

# 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 A**

### **West Mediterranean case study**



This report presents a more detailed overview of the analytical approach to be applied by the project. This Applied Research Project is conducted within the framework of the ESPON 2013 Programme, partly financed by the European Regional Development Fund.

The partnership behind the ESPON Programme consists of the EU Commission and the Member States of the EU27, plus Iceland, Liechtenstein, Norway and Switzerland. Each partner is represented in the ESPON Monitoring Committee.

This report does not necessarily reflect the opinion of the members of the Monitoring Committee.

Information on the ESPON Programme and projects can be found on [www.espon.eu](http://www.espon.eu)

The web site provides the possibility to download and examine the most recent documents produced by finalised and ongoing ESPON projects.

This basic report exists only in an electronic version.

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## List of authors

Oriol Biosca (Mcrit)

Rafael Rodrigo (Mcrit)

Andreu Ulied (Mcrit)

# Table of contents

	Page
1 Introduction.....	1
2 The West Mediterranean case study region .....	2
2.1 Spatial structure .....	4
2.2 Socioeconomic situation .....	7
2.3 Transport aspects .....	7
3 Accessibility patterns at regional and local scale.....	11
3.1 Access to regional centres .....	11
3.2 Daily accessibility of jobs.....	14
3.3 Regional accessibility potential .....	17
3.4 Access to health care facilities .....	21
3.5 Availability of higher secondary schools.....	24
3.6 Accessibility potential to basic health care .....	27
4 Accessibility situation at different regional subtypes.....	32
5 Accessibility effects of future TEN-T developments.....	40
6 Conclusions .....	49
Annexes.....	50
Annex 1 References .....	50
Annex 2 Database .....	50
Annex 3 Accessibility model used .....	51

## Figures

- Figure 1 The West Mediterranean case study region.
- Figure 2 Population distribution
- Figure 3 Job distribution
- Figure 4 Road network
- Figure 5 Rail network
- Figure 6 Travel time by car to next regional centre
- Figure 7 Travel time by public transport to next regional centre
- Figure 8 Travel time to next regional centre, by urban-rural typology
- Figure 9 Travel time to next regional centre, cumulative distributions
- Figure 10 Jobs accessible by car within 60 minutes
- Figure 11 Jobs accessible by public transport within 60 minutes
- Figure 12 Jobs accessible within 60 minutes, by urban-rural typology
- Figure 13 Jobs accessible within 60 minutes, cumulative distributions
- Figure 14 Potential accessibility to population by car
- Figure 15 Potential accessibility to population by public transport
- Figure 16 Potential accessibility to population, by urban-rural typology
- Figure 17 Potential accessibility to population, cumulative distributions
- Figure 18 Car travel time to next hospital
- Figure 19 Public transport travel time to next hospital
- Figure 20 Travel time to next hospital, by urban-rural typology
- Figure 21 Travel time to next hospital, cumulative distributions
- Figure 22 Higher secondary schools within 30 minutes travel time by car
- Figure 23 Higher secondary schools within 30 minutes travel time by public transport
- Figure 24 Higher secondary schools within 30 minutes travel time, by urban-rural typology
- Figure 25 Higher secondary schools within 30 minutes travel time, cumulative distributions
- Figure 26 Potential accessibility to medical doctors by car
- Figure 27 Potential accessibility to medical doctors by public transport
- Figure 28 Potential accessibility to medical doctors, by urban-rural typology
- Figure 29 Potential accessibility to medical doctors, cumulative distributions
- Figure 30 Zoom-in regions
- 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
- Figure 33 Jobs accessible within 60 minutes, by zoom-in region
- Figure 34 Jobs accessible within 60 minutes, cumulative distributions by zoom-in region



- Figure 35 Potential accessibility to population, by zoom-in region
- Figure 36 Potential accessibility to population, cumulative distributions by zoom-in region
- 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 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
- Figure 43a TEN-T road infrastructure projects
- Figure 43b TEN-T rail infrastructure projects
- Figure 44 Potential accessibility to population by car with TEN-T projects
- Figure 45 Potential accessibility to population by public transport with TEN-T projects
- Figure 46 Relative increase of potential accessibility to population by car with TEN-T projects
- Figure 47 Relative increase of potential accessibility to population by public transport with TEN-T projects
- Figure 48 Absolute increase of potential accessibility to population by car with TEN-T projects
- Figure 49 Absolute increase of potential accessibility to population by public transport with TEN-T projects

## Tables

- Table 1 Accessibility by car, deviations of zoom-in regions from case study averages
- Table 2 Accessibility by public transport, deviations of zoom-in regions from case study averages

## 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 of Prague, Faculty of Science, Department of Social Geography and Regional Development (PrF UK), Prague, Czech Republic
- RRG Spatial Planning and Geoinformation, Oldenburg i.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 Finland 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 subregions, 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.

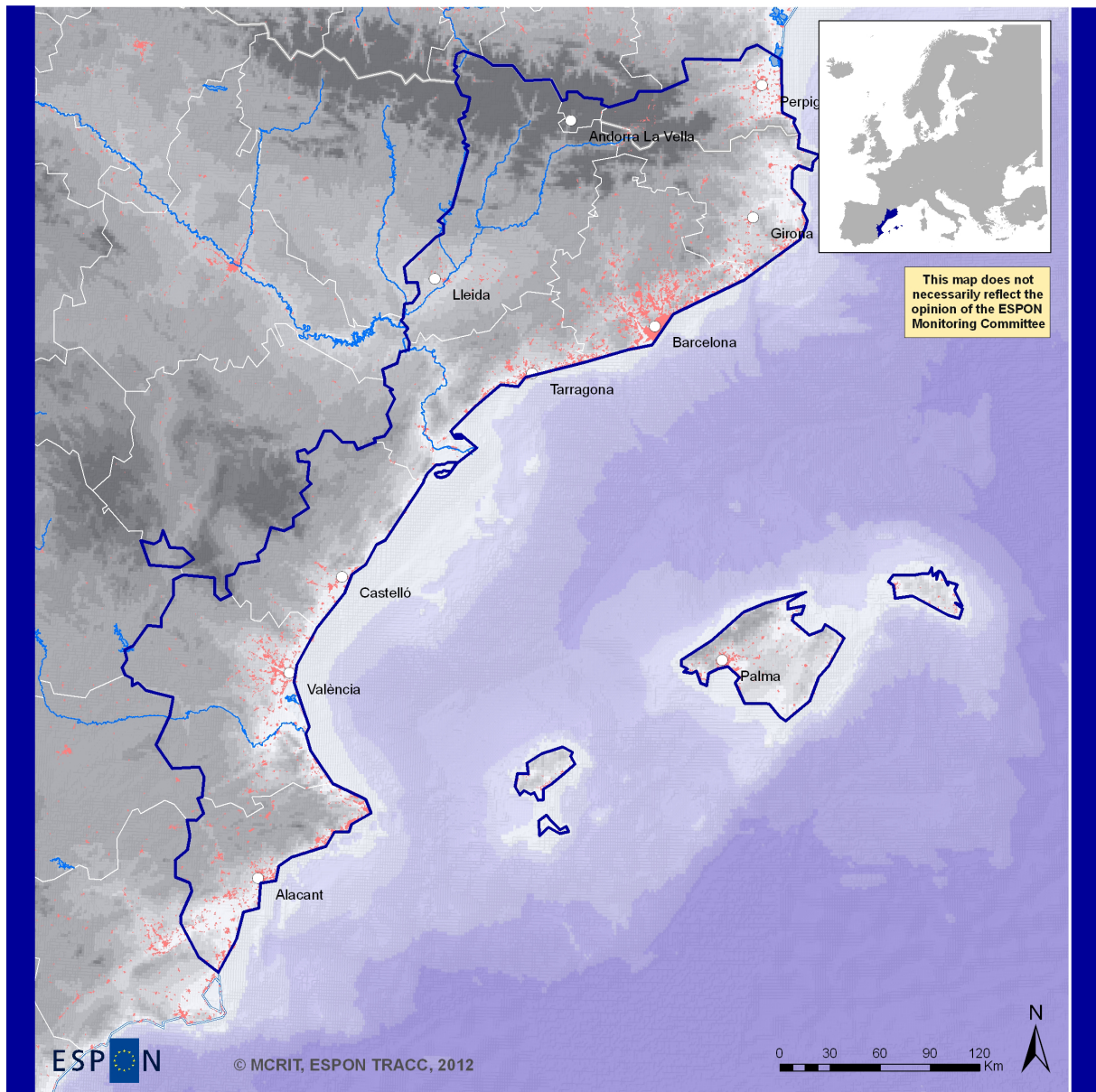
The design of the case study analysis was made in a way that all seven case studies are highly comparable as the definition of the accessibility indicators and its implementation were handled in a rather strict way. Also, the way results are presented in maps, diagrams and more general in the case study 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](http://www.espon.eu).

## **2 The West Mediterranean case study region**

The West Mediterranean Regions case study covers Spanish and French cross border regions, and Andorra. It is stretching over three different states, contains some autonomous communities, about 10 regions and departments, several hundred counties, and about 2,000 municipalities. It has more than 1000 km of coastal areas, mountain regions with highs up to 3,000 m, four islands, highly populated metropolitan regions with densities up to 15,500 inh./km<sup>2</sup>, and sparsely populated rural areas with densities below 10 inh./km<sup>2</sup>.

Between 1998 and 2008, the population increased by 20 % up to 14.2 million inhabitants and the number of jobs by 2.1 million (50 %). Approximately 13 % of the population is now composed by foreigners, most of them attracted to fill job vacancies generated during the period of strong growth of 3.5 % GDP per year between 1997 and 2007, but a significant number were also attracted by the climate and quality of life of the region. About one in every five immigrants is from another EU nation, and in some places the proportion stands at one in every three, similar to the level found in the American Sunbelt.

The present territorial organisation of these regions involves a large number of jurisdictions and a complex distribution of responsibilities and resources between administrations. This introduces rigidities and inefficiencies in the public sector: on the one hand it hinders the attainment of scale economies in the supply of public services and, on the other, the difficulties of reaching consensus under very different political agendas often create insurmountable obstacles to carry out major strategic projects




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### West Mediterranean Regions Physical Framework





-  NUTS3 Capitals
-  Settlement areas
-  Rivers
-  National borders

Figure 1. The West Mediterranean case study region.

## 2.1 Spatial structure

The population in the case study area is heavily concentrated along the coastal fringe along the Mediterranean Sea. The three main agglomerations are Barcelona's (5 million inhabitants), Valencia's (1.8 million inhabitants) and Alacant-Elx (0.8 million inhabitants).

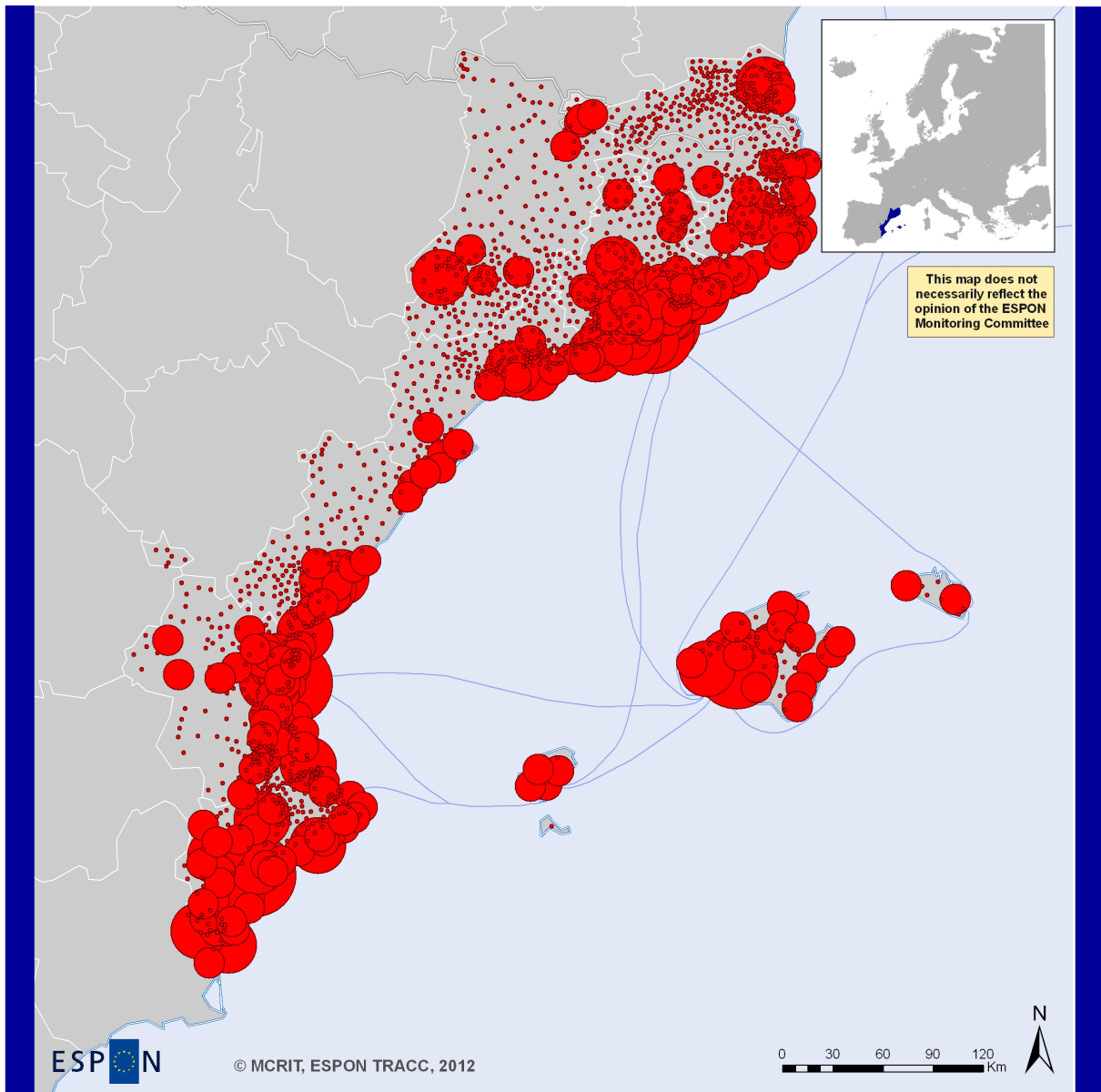
Barcelona's metropolitan region concentrates some 5 million inhabitants which represents about 70 % of the population of Catalonia autonomous community in only 10 % of its territory. The metropolitan region of Barcelona is composed of seven counties and 800 municipalities, and it includes 18 cities with more than 50,000 inhabitants, only 7 with more than 100,000 inhabitants. The municipality of Barcelona itself has 1.6 million inhabitants.

Valencia's metropolitan region concentrates some 1.8 million inhabitants, representing 35 % of its autonomous community population, while Alacant-Elx metropolitan region holds 760,000 inhabitants. Both regions together accommodate 50 % of the region's population in 10 % of its territory.

The Balearic insular region is composed of four islands, Majorca, Minorca, Eivissa and Formentera, and has 1.1 million inhabitants. It is a heavily frequented summer destination (as many other neighbouring coastal regions), having its transport and service infrastructures prepared for some 10 million visitors yearly.

The department of Pyrénées-Orientales has 437,000 inhabitants. Its head city Perpignan houses the largest fruit and vegetables market in Europe, managing some 1.5 million tonnes of products yearly, and constituting an important logistics centre connected to air and to sea modes.

Andorra is an independent state in the heart of the Pyrenees with 85,000 inhabitants. It is located at a high between 800 m and 3,000 m. Population is mainly settled in two narrow river valleys between mountains. Being a major tourist, leisure and commercial centre oriented to both Spanish and French visitors, it registers important flows of visitors, mostly by car (some 25,000 vehicles across its borders daily), and therefore transport infrastructures is a major concern.




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**West Mediterranean Regions  
Population**

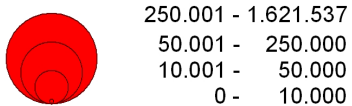
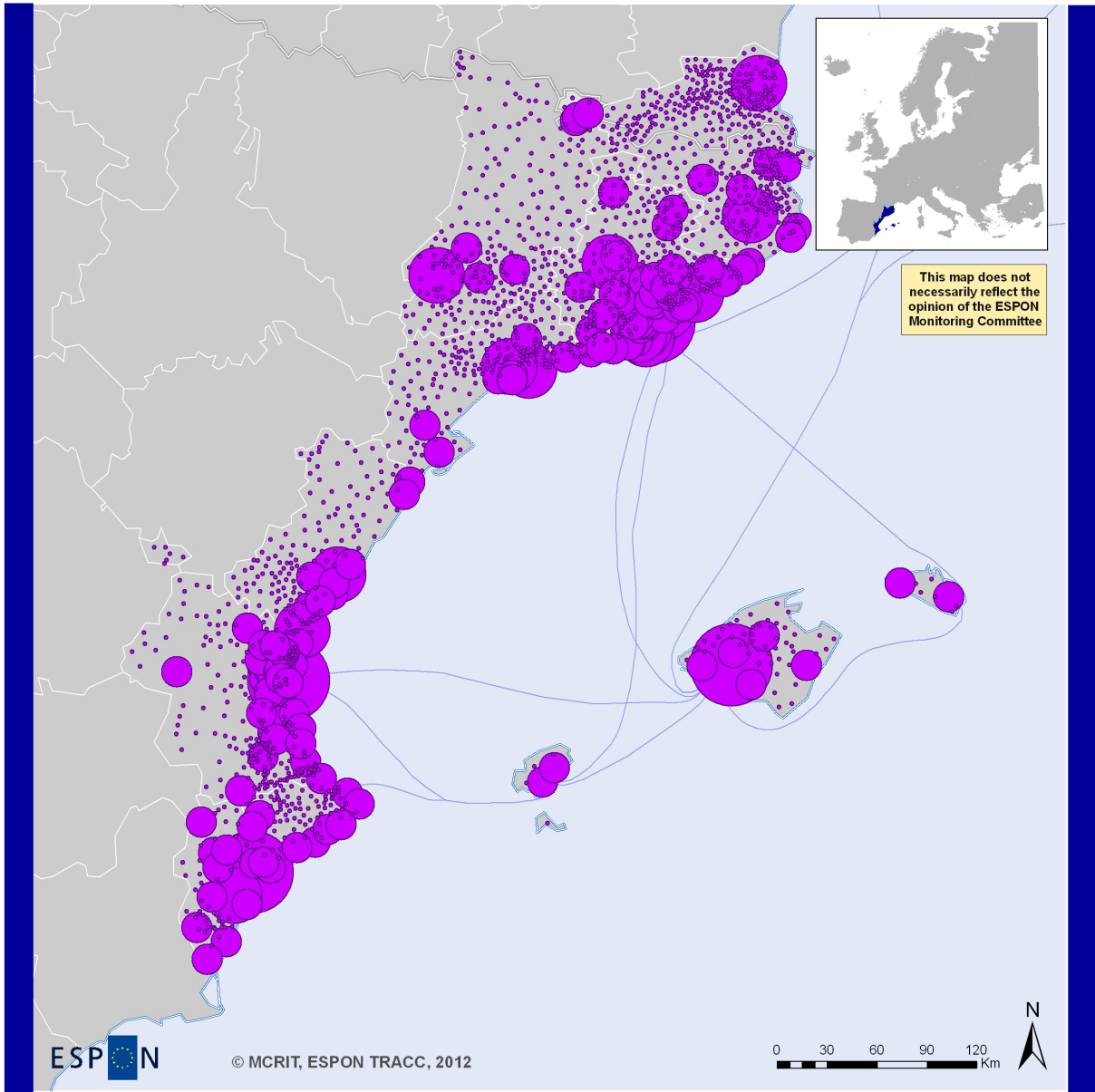


Figure 2. Population distribution




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**West Mediterranean Regions  
Number of employees**

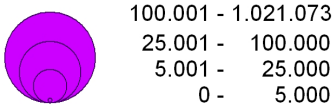


Figure 3. Job distribution



## 2.2 Socioeconomic situation

The West Mediterranean Regions area has an important industrial tradition. The sector is characterised by the presence of some multinational firms attracted during the 1980s and 1990. But it is essentially composed of a broad network of small and medium-sized family firms in mature sectors, sometimes constituting sectoral clusters such as ceramics, footwear, textiles, toy industry, furniture, or agri-food. The relocation of some major multinational industrial firms may be inevitable; nonetheless, de-industrialisation of the territory is a major political objective in the mid-term.

