AutoCarto 2020

Optimising road selection for small-scale maps using decision tree-based models

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Motivation

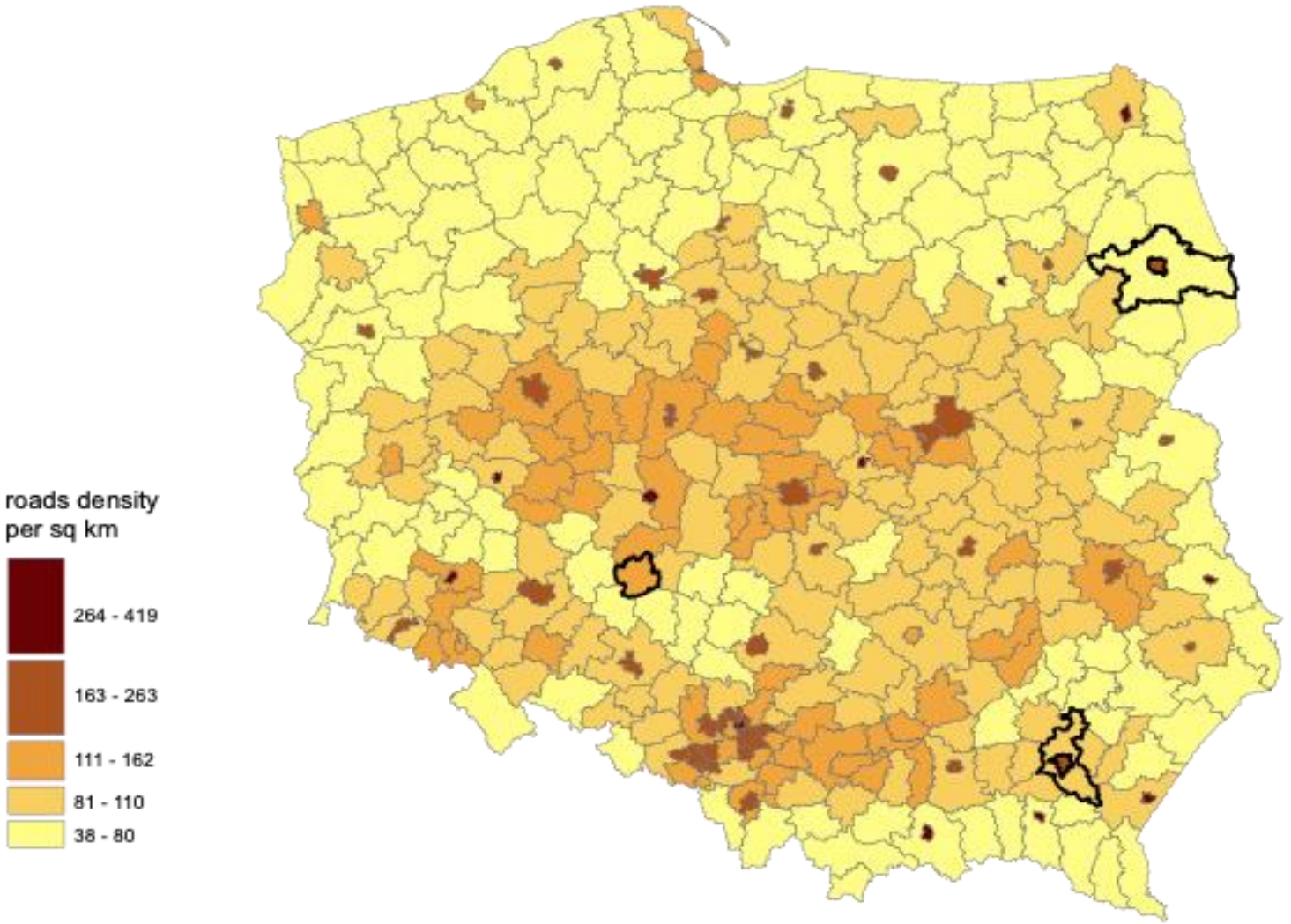
- improving road selection for small-scale maps
- exploring new variables, important in road selection
- receive the automatic selection results, which are closer (similar) to manual map design
- expanding the approach proposed for automated settlement selection (Karsznia & Weibel 2018, Karsznia & Sielicka 2020) on road network.

