ESP◉N

TRACC
Transport Accessibility
at Regional/Local Scale and
Patterns in Europe

Applied Research 2013/1/10

Final Report | Version 30/06/2013

Volume **3**

TRACC Regional Case Study Book

Part D
Czechia case study

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1 Introduction

The ESPON project TRACC (**Tr**ansport **ACC**essibility at regional/local scale and patterns in Europe) aimed at taking up and updating the results of previous studies on accessibility at the European scale, to extend the range of accessibility indicators by further indicators responding to new policy questions, to extend the spatial resolution of accessibility indicators and to explore the likely impacts of policies at the European and national scale to improve global, European and regional accessibility in the light of new challenges, such as globalisation, energy scarcity and climate change.

The Transnational Project Group (TPG) for the ESPON project TRACC consisted of the following seven Project Partners:

- Spiekermann & Wegener, Urban and Regional Research (S&W), Dortmund, Germany (Lead Partner)

- Charles University in Prague, Faculty of Science, Department of Social Geography and Regional Development (PrF UK), Prague, Czechia

- RRG Spatial Planning and Geoinformation, Oldenburgi.H., Germany

- MCRIT, Barcelona, Spain

- University of Oulu, Department of Geography (FOGIS), Oulu, Finland

- TRT Trasporti e Territorio, Milan, Italy

- S. Leszczycki Institute of Geography and Spatial Organisation, Polish Academy of Sciences (IGSO PAS), Warsaw, Poland

This report is part of the TRACC Final Report. The TRACC Final Report is composed of four volumes.

- Volume 1 contains the Executive Summary and a short version of the Final Report

- Volume 2 contains the TRACC Scientific Report, i.e. a comprehensive overview on state of the art, methodology and concept, and in particular results on the global, Europe-wide and regional accessibility analyses and subsequent conclusions of the TRACC project.

- Volume 3 contains the TRACC Regional Case Study Book. Here, each of the seven case studies conducted within the project is reported in full length.

- Volume 4 contains the TRACC Accessibility Indicator Factsheets, i.e. detailed descriptions of all accessibility indicators used in the project.

This report on the Czechia case study region is one of the major parts of Volume 3 TRACC Regional Case Study Book. The report starts with a short description of the case study region. Then, the results for six different accessibility indicators will be presented and discussed, first for the whole case study region and then in more detail for selected sub-regions, so called zoom-in regions. This analysis of the current accessibility conditions in the region for car travel as well as for public transport is followed by an analysis of how the planned trans-European transport networks would change the accessibility pattern within the region.

The design of the case study analysis was made in a way that all seven case studies are highly comparable as the definition of the accessibility indicators and its implementation were handled in a rather strict way. Also, the way results are presented in maps, diagrams and more general in the case study reports is highly comparable. A comparable analysis across all case studies is provided in Volume 2, the TRACC Scientific Report. All reports are available at the ESPON website www.espon.eu.

2 The Czechia case study region

Czechia is a landlocked country situated in Central Europe. Its area comprises the historical territories of Bohemia, Moravia and a part of Silesia. It shares borders with Poland (762 km), Germany (810 km), Austria (466 km) and Slovakia (252 km). The capital city is Prague. The area covers 78,864 km² (21st position in Europe) with a population of 10.5 million (12th in Europe). The average density of population is approximately 1330 inhabitants/km². Czechia is located between two mountain systems. The western and central part of the country is formed by Czech Highlands; the eastern part is formed by the Carpathian mountain range.

Figure 1. The Czechia case study region.

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

© RRG, ESPON TRACC, 2011

0   25   50   75   100
Km

Data source: ArcGIS Online, ESRI 2012
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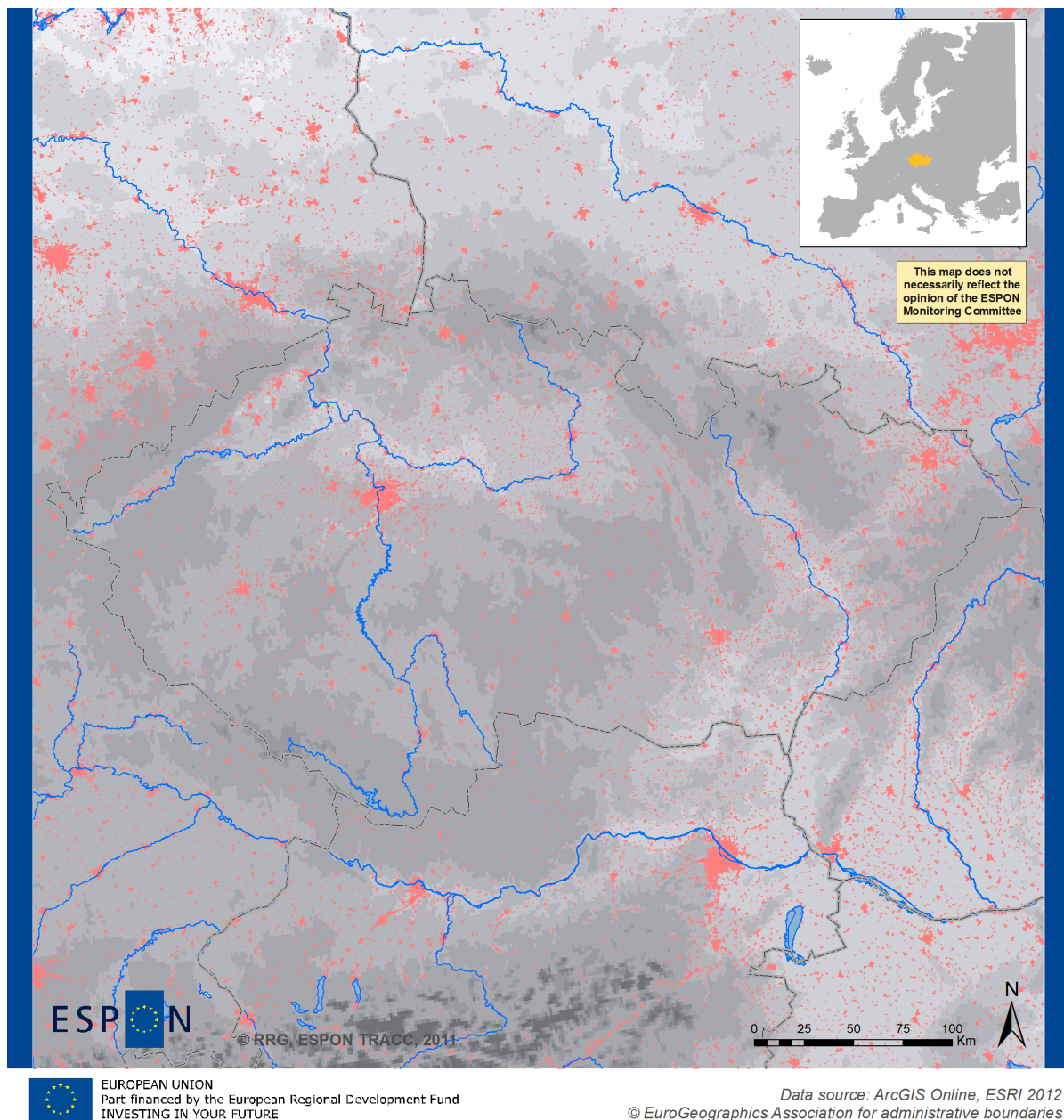
Czech Republic Case Study
Physical map

2.1 Spatial structure

Czechia can be divided into levels of territorial self-governing units: a lower one (municipalities) and a higher on (regions or provinces; "kraj" in Czech). In 1997, a constitutional act established 14 higher territorial self-governing units (regions), which did not correspond to the regional demarcations valid between 1960 and 1989. However, this act did not regulate the organisation or the structure or competences of bodies at the regional level. Therefore the regional system at the beginning functioned only formally (de iure). At the regional level, the state administration and self-government started to work as late as 2000 (de facto). It means since then Czechia has the new administrative structure of 14 NUTS-3 regions (Figure 2).

Municipalities administer their territories within the framework of autonomous competence. Within their self-competence, all municipalities (either villages, towns or cities) have equal rights and obligations. Besides, they execute delegated competences on behalf of the state. Execution of the delegated competences depends on the size of the municipality and the territory it administers. Municipalities are divided into three groups, according to the scope of competencies delegated:

- Municipalities with the basic range of competency – of which there were 6,249 self-administrative municipalities on 1st January 2010

- Municipalities with authorised municipal offices – 388 municipalities whose municipal offices exercise transferred state competency, especially in the domain of offences, construction administration and agricultural land resources.

- Municipalities with extended powers – 205 municipalities, which exercise in their territory the largest range of the transferred state competency especially in the domain of issue of passports, driving and trading licences, waste management, transport and road management etc.

Czech NUTS-2 regions are always made up of one to three NUTS-3 regions called "kraj". NUTS-2 regions are only statistical units without self-government and responsibility. Coordination of NUTS2 development is led by so called Regional councils. On the other hand NUTS-3 regions ("kraje") play a key role in regional and local development governance.

Czechia is characterised by a fragmented structure of settlements, with a historically high number of municipalities (6249 in 2010). As mentioned above there is a large number of municipalities of which only a minor part can be regarded as towns by international standards. Nonetheless the urban areas play an important role in the development of the regions. From the functionality viewpoint, the following urbanised areas (mostly regional capitals) can be identified: Prague agglomeration (1.7 million inhabitants), East-Bohemian agglomeration (Hradec Králové and Pardubice cities, 370,000 inhabitants), North-Bohemian conurbation (650,000), Liberec agglomeration (200,000), Plzeň (330,000), České Budějovice (150,000), Karlovy Vary (200,000), Ostrava agglomeration (890,000), Brno agglomeration (590,000), Central-Moravian conurbation (Olomouc, 370,000) and Zlín (240,000).

With regards to the potential for further development, the Czech spatial development policy defines twelve main development areas. Far more frequent requests are made for zoning changes in the following areas because they are centres of international or nationwide businesses: Prague, Ostrava, Brno, Hradec Králové-Pardubice, Plzeň, Ústí nad Labem, Liberec, Olomouc, Zlín, České Budějovice, Jihlava and Karlovy Vary. These development areas are linked by eleven development axes.

The northern part of Czechia is more densely populated, and there is a higher rate of urbanisation; the area south of the line Karlovy Vary - Plzeň - Prague - Pardubice - Olomouc - Brno is rather rural, historically less industrialised.

Figure 2. Population distribution
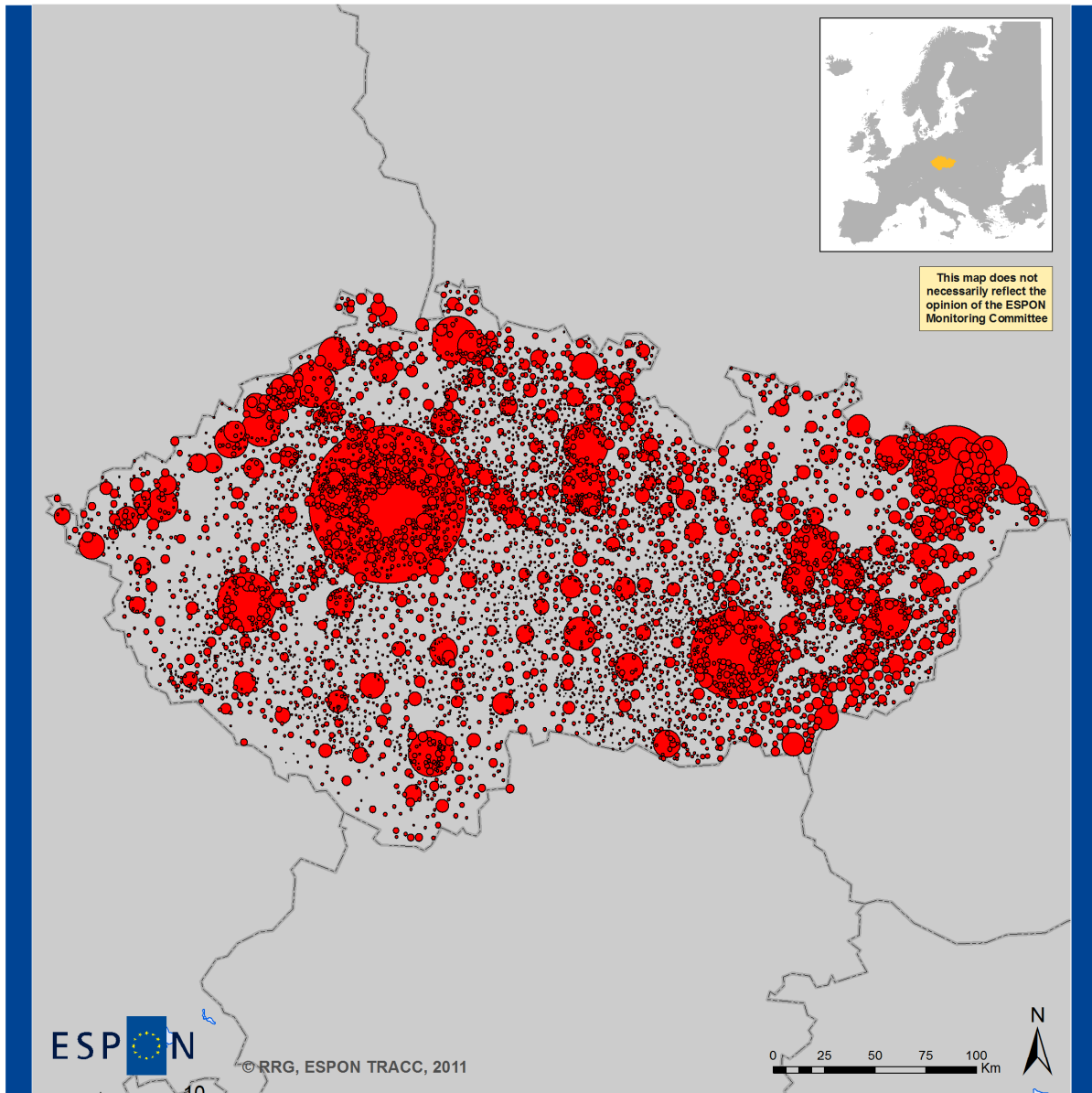
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This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

Source: Population and Housing Census, 2001
Origin of data: ESPON Databank Project,2010/2011
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**Czech Republic Case Study
Population (2001)**

1 000 000

500 000

100 000

Figure 3. Job distribution

Czech Republic Case Study
Number of jobs

1 000 000

100 000

10 000

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0 25 50 75 100
Km

N

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Source: Population and Housing Census, 2001
Origin of data: ESPON Databank Project,2010/2011
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2.2 Socioeconomic situation

Regional development and differences in Czechia are strongly influenced by a unique position of Prague in the Czech economy. The capital city of Prague (NUTS-2 region) is currently one of the most dynamic and most successful regions of Central Europe. Prague forms a quarter of Czech GDP and its value is twice the Czech average and 155 % of the EU NUTS2 average (2010). Prague i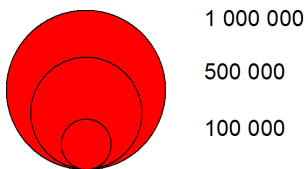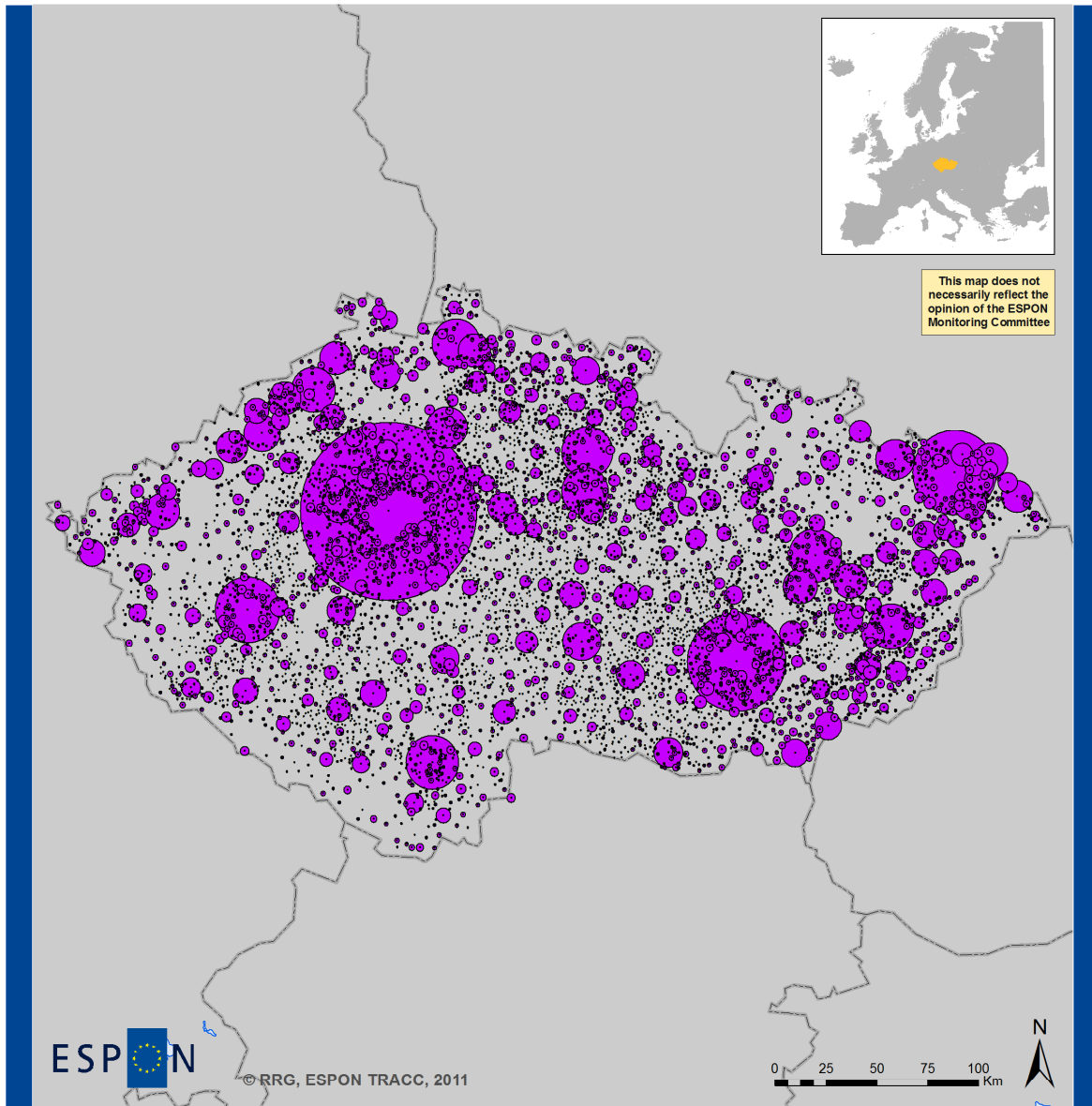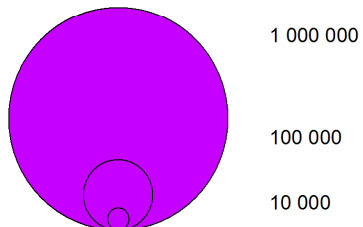s a key administrative centre in Czechia and has a modern services economy, specialising in financial services and activities related to tourism. As the largest city by far in Czechia (1.2 million), it is also the location of the main national companies and the principal bodies concerned with scientific research and education. Prague has become a favoured destination for foreign banking activity during the transformation period in Czechia and holds this position to present time. Prague belongs to the ten wealthiest regions in the whole European Union. At the same time it is the wealthiest region in the new EU member states. On the other hand, Prague has also number of serious problems typical for large metropolitan regions, as for example a disrupted environment, transport problems, pollution, criminality, etc.

The remaining NUTS-2 regions in Czechia can be placed into four groups:

- regions with strong economic growth that are catching up with the EU average (about 70 %): South-West (Jihozápad) and Central Bohemia (Střední Čechy),
- regions of low-moderate economic growth: South-East (Jihovýchod) and North-East (Severovýchod),
- regions lagging because of very slow growth: Central Moravia (Střední Morava),
- declining regions: Moravia-Silesia (Moravskoslezsko) and North-West (Severozápad), i.e. regions including coal basins undergoing structural problems.

Currant unemployment rate is about 8 % in total (September 2012), but in some districts it is even 20 % – in coal basin regions, i.e. Moravia-Silesia region and Ústecký region. The minimum value is in the Prague metropolitan area (up to 3 % registered). In other NUTS-3 regions the unemployment rate decreases roughly from west to east. In general, rural regions show worse performance than metropolitan ones.

2.3 Transport aspects

Due to its position in Central Europe, Czechia is well-advantaged to make the most of its good transport accessibility. The country is indeed covered with a dense network of railways and roads, but it does not always meet the standards demanded by modern transport. Railway network density is historically higher in the northern part of the Czech territory. The main corridors are the axes Dresden – Prague – Brno – Vienna and Katowice – Ostrava – Břeclav – Vienna. Main motorways are constructed radially from Prague to other regional capitals. The main motorway connects Prague, Brno and Ostrava (D1).

Since 1990 the shares of the various modes of transport have changed substantially, in relation with a general transition of the society and the country's accession to the EU (2004). The greatest decline in performance, and the volume carried, was noted by the railway, by public road transport (passenger), and water transport (which was always minor). On the other hand, transport by heavy trucks over 12.5 tonnes has increased substantially, as well as individual road passenger and air transport. The performance of all the transport modes with a negative impact on the environment has increased. Prague international airport ranks among main Central European ones. Its performance has increased from 1.8 million passengers in 1989 to 11.6 million in 2010. Prague airport handles near 94 % of air passengers in Czechia.