Agriculture accounts for 2 % of the GDP and employs 2 % of its active population. Nevertheless, the agro-food industry is of considerable importance, producing 15 % of Spanish food exports and hosting some of the largest food production, transformation and distribution firms of Spain. Agricultural land has a trend to decrease in extension.

With 60 million visitors per year, Spain ranks second only to France as the world's leading tourism destination. Some 30 million visit these regions every year (15 million in Catalonia; 10 million in Balearic Islands; 5 million in Valencia). Tourism is expected to evolve towards the provision of additional services related to education and training, health and wellbeing, sport and leisure and cultural and business activities, and constitutes a strategic sector.

After the present downturn, the construction sector should slowly recover, although growing at a slower pace than in the past decade. In 2004, Spain's six leading building firms had a joint turnover of around 35 billion Euros, threefold increase with respect to 1999. The construction sector is in a process of business diversification towards other economic sectors such as concessions and infrastructure management, which account now in many cases for up to 50 % of their business turnover. Most of these major firms are immersed in a process of growing internationalisation.

## 2.3 Transport aspects

Mobility for both passengers and freight is expected to continue growing in the future with the pace of economy. Urban trips motivated by factors other than work and medium to long-distance travel will increase and become more variable throughout the day and the territory, while international and intercontinental travel may undergo exponential growth. In 1981, 28 % individuals living in the Barcelona urban region worked outside their home municipality. By 2001 this percentage had risen to 47 %; forecasts indicate that this figure will rise to 60 % by 2026.

The long distance road corridors of these regions comprise essentially the Mediterranean axis along the coast (integrated by two parallel motorways), three axes linking the coast to Zaragoza (from Barcelona, Tarragona and Valencia) and two axes linking the coast to Madrid (from Valencia and Alacant). All these axes are served by motorways, and some of them are tolled. Road capacity in these corridors has already difficulties in fulfilling demand needs in many sections, notably around metropolitan areas. Particularly during peak tourism seasons some motorway and trunk road sections reach congestion levels that are unacceptable.

In ten years, the Spanish high-speed train network has become one of the most developed in the world. There are many new sections being built across the Iberian Peninsula and, following the inauguration of the Barcelona-Madrid line in 2008 (6.2 million passengers in 2010 in the corridor, 2.6 million between Barcelona and Madrid) the connection from Barcelona to France in Perpignan is under construction and expected to be finalised by 2014, according to latest schedules. The missing stretch from Perpignan to Montpellier may not be connected until after 2020. The high speed rail line between Madrid and Valencia is in service since December 2010 (2.4 million passengers in 2011 in the corridor, 1.8 million between Valencia and Madrid). A line connecting Madrid to Alacant is under construction, but no official schedule is available. Along the costal line, Euromed rail services are run between Alacant, Valencia, Castelló, Tarragona and Barcelona (2.5

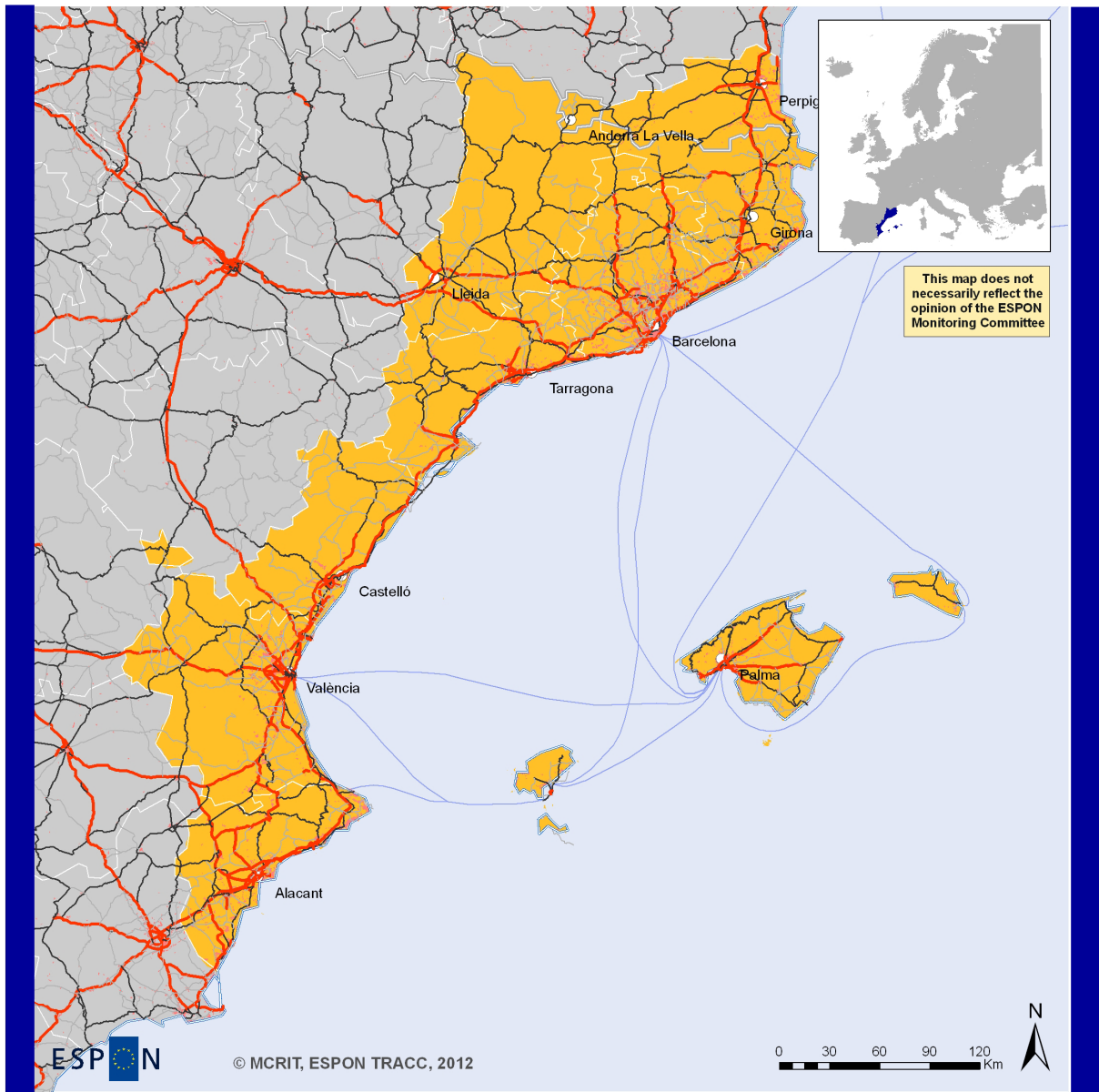


million passengers in 2006) in an upgraded rail corridor allowing 200km/h speeds, but not integrated with the rest of the high speed network which runs on a different gauge.

The explosion of low-cost companies has led to a sharp rise in air traffic in the West Mediterranean region linked to the increase in tourism. Air traffic rose from 56 million passenger in 2000 to 87 million passenger 2007, and dropped to 78million in 2010 and recovered to 84million in 2011. In 2011, Barcelona handled around 34 million passengers, Palma 23 million passenger and Alacant 10 million passenger. The global traffic growth has benefited some regional airports but whose traffics remain heavily linked to the corporate decisions of low cost carriers: Girona airport traffic increased between 2000 and 2009 by 650 % up to 5 million passenger, and then dropped to 3 million passengers when Ryanair opened a permanent base in Barcelona airport (only 100km far). The current capacity of the West Mediterranean regional airport system, taking planned extensions into account, is globally sufficient in the short and medium terms.

The port of Valencia currently leads the container traffic in the West Mediterranean with 3.6 MTEU in 2008 (+20 % compared to 2007), while the port of Barcelona handled 2.6 MTEU (+0 % compared to 2007). While other competitive hubs like Algeciras or TangerMed are better located geographically on the Suez-Gibraltar route, the ports of Barcelona-Tarragona and Valencia-Sagunt still offer excellent opportunities to become maritime gateways for Southern Europe. Pursing this strategy, all major ports in the Mediterranean basin are currently undergoing extensions or planning them to capture a higher share of Asian imports to Europe, which are currently handled by 75 % in the ports of Northern Europe.

The West Mediterranean region is willing to become a Mediterranean's logistic gateway for Europe. Should this ambition materialise, the in-land transport corridor to Central Europe should be able to accommodate far greater flows of goods in relation to today. The provision of competitive rail services in this corridor might contribute to reduce the pressure on motorways. Despite public support, however, railways play a modest role in goods transport in the corridor. Rail network is scarcer in Spain than in central Europe, where new lines require important investments due to difficult topographies and heavily populated environments.



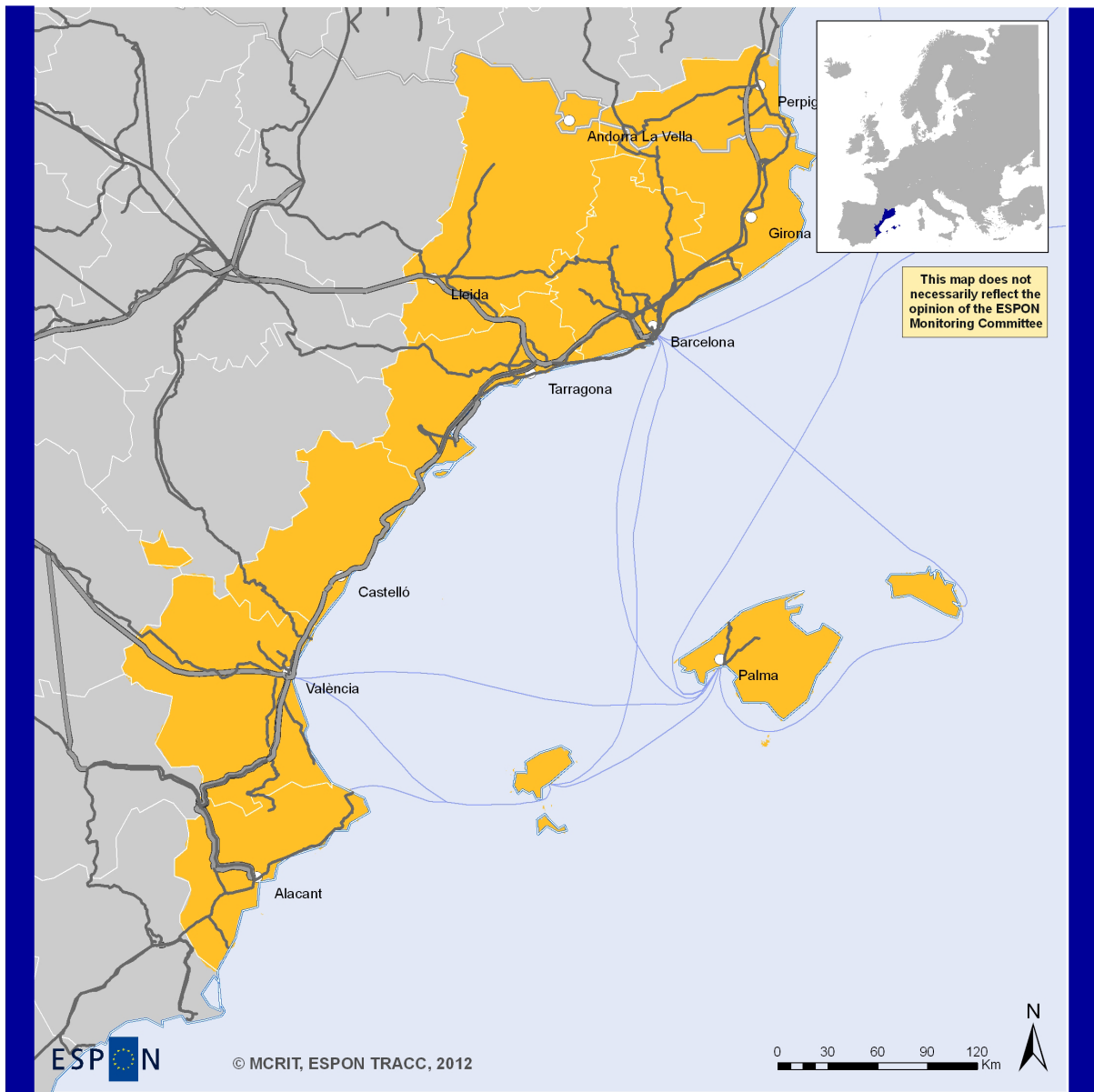
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**West Mediterranean Regions  
Road network**

- Motorways + Expressways
- 1st class roads
- 2nd class roads
- NUTS 3 Capital

Figure 4. Road network




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### West Mediterranean Regions Rail network




-  High Speed Network
-  Conventional Network
-  NUTS 3 Capital

Figure 5. Rail network

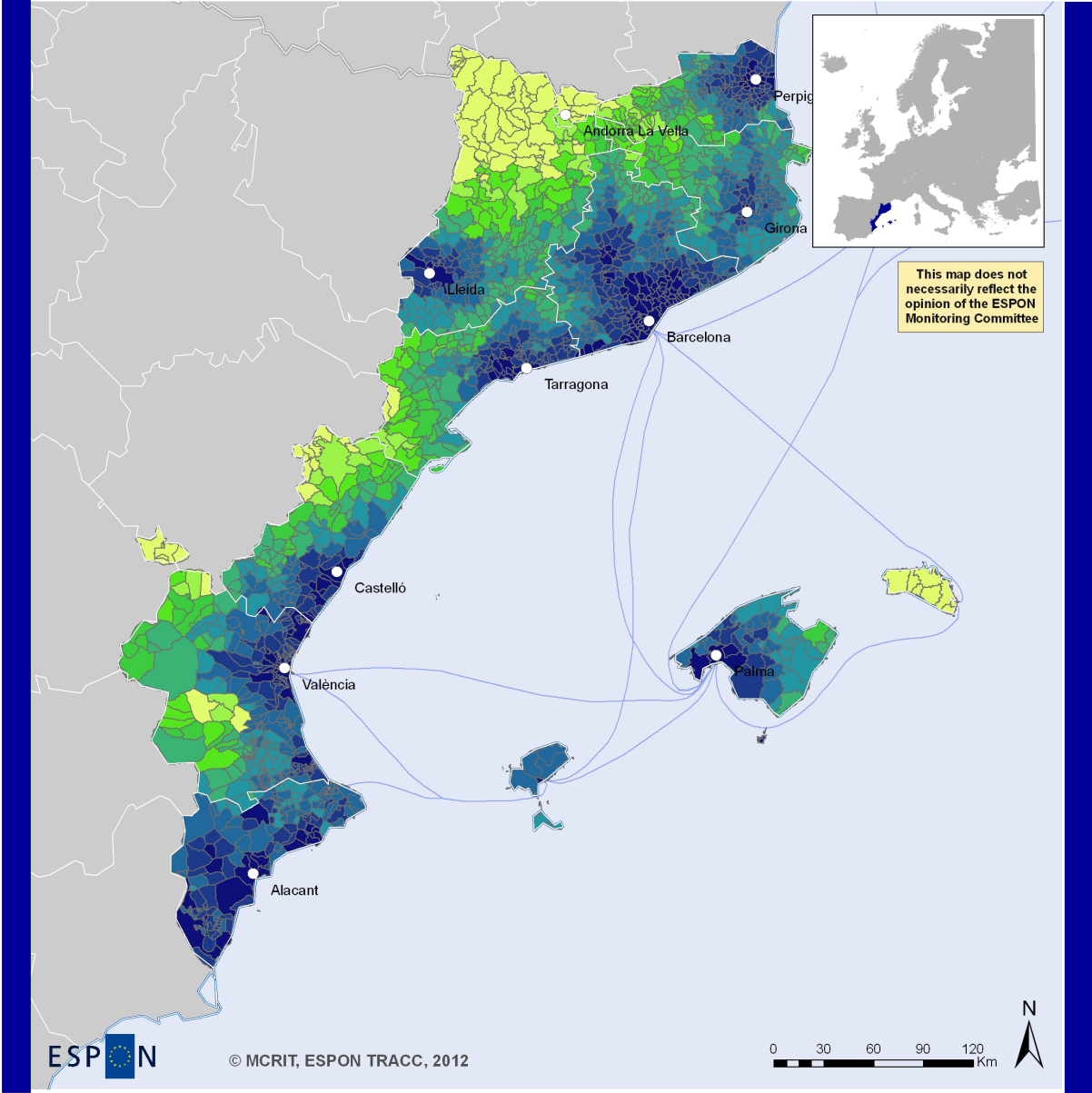
### **3 Accessibility patterns at regional and local scale**

Accessibility analysis at regional and local scale has been performed in the West Mediterranean region at a LAU2 resolution. The analysis considers both accessibility by road and accessibility by public transport. The latter includes (interurban) public bus and coach services as well as train services. The various indicators computed are introduced and commented below.

#### **3.1 Access to regional centres**

Regional centres are defined as NUTS3 capitals (centres of administrative services) or cities with more than 50.000 inhabitants. The West Mediterranean region there are 42 regional centres distributed all over the whole study area, but especially concentrated in coastal areas and around the largest metropolitan areas in Barcelona, Valencia and Alacant. In the neighbouring territories, there are around 10 additional regional centres, which are also taken into consideration in the analysis.

