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Mobility data analyses for the transport model of the Slovak Republic in REMOT project

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INTRODUCTION

Backround information & Market Context

Creating strategic transport models is crucial for infrastructure planning. They optimize traffic, support sustainability, and improve resource use. A key step is model calibration with reliable data, though obtaining such data is often challenging due to aggregation and verification issues.

Problem Statement & Stakeholders

Strategic transport models optimize traffic and infrastructure, but data reliability is a challenge. Slovakia integrates census and SIM card data to improve accuracy. Key stakeholders include the Ministry of Transport, researchers, and urban planners.

Research Objectives & Expected Impact

The REMOT project analyzes mobility and emissions in Slovakia using diverse data sources to enhance transport models and infrastructure planning. Its impact includes improved traffic management, sustainable mobility, and data-driven decisions, benefiting policymakers.

MATERIALS, METHODS & IMPLEMENTATION

Description of research methods and materials

The project REMOT (Research on mobility and emission attributes of the transport process) redefined Slovakia's strategic transport model to enhance mobility analysis and infrastructure planning. The model's zonal structure was expanded from 275 to 2,927 transport zones, significantly improving spatial resolution and enabling a more detailed assessment of transport flows and interactions between urban and rural areas. This refined structure facilitated the integration of diverse data sources essential for transport modeling. One of the key datasets used was SIM card movement data from Orange France, analyzed through the Flux Vision platform. This system processed anonymized mobile network signals to generate origin-destination (O/D) matrices, offering real-time insights into population mobility. Another critical source was TomTom Move statistics, which provided GPS-based data on traffic speeds, congestion levels, and travel times, allowing for a comprehensive analysis of Slovakia's road network. Additionally, the project incorporated data from the 2021 National Census, which included demographic information and commuting patterns, further enhancing the model's accuracy.To process and analyze these datasets, the project utilized Matlab and PTV Visum, enabling advanced modeling and visualization. The integration of these diverse data sources resulted in a more precise transport model, supporting improved decision-making in infrastructure

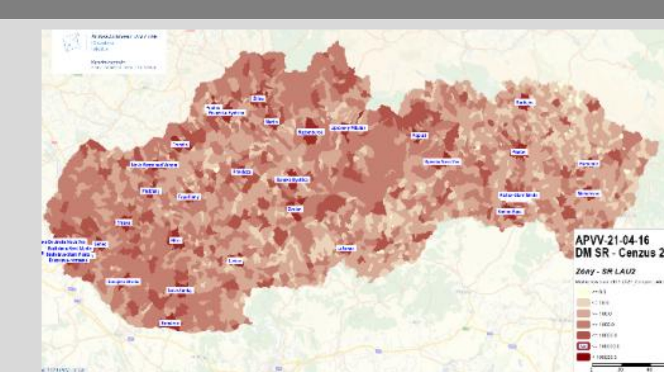

Fig. 1 Old Zonal system

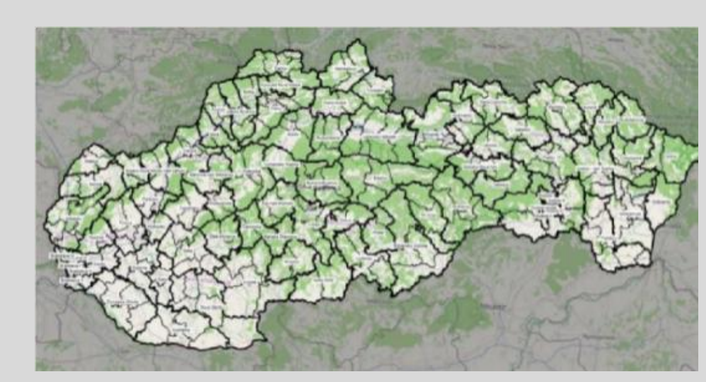

Fig. 1 new Zznal system

RESULTS

Academic Findings & Innovation

Practical Applications

The REMOT project introduced innovative approaches to transport modeling by developing transport distribution functions, which analyze population movement based on infrastructure and socioeconomic factors. These functions were determined using census data and categorized into four settlement groups based on population size. Additionally, economic activity, education level, and employment were considered to refine mobility predictions.A key innovation was the parameterization of distribution functions, which generalized mobility patterns across various transport zones. Different mathematical models, such as Power, Combined, and Logit functions, were used to analyze transport relationships, providing predictive insights into commuting behaviors. The Power and Combined functions in larger population categories demonstrated high accuracy, with R^2 values exceeding 0.7, making them highly effective for transport planning. In practical applications, these findings enhance mobility forecasting and infrastructure planning, allowing policymakers to optimize traffic flow and resource allocation. The refined models offer data-driven insights for urban and regional planning, ensuring sustainable transport development. By integrating advanced statistical analysis, the project significantly improves the accuracy of transport models, supporting more efficient decision-making in Slovakia's infrastructure policies.

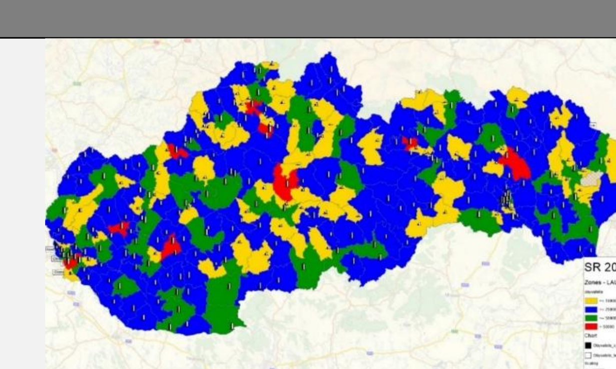

Fig. 3 Categorization of territory by population

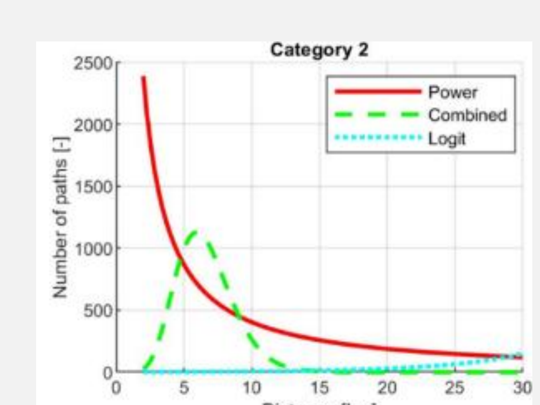

Fig. 4 Examples of distribution functions

CONCLUSION & IMPLEMENTATION PATH

The REMOT project analyzes mobility data and parameterizes selected indicators to enhance transport modeling. The model, covering nearly 3,000 zones within the LAU2 structure, requires an extensive database. Integrating data from CENSUS 2021 and combining it with other datasets was essential to constructing an accurate model of transport flows. A critical step involved processing SIM card movement data from Orange, necessitating adjustments in territorial divisions to align with the LAU2 framework. The initial results confirm consistency between observed mobility patterns and CENSUS 2021 data, validating the applied methodology. Additionally, speed model data were incorporated to identify capacity constraints in the transport infrastructure, a parameter currently under evaluation for optimizing transport planning. Another key aspect of the study is the parameterization of distribution functions based on municipality categorization by population size. Testing multiple fit functions revealed limitations in explaining data variability, prompting a more detailed categorization of roads and transport layers using data from the Statistical Office. This phase aims to refine the model's accuracy and improve predictions of transport flows. The final project stages will focus on further refining these analytical methods to ensure reliable insights for strategic transport planning and infrastructure development.

ACKNOWLEDGEMENTS

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