Figure 4. Road network
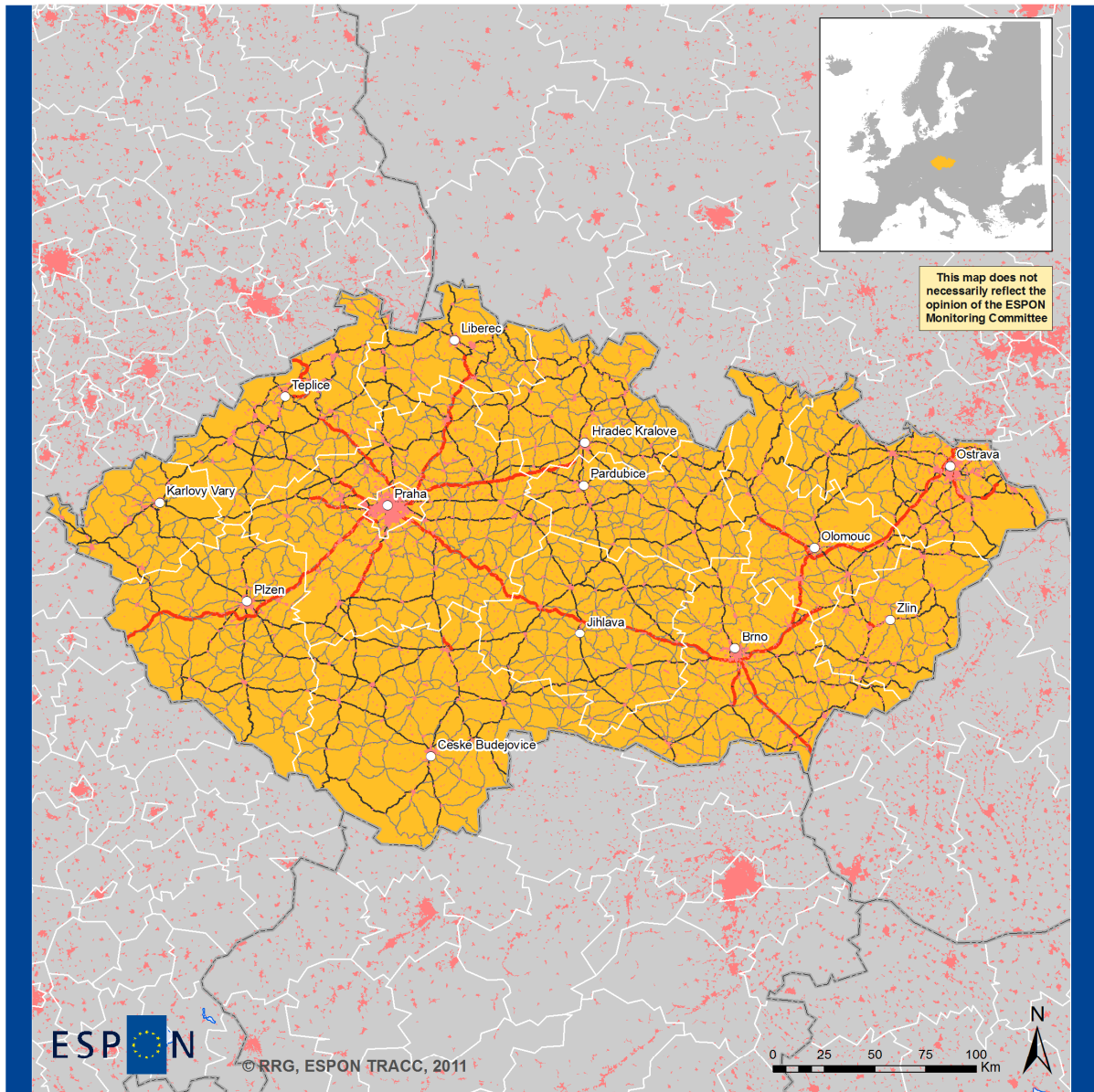
Czech Republic Case Study
Road network

○   NUTS3_CZ

komunikace

ROAD_CLASS

——— 0

——— 1

——— 2

Figure 5. Rail network
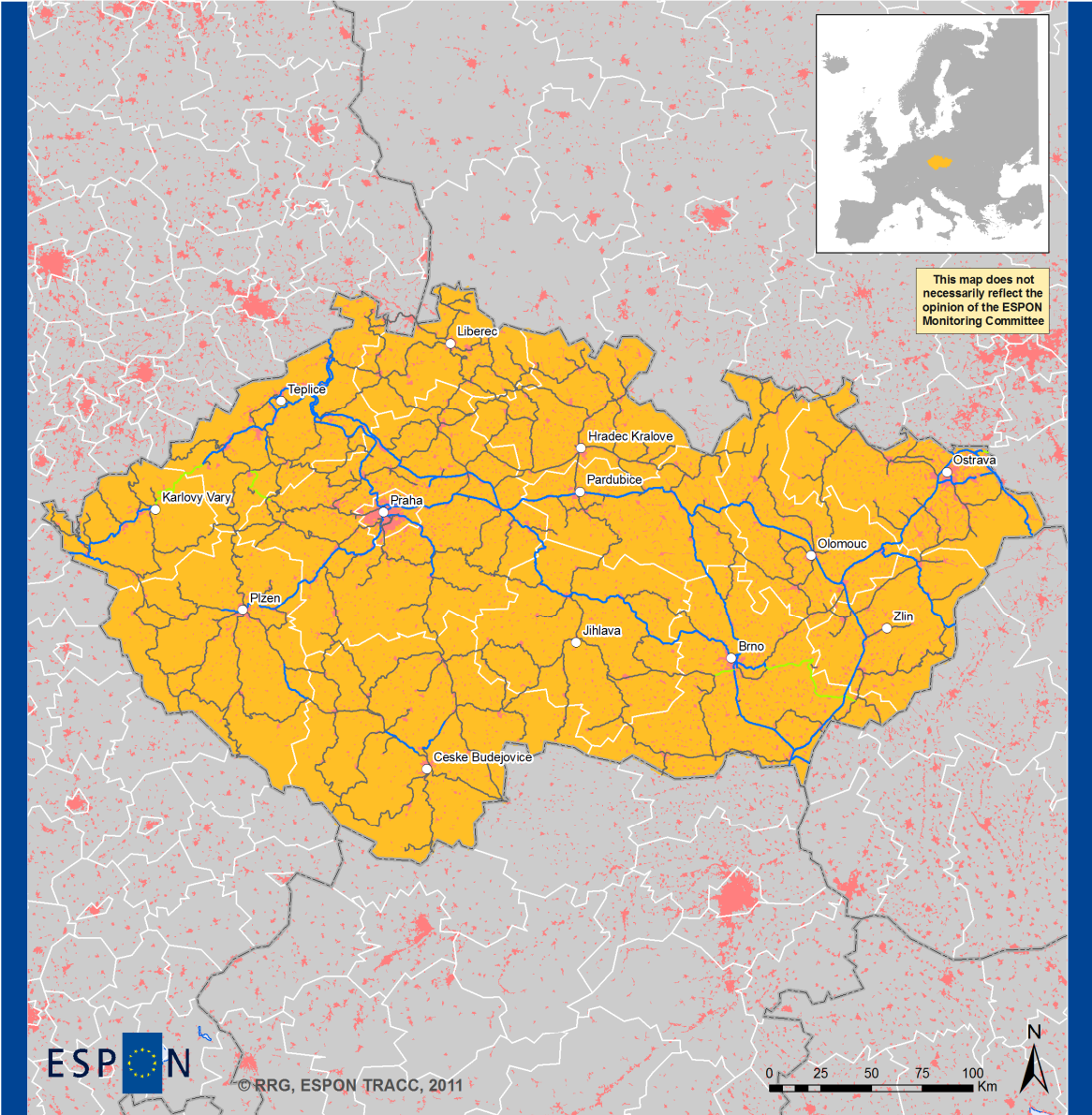
Czech Republic Case Study
Railway network

——— multi-track electrified

——— multi-track non-electrified

——— single-track

◦ NUTS 3 Capitals

3 Accessibility patterns at regional and local scale

3.1 Access to regional centres

Figure 6 shows a map of time accessibility of important residential centres in Czechia (towns with more than 50 000 residents). The results imply significant geographic differentiation of municipallities in respect of time accessibility. On one hand they highlight the hinterland of all agglomerations where the mobility of residents is of high significance (dominated by commuting to work, school and services). Disparities in time accessibility are affected by the current state of the road infrastructure in Czechia. In the map, radial express and high-capacity roads can be observed in the hinterland of Prague, in particular. On the other hand the results show the most distant and peripheral areas located primarily at the borders with Poland (Krkonoše and Jeseníky Mts.) and Bavaria (Šumava Mts.). There are also so-called inner peripheries in Czechia, which can be found around the borders of the NUTS III regions (mainly around the Central Bohemian Region and between Bohemia and Moravia). These areas are predominantly characterized by the decline in the resident population and other socioeconomic indicators of a below-average level. The transport-related exclusion of the residents is important factor here. This is for example the interface of the Central Bohemian and South Bohemian Regions or the border between the Pardubice and Vysočina Regions.

Time accessibility by communities of the nearest regional centre with more than 50 000 residents via public transport (Figure 7) shows a similar spatial pattern as the previous map. The main difference is the size of the hinterland with time accessibility of up to 30 minutes and its concentric shape resulting from the lower transportation speed of public transport (PT). The results also show much more peripheral communities where travelling by public transport takes more than 80 minutes. For most of these communities it is typical that there is an above-average number of vehicles in households as it partially compensates for the insufficient offer of PT. Although the Czechia has a relatively good and stabilized offer of public transport (compared to other European states), competition from private vehicles is very important and more and more people prefer to commute by car instead of public transport. Nevertheless, integrated transportation systems have been introduced to most areas around regional metropolises in Czechia and the position of public transport in the hinterland of large regional centres is very strong. On the other hand, the transport-related exclusion of variously disadvantaged groups of residents of peripheral municipalities (considered in terms of transport) is becoming a significant threat for the future.

Furthermore, figure 8 and 9 presents travel time to next regional centre according to urban-rural typology as well as travel time to next regional centre like a cumulative distributions. The worse time accessibility of rural areas is obvious.

Figure 6. Travel time by car to next regional centre

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Source: PrF UK Prague - accessibility model CAR
Origin of data: ESPON Databank Project,2010/2011
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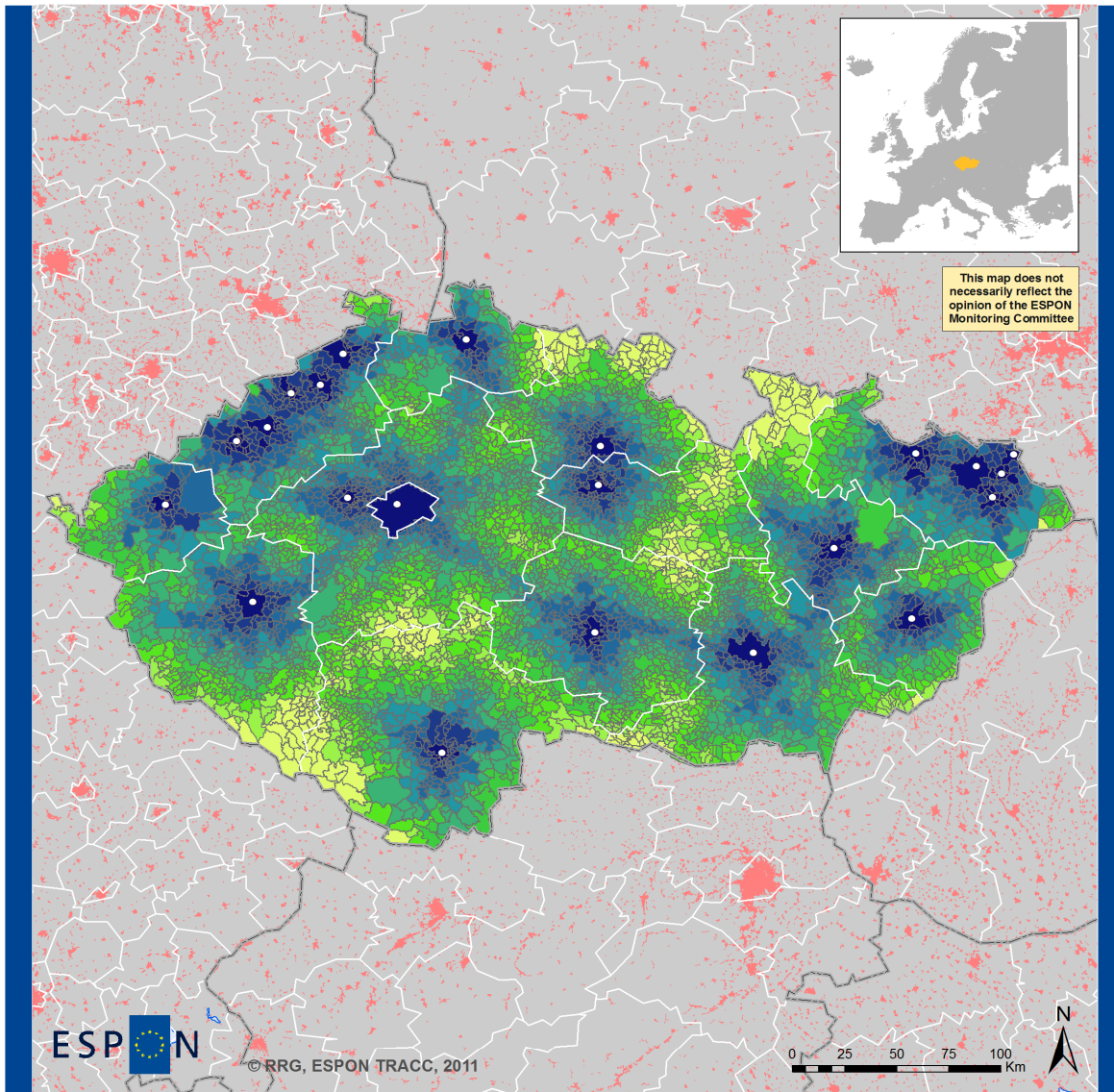
Czech Republic Case Study
Travel time to regional centre by car [min]

■	0 - 10	■	51 - 60
■	11 - 20	■	61 - 70
■	21 - 30	■	71 - 80
■	31 - 40	■	80 <
■	41 - 50	○	Regional centre (50,000 <)
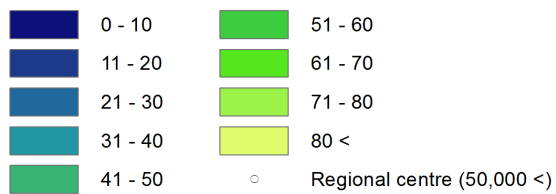
Figure 7. Travel time by public transport to next regional centre

Source: PrF UK Prague - accessibility model PUBLIC TRANSPORT
Origin of data: ESPON Databank Project,2010/2011
© EuroGeographics Association for administrative boundaries

Czech Republic Case Study
Travel time to regional centre by public transport [min]

■ 0 - 10	■ 51 - 60	
■ 11 - 20	■ 61 - 70	
■ 21 - 30	■ 71 - 80	
■ 31 - 40	■ 80 <	
■ 41 - 50	○ Regional centre (50,000 >)	
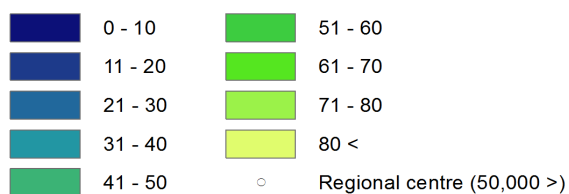
Figure 8. Travel time to next regional centre, by urban-rural typology

Travel time to next regional centre (minutes)
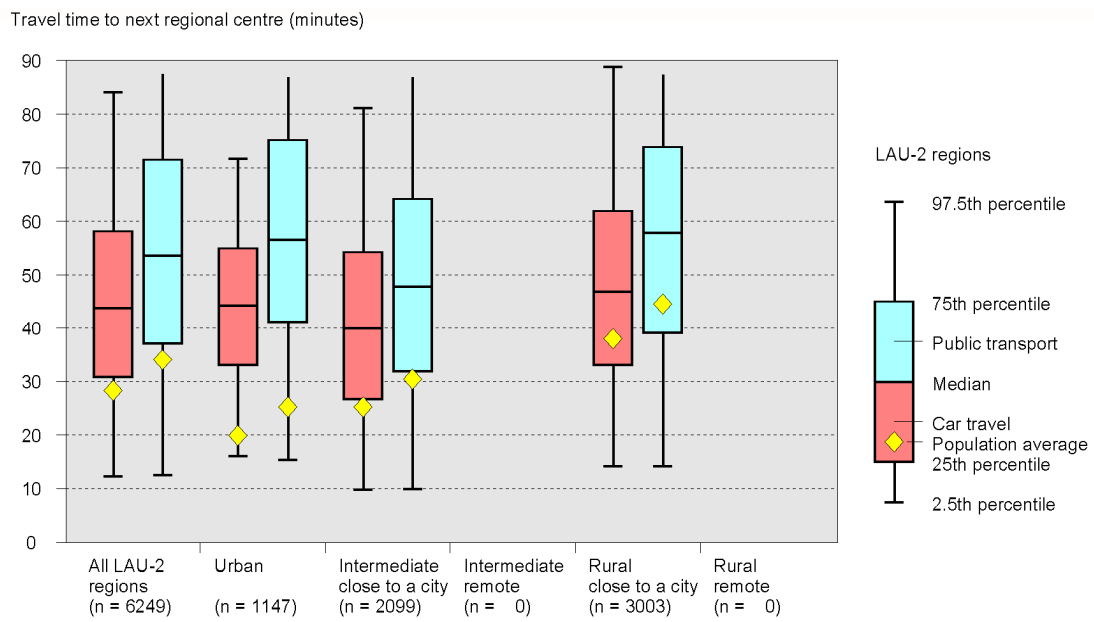
Figure 9. Travel time to next regional centre, cumulative distributions

Population (cumulative percentage)

Travel time to next regional centre (minutes)
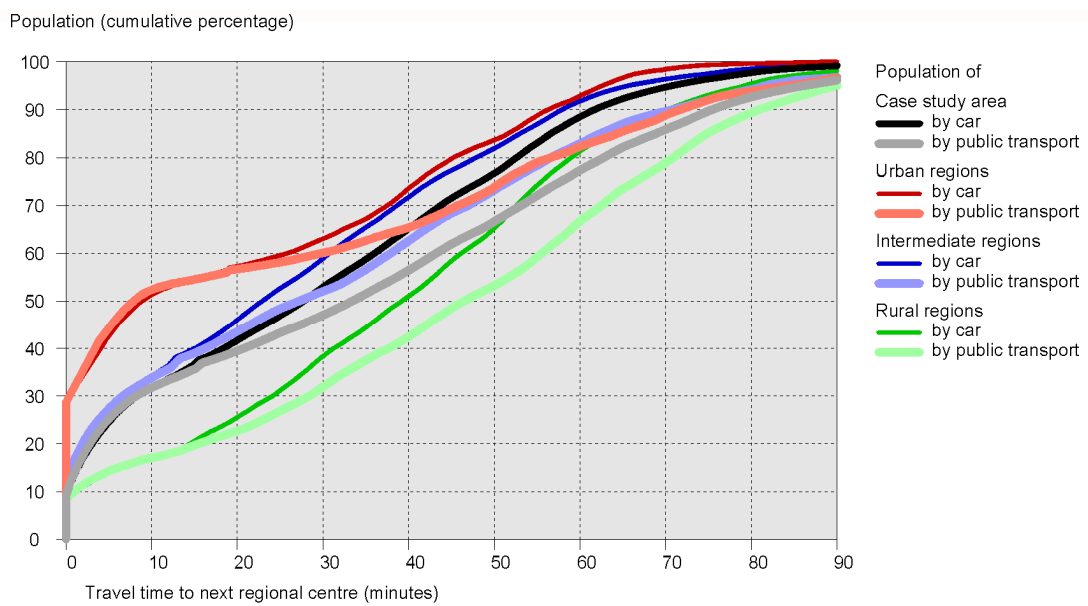
3.2 Daily accessibility of jobs

During the transformation period job opportunities have been concentrated in hierarchically more important settlement centres. The trend was supported by the fall of often artificially maintained employment in agriculture in areas with inconvenient nature conditions and in small rural industrial plants established or promoted within so-called socialist industrialization. Job opportunities in the smallest municipalities have been decreasing on a long-term basis. The map below (Figure 10) shows the number of job opportunities accessible within 60-minute driving distance by passenger car. It is necessary to point out that the job opportunities data refer to 2001 (the last census with available data). In the last 10 years the job opportunities have been concentrated in larger towns (over 10 000 residents) even more. The results imply the most significant potential for the residents of municipalities in the broad hinterland of Prague as there is more than one million of theoretically available job opportunities (situated in Prague) at an hour´s distance. Furthermore, radial express roads can be observed in the agglomeration of Prague, which affect the higher accessibility of job opportunities from more distant municipalities. Similar conditions for municipalities with good accessibility can be noticed around all remaining regional capitals (despite the absolute number of job opportunities being significantly lower). The results also identify municipalities with a minimum amount of available job opportunities (border areas, inner peripheries at regional borders), which have been stagnating in terms of economic development in the long term. Expressing accessibility as a cumulated opportunity provides a new view of some peripheral areas. For example, despite being distant from the regional capitals, the relatively lagging area between Prague, Hradec Králové and Liberec can benefit from the offer of job opportunities in all three centres. A similar effect can be observed in central Vysočina (Pardubice, Jihlava, Brno, Prague) or on the boundary between the Central Bohemian and South Bohemian Regions. The essential importance of the express transport infrastructure is also apparent – as evidenced by relatively isolated South or East Bohemia as well as the frontier areas bordering Bavaria and Poland.

As opposed to the previous map, the importance of regional capitals as the centres of employment is highlighted by expressing cumulated accessibility via public transport (figure 11). Therefore, population relying on public transport is more strongly dependent on job opportunities in regional capitals or near to their home. The regional focus of public mass transport is also apparent as it does not make long-distance daily commuting possible by virtue of its nature. An increased influence of the settlement structure can be observed for the same reason – compared to Bohemia, Moravia has the advantage of the in-line arrangement of the regional capitals and the existence of overall larger villages. In particular, the southern and western parts of Bohemia suffer from the fragmentation of settlements and the absence of larger town centres. The importance of suburban railroads is supported by the fact that the zone of cumulated opportunities in the largest towns expands along the main railroads (for Prague to the east and north-west, for Brno to the south-east, for Pardubice to the east).

Figure 10. Jobs accessible by car within 60 minutes

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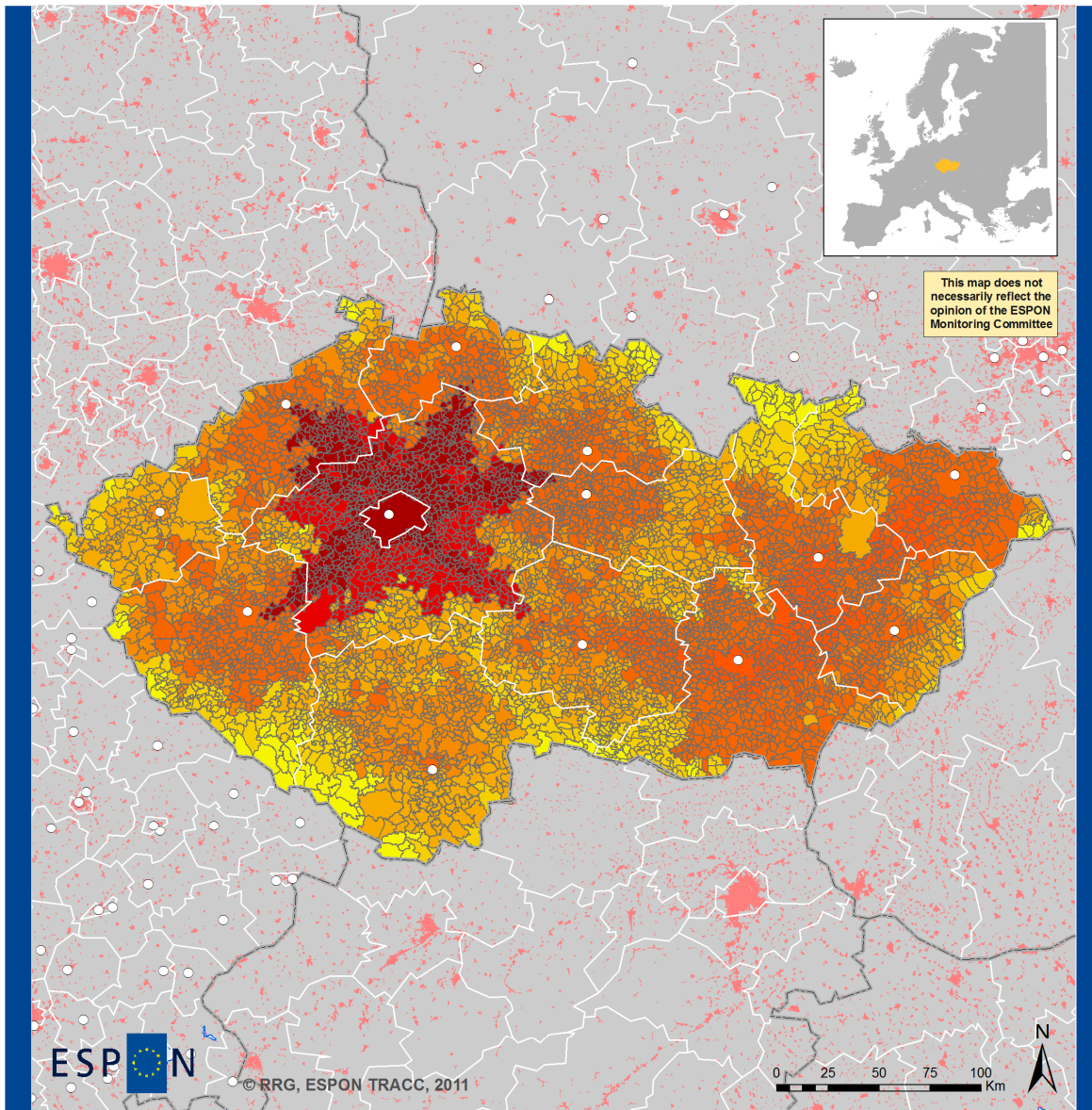© RRG, ESPON TRACC, 2011

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Source: Population and Housing Census, 2001
PrF UK Prague - accessibility model CAR
Origin of data: ESPON Databank Project,2010/2011
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Czech Republic Case Study
Daily accessibility of jobs by car

0 - 50,000	200,001 - 500,000
50,001 - 100,000	500,001 - 750,000
100,001 - 150,000	750,001 - 1,000,000
150,001 - 200,000	1,000,000 <

○ NUTS 3 Capitals

Figure 11. Jobs accessible by public transport within 60 minutes

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

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Source: Population and Housing Census, 2001
PrF UK Prague - accessibility model PUBLIC TRANSPORT
Origin of data: ESPON Databank Project,2010/2011
© EuroGeographics Association for administrative boundaries

Czech Republic Case Study
Daily accessibility of jobs by public transport
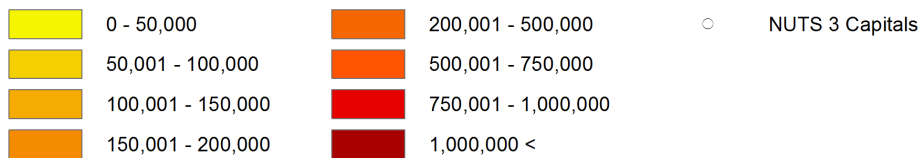
0 - 50,000	200,001 - 500,000	○ NUTS 3 Capitals
50,001 - 100,000	500,001 - 750,000	
100,001 - 150,000	750,001 - 1,000,000	
150,001 - 200,000	1,000,000 <	

Furthermore, next diagrams (figure 12 and 13) present jobs accessible within 60 minutes according to urban-rural typology and number of accessible jobs within 60 minutes expressed like cumulative distributions. Results confirm important differentiation between individual (car) and public transport in rural as well as urban areas. Great variety in urban regions to rural ones is clear apparent.