The accessibility to regional centres by car (figure 6) is relatively good for most of the LAU2 units. One out of every five inhabitants in the West Mediterranean region (19%) lives within 15 minutes drive from a regional centre, half of the population lives within 30 minutes (52%), and four out of five inhabitants (78%) lives within 45 minutes. More than 90% of the population lives within 1 hour from a regional centre. Municipalities with worse accessibility conditions are located in peripheral areas of the case study region, e.g. in the Pyrenees, in the backcountry mountains of Valencia, in the area around the Ebre delta, and in the smallest islands.

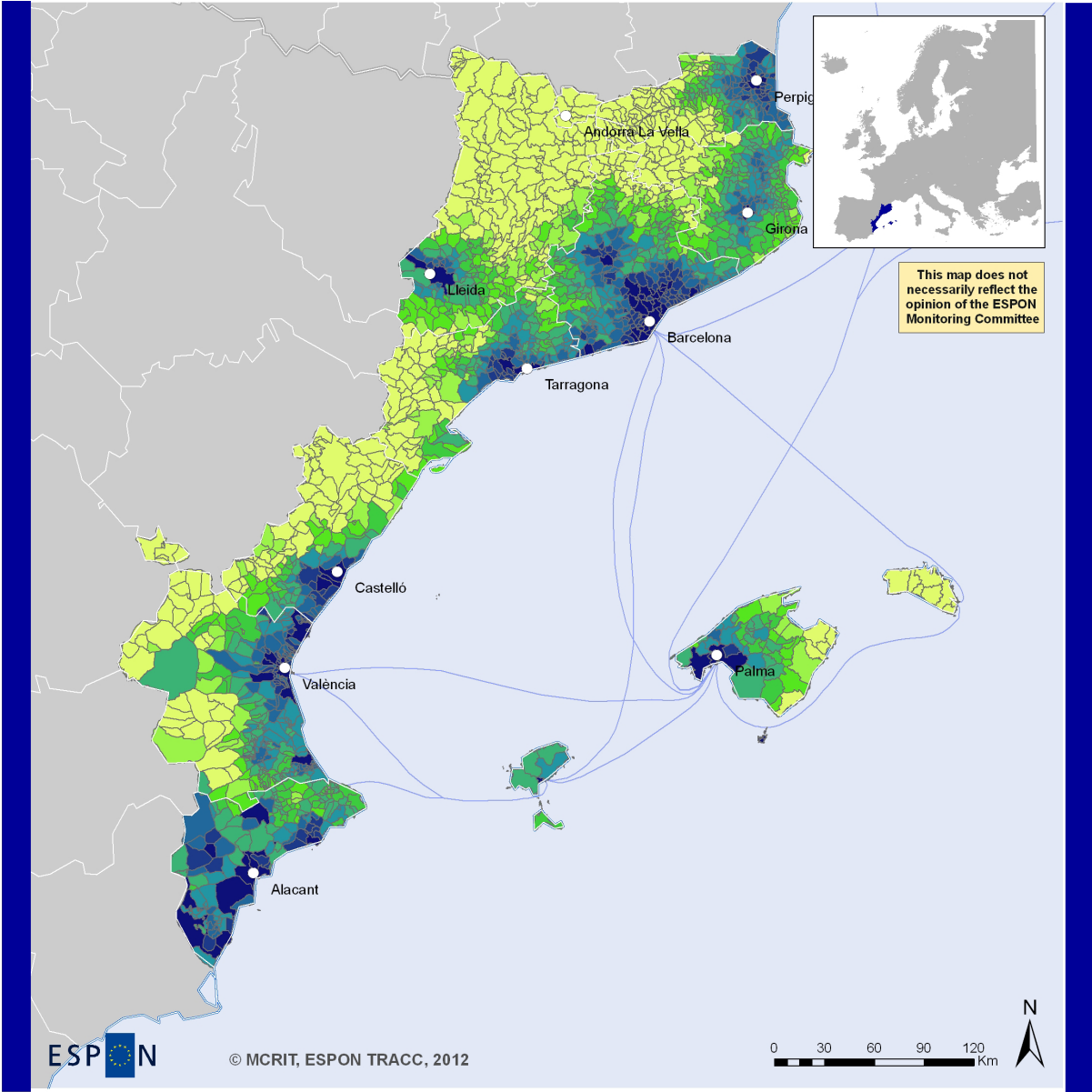


**West Mediterranean Regions**  
Travel time to regional centre by car (min)

- 0 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- 71 - 80
- 80 <
- NUTS 3 Capital

Figure 6. Travel time by car to next regional centre

Travel time to regional centres by public transport is less good than by car (figure 7). When taking into consideration access times, service frequencies, and commercial speeds, only 23% of inhabitants of the region live within 30 minutes from a regional centre by public transport, only 63% of the population lives within 60 minutes, and 83 minutes are needed for 80% of the total population to reach a regional centre. Low public transport accessibility is found in mountain areas but also in those portions of the study region where rail infrastructure is underdeveloped or simply inexistent (i.e. most of the interior areas).



**West Mediterranean Regions**  
Travel time to regional centre by public transport (min)

- 0 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- 71 - 80
- 80 <
- NUTS 3 Capital

Figure 7. Travel time by public transport to next regional centre

Box plots portray accessibility indicators according to urban-rural typology (first) and expressed like cumulative distributions (second). Cumulative distributions correspond to the percentage of population (y-axis) that performs equal to or better than each of the values for the indicator specified on the x-axis. The figures are to be read with care, as the low number of NUTS3 included in the region (only 9 plus Andorra), and the low number of LAU2 in some of the typologies (only 6 municipalities for intermediate remote) may not be sufficient to show sufficiently precise patterns which allow for generalisation.

Rural municipalities in figure 9 show a discontinuity with up to 30% of rural population having a different pattern of accessibility than the remaining 70%. This can be explained in part due to the scattered nature of most rural settlements, in opposition to most intermediate and urban settlements tending to be more concentrated along the transport corridors and better connected, altogether with the first 30% rural population.

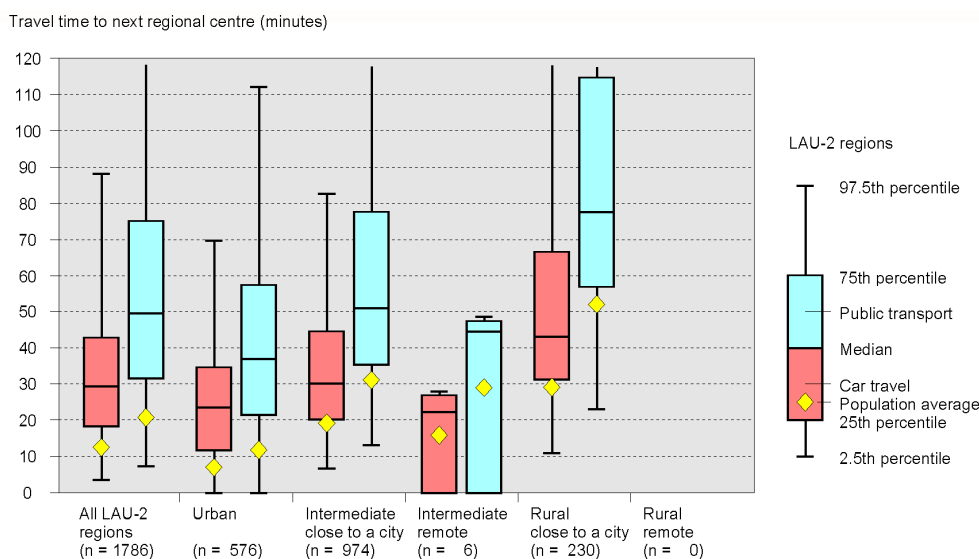


Figure 8. Travel time to next regional centre, by urban-rural typology

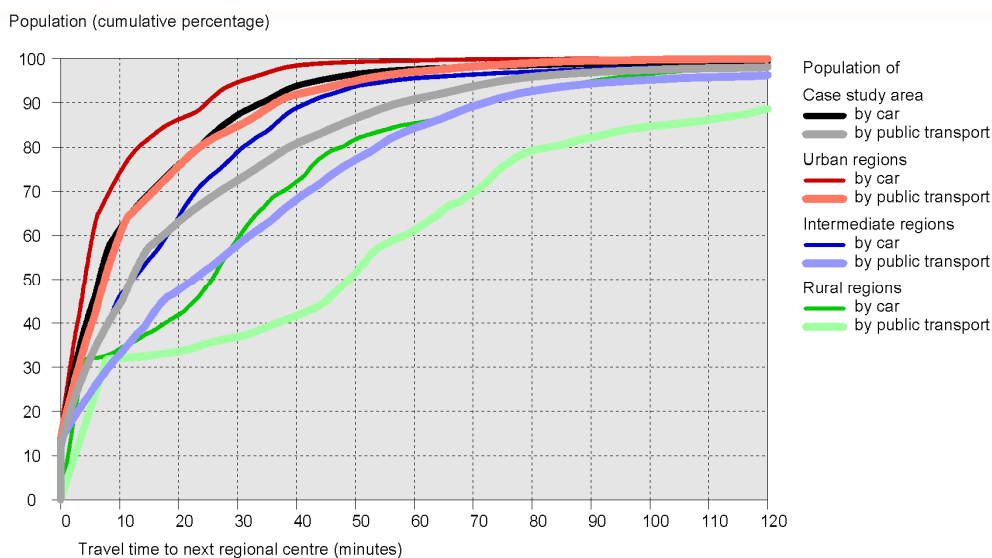


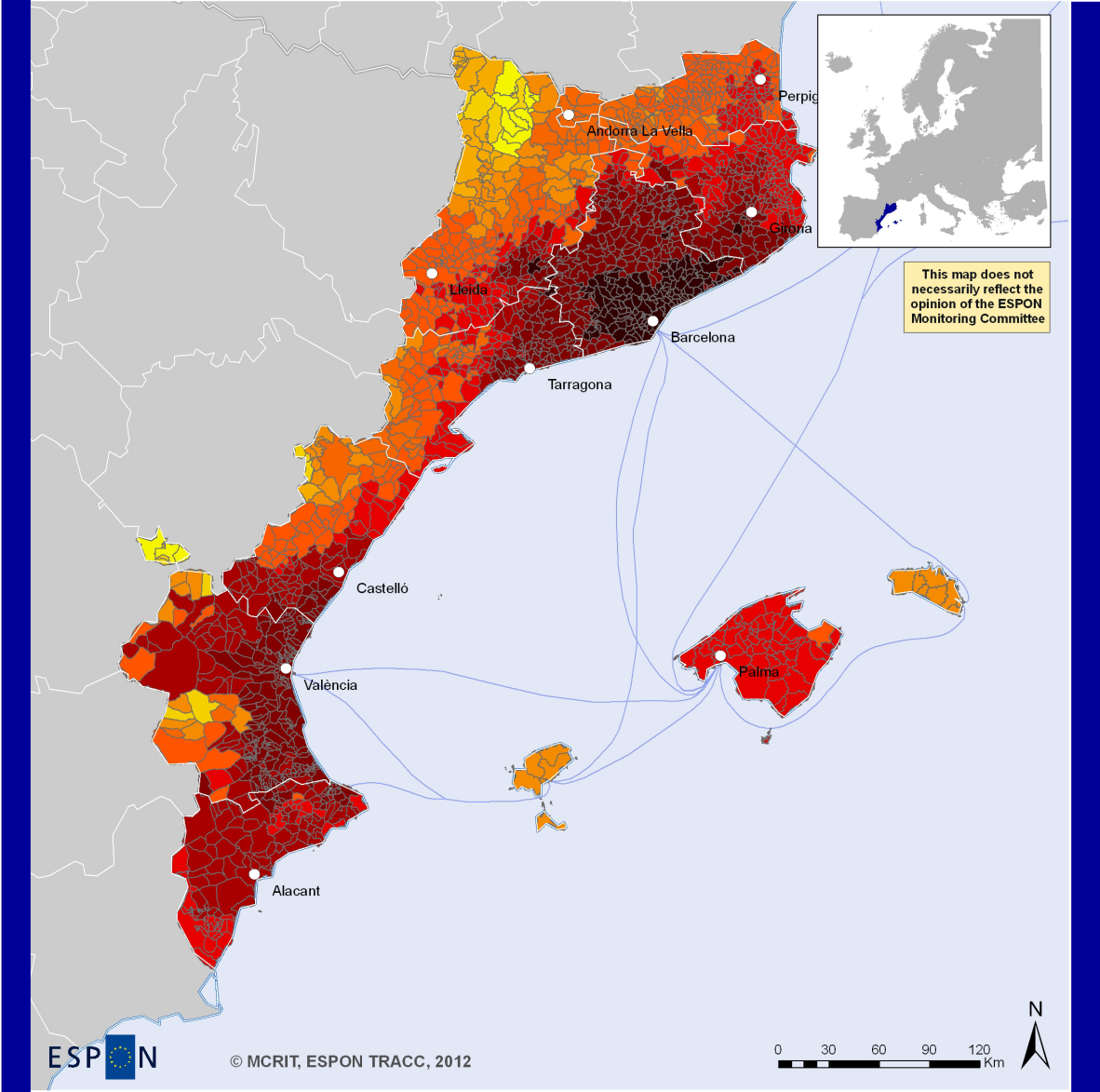
Figure 9. Travel time to next regional centre, cumulative distributions

### 3.2 Daily accessibility of jobs

The West Mediterranean region has a labour market spreading over most of its territory even if the density of activities is higher in the coastal areas (as it is with population) and especially high in the areas around Barcelona, Valencia and Alacant.



As a result of this level of density, around 65% of the population in the region has over 1 million jobs accessible in less than one hour by car, and more than 40% of the population has 2 million jobs accessible within 60 minutes drive. Only a small share of population, living in a minority of areas mainly located in mountain areas, can reach less than 100.000 jobs within 60 minutes. The area around the Ebre delta (between Tarragona and Castelló) remains an area of lower job availability compared to other parts of the region, despite its central position, due mostly to its sparse settlement structure and because of being too far from Barcelona and Valencia to reach their labour markets within a 60 minutes drive.



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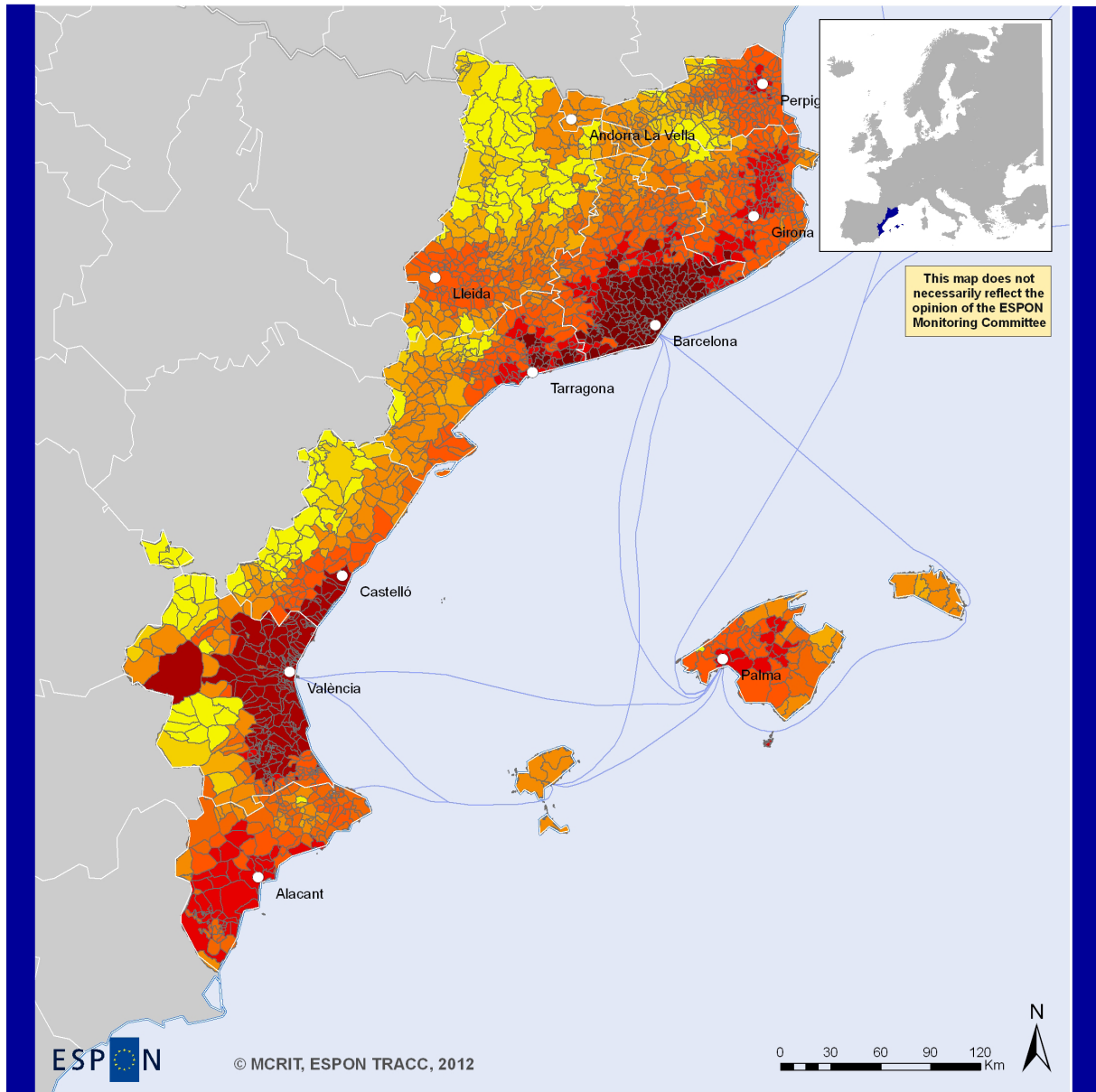
**West Mediterranean Regions  
 Daily accessibility of jobs by car**

	0 - 2.500		100.001 - 250.000		NUTS3 Capital
	2.501 - 5.000		250.001 - 500.000		
	5.001 - 10.000		500.001 - 1.000.000		
	10.001 - 50.000		1.000.001 - 2.500.000		
	50.001 - 100.000		2.500.000 <		

Figure 10. Jobs accessible by car within 60 minutes



Territories around the largest cities in the area (figure 11) logically show the greatest values for job accessibility by public transport, because of geographical proximity to them but most importantly, because of having more public transport endowment, especially rail infrastructure and services. The amount of jobs accessible in the inland areas of the region is still relatively high except for mountain areas in the western Pyrenees and in interior Valencia and Castelló.