Related works

- Various methods of road network generalization: graph-theory-based methods, stroke-based methods, methods based on information theory, various other measures (Richardson & Thomson 1996; Jiang & Claramunt, 2004; Liu et al., 2010; Touya, 2010; Benz & Weibel 2014).
- Machine learning usage in the road network generalization: smoothing and selecting line objects (Lagrange et al. 2000; Balboa and López, 2008; Zhou & Li, 2014), settlement selection at small scales (Karsznia & Weibel, 2018; Karsznia & Sielicka, 2020), generalization of buildings (Sester et al. 2018; Feng et al. 2019).

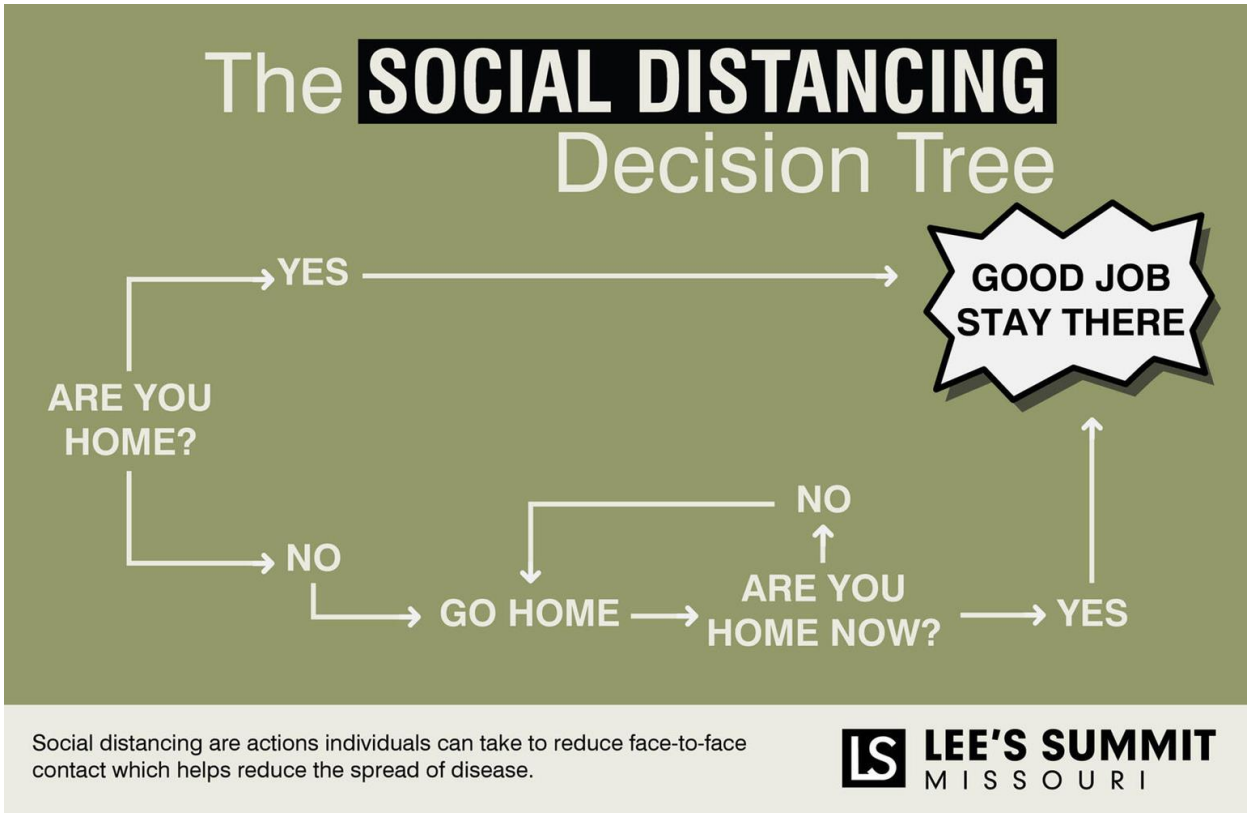
Scope of the research

Poland



Research methods

- road data enrichment,
- decision trees (DT),
- decision trees supported with genetic algorithms (DT_GA).