Figure 12. Jobs accessible within 60 minutes, by urban-rural typology
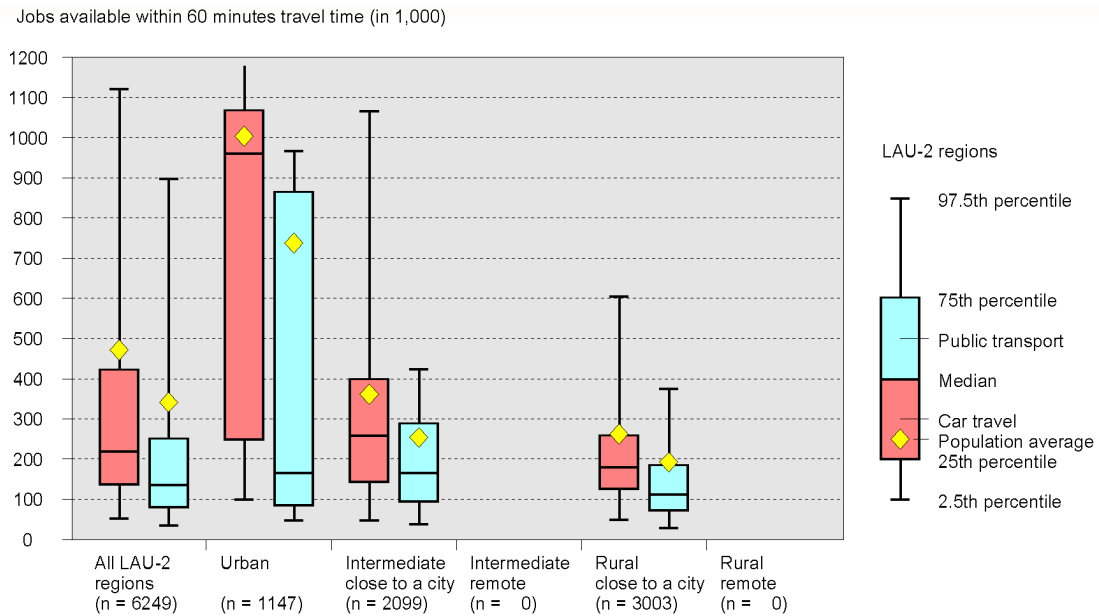
Figure 13. Jobs accessible within 60 minutes, cumulative distributions
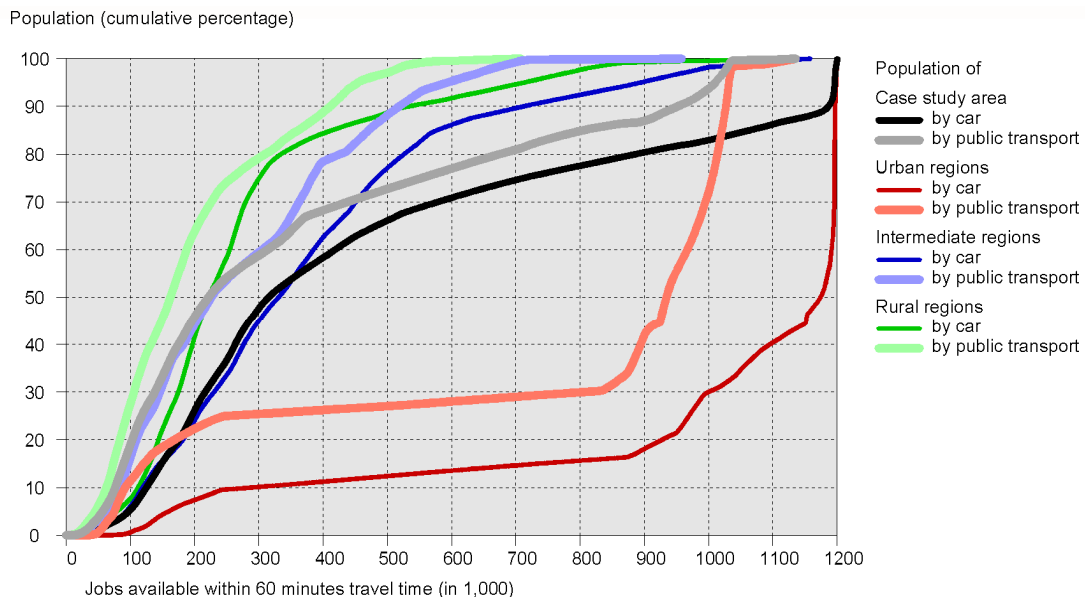
3.3 Regional accessibility potential

In aggregate, the results of the potential accessibility show the main concentration areas and their locations in the transport networks in Czechia. The map clearly illustrates the relative separation of the two historically autonomous settlement systems of Czechia (Moravia vs. Bohemia). The Moravian system is dominated by the axis Brno – Olomouc/Zlín – Ostrava, Bohemia is dominated by Prague situated in the centre of the radial system of roads. The following have been highlighted from among isolated agglomerations: South Bohemian centre of České Budějovice, relatively weak NUTS III centre of Karlovy Vary and Jihlava. The first two regional capitals mentioned have not been connected to the motorway network yet. Areas with the worst potential accessibility include, first, the sparsely populated border area, and, second, so-called inner peripheries. The map shows also the positive importance of unfinished motorway axes and first-class roads which substitute for absent motorways. An example of that is R4 from Prague heading to South-Western Bohemia, R35 from Olomouc to North-Western Bohemia or I/3 from Prague to the south of Bohemia. The map indicates a useful potential of the structurally affected region of South-Western Bohemia that has large residential areas and is relatively close to the Prague centre. Czechia is presented in this analysis in an isolated way, i.e. with no relations to the neighbouring states. When taking into account foreign centres, the potential accessibility of North-Western Bohemia would be even higher thanks to the presence of Dresden, and the region of Ostrava communicating with the region of Polish Katowice would also stand out.

Figure 14. Potential accessibility to population by car

Source: Population and Housing Census, 2001
Prf UK Prague - accessibility model CAR
Origin of data: ESPON Databank Project,2010/2011
© EuroGeographics Association for administrative boundaries

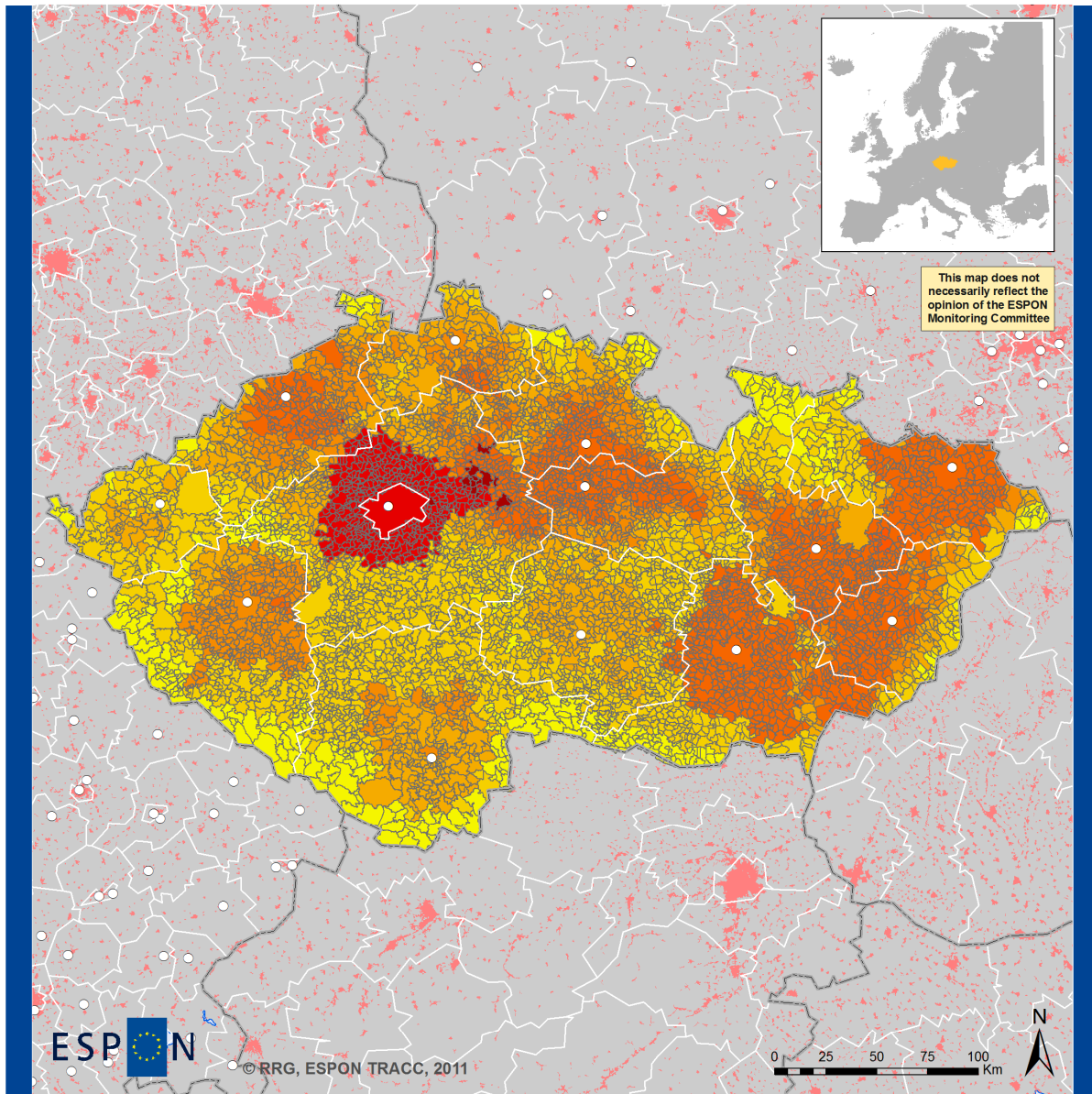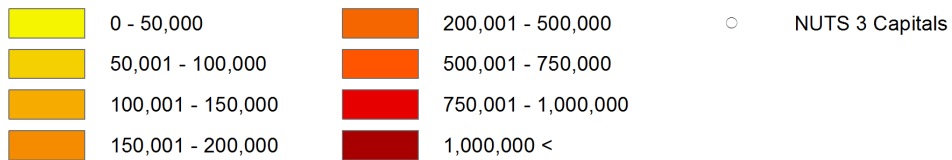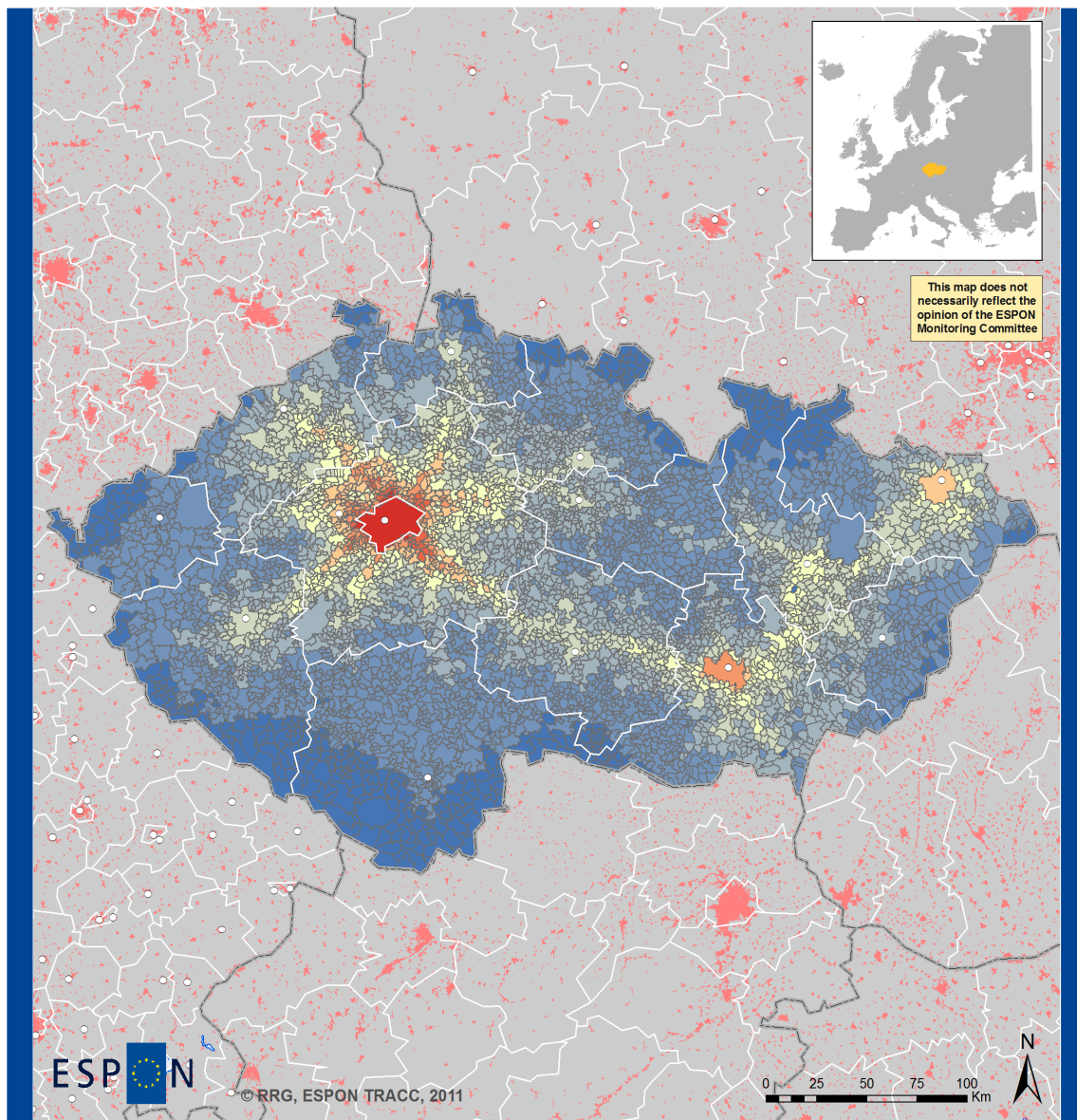**Czech Republic Case Study**
Potential accessibility to population by car [β = 0.034657]

▤ 0 - 25	○ NUTS 3 Capital
▤ 25,1 - 50	
▤ 50,1 - 75	
▤ 75,1 - 100	
▤ 100,1 - 125	
▤ 125,1 - 150	
▤ 150,1 - 175	
▤ 175,1 - 200	
▤ 200 <	
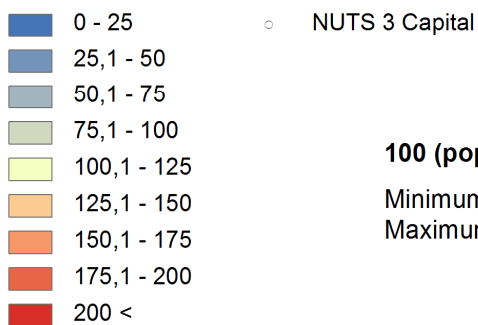
100 (population weighted average) = 524030,6755

Minimum: 2525076,61985
Maximum: 1631466,974

Figure 15. Potential accessibility to population by public transport

Source: Population and Housing Census, 2001
Prf UK Prague - accessibility model PUBLIC TRANSPORT
Origin of data: ESPON Databank Project,2010/2011
© EuroGeographics Association for administrative boundaries

Czech Republic Case Study
Potential accessibility to population by public transport - public averaging [β = 0.034657]

- 0 - 25   ○ NUTS 3 Capital
- 25,1 - 50
- 50,1 - 75
- 75,1 - 100
- 100,1 - 125
- 125,1 - 150   **100 (population weighted average) = 387057,3026**
- 150,1 - 175
- 175,1 - 200   Minimum: 14613,91438
- 200 <   Maximum: 1401258,017

Furthermore, next diagrams (figure 16 and 17) present potential accessibility to population by urban-rural typology and potential accessibility to population according to cumulative distributions. Results stress an importance of individual (car) transport especially in urban areas (it caused substantial increase of potential accessibility values.

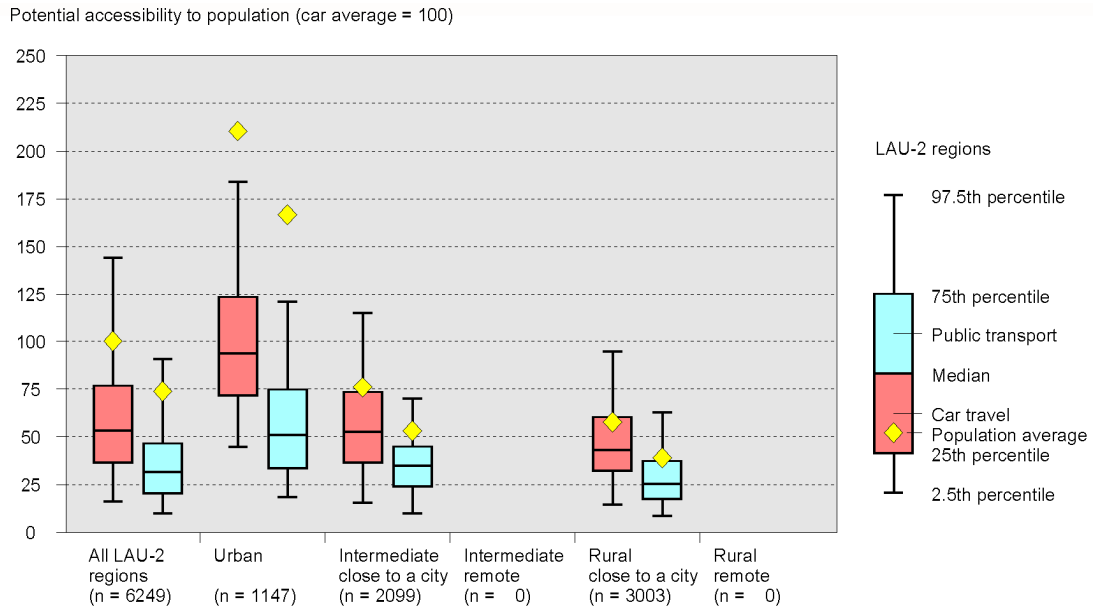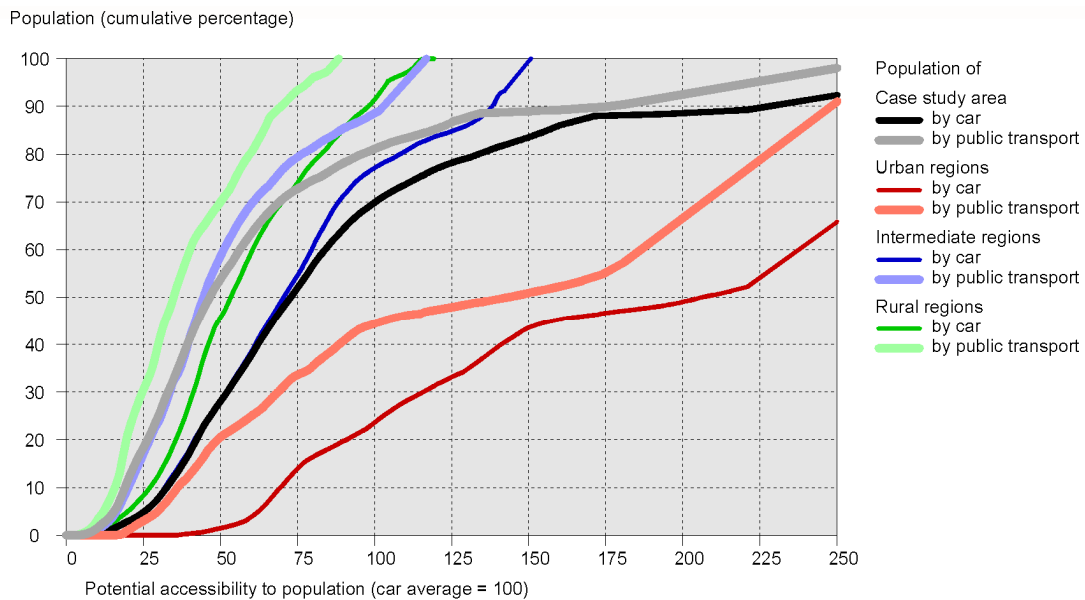Figure 16. Potential accessibility to population, by urban-rural typology

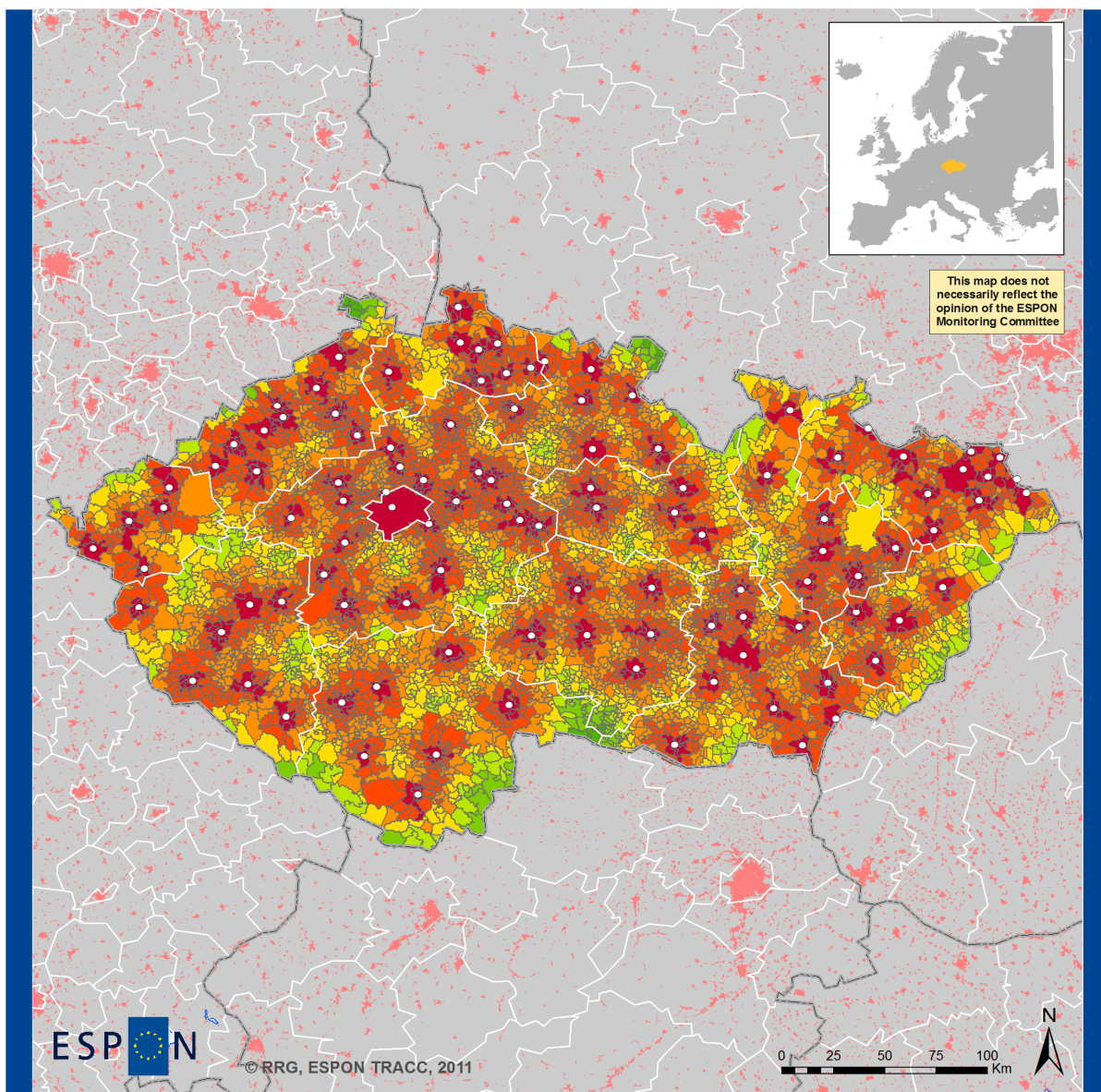Figure 17. Potential accessibility to population, cumulative distributions

3.4 Access to health care facilities

The health care infrastructure (hospitals) is very evenly distributed in Czechia because it still builds upon the district-based arrangement established by the totalitarian regime. The accessibility of health care for the population is still relatively balanced in each regions but the health care system is currently being restructured and the process will include cancellation of some hospitals or reorganization of the rescue service system. There are 189 hospitals in Czechia (19 are managed by the Ministry of Health, 24 are managed by Regions, 17 hospitals are managed by communities/towns and the remaining hospitals are managed by another legal entity). The results of time accessibility of hospitals show that a large majority of municipalities are within a 40-minute distance. In Czechia, the accessibility of health care institutions is also laid down by the law. The worst accessibility is from municipalities in the border areas of Czechia. Most hospitals are located in the major residential centres situated inland.