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### West Mediterranean Regions

#### Daily accessibility of jobs by public transport

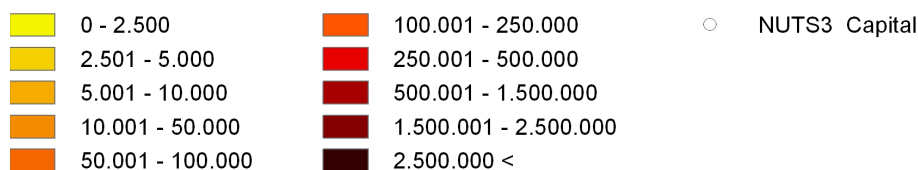


Figure 11. Jobs accessible by public transport within 60 minutes

Box plots portray accessibility indicators according to urban-rural typology (first) and expressed like cumulative distributions (second). Cumulative distributions correspond to the percentage of population (y-axis) that performs equal to or better than each of the values for the indicator specified on the x-axis. The figures are to be read with care, as the low number of NUTS3 included in the region (only 9 plus Andorra), and the low number of LAU2 in some of the typologies (only 6 municipalities for intermediate remote) may not be sufficient to show sufficiently precise patterns which allow for generalisation.

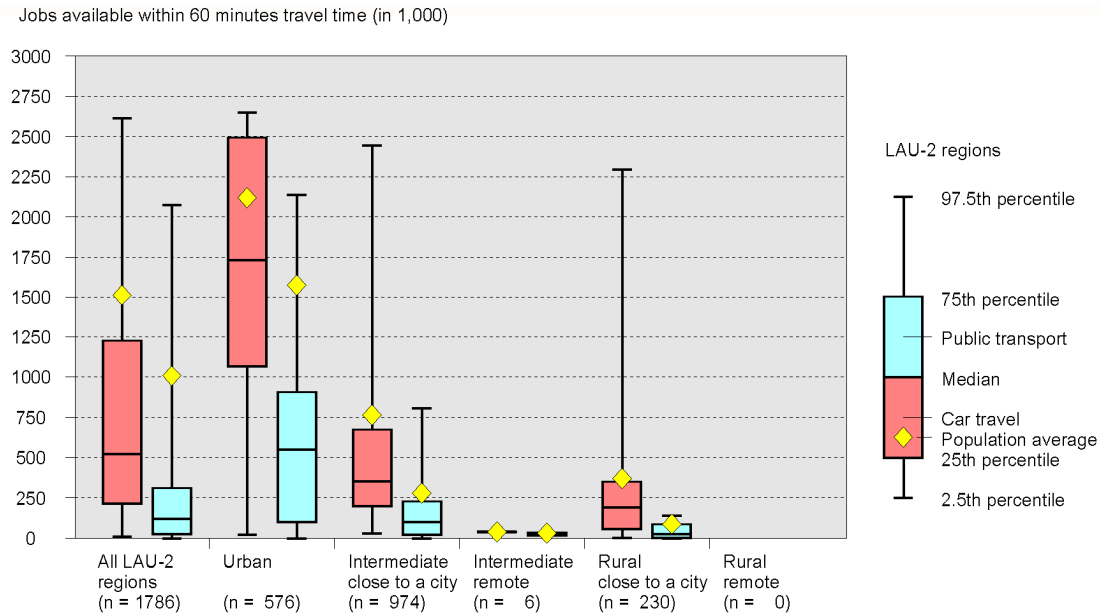


Figure 12. Jobs accessible within 60 minutes, by urban-rural typology

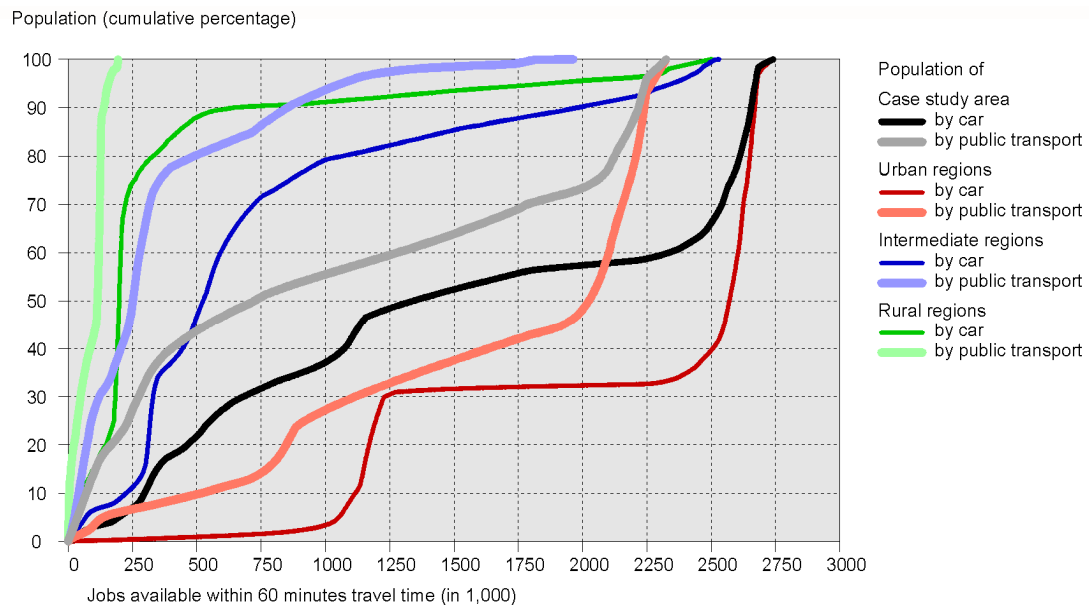
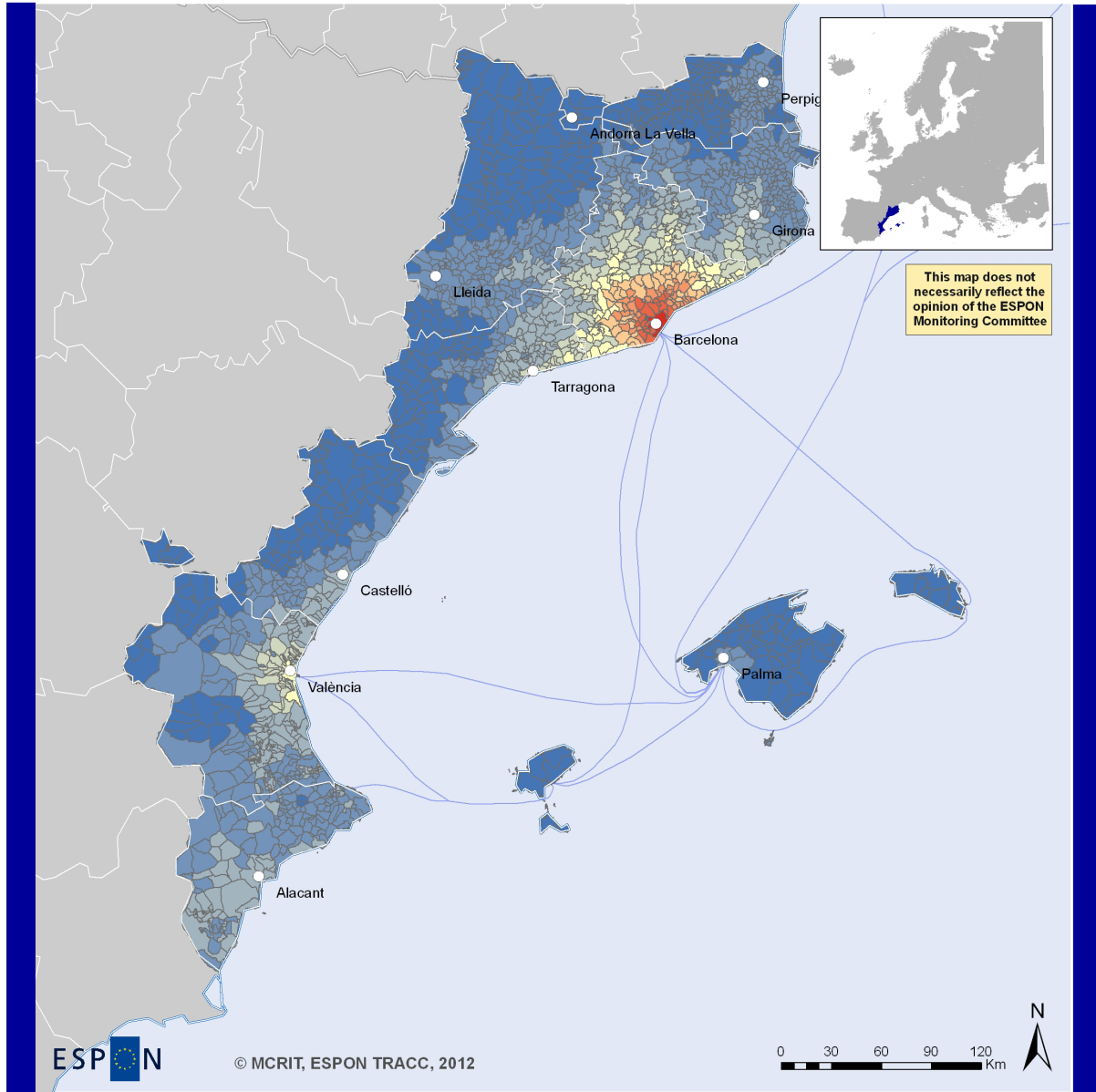


Figure 13. Jobs accessible within 60 minutes, cumulative distributions

### 3.3 Regional accessibility potential

The map of the accessibility potential by car to population makes visible the “enlarged cities” in the case study area, the metropolitan areas at large.

In Catalonia, the fairly concentric network of motorways around Barcelona becomes perceivable as accessibility potential decreases from this city onto the backcountry following the major transport corridors. The influence of Barcelona can be perceived in the four Catalan NUTS3 capitals, in addition to Perpignan in France. In the south, the influence of Valencia also spreads widely in the territory, and almost merges with the metropolitan area of Alacant-Eix, even Murcia. The values for potential accessibility in the islands are limited.



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**West Mediterranean Regions**  
**Potential accessibility to population by car.**  
**Regional average=100**











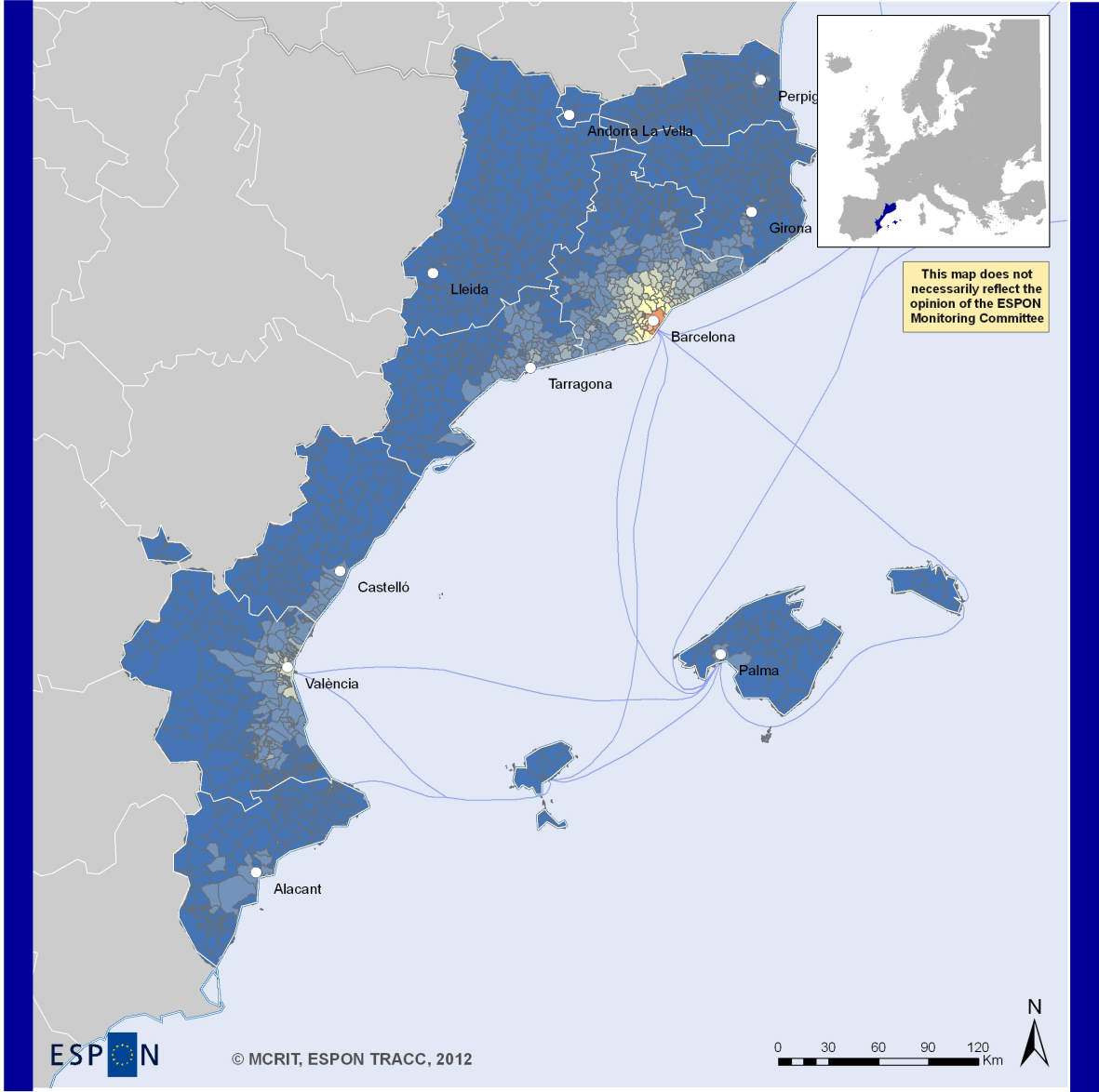
	0,0 - 25,0		125,1 - 150,0
	25,1 - 50,0		150,1 - 175,0
	50,1 - 75,0		175,1 - 200,0
	75,1 - 100,0		200 <
	100,1 - 125,0		NUTS 3 Capital

Figure 14. Potential accessibility to population by car (standardised on road average)

The map of potential accessibility to jobs by public transport reflects the public transport corridors around the largest cities in the region. In Barcelona, the map reflects the trace of the suburban rail lines to Igualada, Manresa and Vic in the interior, and along the coast to Girona and to Tarragona. The new high speed rail station in inner Tarragona province provides a higher accessibility potential to jobs in the area, which cannot be perceived yet in Girona as the high speed rail line there is still not in service. Suburban rail services can also be tracked in Valencia (eg to Castelló).



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Source: MCRIT, 2012  
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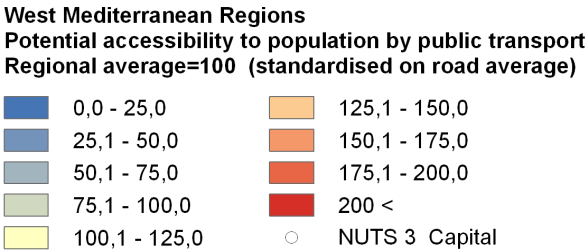
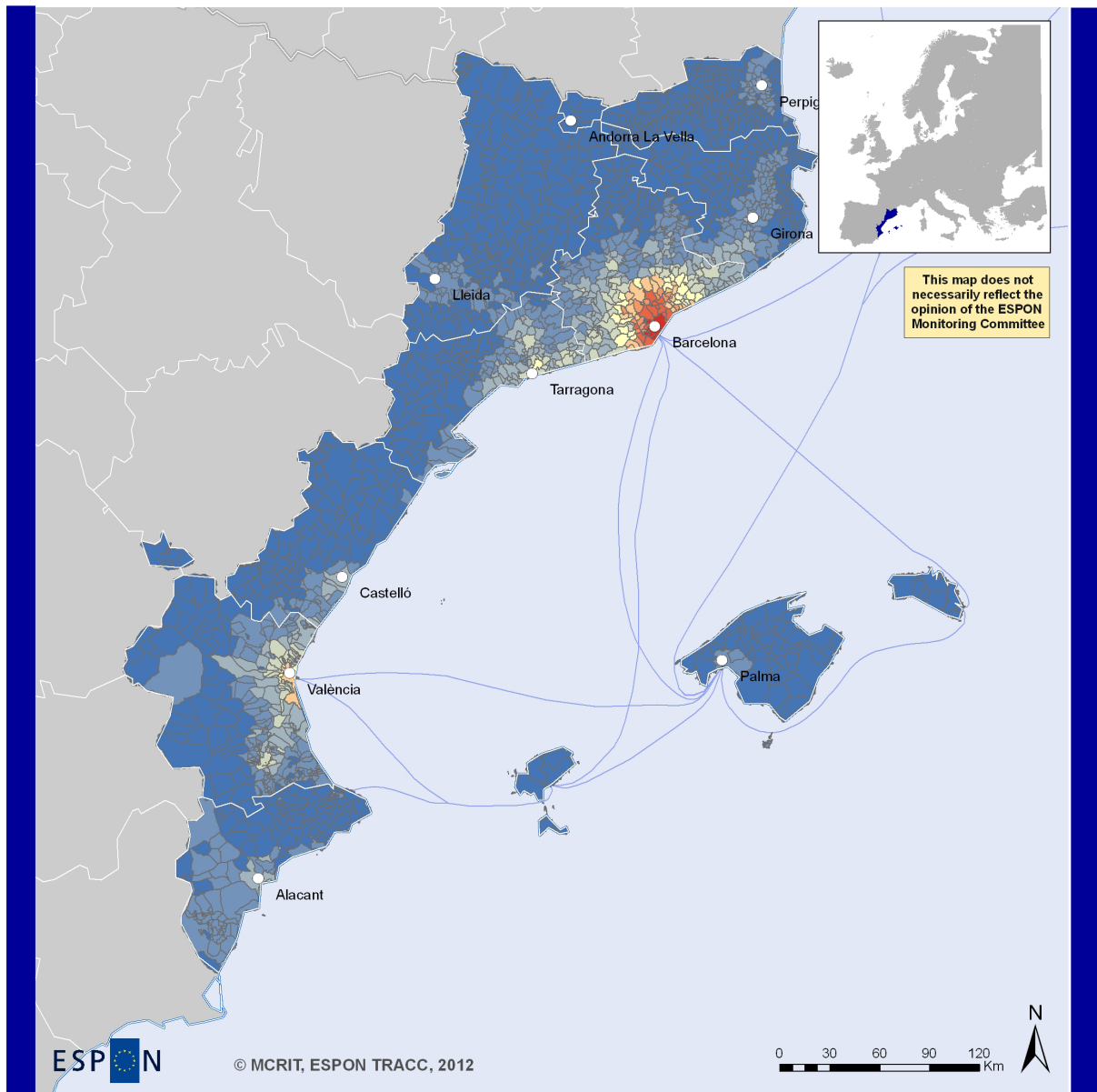


Figure 15a. Potential accessibility to population by public transport (standardised on road ave.)