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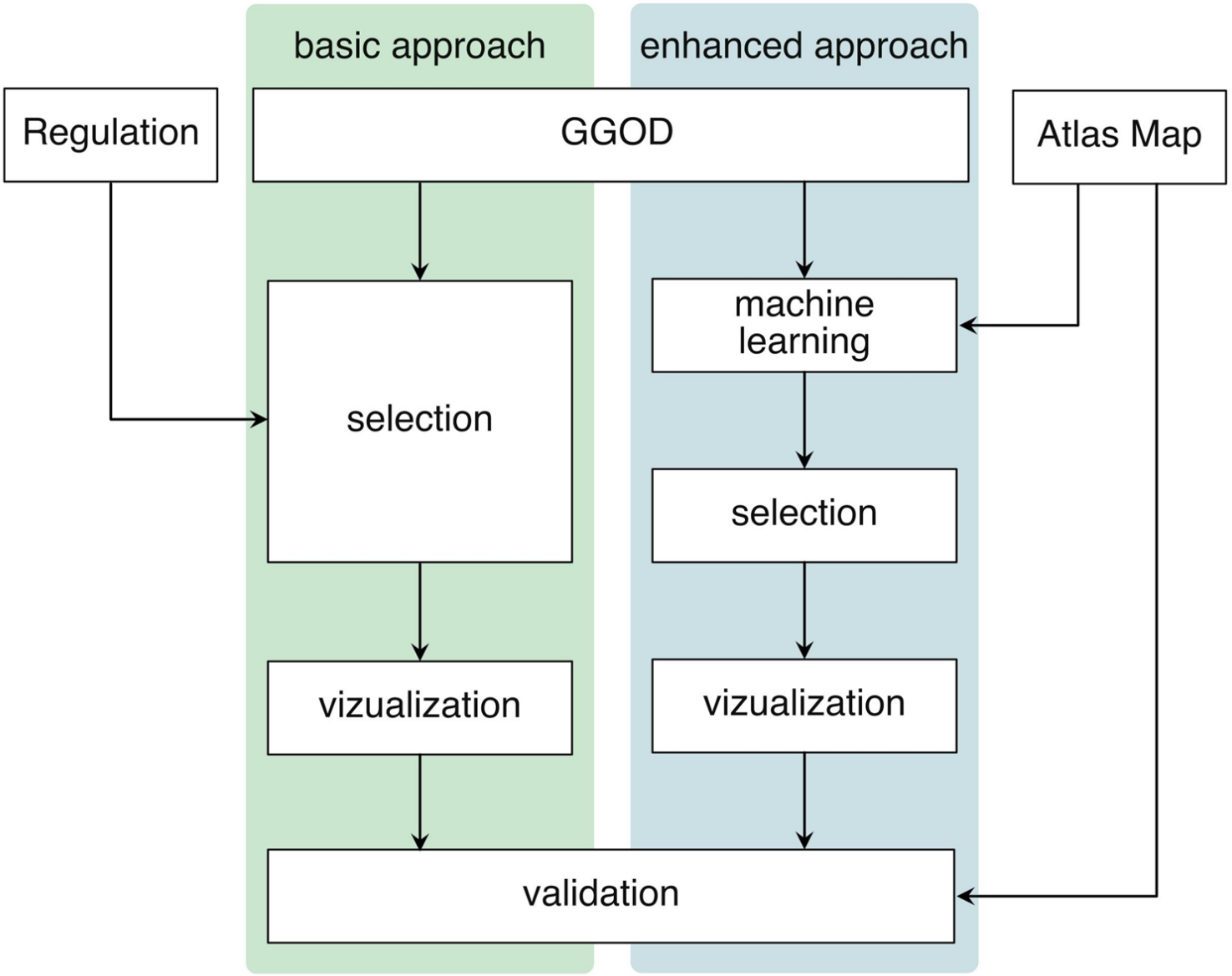
Schema of the research methodology



Variables. Basic approach

- road class (highway, expressway...)
- road category (national, voivodeship, district...)
- type of surface (paved/unpaved)
- number of lines

DZIENNIK USTAW
RZECZYPOSPOLITEJ POLSKIEJ

Załącznik do nru 279, poz. 1642 z dnia 27 grudnia 2011 r.