As expected, the time accessibility of the closest hospitals by public transport (figure 19) is naturally worse than time accessibility by individual car transport. In particular, municipalities which are not situated on main roads show long time accessibility. This concerns primarily small municipalities in South-Western Bohemia which are more distant from regional capitals, where there is a generally lower offer of public transport connections (compared to relatively large municipalities in South-Eastern Moravia with corresponding higher supply of public transport connections) and less available express roads (and first-class roads). It is true, though, that public transport is used by the population for out-patient care.

Figure 18. Car travel time to next hospital

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Czech Republic Case Study
Travel time to closest hospital by car [min]

0 - 10	41 - 50
11 - 20	51 - 60
21 - 30	60 <
31 - 40	○ Hospital
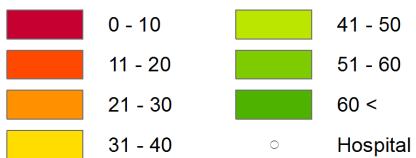
Figure 19. Public transport travel time to next hospital
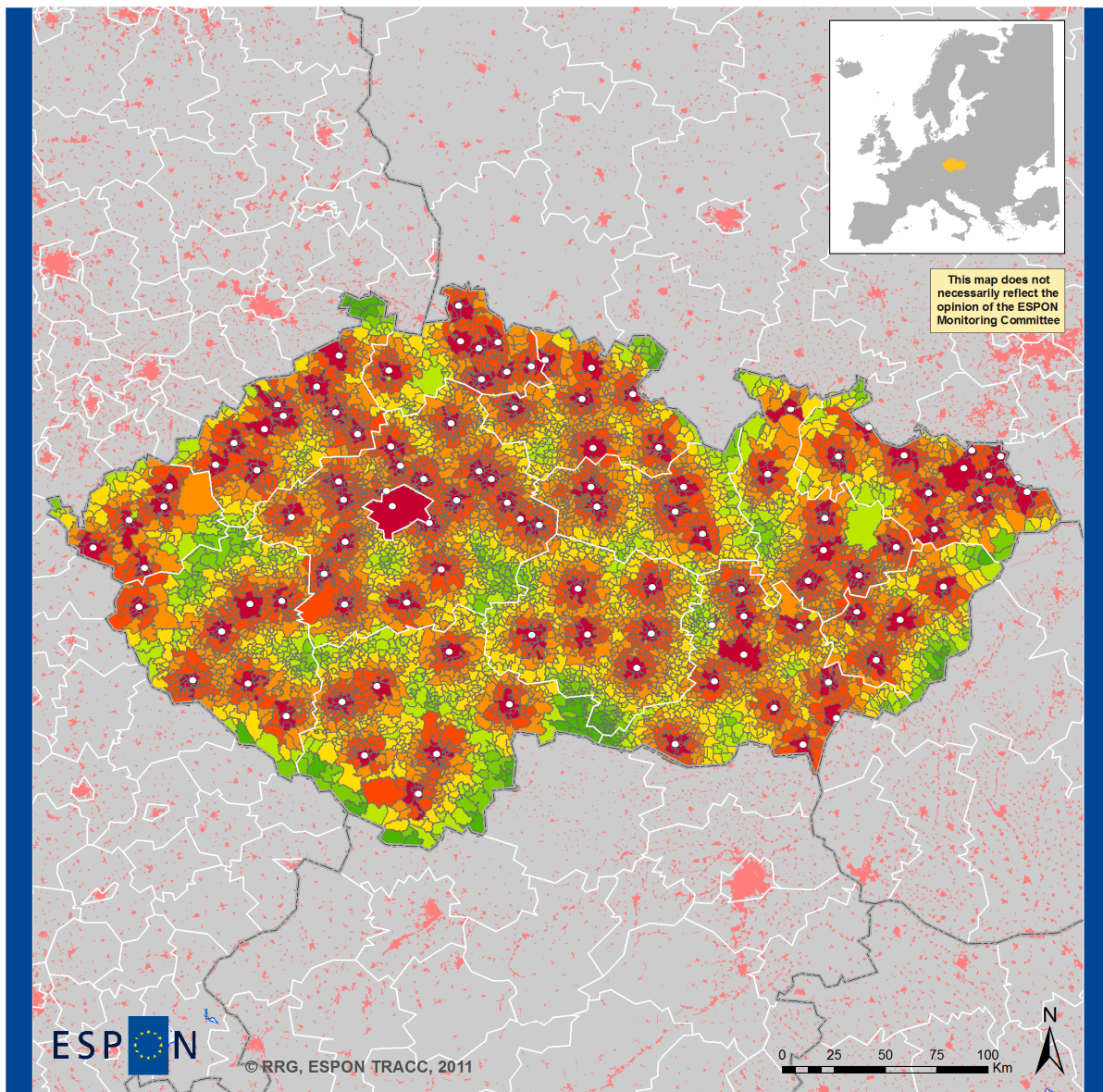
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Czech Republic Case Study
Travel time to closest hospital by public transport [min]

0 - 10	41 - 50
11 - 20	51 - 60
21 - 30	60 <
31 - 40	○ Hospital

Furthermore, next diagrams (figure 20 and 21) present travel time to next hospital, by urban-rural typology and travel time to next hospital expressed like cumulative distributions. Results show that there are relatively unimportant differentiation between individual (car) and public transport in rural as well as urban areas. It is influenced by still relatively dense network of hospitals and spatially regular pattern.

Figure 20. Travel time to next hospital, by urban-rural typology
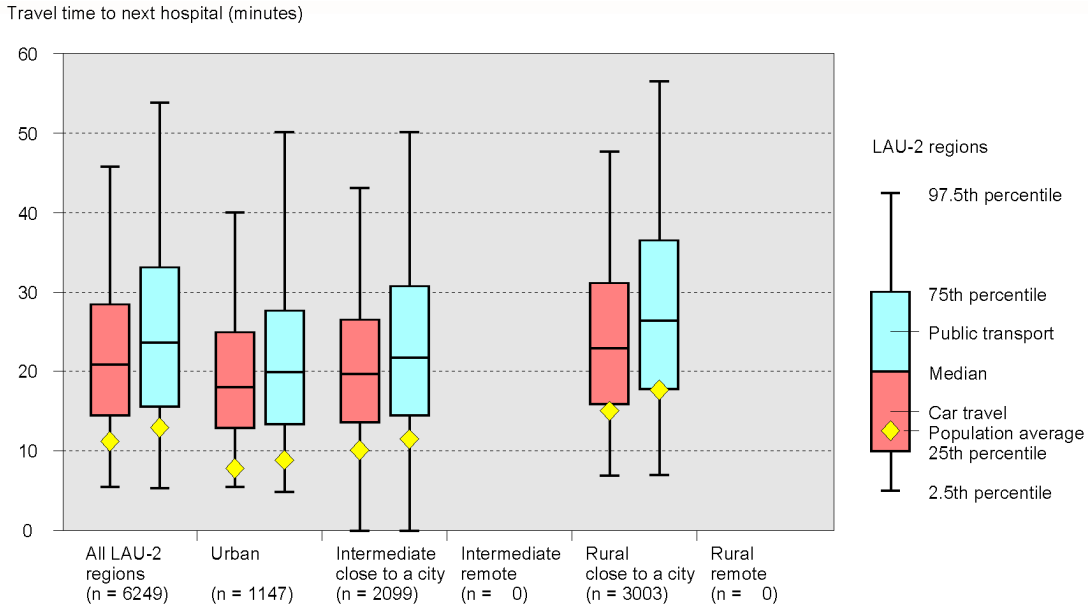
Figure 21. Travel time to next hospital, cumulative distributions
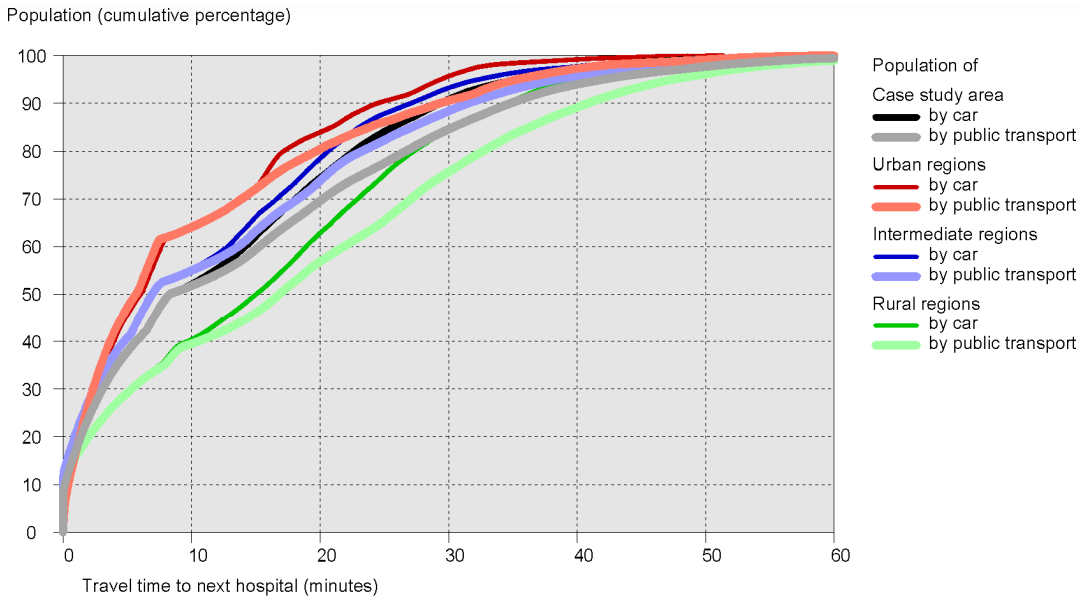
3.5 Availability of higher secondary schools

Secondary schools in Czechia are mainly situated in municipalities of at least micro-regional importance (about 10 000 residents and more). However, secondary school students cannot drive a car to get to school before they are 18 and, therefore, the map below (figure 22) shows rather theoretical opportunities of the accessibility of secondary schools. There is the highest accessibility of secondary schools within the range of 30 minutes in the hinterland of the largest Czech agglomerations (Prague, Brno, Ostrava, Olomouc etc.), of course. Assessing by accessibility, municipalities in the hinterland of the agglomerations in the eastern part of Czechia (Brno, Olomouc, and Ostrava) have a larger opportunities than municipalities in Bohemia.

The results of accessibility by public transport (Figure 23) show a significantly lower number of secondary schools within the 30-minute time accessibility. It is even possible to identify several dozens of municipalities which do not have any secondary schools within the 30-minute distance. In particular, this is the case of border municipalities and, surprisingly, of some inland areas (in so-called inner peripheries) which are distant from major residential centres. Again, the highest number of available secondary schools is in Prague and its hinterland, in the area of basin districts in North Bohemia and in the major agglomerations in Moravia (Brno, Olomouc, and Ostrava). In terms of travel behaviour it is necessary to point out that most secondary school commuters (students) use a public transport.

Disparities between individual (car) and public transport in rural as well as urban areas are presented in the last part of the chapter about secondary school accessibility. Results show that there are not important differentiations between urban and rural regions. The total number of high secondary schools available within 30 minutes is more less similar by using individual (car) as well as public transport. It is influenced by relatively high density of secondary schools network and spatially regular pattern. But, it must be concerned secondary schools have various specialization, so the number of institutions accessible is only on dimension of a freedom of choice.

Figure 22. Higher secondary schools within 30 minutes travel time by car
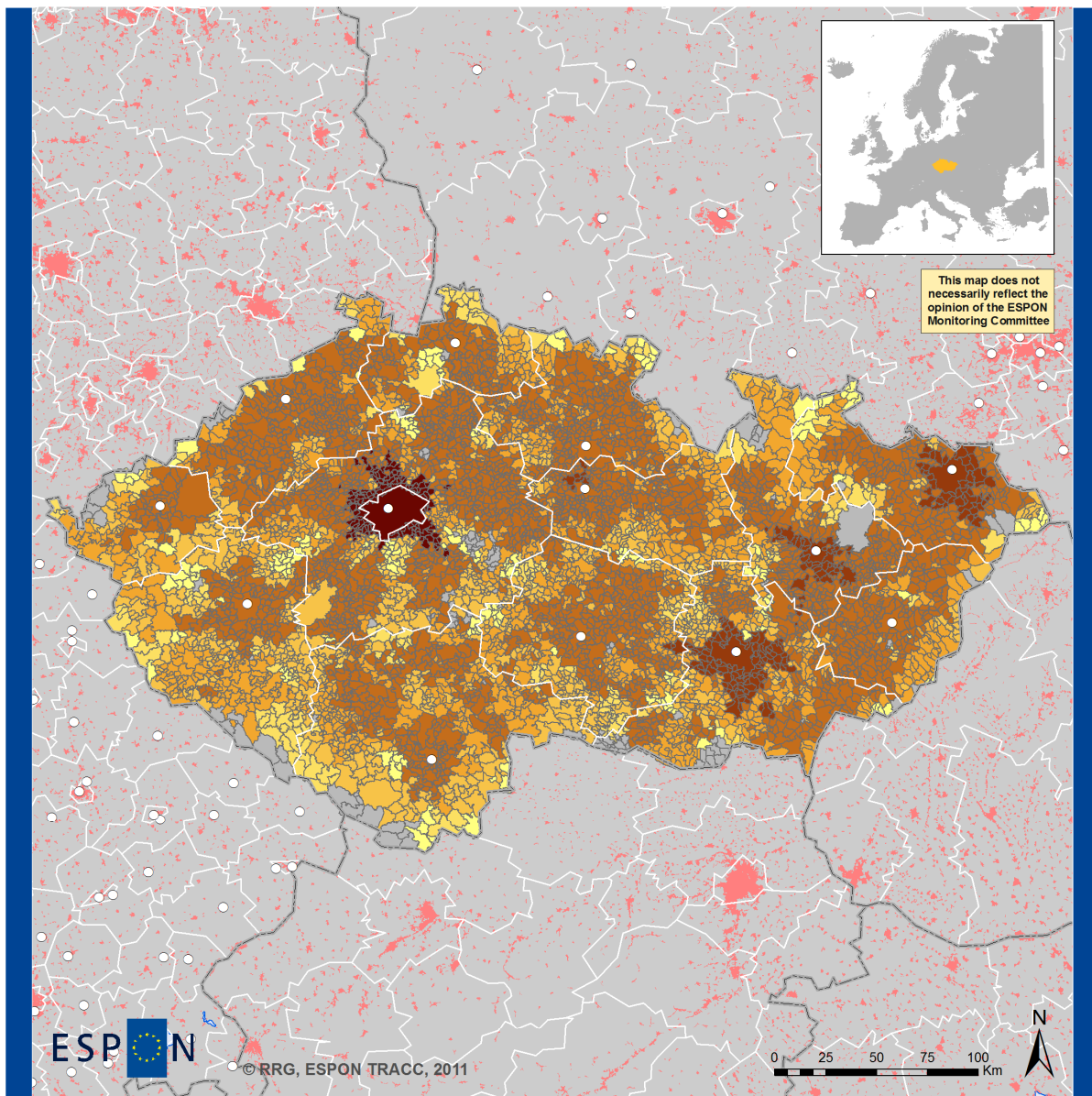
Czech Republic Case Study
Daily accessibility of secondary schools by car

0	6 - 10	○ NUTS 3 Capitals	
1	11 - 50		
2	51 - 100		
3 - 5	101 - 242		

Source: Ministry of Education, Youth and Sports, 2010
PrF UK Prague - accessibility model CAR
Origin of data: ESPON Databank Project,2010/2011
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Figure 23. Higher secondary schools within 30 minutes travel time by public transport

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Source: Ministry of Education, Youth and Sports, 2010
PrF UK Prague - accessibility model PUBLIC TRANSPORT
Origin of data: ESPON Databank Project,2010/2011
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Czech Republic Case Study
Daily accessibility of secondary schools by public transport

0	6 - 10	○ NUTS 3 Capitals
1	11 - 50	
2	51 - 100	
3 - 5	101 - 230	
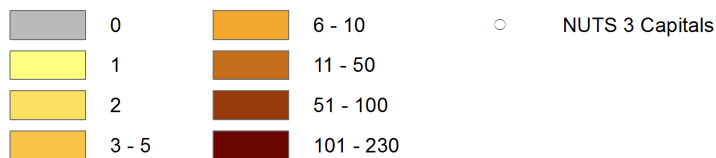
Figure 24. Higher secondary schools within 30 minutes travel time, by urban-rural typology

Higher secondary schools available within 30 minutes travel time

LAU-2 regions

- 97.5th percentile
- 75th percentile
- Public transport
- Median
- Car travel
- Population average
- 25th percentile
- 2.5th percentile

All LAU-2 regions (n = 6249) | Urban (n = 1147) | Intermediate close to a city (n = 2099) | Intermediate remote (n = 0) | Rural close to a city (n = 3003) | Rural remote (n = 0)
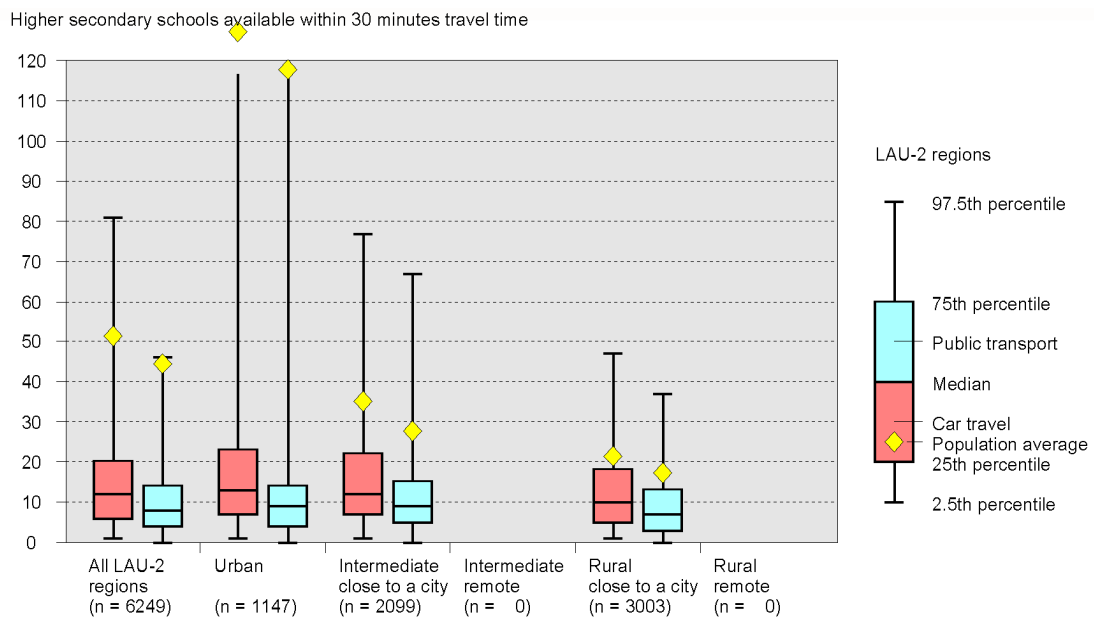
Figure 25. Higher secondary schools within 30 minutes travel time, cumulative distributions

Population (cumulative percentage)

Higher secondary schools available within 30 minutes travel time

Population of
Case study area
- by car
- by public transport
Urban regions
- by car
- by public transport
Intermediate regions
- by car
- by public transport
Rural regions
- by car
- by public transport
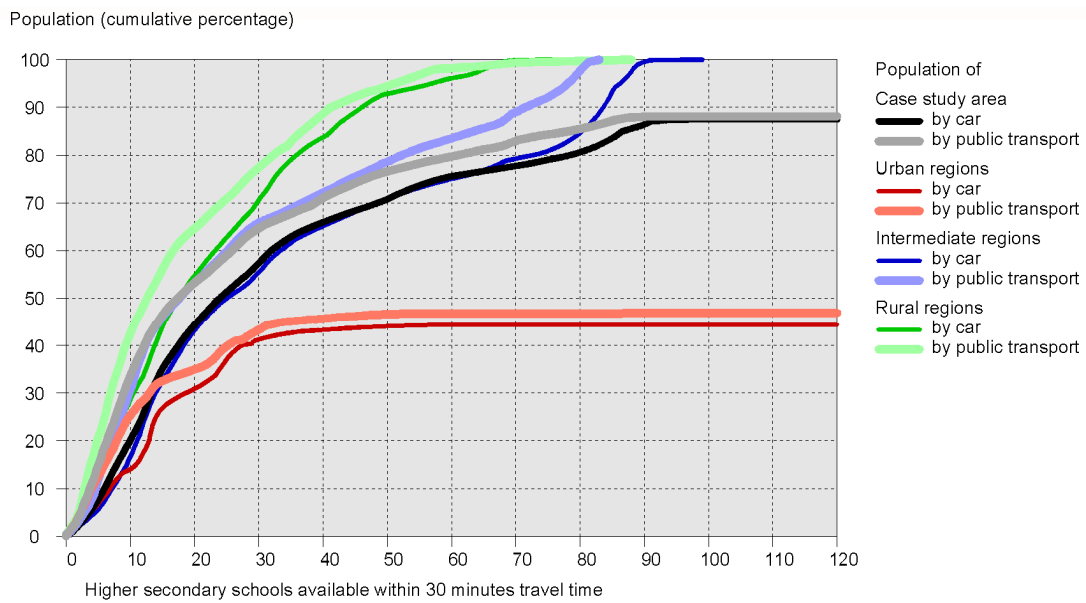
3.6 Accessibility potential to basic health care