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### West Mediterranean Regions

#### Potential accessibility to population by public transport Regional average=100 (standardised on public transport average )

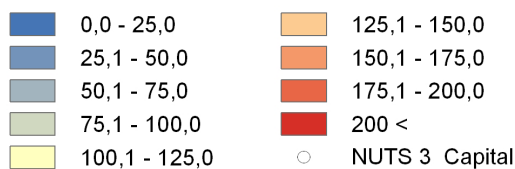


Figure 15b. Potential accessibility to population by public transport  
(standardised on public transport average)

*Box plots portray accessibility indicators according to urban-rural typology (first) and expressed like cumulative distributions (second). Cumulative distributions correspond to the percentage of population (y-axis) that performs equal to or better than each of the values for the indicator specified on the x-axis. The figures are to be read with care, as the low number of NUTS3 included in the region (only 9 plus Andorra), and the low number of LAU2 in*

some of the typologies (only 6 municipalities for intermediate remote) may not be sufficient to show sufficiently precise patterns which allow for generalisation.

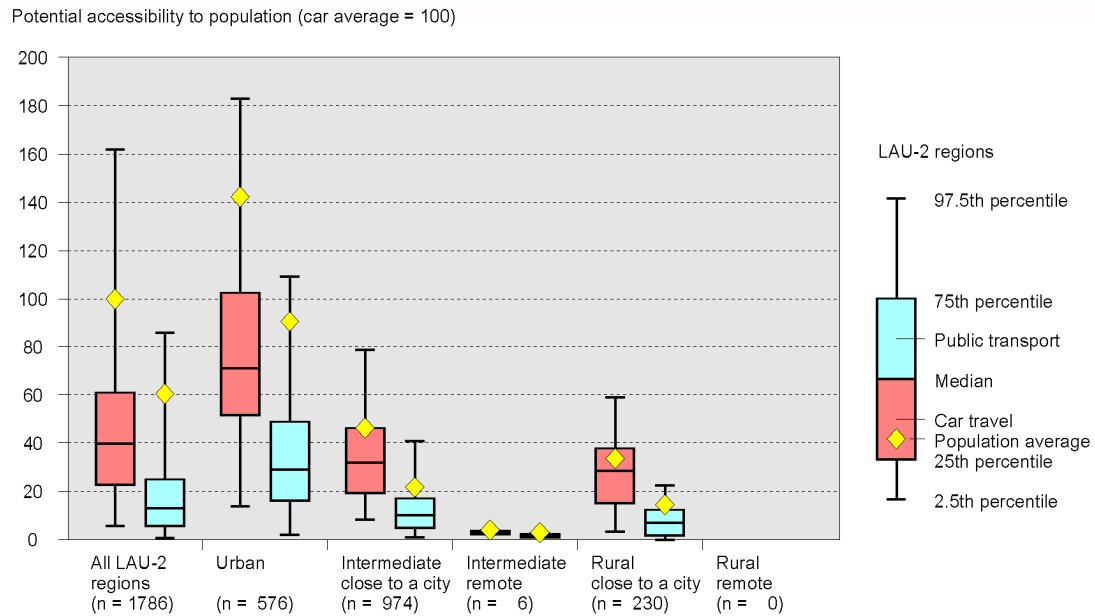


Figure 16. Potential accessibility to population, by urban-rural typology

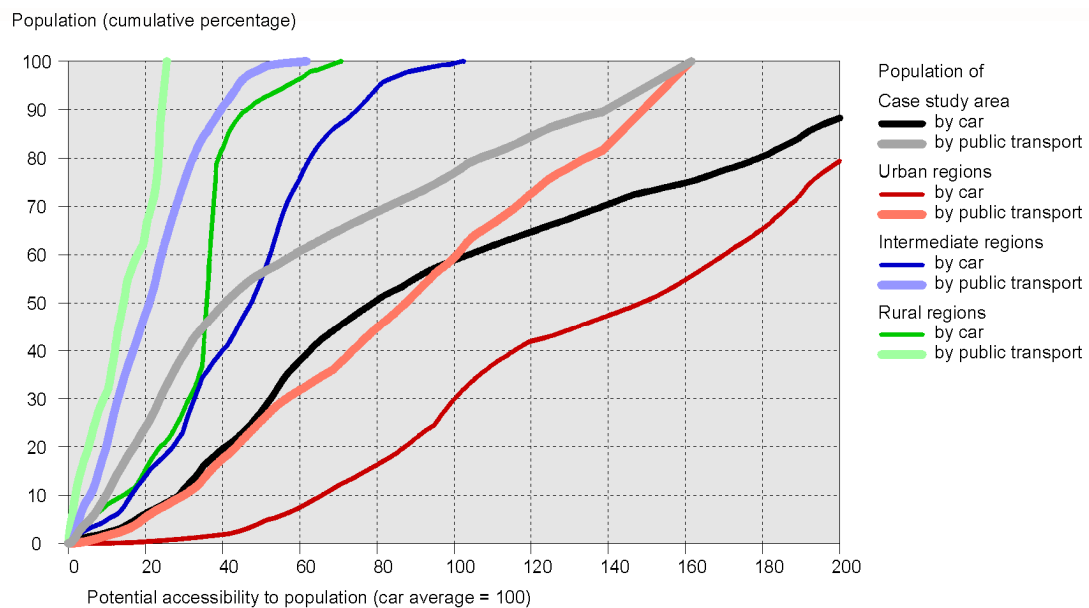


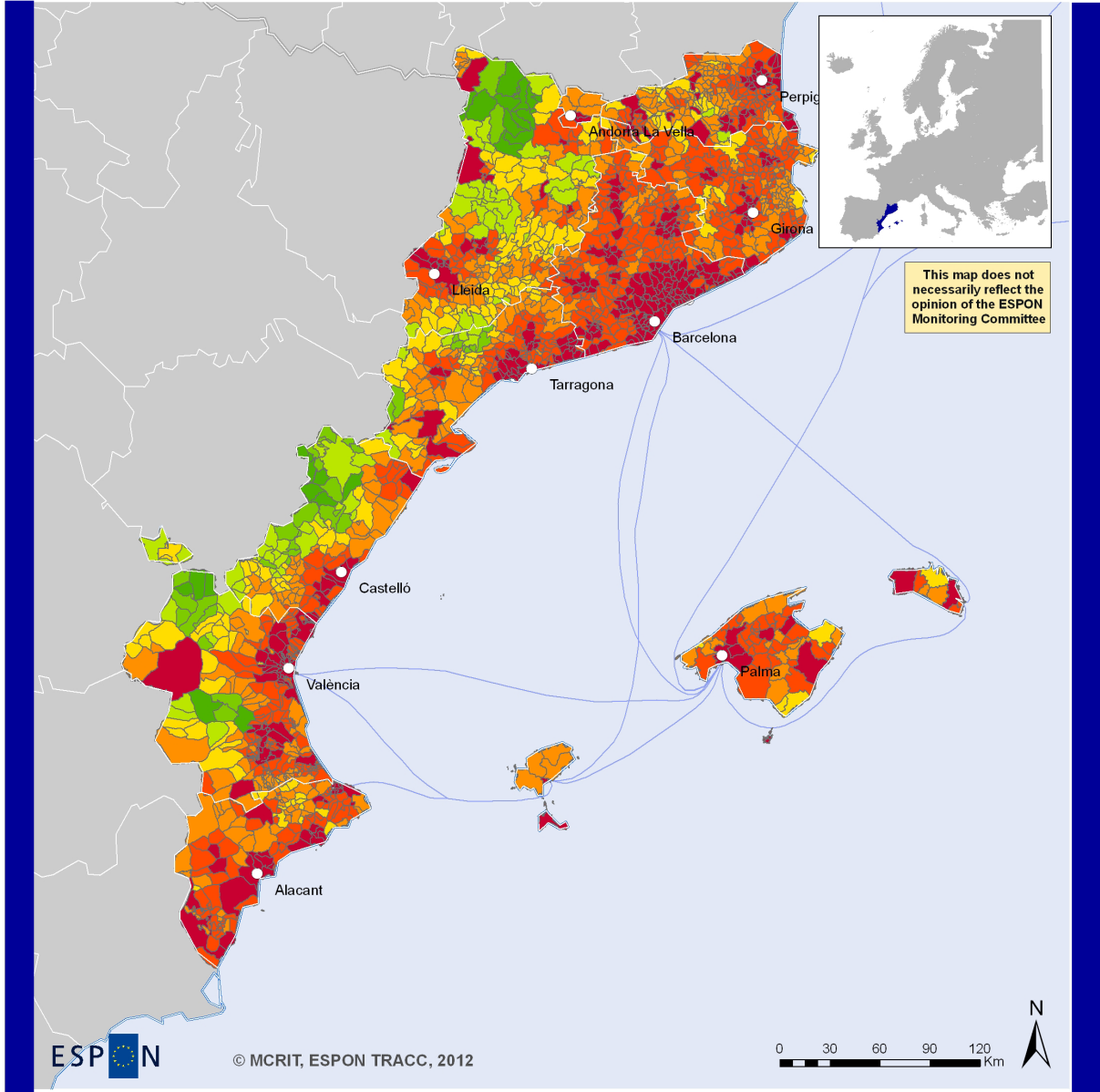
Figure 17. Potential accessibility to population, cumulative distributions

### 3.4 Access to health care facilities

In Spain, the public health system has seen a very important development in the last decades. Today, a majority of counties in the West Mediterranean region (NUTS4) is served by a public hospital. For instance, in Catalonia there are at least 30 counties with a public reference public hospital (73%), and in the Valencia and Balearic autonomous communities, the health infrastructure endowment is also very high.



Accessibility to hospitals is in general better than accessibility to regional centres, reflecting that hospital endowment is often made available to municipalities under the threshold established by ESPON TRACC to consider regional centres (> 50.000 inhabitants and NUTS3 capitals). 39% of population lives within 15 minutes to hospital (vs 18% a regional centre), 81% of population within 30 minutes (vs 52% to a regional centre), and 95% within 45 minutes (vs 78% to a regional centre). The territorial pattern of accessibility to hospitals is more homogeneous than to regional centres, and good performance spreads in most of the territory under study.



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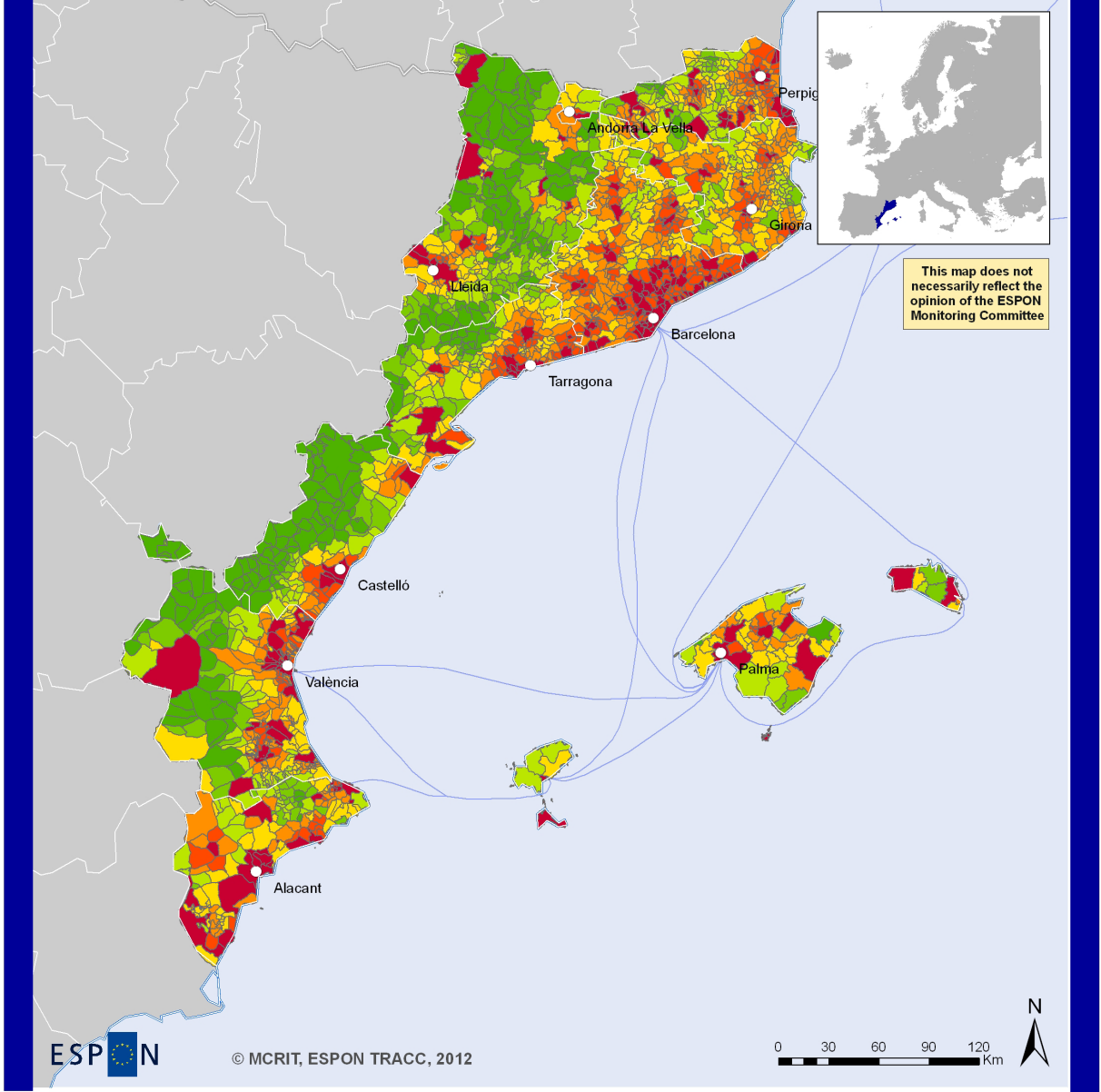
Source: MCRIT, 2012  
Origin of data: Hospitals database: Ministerio de Sanidad (Spain),  
Agence Régionale de Santé du Languedoc-Roussillon (France), Govern d'Andorra, 2011  
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**West Mediterranean Regions**  
**Travel time to closest hospital by car (min)**

- 0 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 60 <
- NUTS 3 Capital

Figure 18. Car travel time to next hospital

The pattern obtained with public transport is similar to the one obtained by private transport, but the influence of hospitals in the territory is more limited, especially in most peripheral regions. Examples of this are for instance Requena -in the backcountry of Valencia- or in Vielha and Tremp in the Catalan Pyrenees. In the West Mediterranean region, 16% of population lives within 15 minutes of a hospital using public transport, 47% within 30 minutes, 74% within 45 minutes, and 88% of the case study population lives within 1 hour from a hospital.



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Source: MCRIT, 2012  
Origin of data: Hospitals database: Ministerio de Sanidad (Spain),  
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**West Mediterranean Regions**  
**Travel time to closest hospital by public transport (min)**

- 0 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 60 <
- NUTS 3 Capital

Figure 19. Public transport travel time to next hospital



Box plots portray accessibility indicators according to urban-rural typology (first) and expressed like cumulative distributions (second). Cumulative distributions correspond to the percentage of population (y-axis) that performs equal to or better than each of the values for the indicator specified on the x-axis. The figures are to be read with care, as the low number of NUTS3 included in the region (only 9 plus Andorra), and the low number of LAU2 in some of the typologies (only 6 municipalities for intermediate remote) may not be sufficient to show sufficiently precise patterns which allow for generalisation.