OPIS BAZ DANYCH
OBIEKTÓW TOPOGRAFICZNYCH
I OGÓLNOGEOGRAFICZNYCH ORAZ STANDARDY
TECHNICZNE TWORZENIA MAP

Załącznik do rozporządzenia
Ministra Spraw Wewnętrznych i Administracji
z dnia 17 listopada 2011 r.
w sprawie bazy danych obiektów topograficznych
oraz bazy danych obiektów ogólnogeograficznych,
a także standardowych opracowań kartograficznych

TOM II

KANCELARIA PREZESA RADY MINISTRÓW

Variables. Enhanced approach

- road class
- road category
- type of surface
- no. of lines
- no. of connected roads
- no. of settlements connected to the network segment
- no. of roads connected to network segment
- minimum no. of segments from settlement, which is connected to road segment
- length of road segment
- betweenness centrality measure

Roads density:

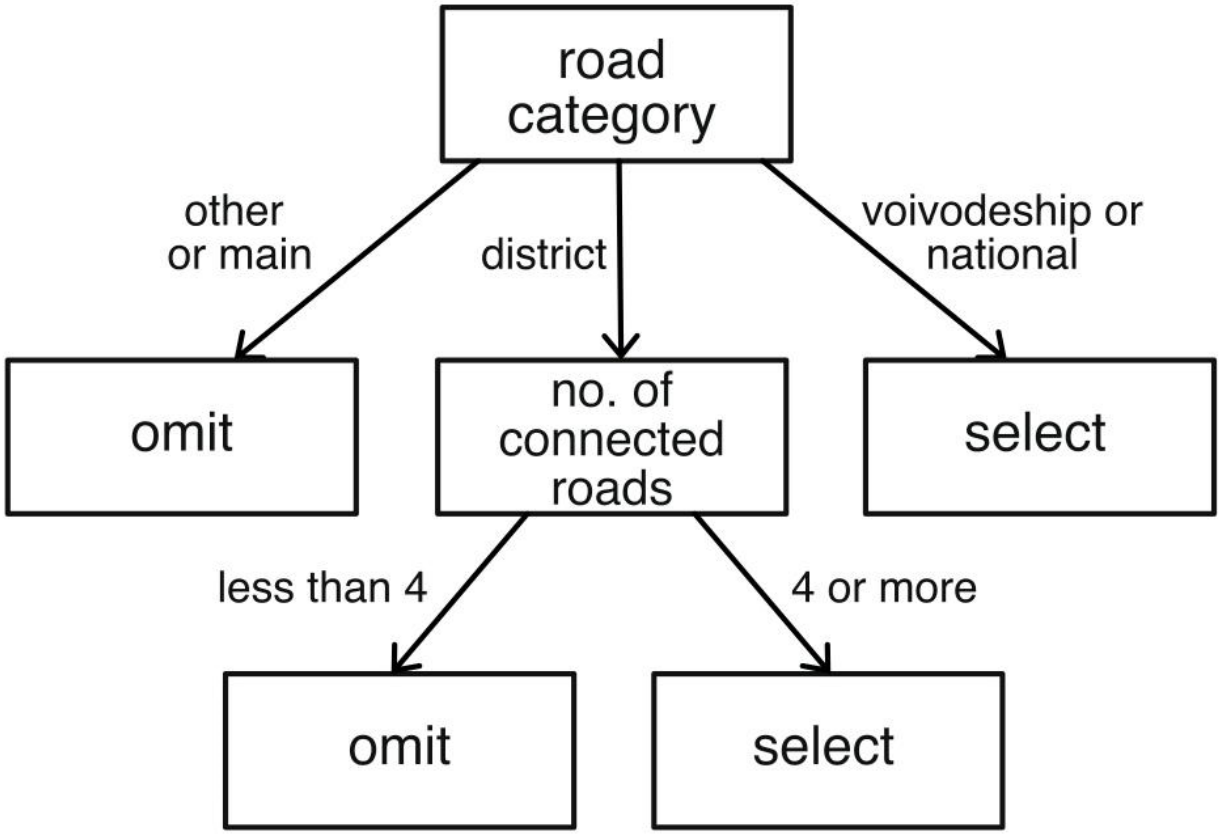
- paved roads in hexagons
- paved roads in districts
- all roads in hexagons
- all roads in districts