Figure 26. Potential accessibility to medical doctors by car
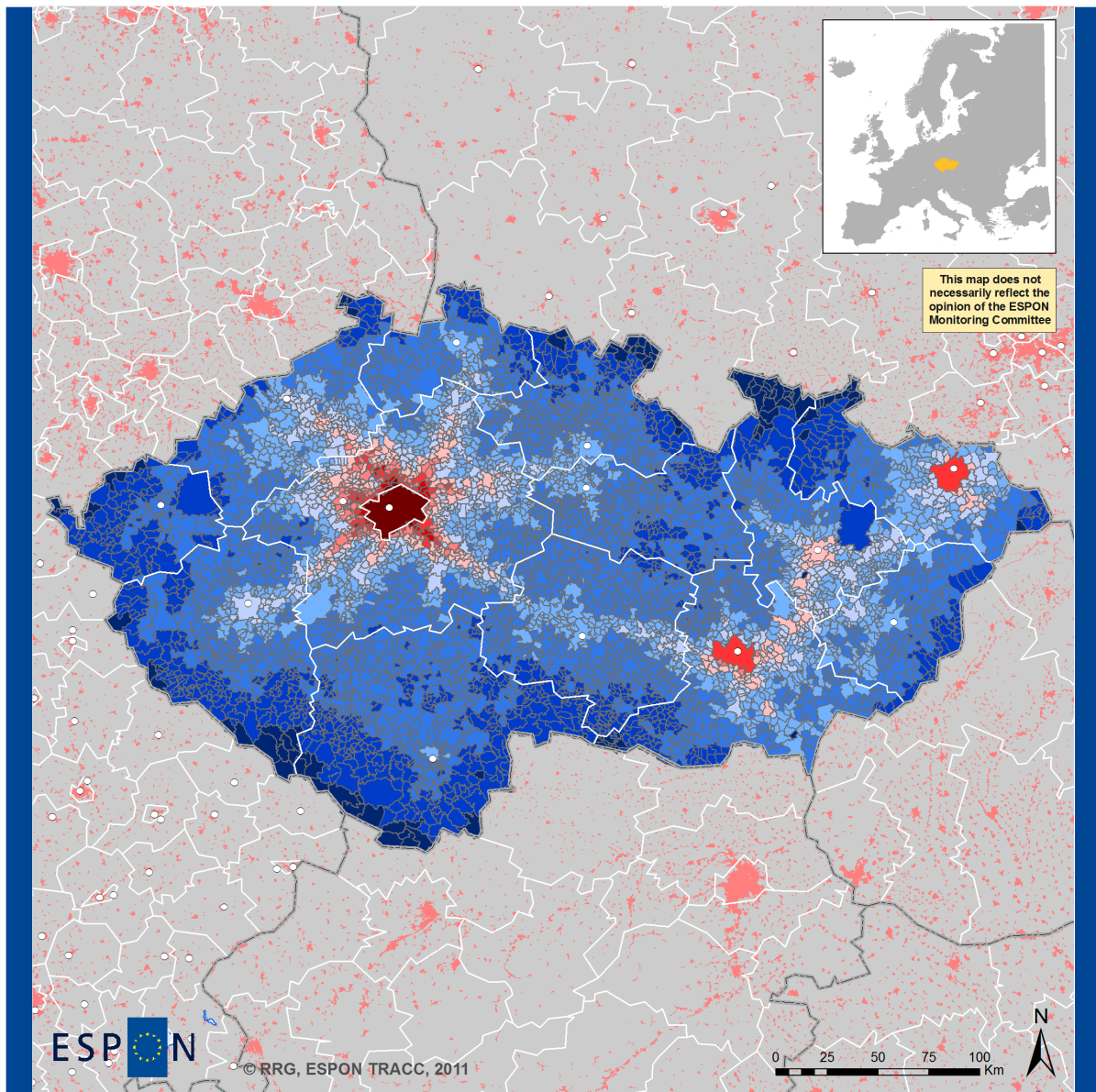
This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

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Source: Ministry of Health official database, 2011
Prf UK Prague - accessibility model CAR
Origin of data: ESPON Databank Project,2010/2011
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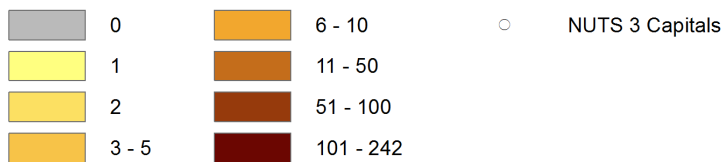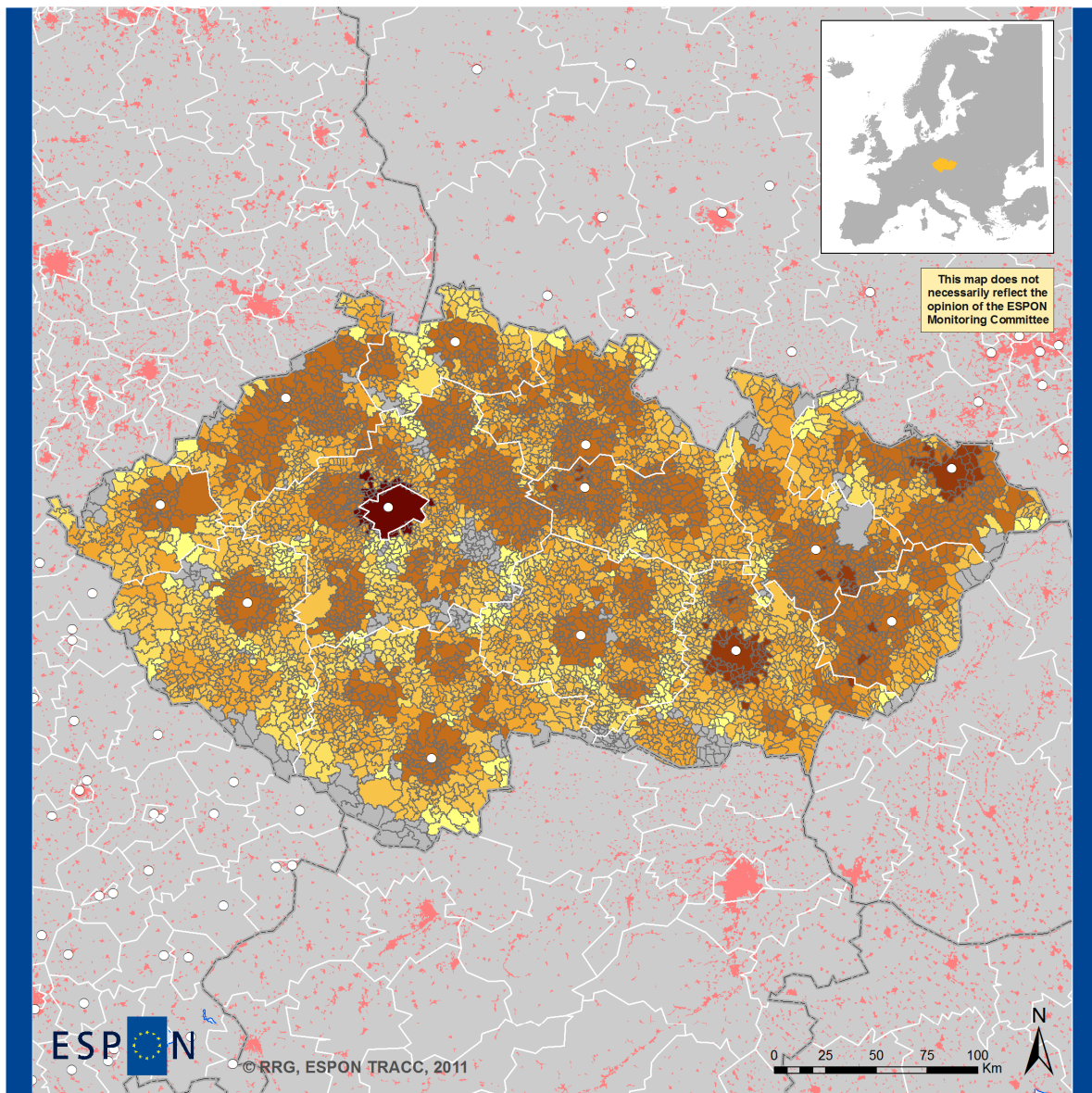**Czech Republic Case Study**
Potential accessibility to doctors by car [β = 0.046210]

- 0 - 10
- 10,1 - 25,0
- 25,1 - 50,0
- 50,1 - 75,0
- 75,1 - 100,0
- 100,1 - 125,0
- 125,1 - 150,0
- 150,1 - 175,0
- 175,1 - 200,0

○ NUTS 3 Capital
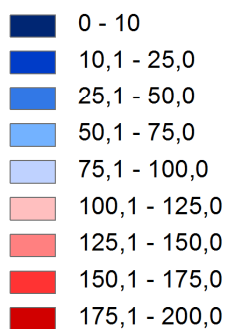
100 (population weighted average) = 201,5323616

Minimum: 4,715179679
Maximum: 747,7782866

Figure 27. Potential accessibility to medical doctors by public transport
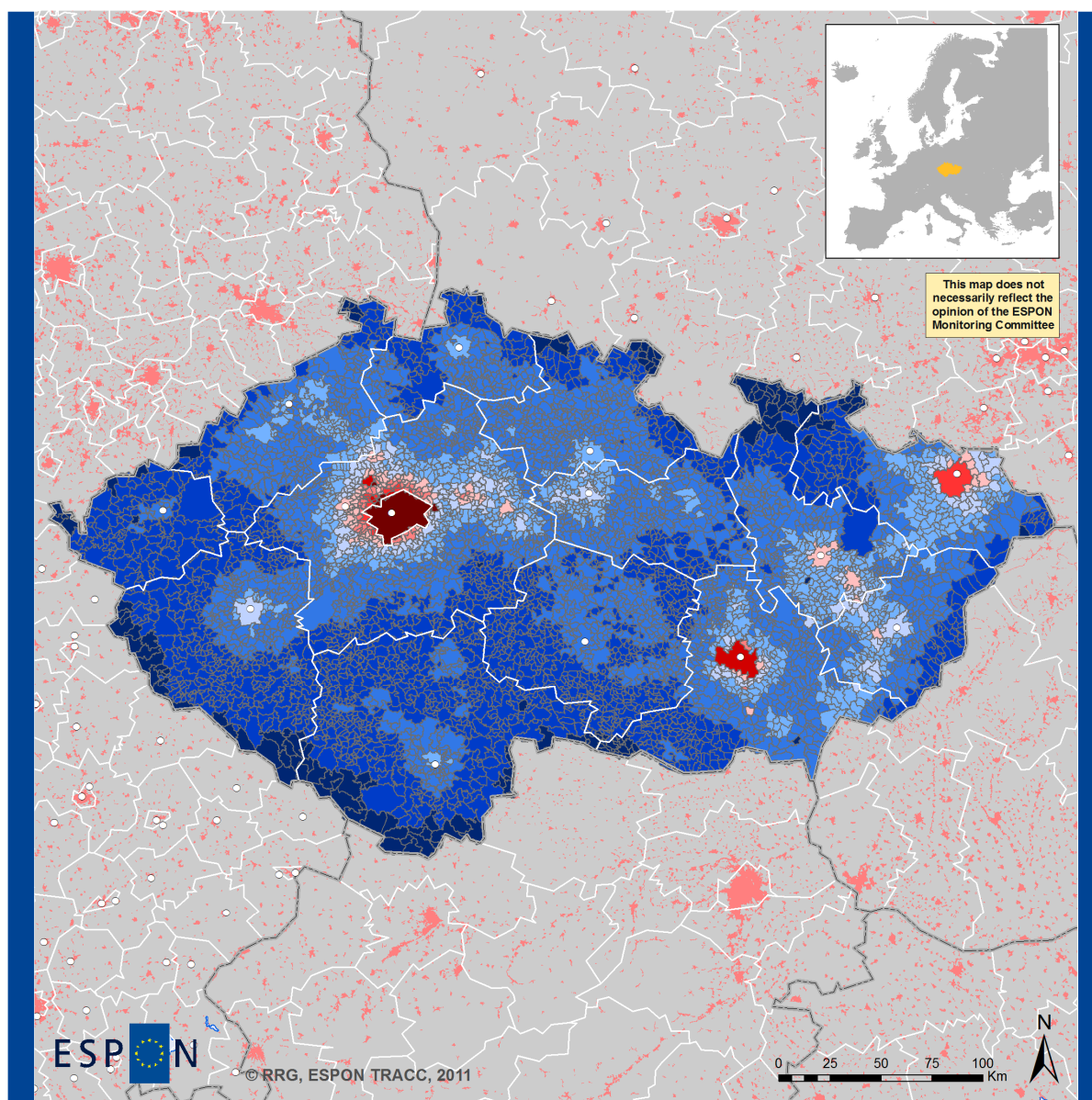
Source: Population and Housing Census, 2001
Prf UK Prague - accessibility model PUBLIC TRANSPORT
Origin of data: ESPON Databank Project, 2010/2011
© EuroGeographics Association for administrative boundaries

Czech Republic Case Study
Potential accessibility to doctors by public transport - public averaging [β = 0.034657]

■ 0 - 10	○ NUTS 3 Capital
■ 10,1 - 25,0	
■ 25,1 - 50,0	
■ 50,1 - 75,0	
■ 75,1 - 100,0	
■ 100,1 - 125,0	
■ 125,1 - 150,0	
■ 150,1 - 175,0	
■ 175,1 - 200,0	

100 (population weighted average) = 157,5117532

Minimum: 2,691561298
Maximum: 669,3794496

The worst potential accessibility to basic healthcare is apparent in borderland of Czechia with Austria and Poland. This Fact could be an impulse for cross-border cooperation.

Disparities between individual (car) and public transport in rural as well as urban areas are presented in following figures 28 and 29. This documents great differences between urban and rural municipalities including municipalities close to the city. Great diversity within urban category is capturing attention.

Figure 28. Potential accessibility to medical doctors, by urban-rural typology

Figure 29. Potential accessibility to medical doctors, cumulative distributions

4 Accessibility situations at different regional subtypes

Accessibility analysis presented above was performed in Czechia for a LAU-2 resolution (municipality). Accessibility analysis included time accessibilit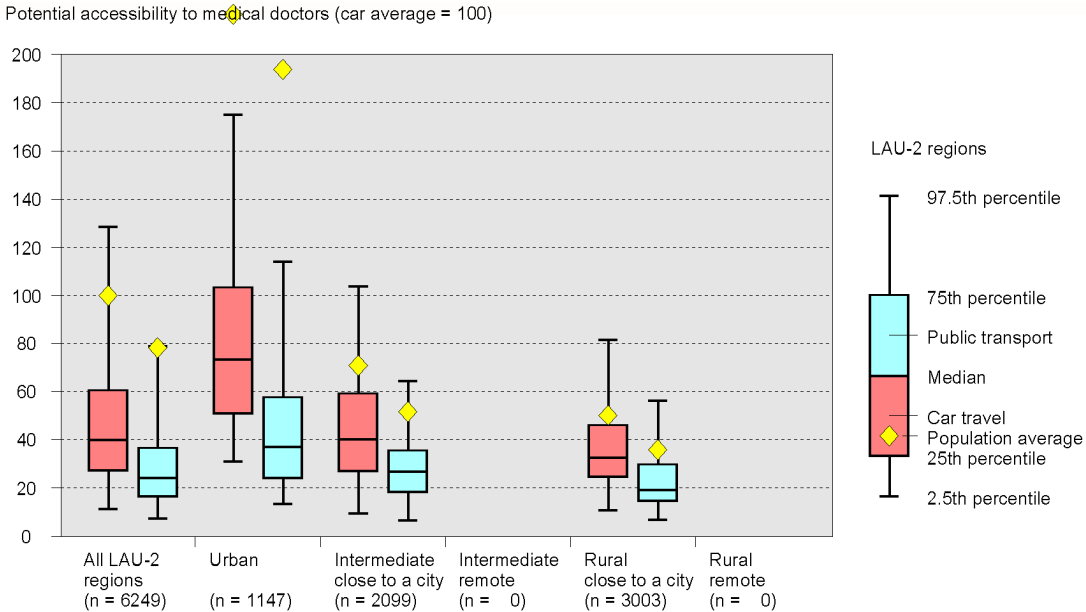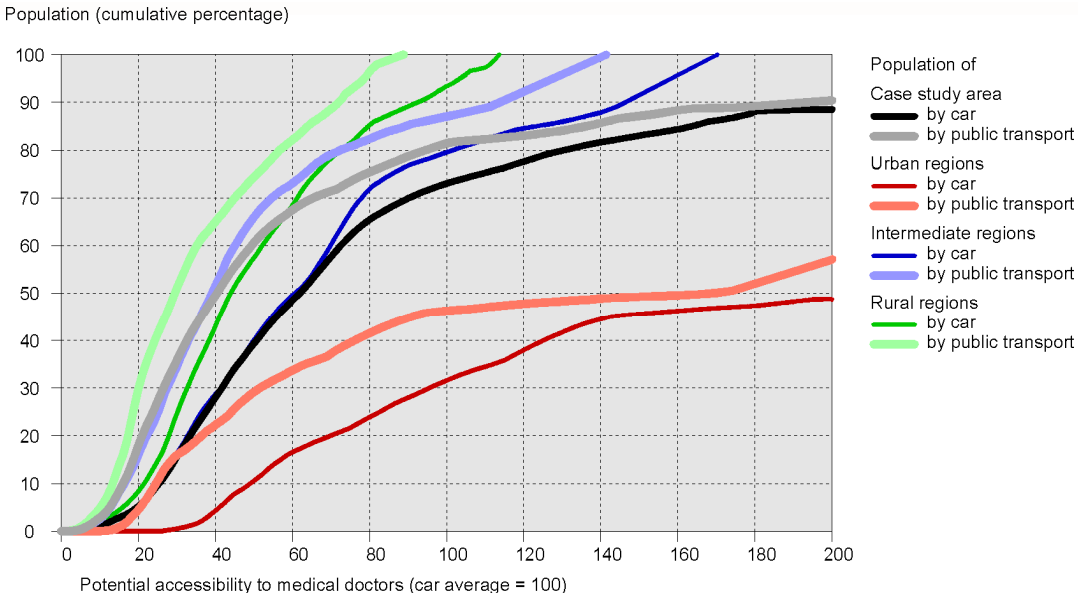y (rail and road) usually to important economic settlement centres. Analyses in this chapter provide images of the accessibility in different types of Czech regions (urban and metropolitan regions, rural and peripheral, lagging regions etc.). The following regions have been chosen as zoom-in areas:

- The Prague metropolitan area as a key economic and service node of Czechia. It consist of the capital city of Prague and its surroundings (districts Prague-East and Prague-West) characterised by intensive commuting, suburbanisation, increasing concentration of inhabitants and economic wealth.

- The Ústecký region (NUTS-3), a part of the North-western NUTS-2 region. Situated in north-west Bohemia at the border to Saxony it represents a coal basin area with long-term high unemployment, below-average education, low tourist attractiveness and economic decline in general. On the other hand, this region has a good position on the important development axis connecting Dresden and Prague. The border parts are relatively mountainous (Ore Mountains).

- The Vysočina region (NUTS-3 region, regional capital Jihlava, part of the South-eastern NUTS-2 region) as representative of mostly rural region with low density of population and settlement systems formed by small municipalities (almost 80 % have less than 500 inhabitants) and a network of regional towns and cities without one dominating centre. The Vysočina region includes peripheral zones between Bohemian and Moravian settlement cores.

- The Olomoucký region (NUTS-3, part of the Central Moravia NUTS-2 region) as region of elongated shape and high inner contrast between the Olomouc regional capital agglomeration in the south (370,000 population) and the Jeseníky mountains in the north. The rural area of Jeseníky Mts. isolates one of the most peripheral areas in Czechia, the Jeseník city district, from the rest of the country. From the point of view of economic development it is lagging region, but it has great development potential by the quality of its human capital.

Figure 30. Zoom-in regions
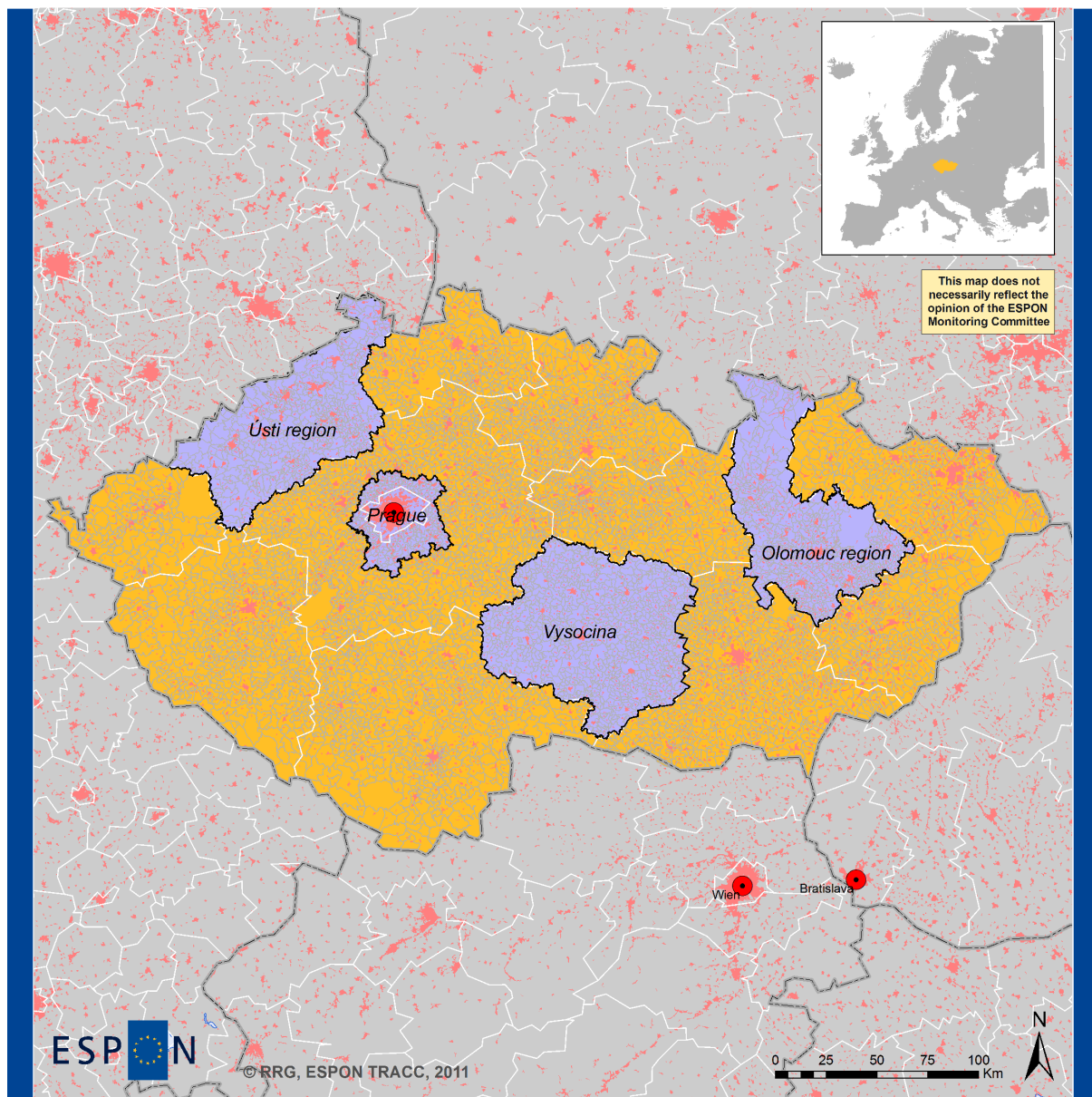
Czech Republic Case Study
Macro region and zoom-in regions

- Macro-region: municipalities
- Zoom-in regions
- Capital city
- Settlement area
- NUTS-3 region boundary

Next figures 31–42 present all indicators expressed in previous chapters on national level. Figure 31 and 32 shows travel time to next regional centre for selected zoom-in regions. Results show significant disparities among zoom-in regions as well as between used modes of transport. Differentiation among regions is not surprising because they have various nature and social conditions and geographical organization of settlement system. The most distinctive difference between car and public transport is in rather rural Vysocina region in comparison with extensively urbanised Ustecky region. In case of Prague metropolitan area and Ustecky region, the median values are surprisingly near the same, but variation range differs substantially.