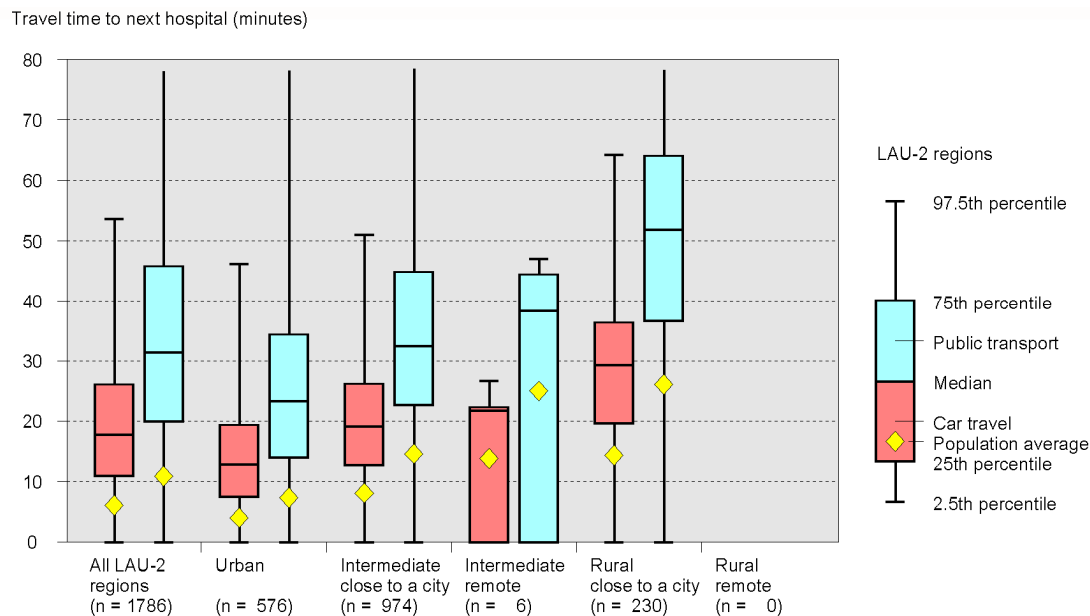


Figure 20. Travel time to next hospital, by urban-rural typology

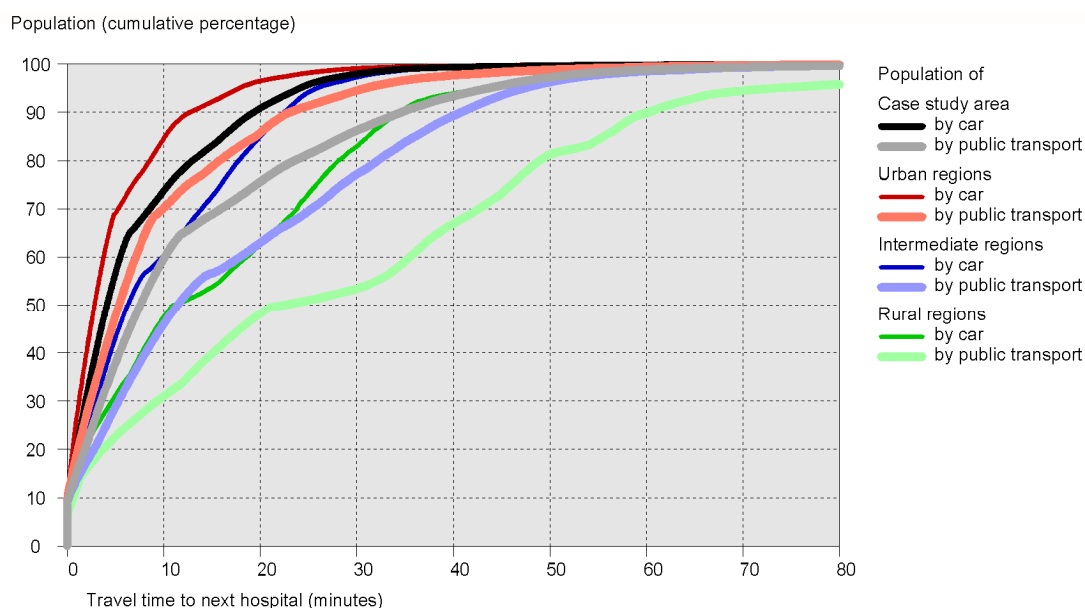
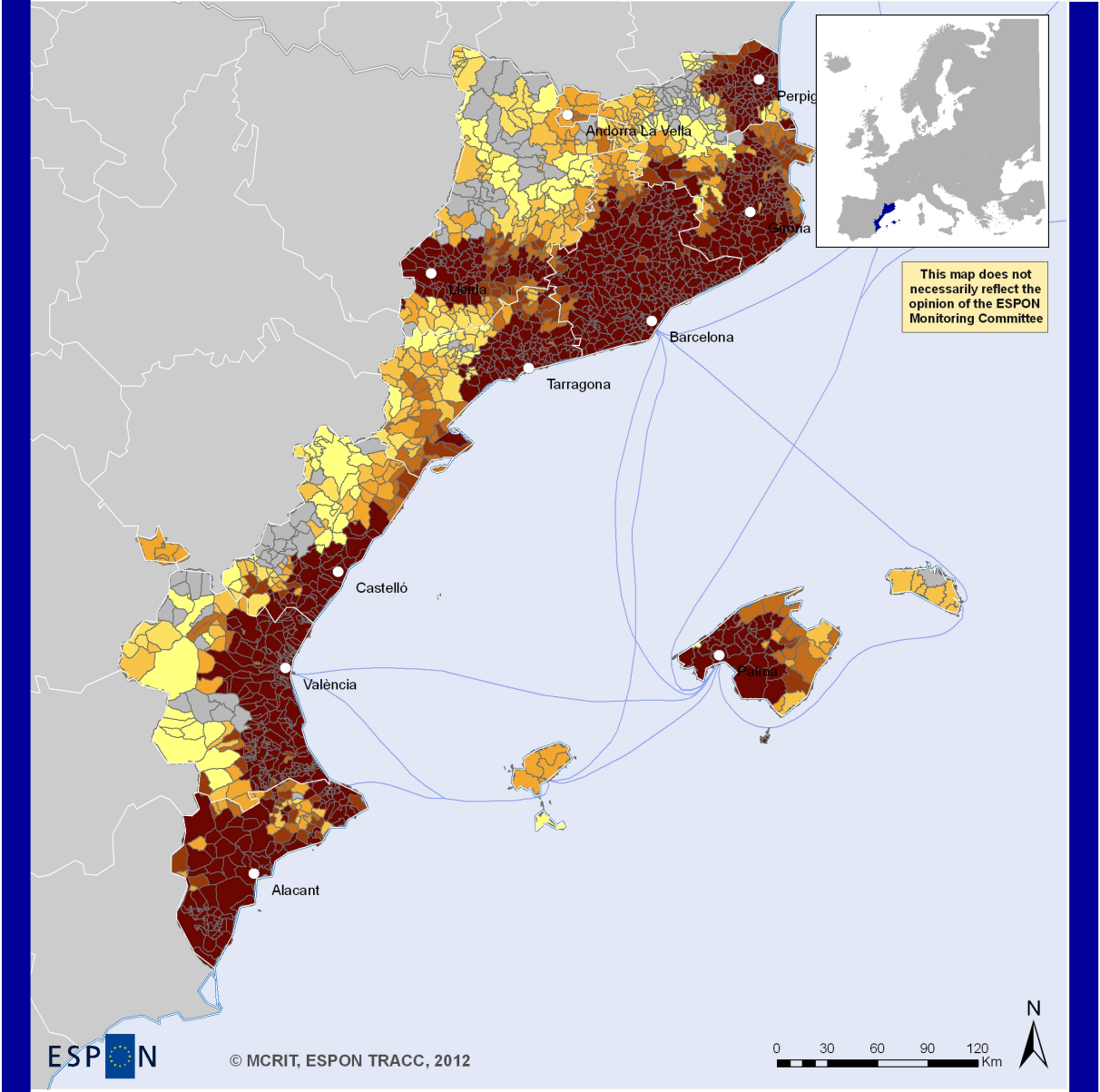


Figure 21. Travel time to next hospital, cumulative distributions

### 3.5 Availability of higher secondary schools

Secondary schools considered in the West Mediterranean region include all those that prepare students for superior education. In Spain these schools are the so called “Institutos” (IES) while in France the term corresponds to “Lycées”. In Andorra, the educational system is composed of schools that follow the Spanish system, therefore “institutos”, and schools that follow the French system, therefore “lycées”. Both public and private secondary schools are considered.

In the West Mediterranean region, secondary schools exist not only in the bigger cities, but also in most of the medium centres. Therefore car accessibility is very high in most of the areas. Only 0,3% of the population, about 46.000 inhabitants living in 108 municipalities (6% of total) has no secondary schools available within 30 minutes drive, and just 1,1% can reach only one secondary school in less than 30 minutes, about 150.000 inhabitants and 216 municipalities (12% of total). Instead 89,0% of the population can reach 20 secondary schools or more in one half an hour drive.



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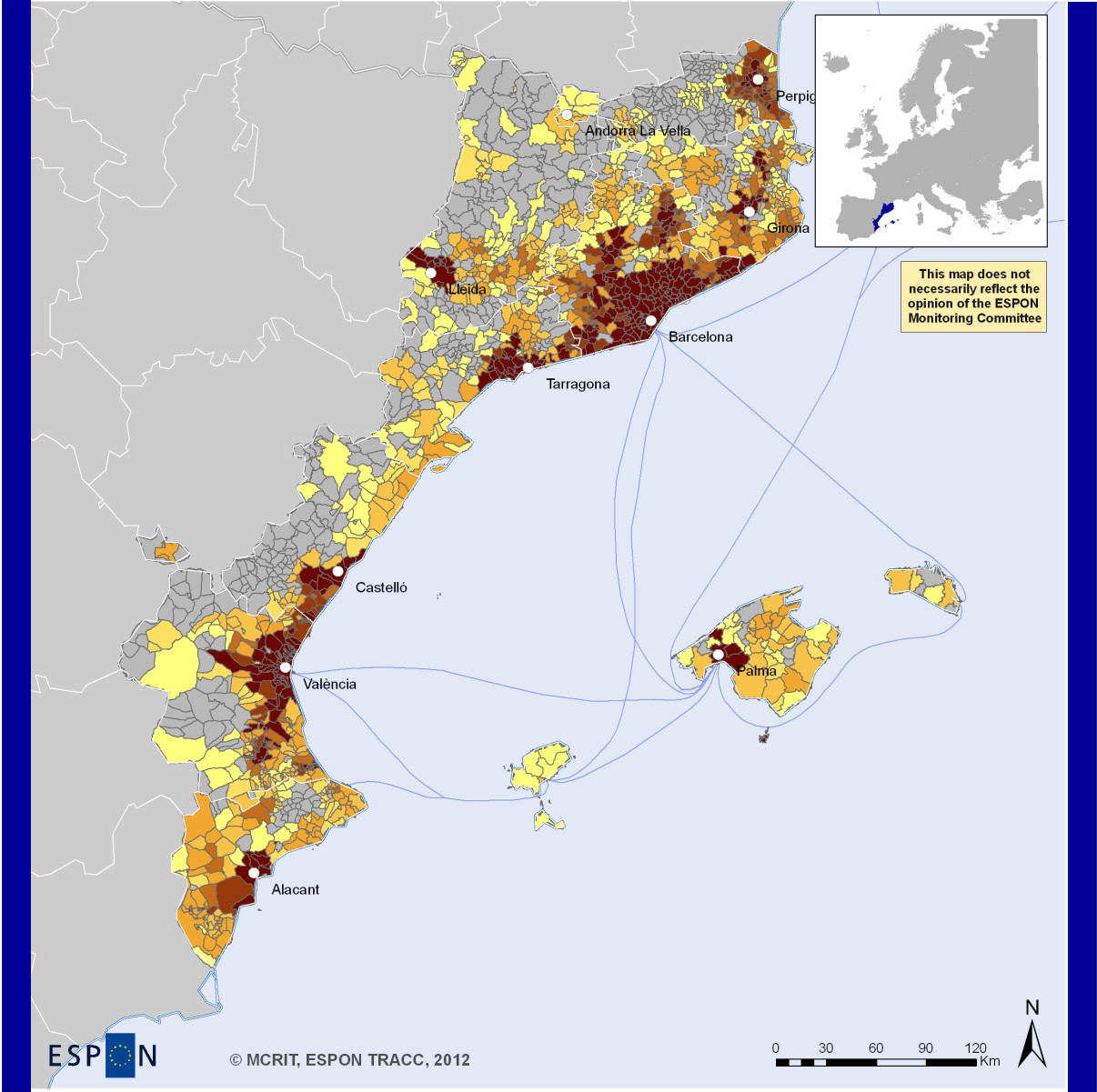
Source: MCRIT, 2012  
Origin of data: Generalitat de Catalunya,  
Generalitat Valenciana and Govern de les Illes Balears (Spain),  
Conseil Général Pyrénées Orientales (France), Govern d'Andorra, 2011.  
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**West Mediterranean Regions**  
**Number of secondary schools accessible by car in less than 30 minutes from each LAU2**

0	6 - 10	○ NUTS 3 Capital
1	11 - 15	
2	16 - 20	
3 - 5	20 <	

Figure 22. Higher secondary schools within 30 minutes travel time by car

Public transport accessibility is much lower. 2,0% of the total regional population, about 285.000 inhabitants in 497 municipalities (28% of total) has no schools available within 30 minutes drive, and 3,8% can reach only one school in less than 30 minutes, a set of 540.000 inhabitants living in 728 municipalities (41% of total). Still, 64,3% of the population can reach 20 secondary schools or more in half an hour by car, that is 9,1 million inhabitants living in the 319 municipalities (18% of the total).



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Source: MCRIT, 2012  
Origin of data: Generalitat de Catalunya,  
Generalitat Valenciana and Govern de les Illes Balears (Spain),  
Conseil Général Pyrénées Orientales (France), Govern d'Andorra, 2011.  
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**West Mediterranean Regions**

**Number of secondary schools accessible by public transport in less than 30 minutes from each LAU2**

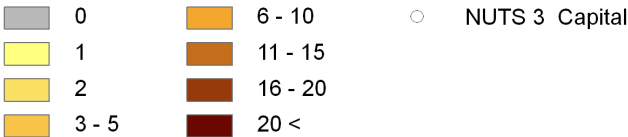


Figure 23. Higher secondary schools within 30 minutes travel time by public transport

Box plots portray accessibility indicators according to urban-rural typology (first) and expressed like cumulative distributions (second). Cumulative distributions correspond to the percentage of population (y-axis) that performs equal to or better than each of the values for the indicator specified on the x-axis. The figures are to be read with care, as the low number of NUTS3 included in the region (only 9 plus Andorra), and the low number of LAU2 in some of the typologies (only 6 municipalities for intermediate remote) may not be sufficient to show sufficiently precise patterns which allow for generalisation.

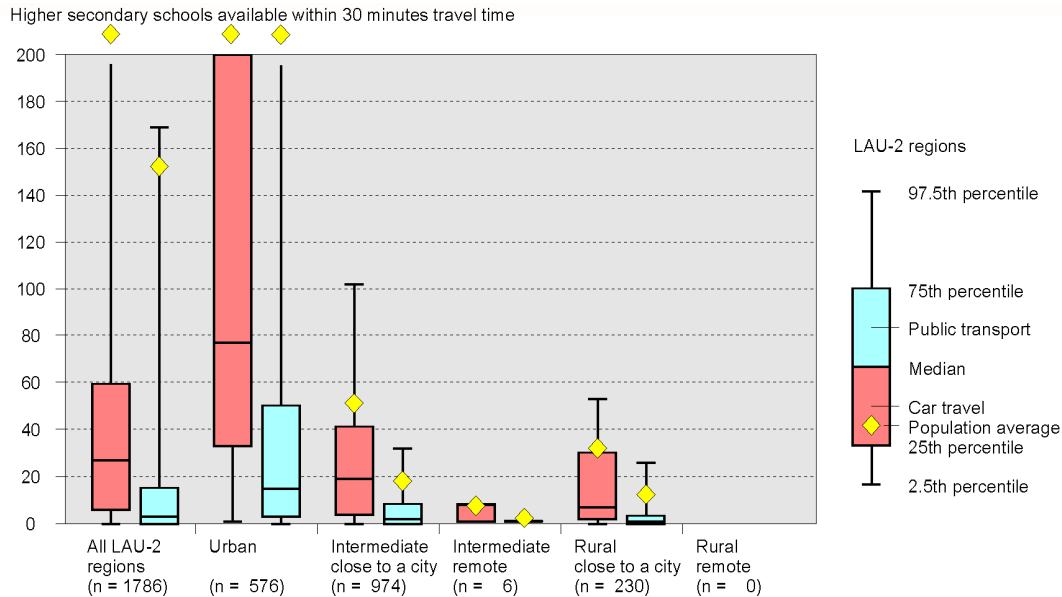


Figure 24. Higher secondary schools within 30 minutes travel time, by urban-rural typology

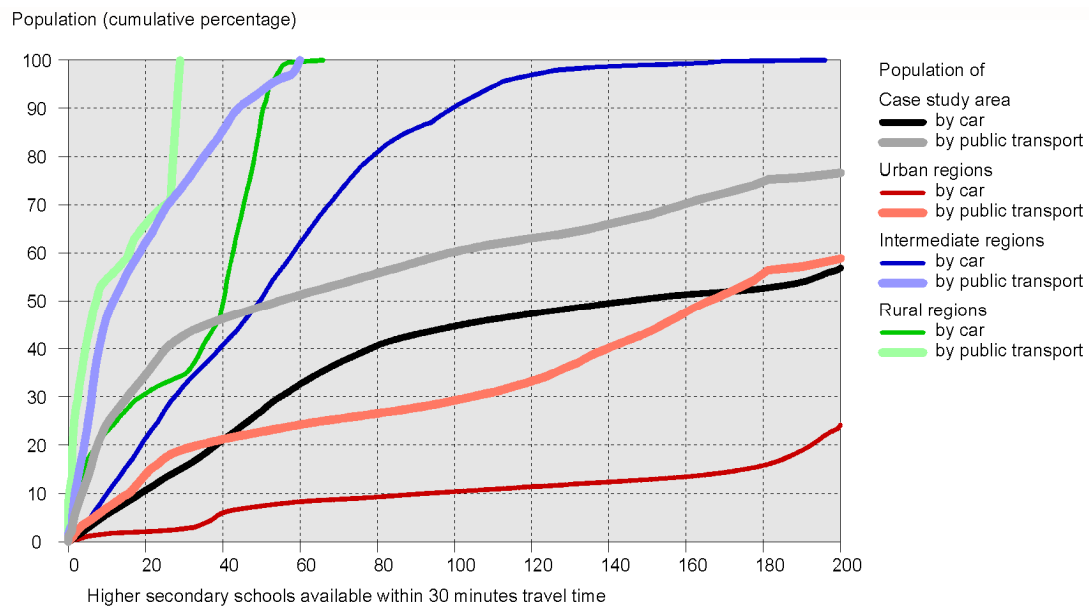
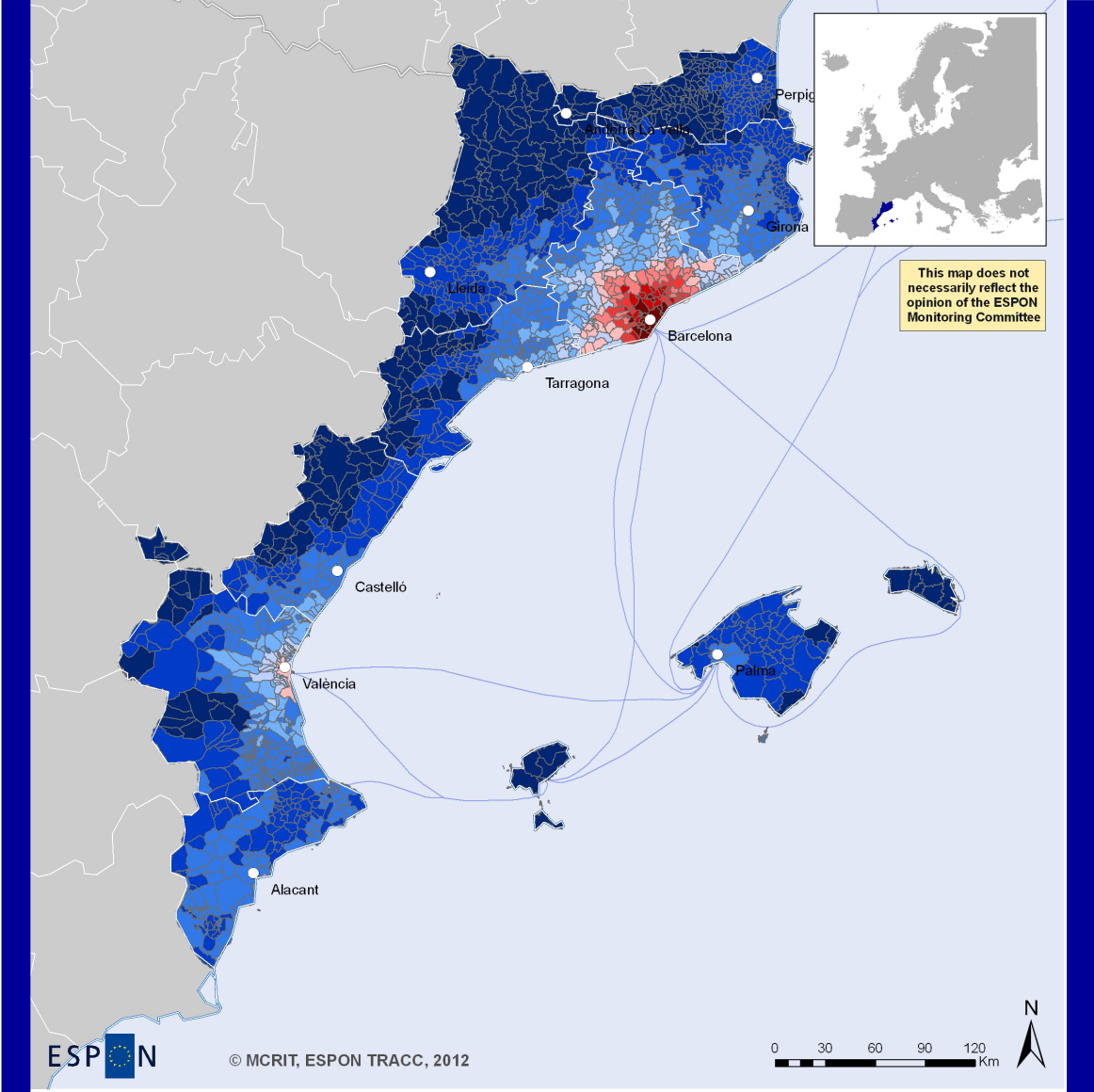


Figure 25. Higher secondary schools within 30 minutes travel time, cumulative distributions

### 3.6 Accessibility potential to basic health care

The pattern of potential accessibility to basic health care (doctors) is similar to the pattern of potential accessibility to population. Largest urban agglomerations concentrate largest hospitals and a large number of public and private health care facilities, while most NUTS4 capitals have country hospitals, medium-small municipalities have primary health centres and smallest municipalities may have health services provided only during certain days of the week.

