population travel preferences (mode choice, route selection) influence traffic situations and sustainability.



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Project registration number CZ.01.01.01/01/24_063/0006761.