Figure 31. Travel time to next regional centre, by zoom-in region
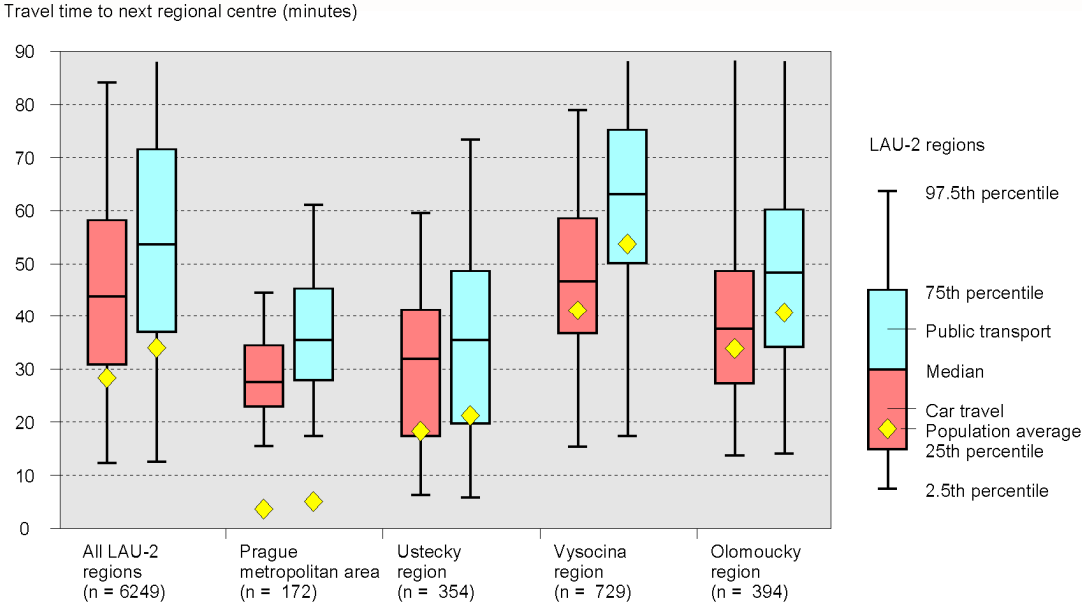
Figure 32. Travel time to next regional centre, cumulative distributions by zoom-in region
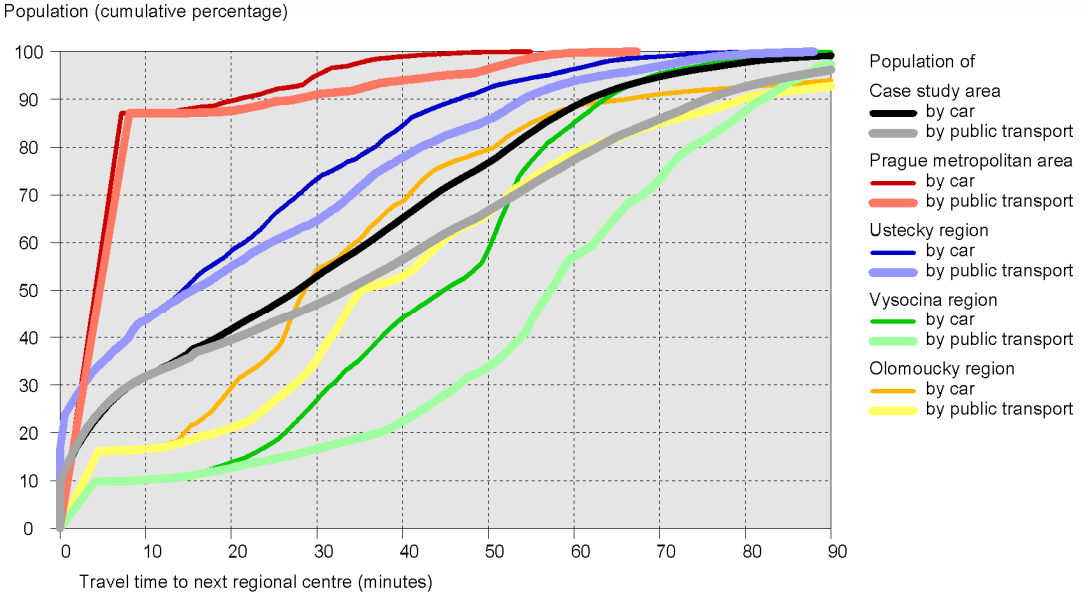
Next two diagrams (figure 33 and 34) identified main differences based on number of job opportunities accessible within 60 minutes. From this point of view case study results reflect achieved state of socioeconomic development and investment attractiveness during the transformation period in Czechia. Results are strongly influenced by extreme number of jobs in Prague metropolitan area (however, the difference between car and public transport is apparent). This fact also causes great variety of cumulative accessibility within Ustecky region as some areas can reach Prague labour market. Another thing is necessary qualification of potential employees.

Figure 33. Jobs accessible within 60 minutes, by zoom-in region
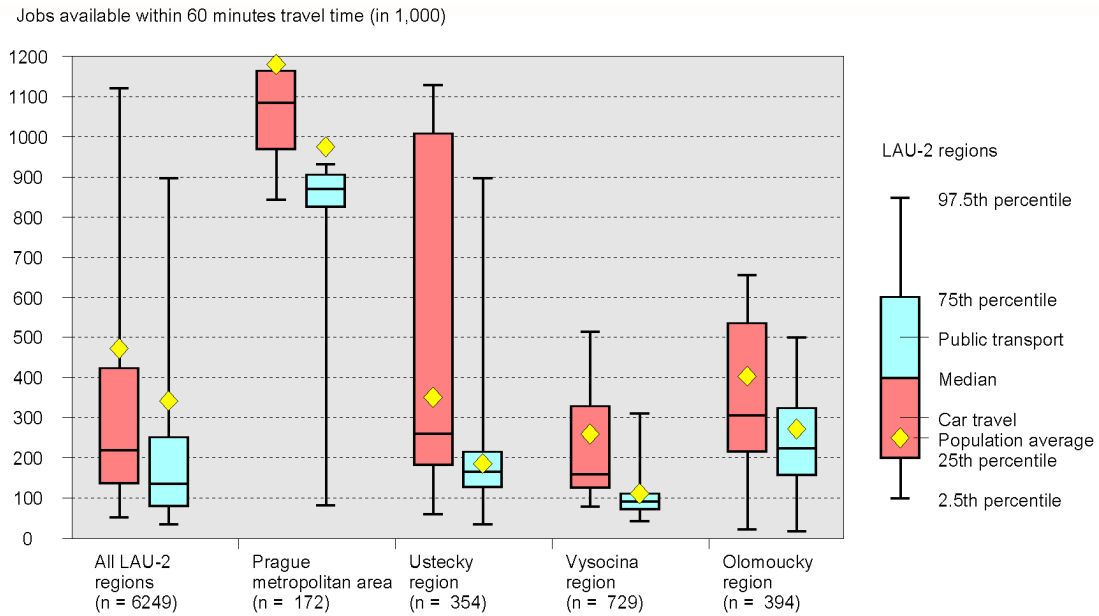
Figure 34. Jobs accessible within 60 minutes, cumulative distributions by zoom-in region
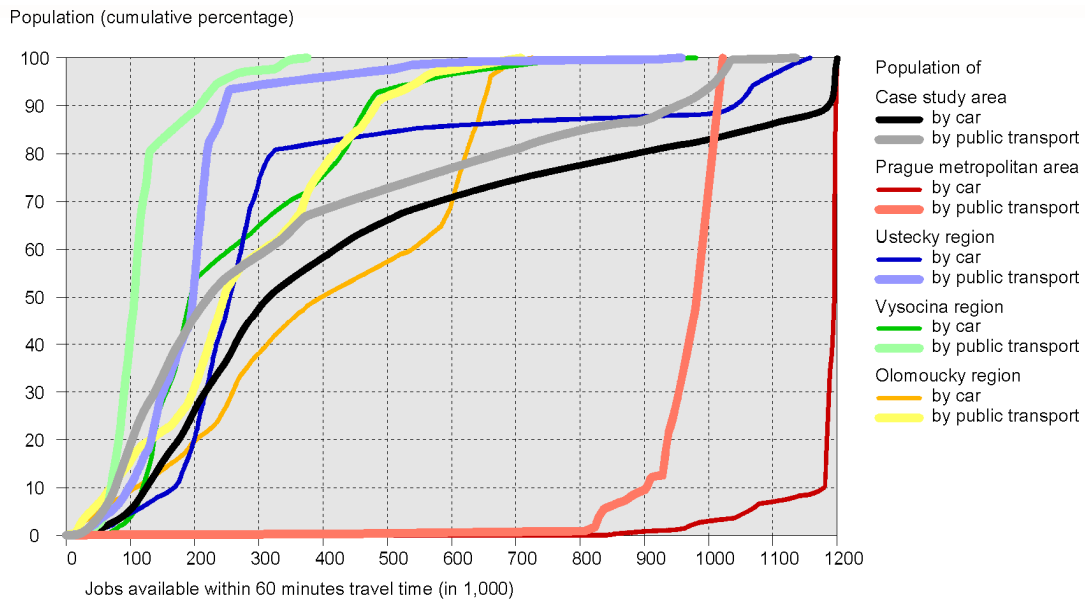
Potential accessibility logically highlights a gap between Prague metropolitan area as urban region and other zoom-in areas. Considering public transport a smaller extend is covered than in case of car transport.

Figure 35. Potential accessibility to population, by zoom-in region
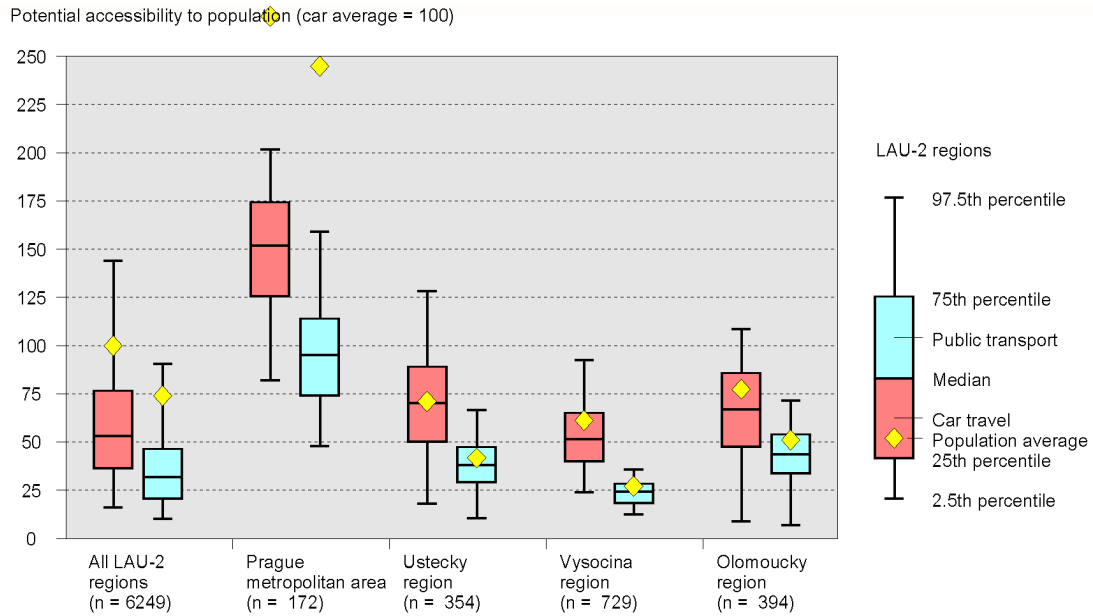
Figure 36. Potential accessibility to population, cumulative distributions by zoom-in region
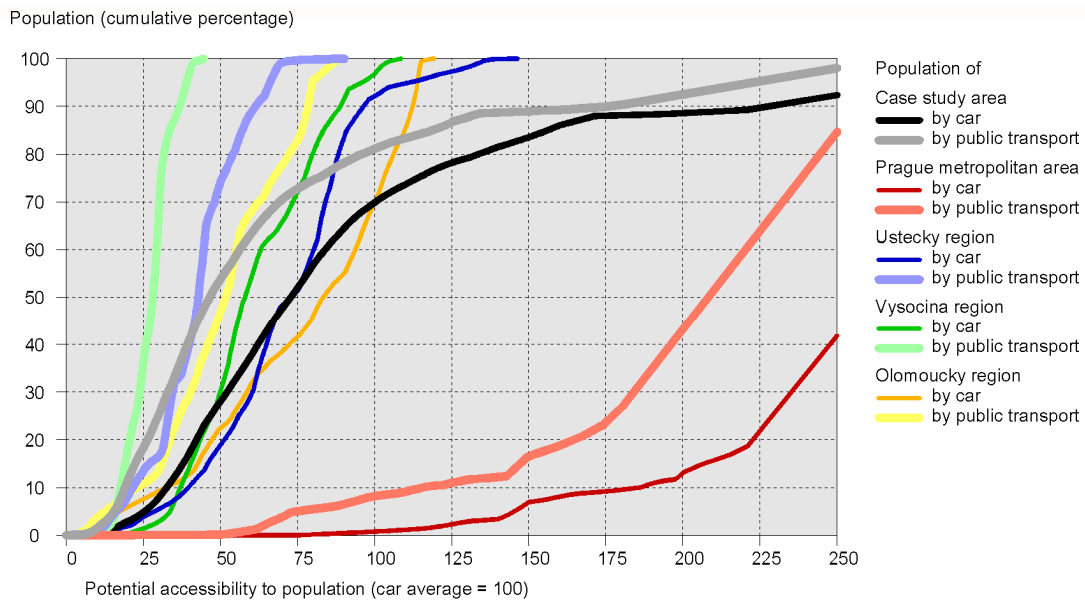
Figure 37 and 38 present travel time to next hospital by zoom-in regions and travel time to next hospital expressed like a cumulative distributions. According to indicator mentioned it is evident, that there are not significant differences among various type of regions. Accessibility of the basic health care and hospital is enacting by law in the Czechia and that is the reason of low disparities. Anyway figure 41 and 42 illustrate potential accessibility to medical doctors and diagrams show a little bit increasing differences among regions.

Figure 37. Travel time to next hospital, by zoom-in region
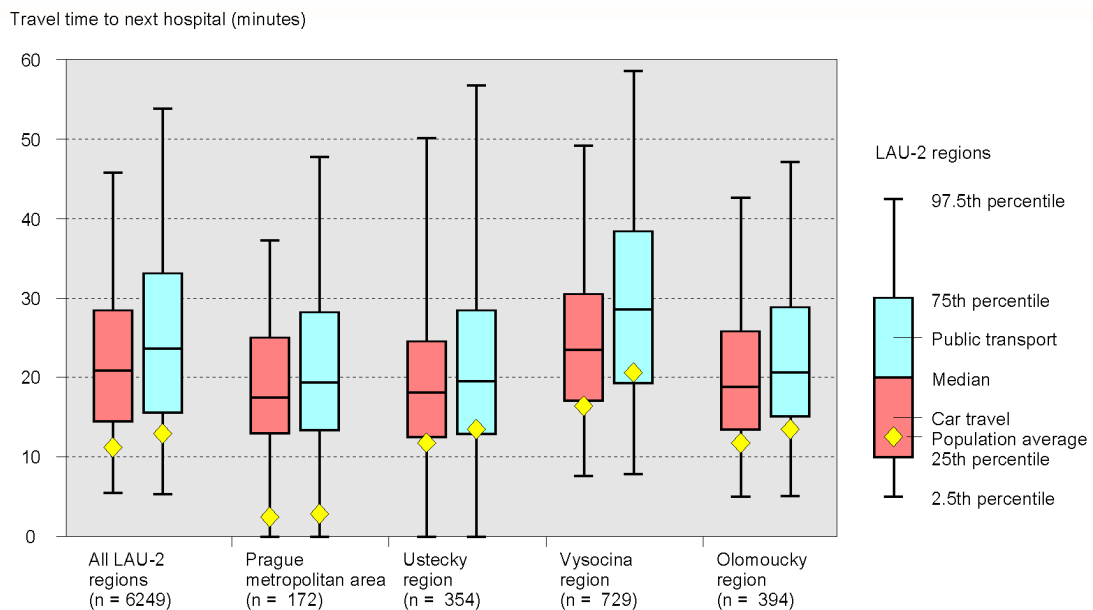
Figure 38. Travel time to next hospital, cumulative distributions by zoom-in region
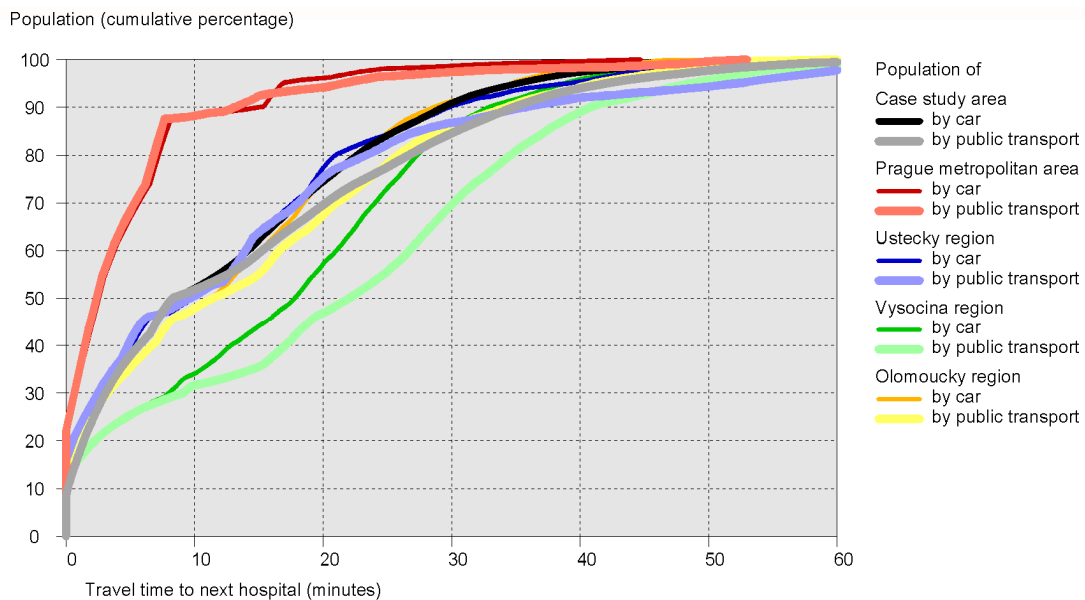
Figure 39 and 40 illustrate accessibility of higher secondary schools within 30 minutes travel time by zoom-in regions as well as the same indicator expressed like a cumulative distributions. Results confirm huge disparities between Prague metropolitan area and the other zoom-in regions. Concentration of upper secondary schools is influenced by attractiveness and especially by the population size of the main centre in the region. From this point of view Prague is the dominant centre with many possibilities for commuting to schools (Prague serves for wider region of Central Bohemia and parts of neighbouring regions).