The pattern of potential accessibility to doctors is very much linked to the pattern of potential accessibility to population, as logically, highest concentrations of doctors are located where population lives. The influence of Barcelona metropolitan region can be perceived in the four Catalan NUTS3 capitals, but not in Perpignan in France (contrary to population potential access.). In the south, the influence of Valencia reaches the metropolitan area of Alacant-Elx. The values for potential accessibility to doctors in the islands are limited, as expected.



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**West Mediterranean Regions**  
**Access to general surgeries by car**  
**Regional average=100**

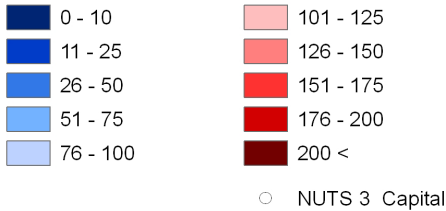
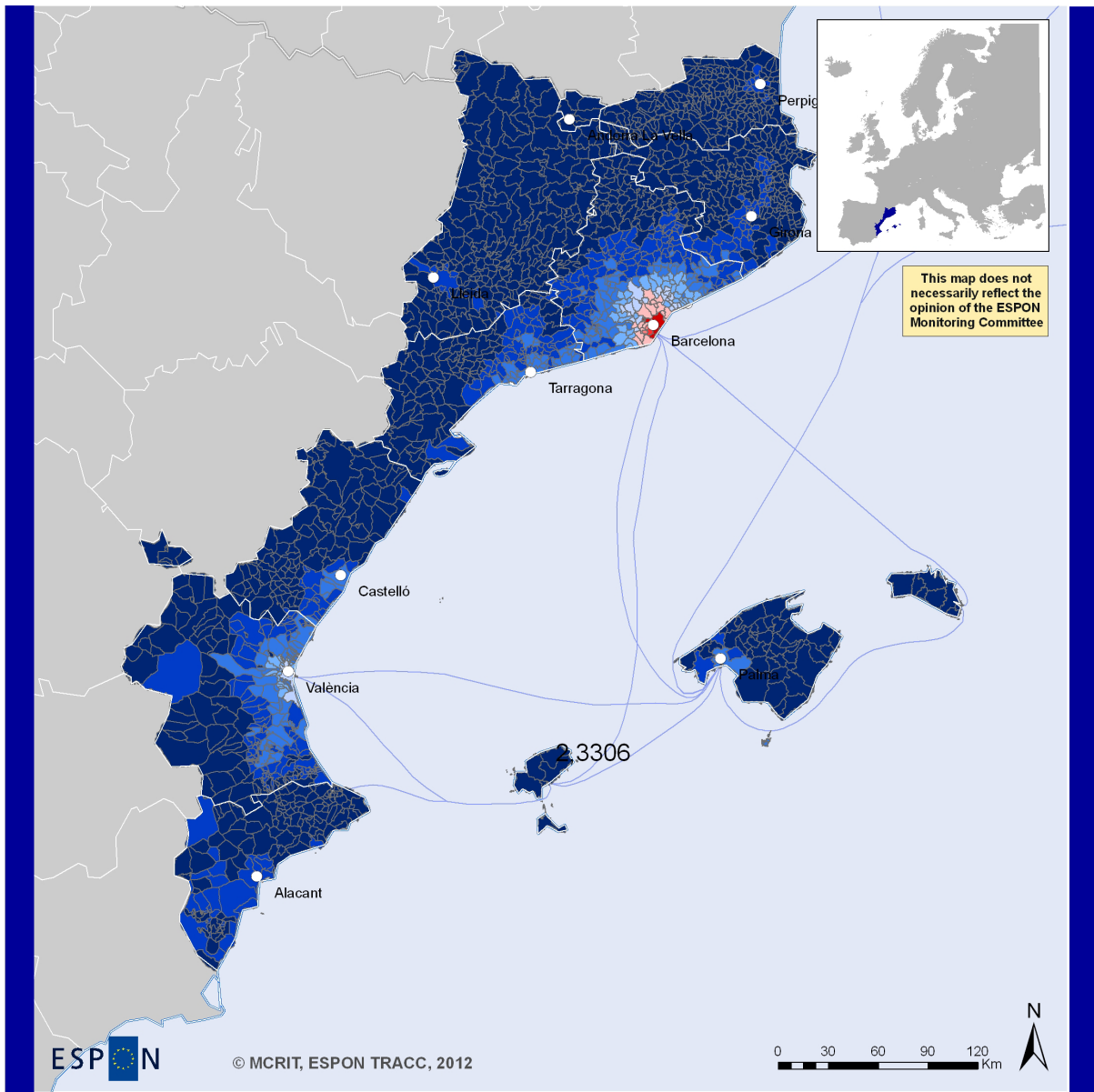


Figure 26. Potential accessibility to medical doctors by car



Large potential accessibilities to doctors by public transport are limited to largest cities in the case study area: in Barcelona and Valencia. Tarragona and Castelló show some positive values, indicating mostly that they benefit to some extent of the much higher health endowment of the Barcelona and Valencia metropolitan areas. .



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**West Mediterranean Regions**  
**Access to general surgeries by public transport**  
**Regional average=100 (standardised on road average)**

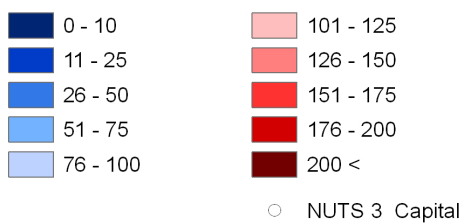
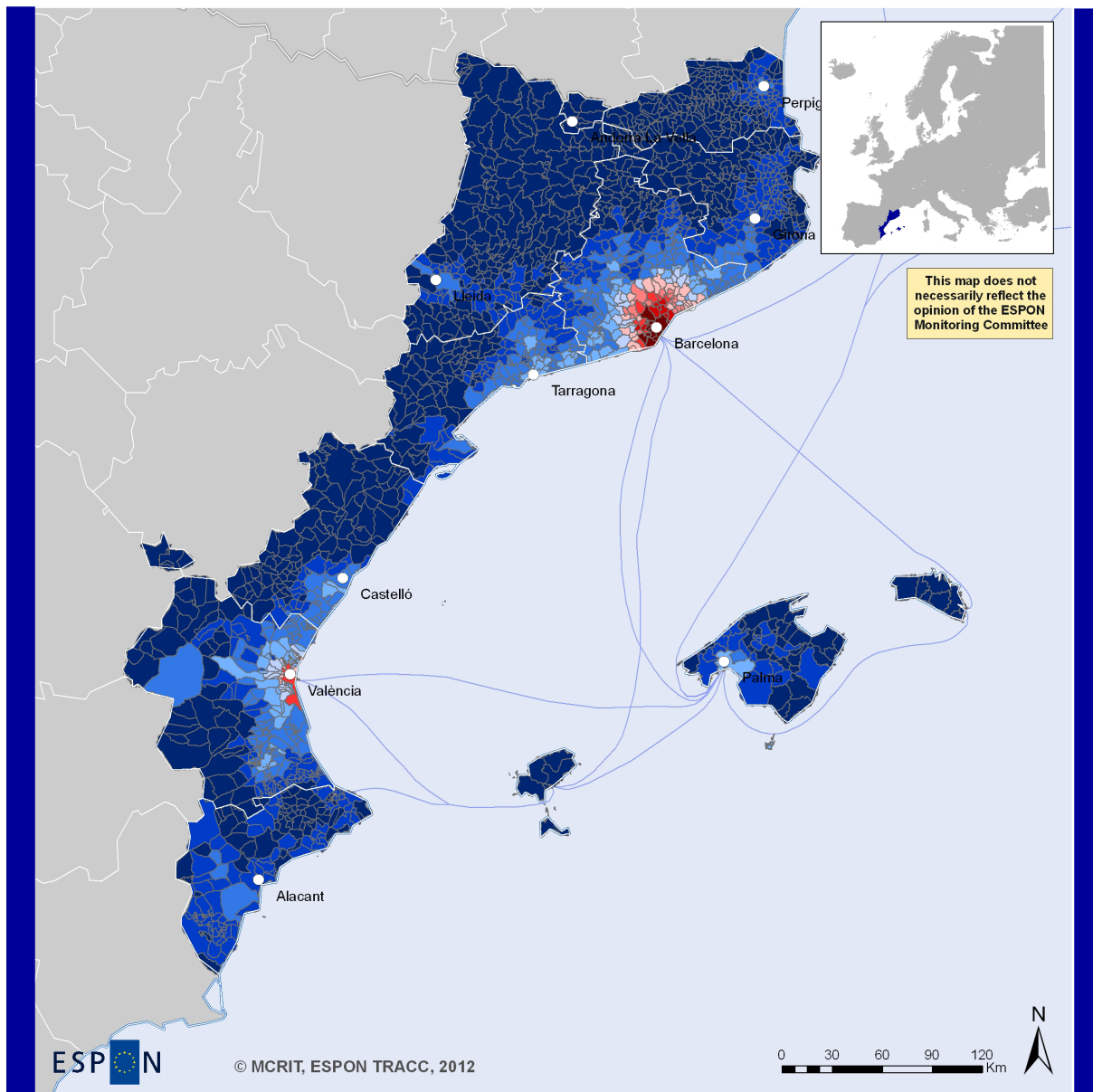


Figure 27a. Potential accessibility to medical doctors by public transport (standardised on road average)



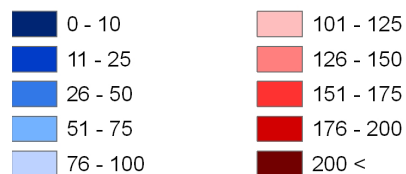
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Source: MCRIT, 2012  
Origin of data: INE (Spain), INSEE (France),  
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### West Mediterranean Regions

#### Access to general surgeries by public transport

Regional average=100 (standardised on public transport average)



○ NUTS 3 Capital

Figure 27b. Potential accessibility to medical doctors by public transport  
(standardised on public transport average)

Box plots portray accessibility indicators according to urban-rural typology (first) and expressed like cumulative distributions (second). Cumulative distributions correspond to the percentage of population (y-axis) that performs equal to or better than each of the values for the indicator specified on the x-axis. The figures are to be read with care, as the low number of NUTS3 included in the region (only 9 plus Andorra), and the low number of LAU2 in some of the typologies (only 6 municipalities for intermediate remote) may not be sufficient to show sufficiently precise patterns which allow for generalisation.

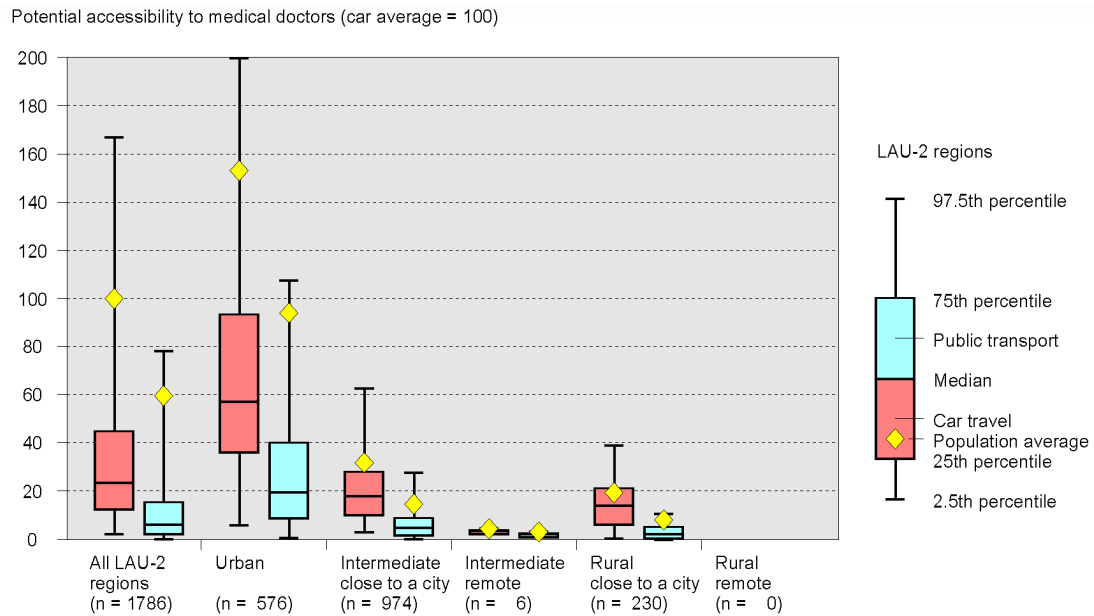


Figure 28. Potential accessibility to medical doctors, by urban-rural typology

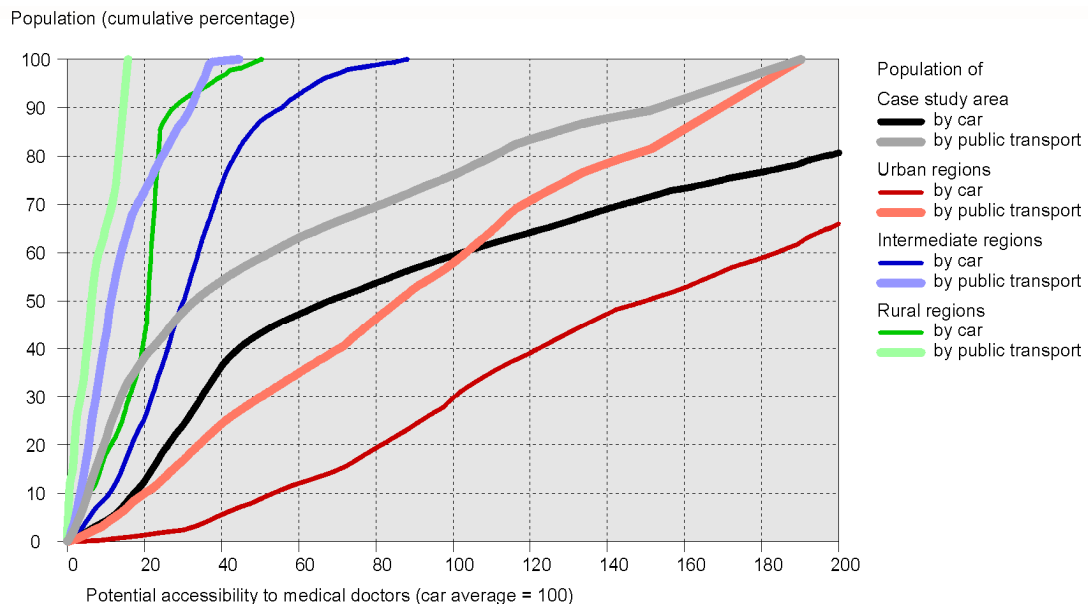


Figure 29. Potential accessibility to medical doctors, cumulative distributions



#### 4 Accessibility situation at different regional subtypes

Zoom-in regions were chosen within the West Mediterranean case study to discuss different accessibility patterns in the area. The following criteria were considered in the choice process:

- *Andorra* is a small mountain country with complex topography but strong accessibility requirements due to a dominating tourist sector aimed at attracting foreign visitors (Spain & France).
- *Barcelona* is the most important urban agglomeration in the West Mediterranean region.
- *Pyrénées Orientales / Girona* zoom-in area is a trans-border region situated between France and Spain, with a common cultural heritage but limited functional inter-relationships.
- *Menorca* zoom-in area focuses on a small Mediterranean island which being a biosphere reserve but also an important familiar tourism economy, needs to make compatible accessibility with environment preservation.
- *Alacant* provides knowledge on accessibility in a coastal region focused on international tourism.

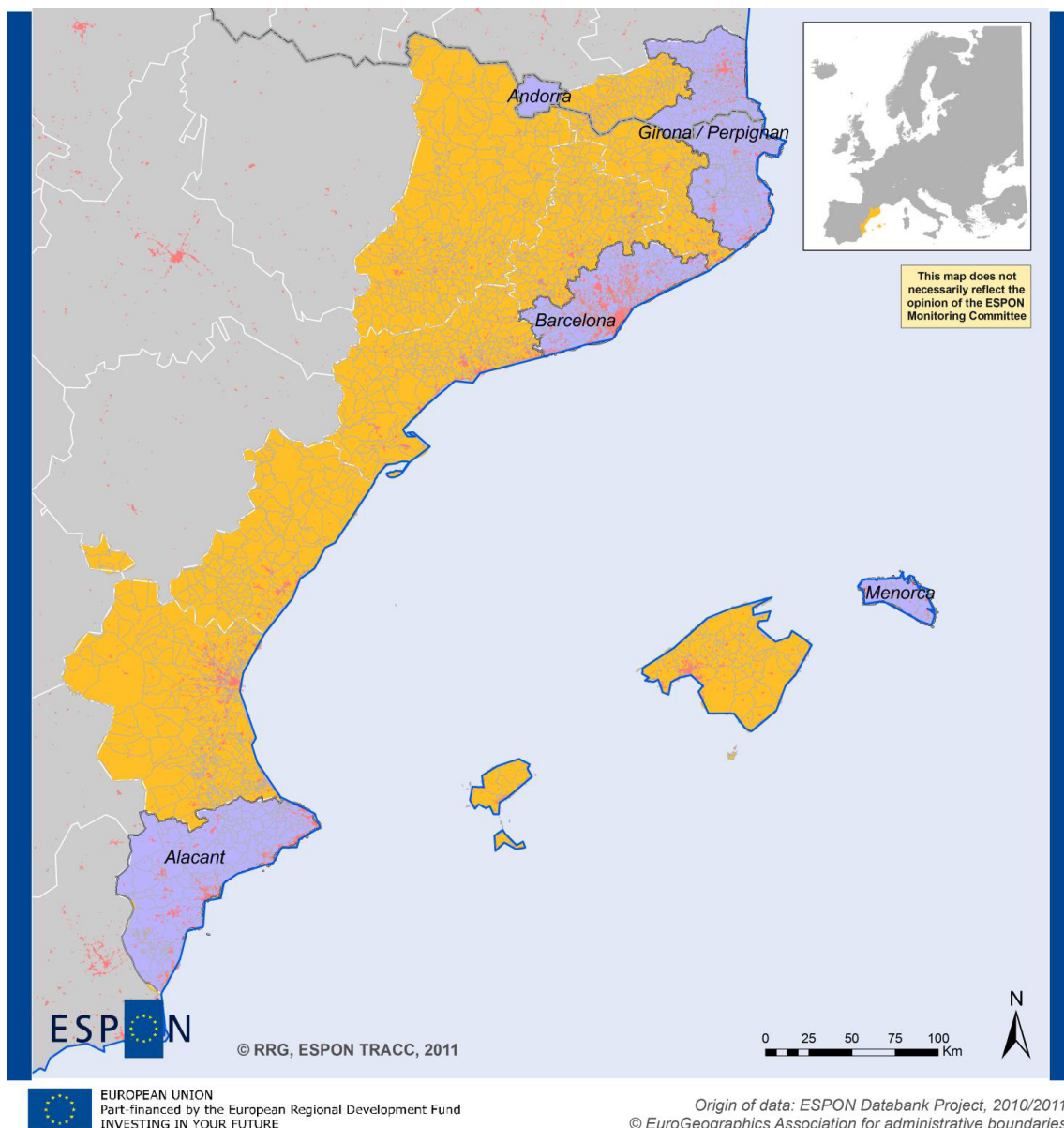


Figure 30. Zoom-in regions

Most of the zoom-in regions perform better than average in relation to accessibility to regional centres, as these regions are in general conformed around reference cities (e.g. Barcelona, Alacant, Girona and Perpignan). Only Menorca performs worse as being a small island it is not possible to reach the NUTS3 capital of Balearic Islands located in Majorca in less than 200 minutes (airplane or ferry are required). This is not to say that Menorca does not have a reference centre for general services to population, but it is much smaller than 50.000 inhabitants and it is not capital of NUTS3. Despite not being a Spanish province, Menorca has some administrative autonomy with respect to the regional government through its Insular Council.