marked blue – newly introduced variables

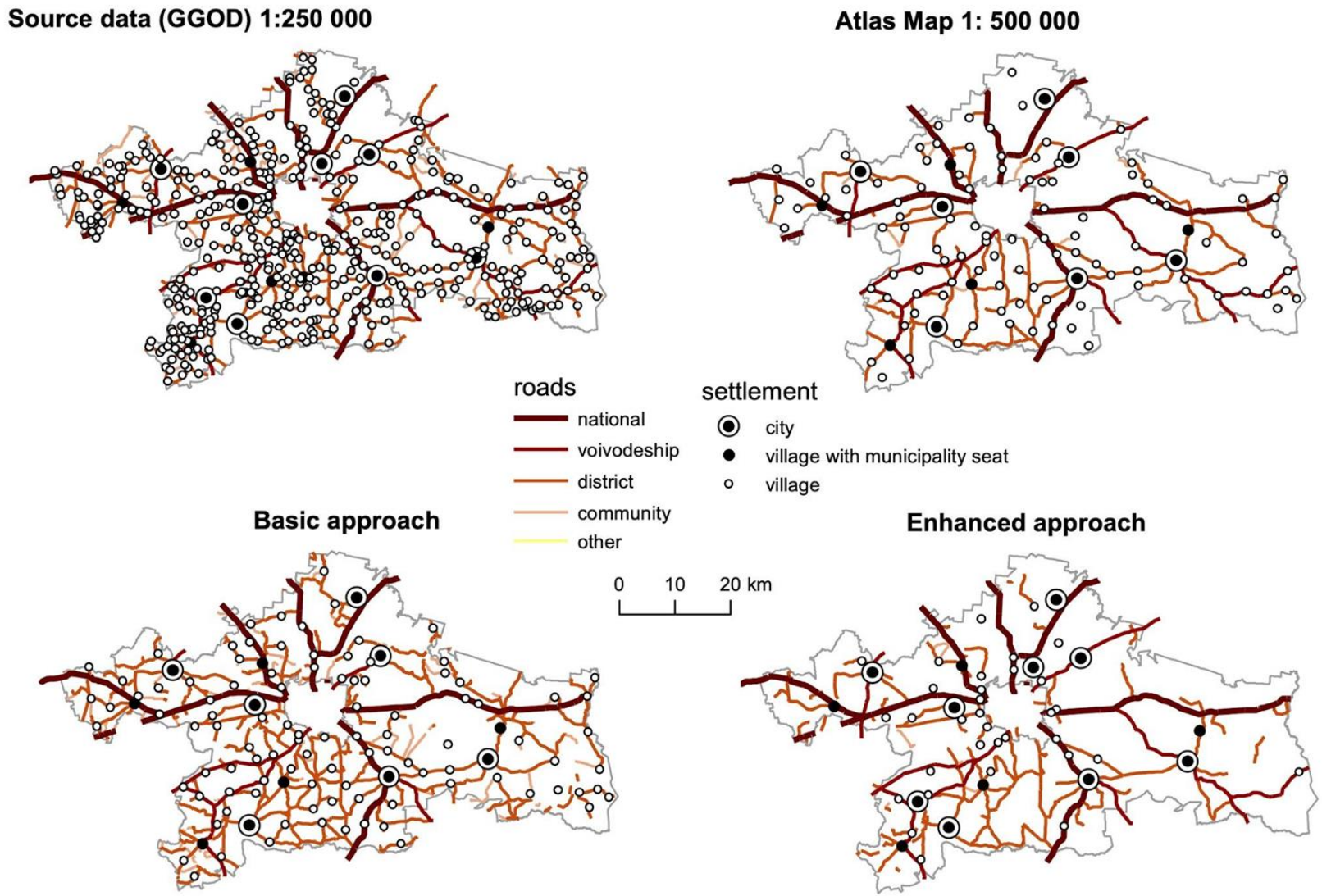
Results

percentage similarity to the atlas map			
area	**basic approach**	**enhanced approach**	**difference**
all districts	45,10 %	**64,61** %	19,51 %
Białostocki	43,70 %	**61,19** %	17,49 %
Rzeszowski	55,25 %	**72,97** %	17,72 %
Kępiński	42,10 %	**65,35** %	**23,25** %