Figure 39. Higher secondary schools within 30 minutes travel time, by zoom-in region

Figure 40. Higher secondary schools within 30 minutes travel time, cumulative distributions by zoom-in region

Figure 41. Potential accessibility to medical doctors, by zoom-in region

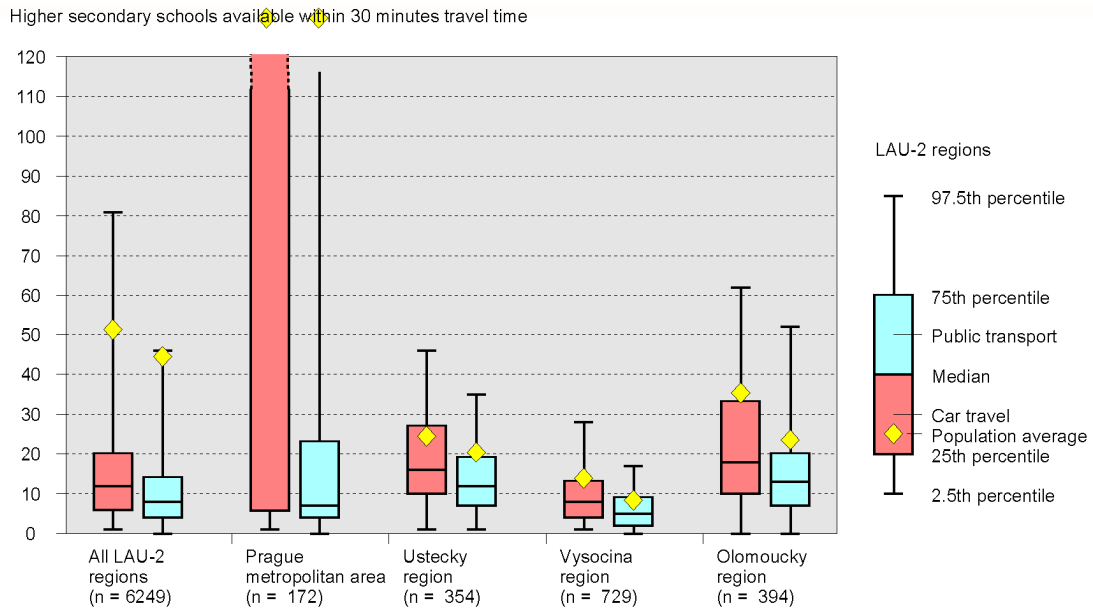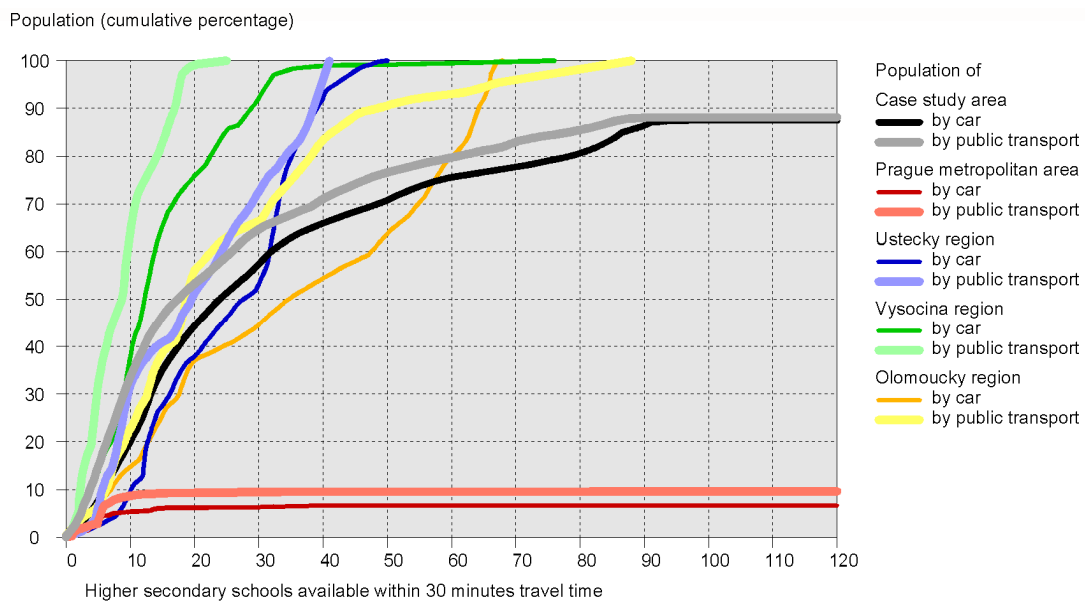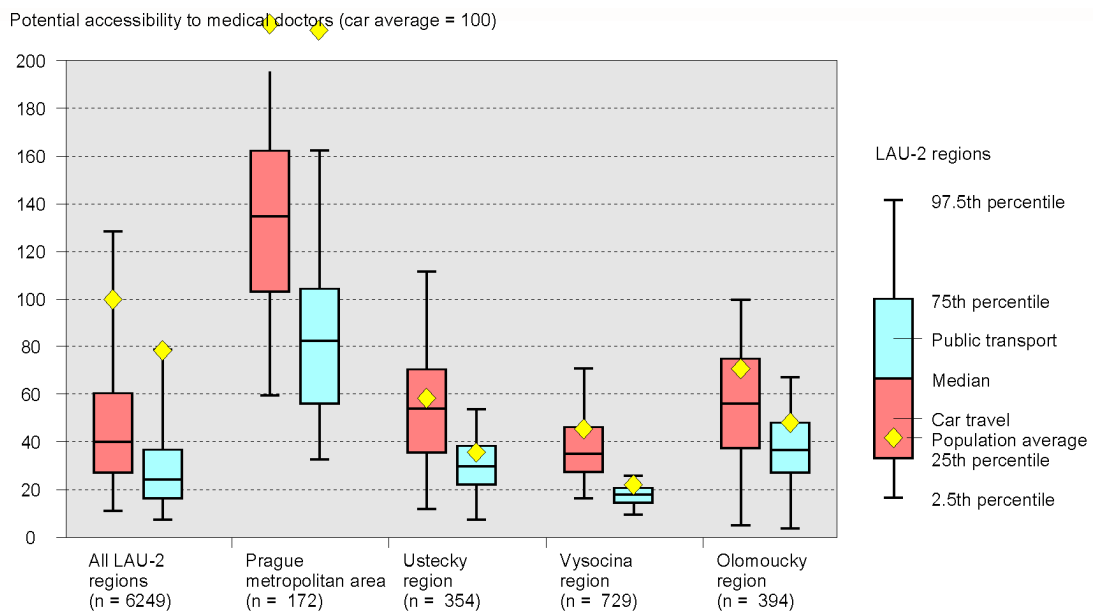Figure 42. Potential accessibility to medical doctors, cumulative distributions by zoom-in region
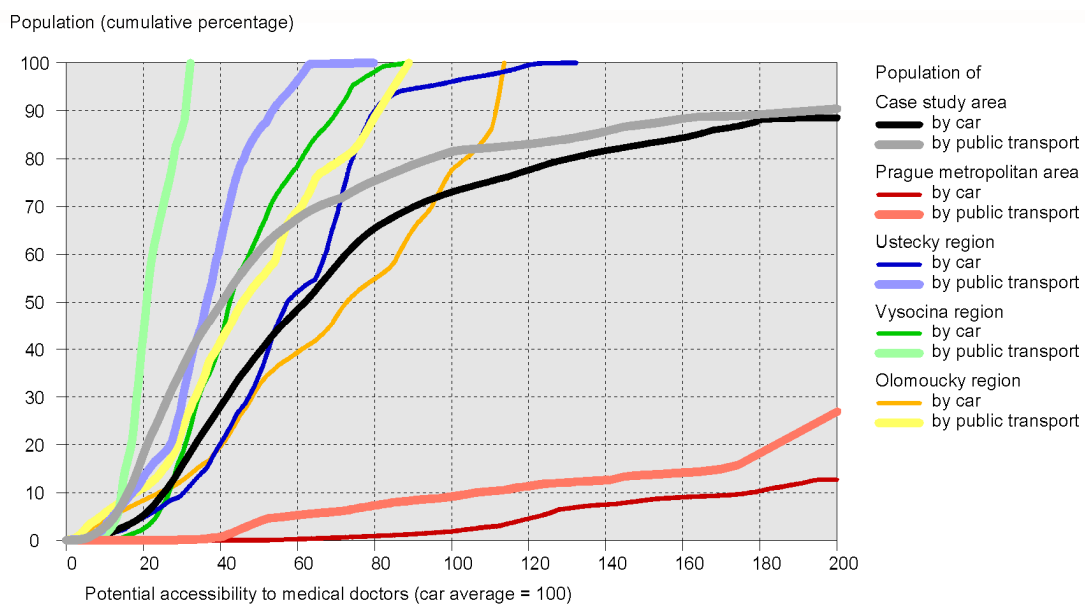
Table 1. Accessibility by car, deviations of zoom-in regions from case study averages

Area	Travel time to next regional centre		Jobs accessible within 60 minutes		Potential accessibility to population	Travel time to next hospital		Higher secondary schools within 30 minutes		Potential accessibility to medical doctors
	Minutes	Index	In 1,000	Index	Index	Minutes	Index	Number	Index	Index
Prague metropolitan area zoom-in	28,96	64,21	1073,65	304,12	150,03	19,41	87,75	130,85	662,20	135,11
Ústecký region zoom-in	30,51	67,65	465, 85	131,96	70,65	19,88	89,87	18,25	92,36	55,75
Olomoucký region zoom-in	42,45	94,12	344,39	97,55	65,52	20,61	93,17	23,38	118,32	55,61
Vysočina region zoom-in	47,44	100,05	223,56	63,33	53,75	24,58	111,12	10,02	50,71	37,77
Case study region	45,10	100,00	353,03	100,00	100,00	22,12	100,00	19,76	100,00	100,00

Table 2. Accessibility by public transport, deviations of zoom-in regions from case study averages

Area	Travel time to next regional centre		Jobs accessible within 60 minutes		Potential accessibility to population	Travel time to next hospital		Higher secondary schools within 30 minutes		Potential accessibility to medical doctors
	Minutes	Index	In 1,000	Index	Index	Minutes	Index	Number	Index	Index
Prague metropolitan area zoom-in	36,94	67,30	841,82	407,62	96,27	22,09	87,66	54,60	440,68	84,31
Ústecký region zoom-in	35,21	64,15	191,96	92,95	38,40	22,23	88,21	14,23	114,85	30,30
Olomoucký region zoom-in	50,39	91,80	232,57	112,61	42,82	23,00	91,27	16,82	135,75	36,83
Vysočina region zoom-in	61,64	112,30	98,81	47,85	23,91	29,78	118,17	6,43	51,90	17,76
Case study region	54,89	100,00	206,52	100,00	100,00	25,20	100,00	12,39	100,00	100,00

5 Accessibility effects of future TEN-T developments

European dimension is very important for the development of transport infrastructure in Czechia. The currently pending proposal for a Regulation on the Union's guidelines for the development of TEN-T will be a very crucial aspect for determining long-term strategy of transport development. A high quality transport infrastructure as an essential condition for traffic is a one of key aspects for solving the transport issues. Transport accessibility is ensured for all self-administrative regions, but not in sufficient quality. This is one of the causes of disequilibrium position of regions, as the quality of transport service is one aspect of the competitiveness of regions. If the draft of regulation for the development of TEN-T is adopted in its current form, Czechia is bound by commitment for 2030 to complete the transport infrastructure of the main TEN-T and multimodal corridors in rail, road, water and air transport. By 2050, Czechia had a commitment to complete the remainder of the TEN-T (the global network).

Below presented figures show all current as well as supposed transport infrastructure projects included in TEN-T programme.

Below presented figures show potential accessibility to population by car and by public transport with TEN-T projects. These results comparing with previous maps, which presented potential accessibility to population at present times, clearly illustrate positive effects of transport projects including in TEN-T programme. Impacts of new TEN-T infrastructure will have stimulation effects for potential accessibility and population mobility. Infrastructure projects TEN-T significantly enlarge potential accessibility in hinterland of the most important agglomerations and it will support transport connection among key settlement centres in Czechia. In case of public transport impacts, which were standardised to car transport, it seems that it would strength transport relations of Prague with North and East Bohemia regions and cities. At the same time the finishing of selected parts of TEN-T projects would positively influenced the transport situation in Moravia-Silesia regions (especially among cities Brno, Ostrava and Olomouc).

Figure 43. TEN-T road and rail infrastructure projects
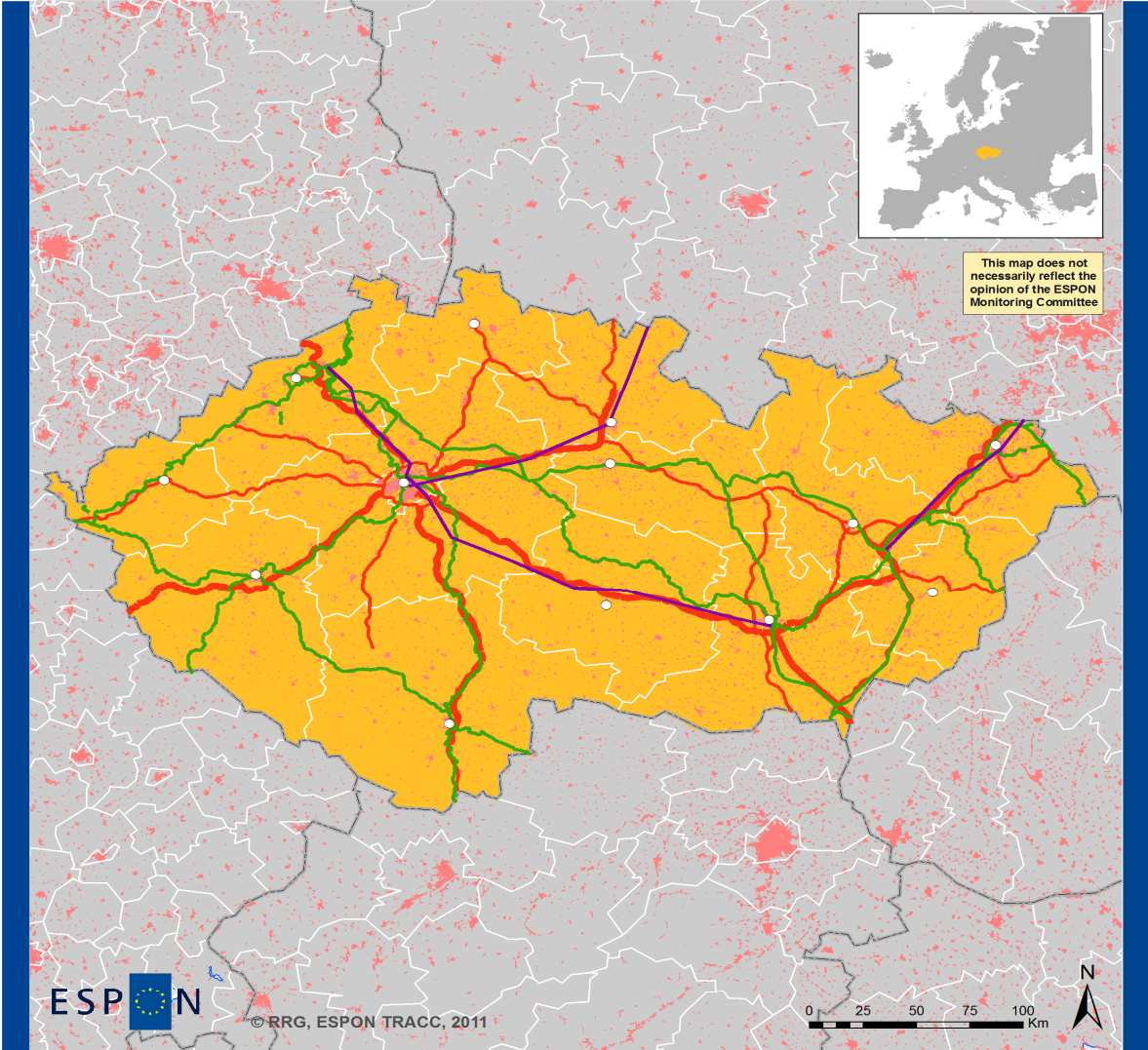
Source: PrF UK Prague - accessibility model
Origin of data: ESPON Databank Project,2010/2011
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Czech Republic Case Study
TEN-T road and rail infrastructure projects

— Expressway
— Motorway
— High speed rail
— Conventional rail
○ NUTS 3 Capitals

Figure 44. Potential accessibility to population by car with TEN-T projects
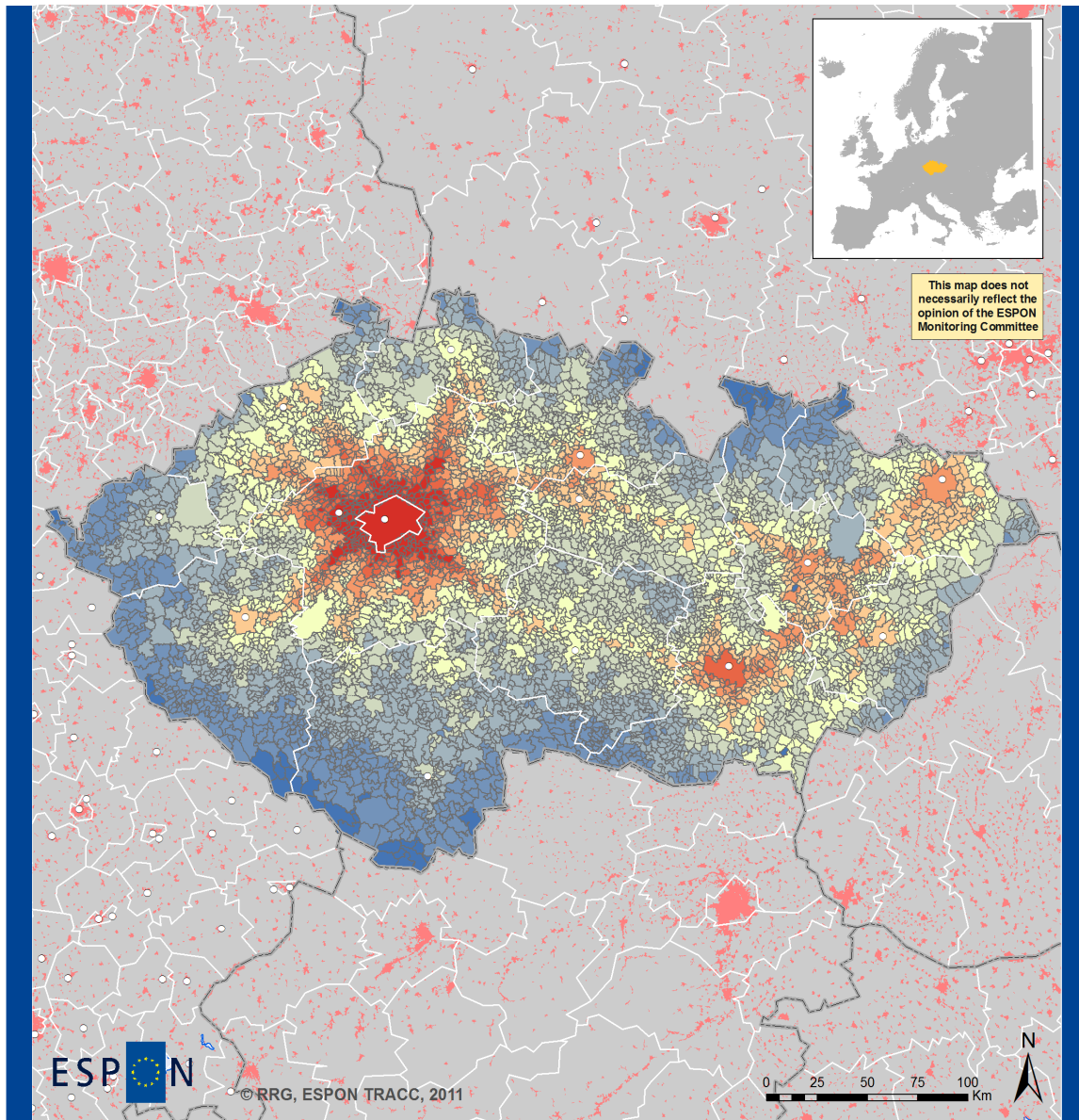
Source: Population and Housing Census, 2001
Prf UK Prague - accessibility model CAR
Origin of data: ESPON Databank Project,2010/2011
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Czech Republic Case Study - Future situation
Potential accessibility to population by car [β = 0.034657]

■ 0,0 - 25,0	○ NUTS 3 Capital
■ 25,1 - 50,0	
■ 50,1 - 75,0	
■ 75,1 - 100,0	
■ 100,1 - 125,0	**100 (population weighted average) = 751132,6401**
■ 125,1 - 150,0	
■ 150,1 - 175,0	Minimum: 62217,46751
■ 175,1 - 200,0	Maximum: 1896609,148
■ 200,1 - 361,9	

Figure 45. Potential accessibility to population by public transport with TEN-T projects
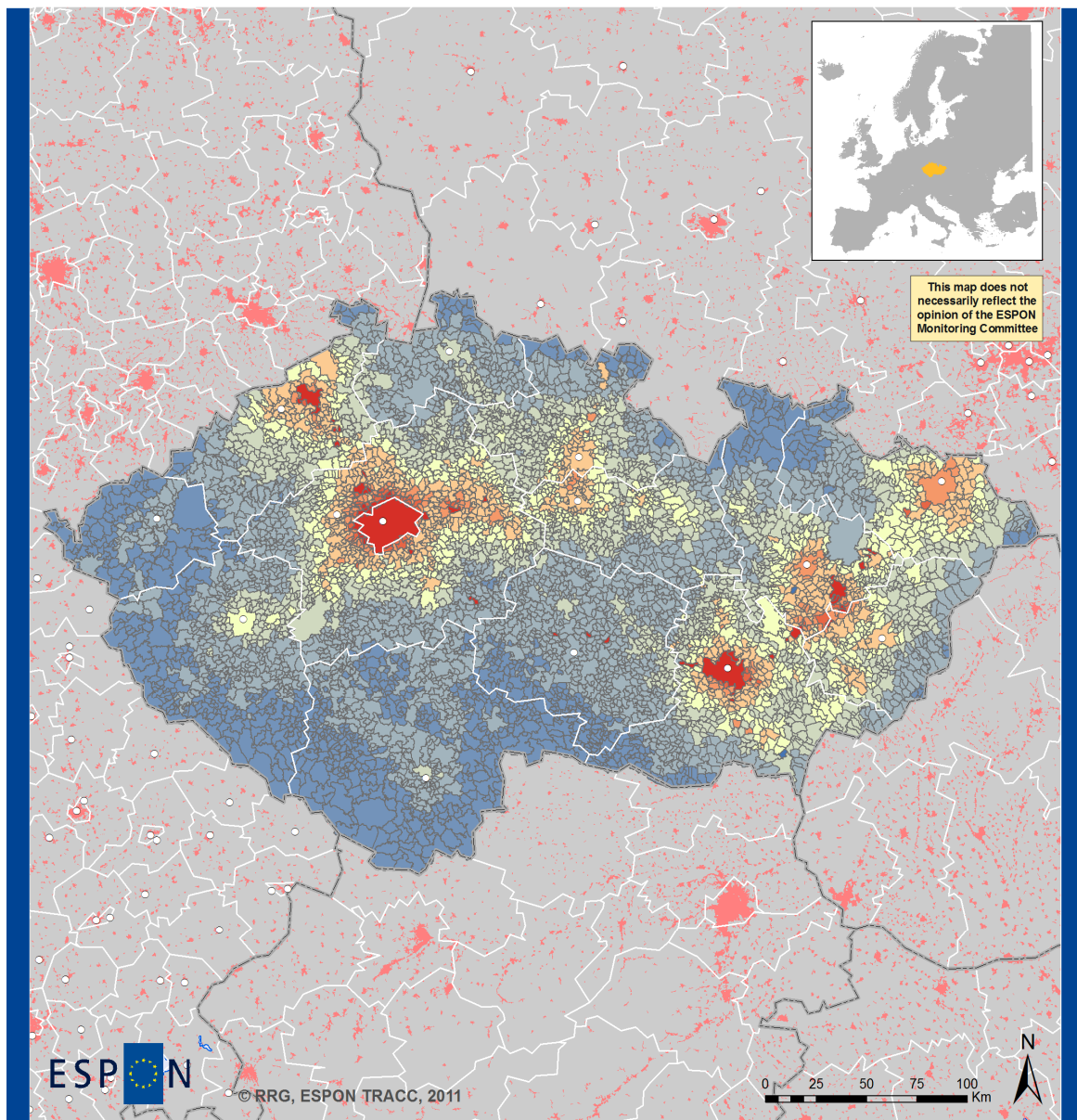
Source: Population and Housing Census, 2001
Prf UK Prague - accessibility model PUBLIC TRANSPORT
Origin of data: ESPON Databank Project,2010/2011
© EuroGeographics Association for administrative boundaries

Czech Republic Case Study - Future situation
Potential accessibility to population by public transport [β = 0.034657]

- 0 - 1
- 1,1 - 25
- 25,1 - 50
- 50,1 - 75
- 75,1 - 100
- 100,1 - 150
- 150,1 - 175
- 175,1 - 200
- 200 <

○ NUTS 3 Capital

100 (population weighted average) = 480277,8107

Minimum: 3412,675591
Maximum: 1637907,862

Relative increase of potential accessibility to population by car and by public transport with TEN-T projects very clearly identify each regions, which will be touched by new infrastructure projects. In case of car accessibility potential contribution for the most of municipalities in Czechia is evident. Anyway the map which presents relative increase of potential accessibility to population by public transport with TEN-T shows significantly more selected results. The most important benefit from the public transport point of view is possible to expect in north and east Bohemia, furthermore in south hinterland of Prague and in the South-Moravia and Zlín regions (partially in the South part of Olomouc regions as well).

Analyses presented were done at national level but an importance of TEN-T corridors for an international interconnection is also apparent. This is a case of axes Prague – Dresden, Prague – Nurnberg/Munich, Prague – Wroclaw or Brno – Vienna).

Figure 46. Relative increase of potential accessibility to population by car with TEN-T projects
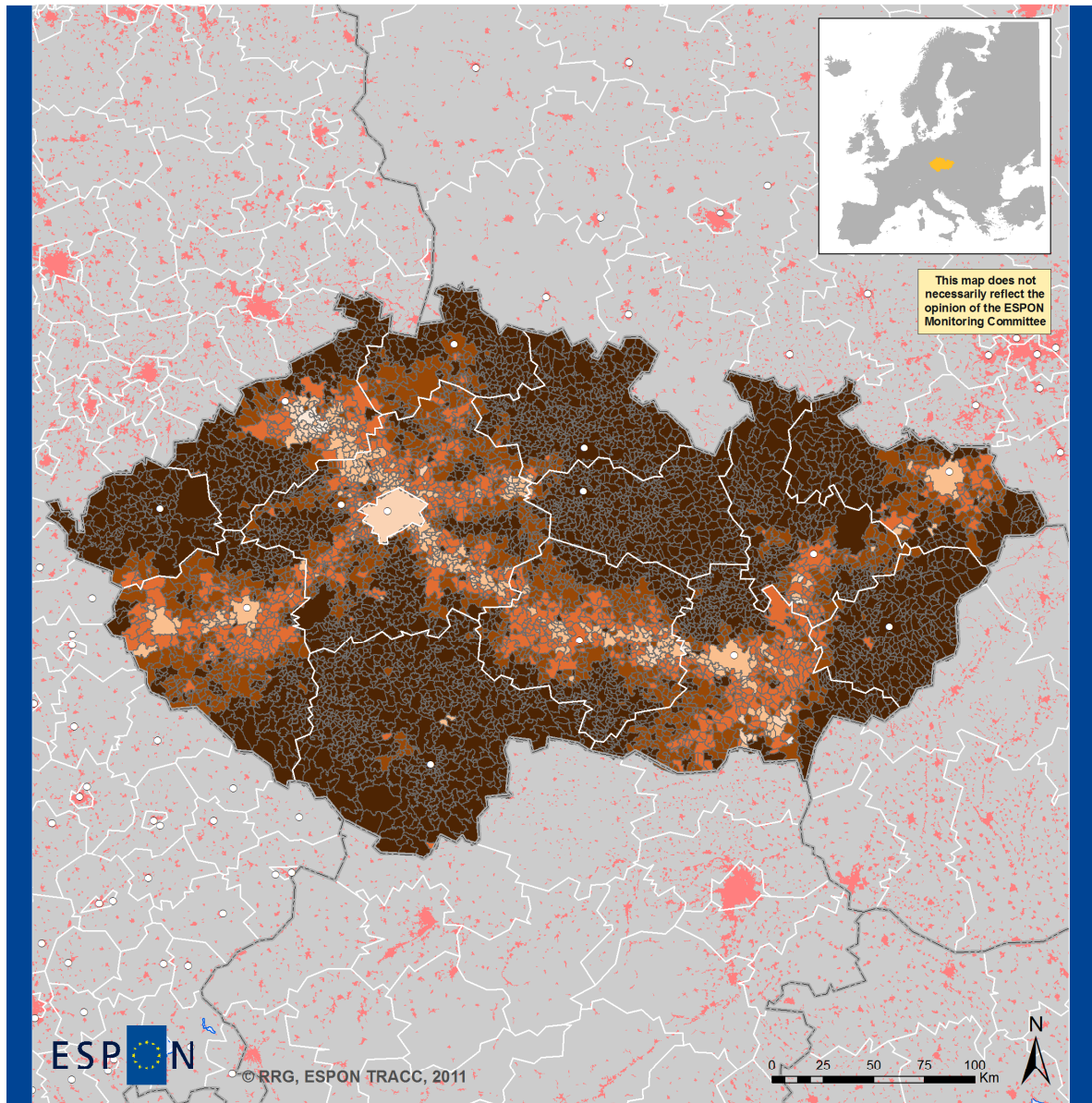
Czech Republic Case Study
Potential accessibility, relative change - car

☐ -22,7 - 5,0	○ NUTS 3 Capital
☐ 5,1 - 20,0	
☐ 20,1 - 35,0	
☐ 35,1 - 50,0	
☐ 50,1 - 65,0	
☐ 65,1 - 285,9	
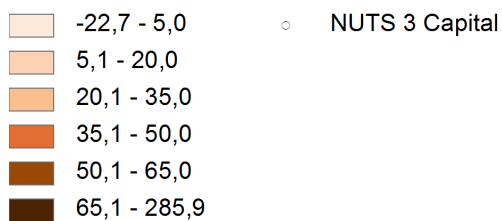
Figure 47. Relative increase of potential accessibility to population by public transport with TEN-T projects

Czech Republic Case Study
Potential accessibility, relative change - public transport

☐ -93,6 - 5,0	○ NUTS 3 Capital
☐ 5,1 - 20,0	
☐ 20,1 - 35,0	
☐ 35,1 - 50,0	
☐ 50,1 - 65,0	
☐ 65,1 - 652,8	

Figure 48. Absolute increase of potential accessibility to population by car with TEN-T projects

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

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Source: Ministry of Health official database, 2011
Prf UK Prague - accessibility model CAR
Origin of data: ESPON Databank Project,2010/2011
© EuroGeographics Association for administrative boundaries
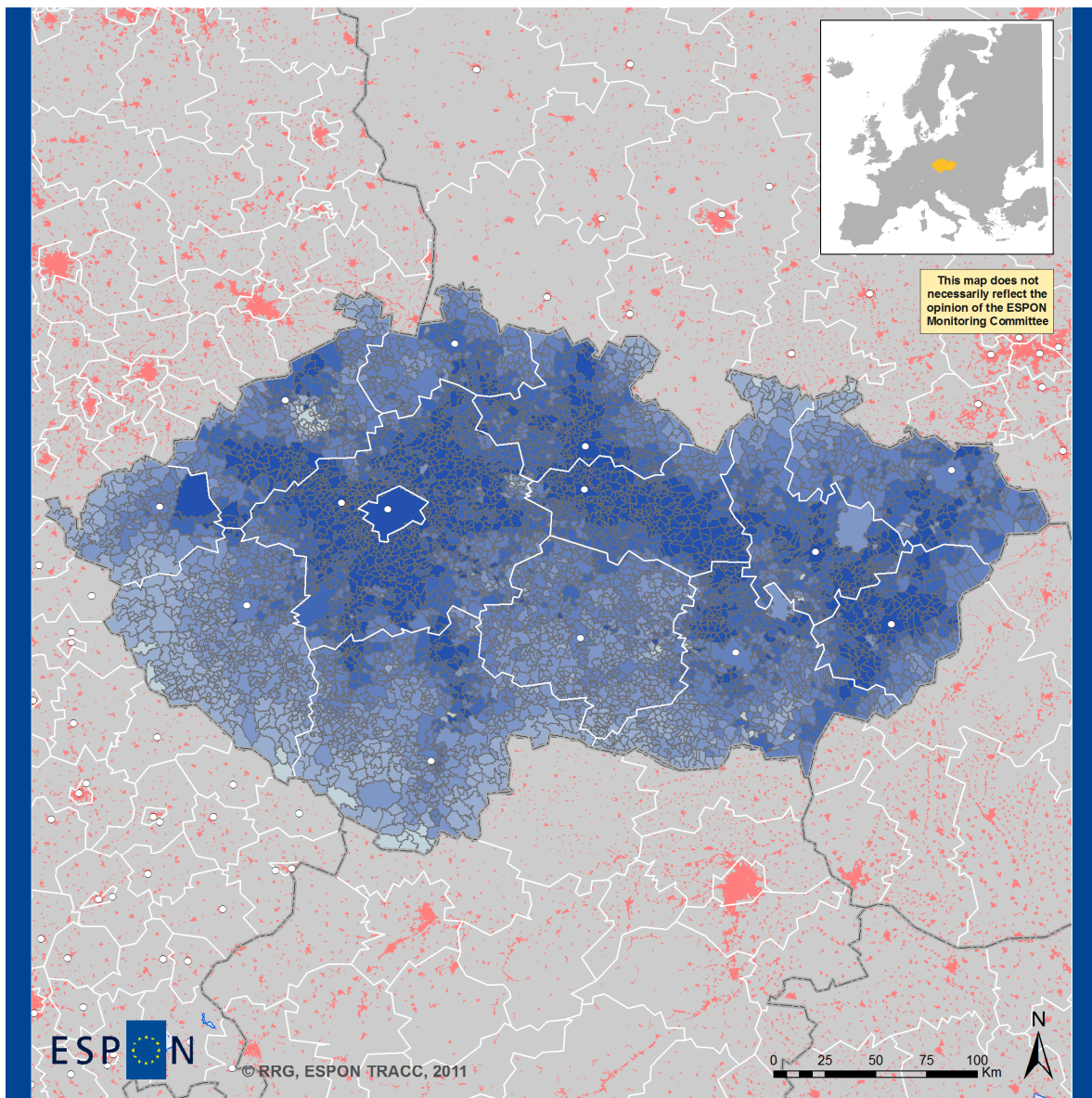
Czech Republic Case Study
Potential accessibility, absolute change - car

- 0 - 10
- 10,1 - 20
- 20,1 - 30
- 30,1 - 40
- 40,1 - 50
- 50 <

○ NUTS 3 Capital

Figure 49. Absolute increase of potential accessibility to population by public transport with TEN-T projects

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

© RRG, ESPON TRACC, 2011
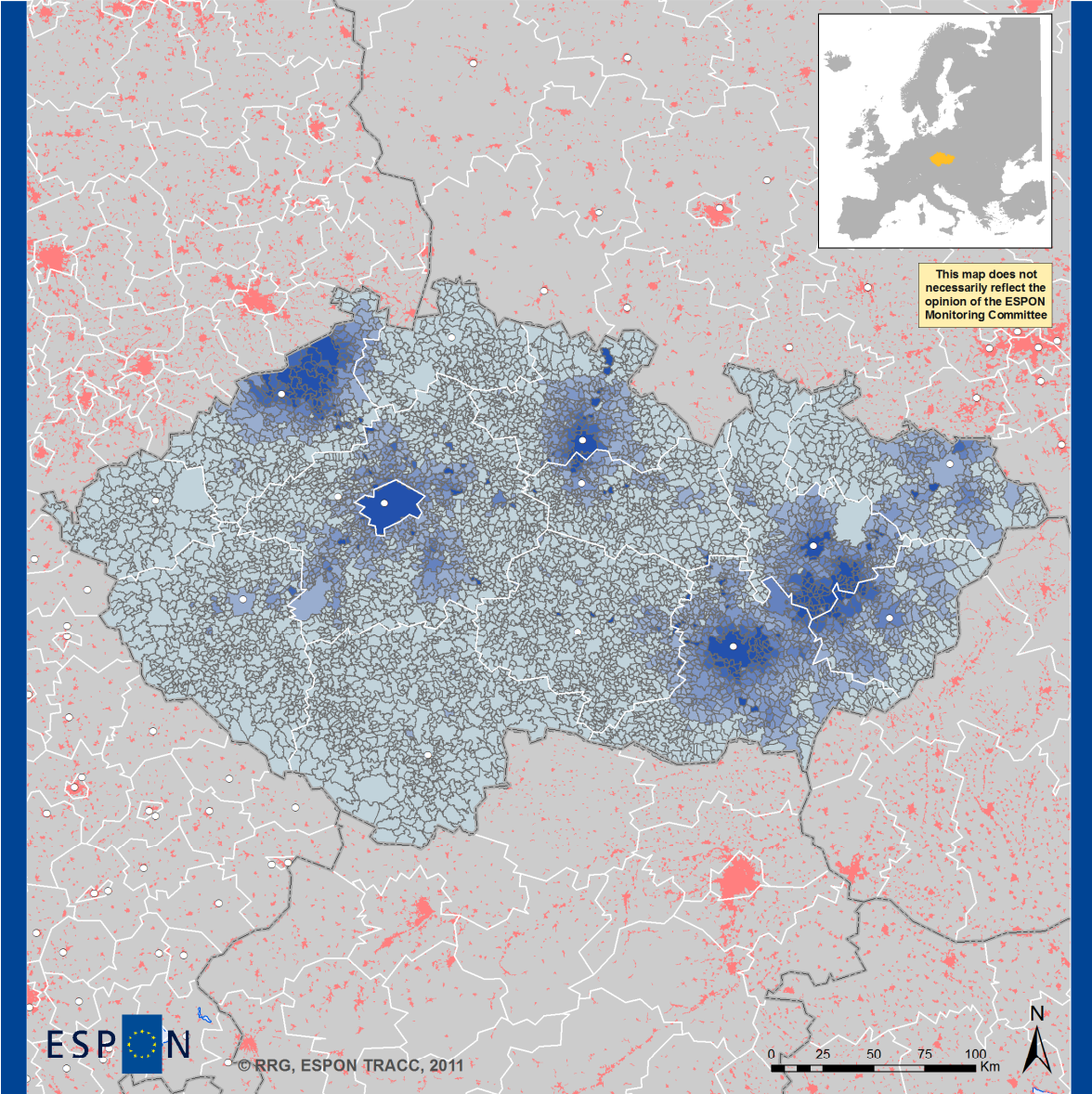
EUROPEAN UNION
Part-financed by the European Regional Development Fund
INVESTING IN YOUR FUTURE

Source: Population and Housing Census, 2001
Prf UK Prague - accessibility model PUBLIC RANSPORT
Origin of data: ESPON Databank Project,2010/2011
© EuroGeographics Association for administrative boundaries

Czech Republic Case Study
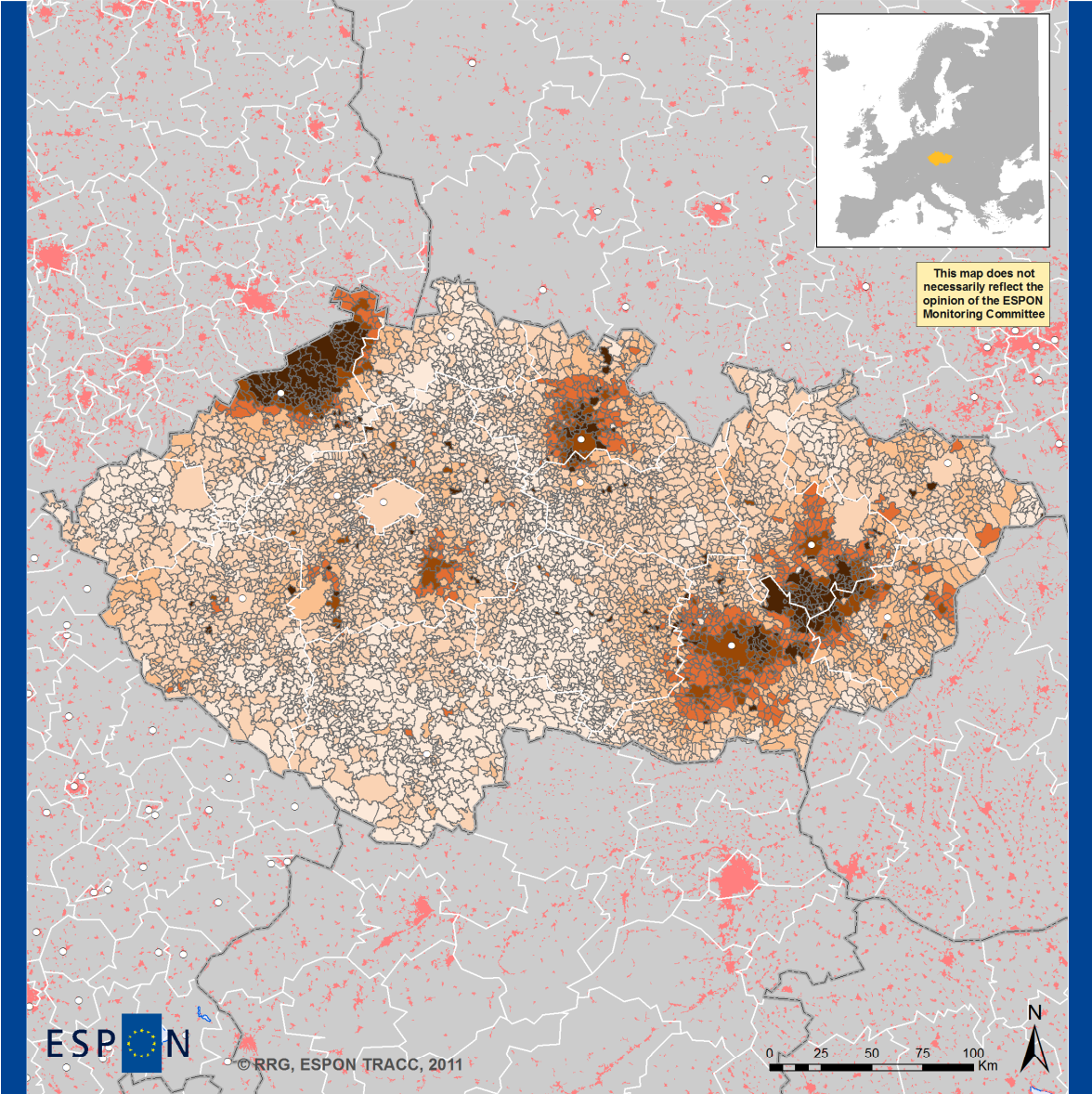**Potential accessibility, absolute change - public transport**

0 - 10	○ NUTS 3 Capital
10,1 - 20	
20,1 - 30	
30,1 - 40	
40,1 - 50	
50 <	

6 Conclusions

The case study identified transport regional patterns in Czechia. Accessibility model used in all ESPON analysis in this regional case study was developed at Faculty of Science, Charles University in Prague (PrF UK), department of social geography and regional development and department of applied geoinformatics and cartography. Model for evaluation of transport accessibility presents main results of access to regional centres, daily accessibility of jobs, potential regional accessibility, access to health care facilities and accessibility of upper secondary schools. Partial assessments of selected specific zoom-in regions were done in the next step. In the last part the accessibility effects of future TEN-T developments were carried out and commented.

Czechia has a relatively high density of road network, while the basic network of motorways and expressways is still not completed and does not reflect the actual needs. Some regional centres still do not have good connection to the network of motorways and expressways. Similarly, it is necessary to continue building bypasses around settlements and to relieve the city centres from the traffic load.

Main railway corridors have been renovated recently for max. speed 160 km per hour. There is still not any high speed rail.

From the key results of Czechia case study it is possible to point out following conclusions:

- The results of main regional centres accessibility imply significant geographic differentiation of municipalities in respect of time accessibility of key settlement centres in Czechia. On one hand they highlight the hinterland, on the other hand the results show the most distant and peripheral areas located primarily at the borders with Poland and Bavaria. There are also so-called inner peripheries in the Czech Republic, which can be found around the borders of the NUTS III regions. Disparities in time accessibility are primarily affected by the current state of the road (motorway) infrastructure, secondarily by railway infrastructure in Czechia. The main difference between car and public transport accessibility is the size of the hinterland with time accessibility of up to 30 minutes and its concentric shape resulting from the lower transportation speed of public transport.

- The results of job accessibility imply the most significant potential for the residents of municipalities in the broad hinterland of larger agglomerations (Prague has exceptional value from this point of view). Radial express roads cause the higher accessibility of job opportunities from more distant communities by car. The results also identify communities with a minimum amount of available job opportunities (border areas, inner peripheries at regional borders). Expressing accessibility as a cumulated opportunity provides a new view of some peripheral areas. Some municipalities laying in-between several regional capitals can benefit from the offer of job opportunities in all surrounding centres. Population relying on public transport is more strongly dependent on job opportunities in regional capitals or near to their home. The importance of suburban railroads is clearly evident.

- In contrary to time and cumulated accessibility the potential accessibility take into account the weight of potentially origin destinations. The results of potential accessibility indicator considering population size of municipalities (LAU2) shows the main concentration areas and their locations in the transport networks in Czechia. There is relative separation of the two historically independent settlement systems of Czechia (Moravia vs. Bohemia). A key role of motorways in the accessibility is clearly evident (NUTS III centres not connected to motorway system are relatively isolated). Areas with the worst potential accessibility include, first, the sparsely populated border area, and, second, so-called inner peripheries.

- The results of time accessibility of hospitals show that a large majority of communities is within a 40-minute distance. The worst accessibility is from communities in the border area of the Czech Republic. Most hospitals are located in the major residential centres situated inland. But, the network of hospitals is currently undergoing changes and some special departments will move away from patients.

- The importance of cities as the centres of secondary education is highlighted by expressing cumulated accessibility. The highest accessibility of secondary schools within the range of 30 minutes is of course in the hinterland of the largest agglomerations (Prague, Brno, Ostrava, Olomouc etc.). The results of accessibility by public transport have crucial importance, because it is not possible to obtain driving licence before 18 years of age in Czechia. It is even possible to identify several zones of communities which do not have any secondary schools within the 30-minute distance. In particular, this is the case of border communities and, surprisingly, of some inland areas (in so-called inner peripheries) which are distant from major residential centres.
- The results of potential accessibility indicator considering number of basic health care surgeries (doctors) in LAU2 (municipalities) shows the logical concentration into main agglomerations, its hinterland and along main transport networks in Czechia. As many inhabitants are dependent on public transport, this indicator could also be important for regional policy improvements.
- Modelling impact of future TEN-T corridors proved key importance for better domestic interconnections of Bohemia and Moravia (West – East directions, R35 alternative corridor to D1 motorway) as well as for European links, mainly with Dresden/Berlin, Nurnberg, Munich, Vienna, Krakow and Wroclaw.

A sharp increase in the volume of road transport, both freight and passenger is typical for Czechia in the last 20 years. In the period to 2020 we can expect continued growth in passenger individual transport. In the road freight transport there is possible increase in performance by a further 30 to 40 % by 2020. The actual course of the performance increase will be affected by the overall economic situation, the amount and extent of the toll (including the internalisation of external costs), not only in the Czechia, but also in neighbouring countries, as well as fuel prices.

Annexes

Annex 1 References

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Annex 2 Database

Accessibility model used in all ESPON analysis in this regional case study used various type of data:

Database:

- Settlements (PrF UK GIS Database; derived from Arc CR),
- Road network dataset (PrF UK GIS Database, based on Arc CR),
- Public transport network dataset (PrF UK GIS Database, based on Arc CR);
- Public transport timetables: www.idos.cz;
- 2001 Population and Housing Census: www.czso.cz

Data format:

ArcGIS shapefile, geodatabase, coverage

Sources:

ArcČR500 (1:500,000), CEDA 150 (1:150,000), Road and Motorway Directorate of the Czech Republic

Annex 3 Accessibility model used

Accessibility model used in all ESPON analysis in this regional case study was developed at Faculty of Science, Charles University in Prague (PrF UK), department of social geography and regional development and department of applied geoinformatics and cartography.

Road accessibility model was constructed using CEDA shape file of vectorised transport network (2006). The state of the network was continuously updated and after the correction check it was transferred into Network Dataset in ArcMap software. According to Tomáš Hudeček research (doctoral thesis 2008), individual categories of roads were given different average speeds of drive. Except the road category, an inclination, physical environment (built-up areas/free landscape) and official traffic rules were taken into account when deriving the speed level. Afterwards, the model was tested to maximally approximate the results to reality. The specific speeds for individual sections are following:

- Motorways (D) – 115 km/h,
- Expressways (R) – 105 km/h,
- Motorways and Expressways in built-up areas (D+R) – 76 km/h,
- First-class roads – 67 km/h,
- Second-class roads – 48 km/h,
- First-class roads in built-up areas – 45 km/h,
- Second-class roads in built-up areas – 35 km/h,
- Third-class roads – 32 km/h,
- Local roads in built-up areas – 25 km/h.

Public transport accessibility model was created by joining the Road accessibility model with railway network shapefile from ArcČR 500 and ArcData official databases. Both segments were connected with help of artificial connectors of railway stations and closest point on road network. These connectors were assigned by walking speed 5 km/h.

The speed of bus on roads was derived from timetables. According to 20 selected local bus connections and 20 long-distance ones, an average speed of 35 km/hour was appointed.

In case of rail speeds an approach of RRG partner was used. According to timetable from recent years (2008–2010) a different speed for individual segment of the network were assigned. Speeds for types/category of rail section were specified as follows (average maximum speeds in km/h):

- Main line, double track, electrified – 77 km/h,
- Main line, double track – 52 km/h,
- Main line, single track, electrified – 57 km/h,
- Main line, single track – 52 km/h,
- Secondary line, single track, electrified – 32 km/h,
- Secondary line, single track – 37 km/h.

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