Decision tree for all three districts.
Result of machine learning

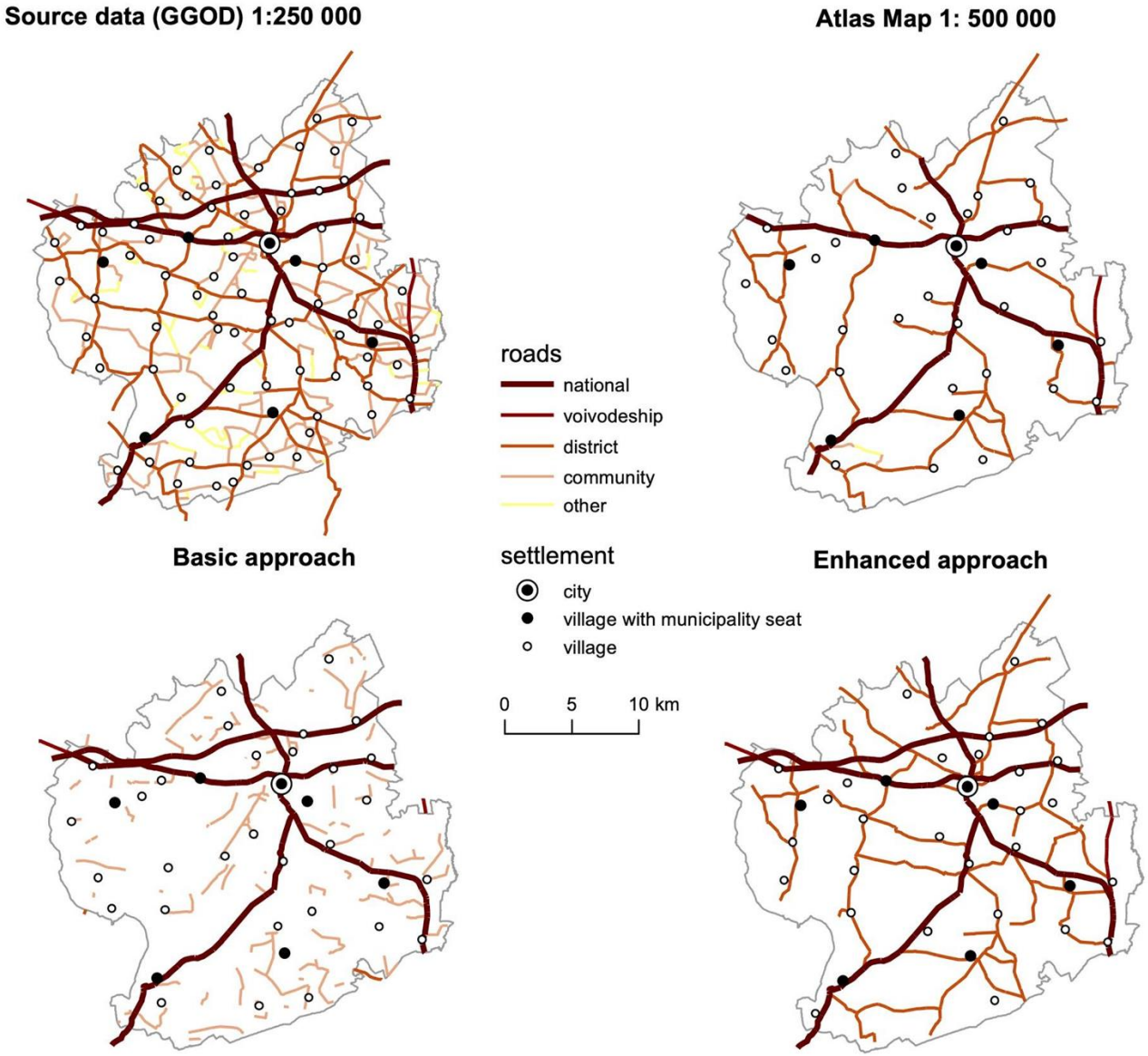


Selection results in Białostocki district



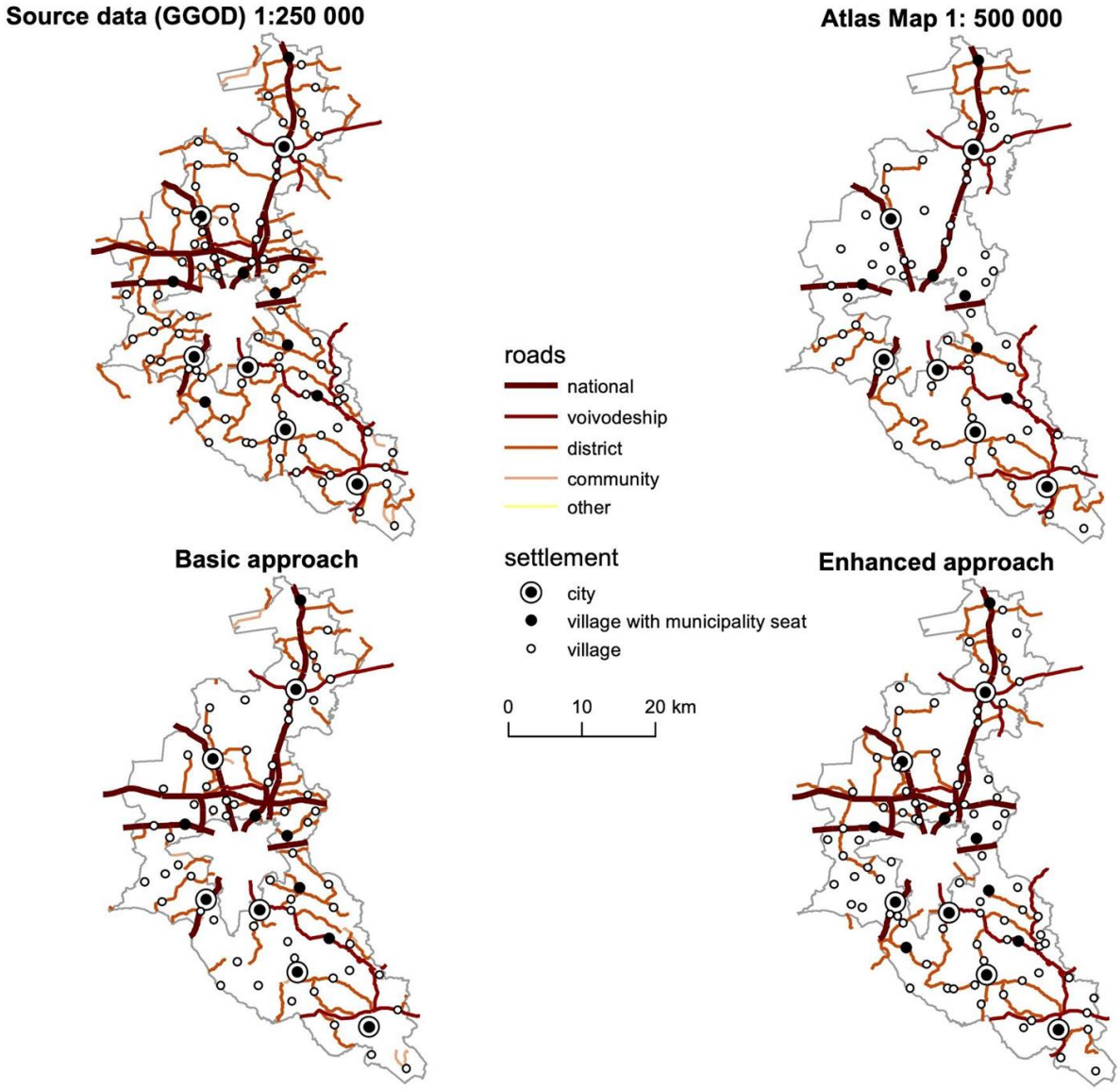
Note that the settlement layer for basic and enhanced approach comes from previous research by Karsznia & Sielicka (2020)

Selection results in Kępiński district



Note that the settlement layer for basic and enhanced approach comes from previous research by Karsznia & Sielicka (2020)

Selection results in Rzeszowski district



Note that the settlement layer for basic and enhanced approach comes from previous research by Karsznia & Sielicka (2020)

Discussion and conclusions

- The use of DT and DT_GA made it possible to observe the decision process and explore important variables (road category, no. of connected roads),
- the use of ML models made it possible to improve the accuracy of selection compared to the solution applied in the basic approach (difference for all districts - 19,52%),
- in all tested cases the selection results are more similar to the selection on atlas reference map,
- in Rzeszowski district, the visual inspection shows that the road network is too dense comparing to the atlas map, however, on the contrary to the atlas map, it is consistent.

Future research

- Extending the data sample on further districts to receive more rich, complex but more holistic decision trees.
- Using other machine learning models to further optimise selection and to achieve better performance.
- Including other topological measures concerning road network to better characterise road network.
- Evaluation of the achieved results with the support of experienced cartographers.

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Thank you for your attention

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