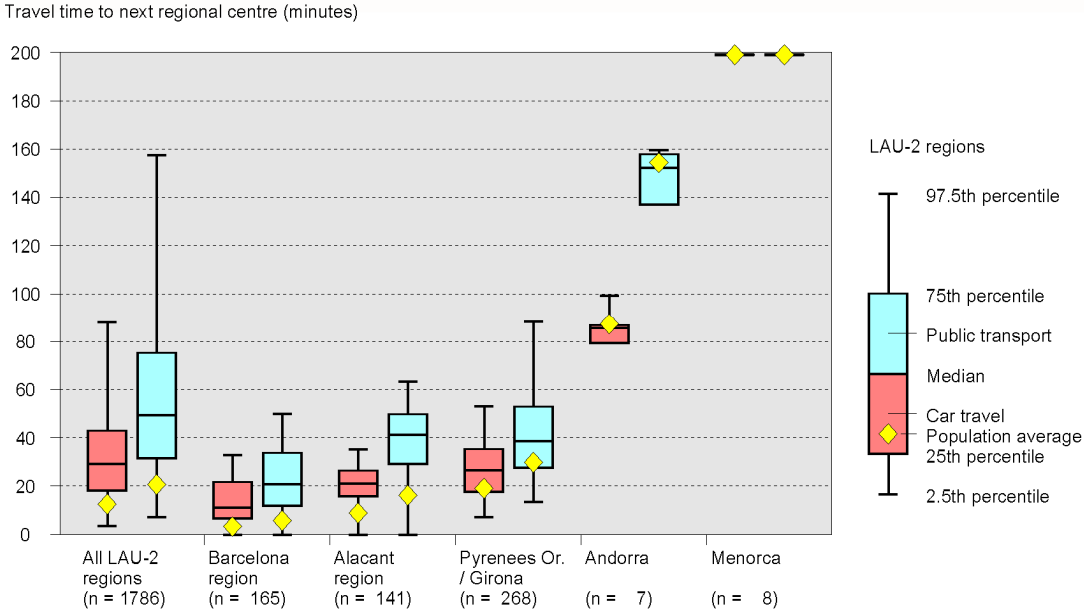


Figure 31. Travel time to next regional centre, by zoom-in region

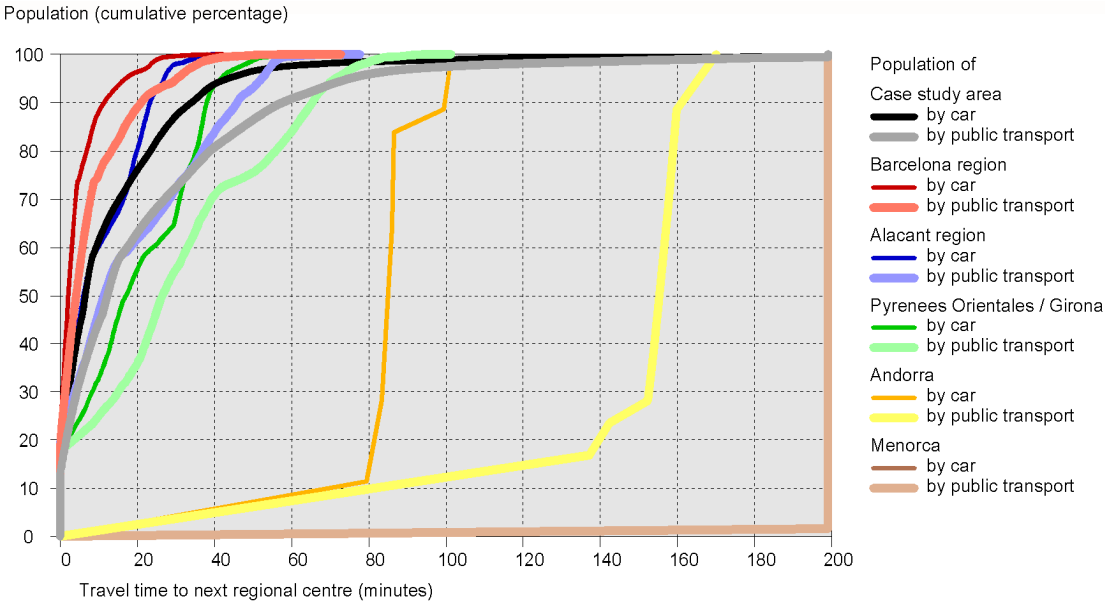


Figure 32. Travel time to next regional centre, cumulative distributions by zoom-in region

The Barcelona Metropolitan region performs much better than any other zoom-in region in the West Mediterranean case study. This is not rare considering that its population amounts up to 5 million inhabitants (only in the metropolitan region) and it has a labour market of around 2,3 million jobs. With these numbers, Barcelona's metropolitan region concentrates 70% of Catalonia's population and labour market just in 10% of the territory, and 35% of the whole West Mediterranean region in 5% of its surface.

The large dispersion of the values in figure 33 in some regions indicates that a number of municipalities follow patterns different than expected for the region where they belong to. Southernmost municipalities in Girona are able to catch part of the Barcelona labour market by car, therefore have typical metropolitan patterns, while some municipalities in the Barcelona metropolitan area are lagging in public transport having patterns resembling to rural. Figure 34 allows detecting additional inner peripheries, like in Alacant where almost 15% of the population has substantially less job opportunities than the rest of the region (e.g. Alcoi mountainous region).

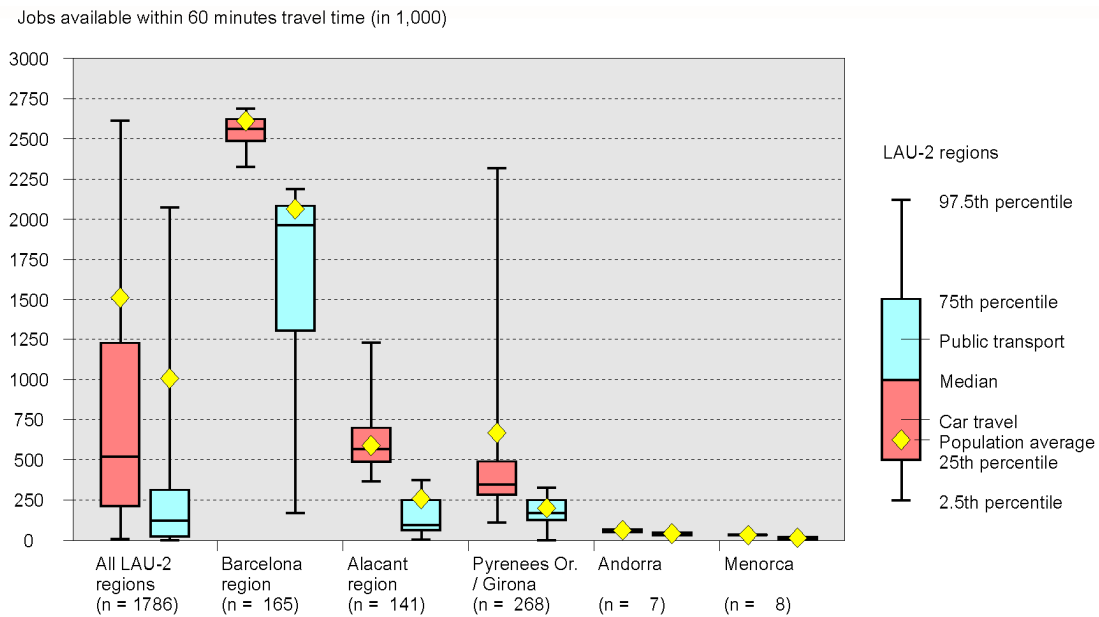


Figure 33. Jobs accessible within 60 minutes, by zoom-in region

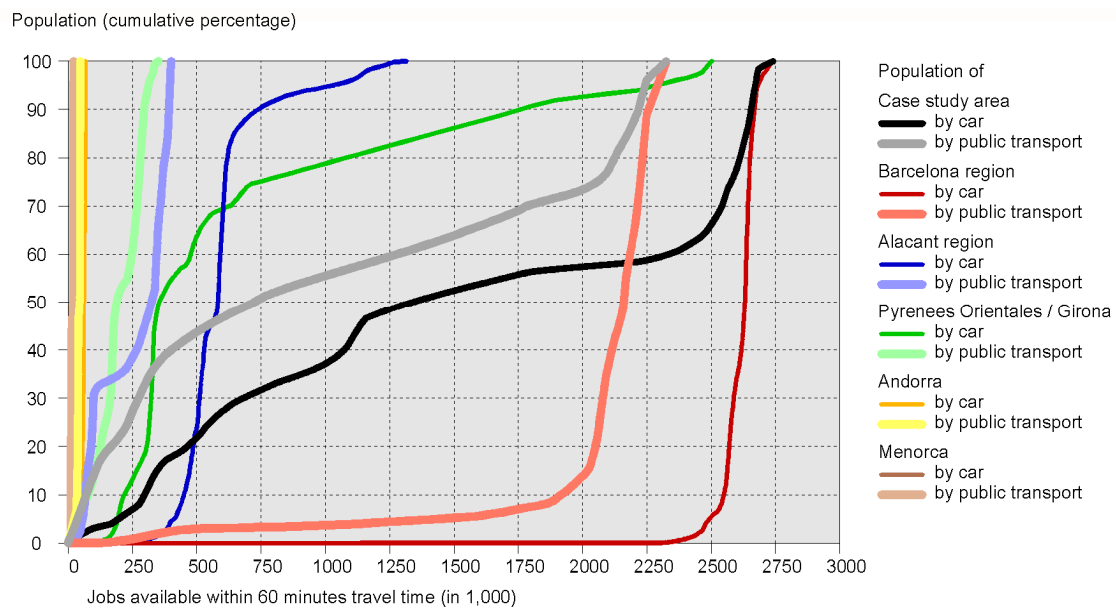


Figure 34. Jobs accessible within 60 minutes, cumulative distributions by zoom-in region

The general pattern for the potential accessibility to population indicator is similar to the available jobs indicator, but the trends become smoother for the later as the potential formulation allows zoom-in regions close to large metropolitan regions to catch part of their influence (e.g. Girona/Pyrenees Orientales).

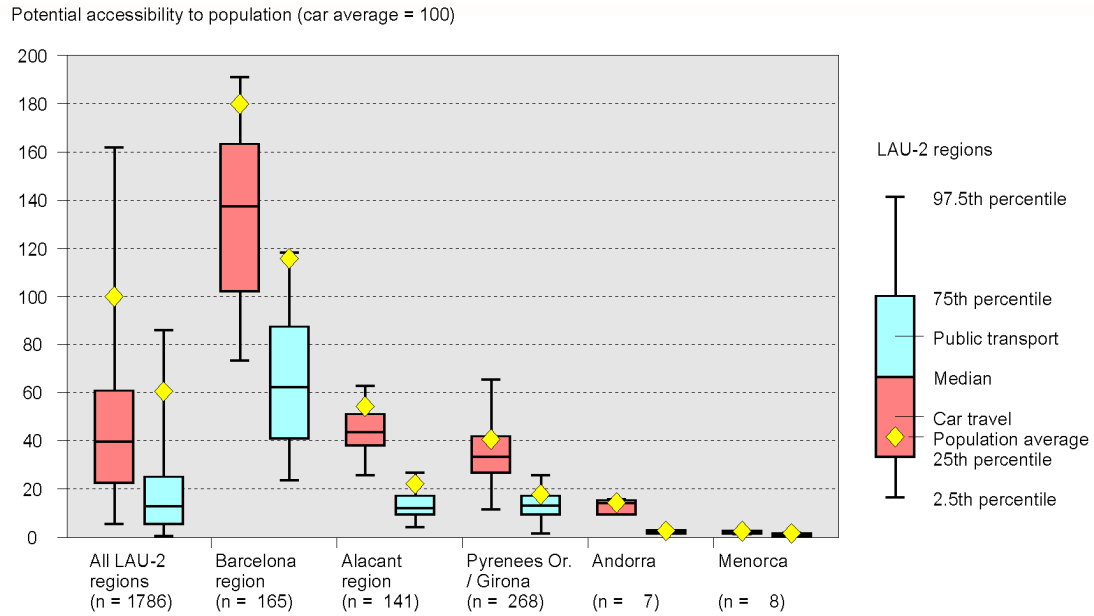


Figure 35. Potential accessibility to population, by zoom-in region

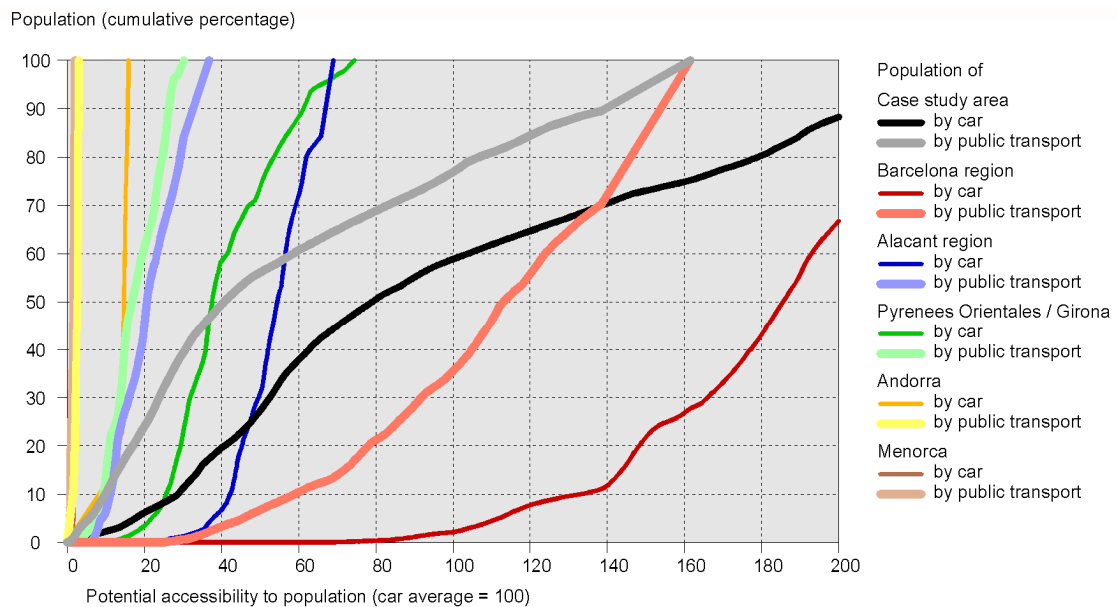


Figure 36. Potential accessibility to population, cumulative distributions by zoom-in region

Accessibility to hospitals shows like no other indicator before an important homogeneity of all zoom-in region's performances, even when Barcelona still do slightly better than others. This reflects the nature of the European welfare systems, which are aimed at granting adequate services to all population, even when economically too costly to be provided by the private sector (e.g. sparsely populated areas).

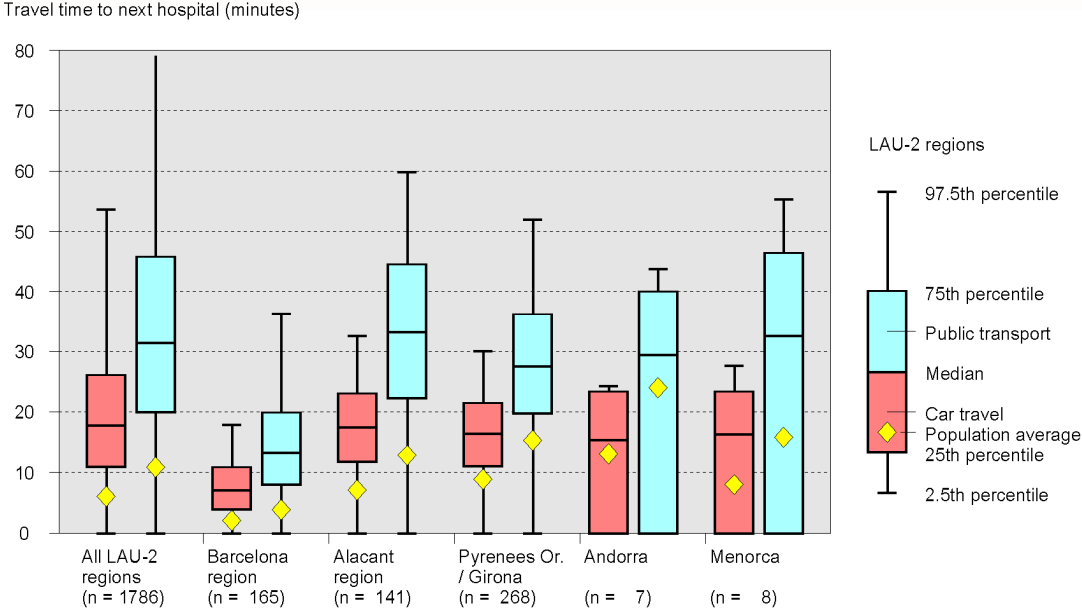


Figure 37. Travel time to next hospital, by zoom-in region

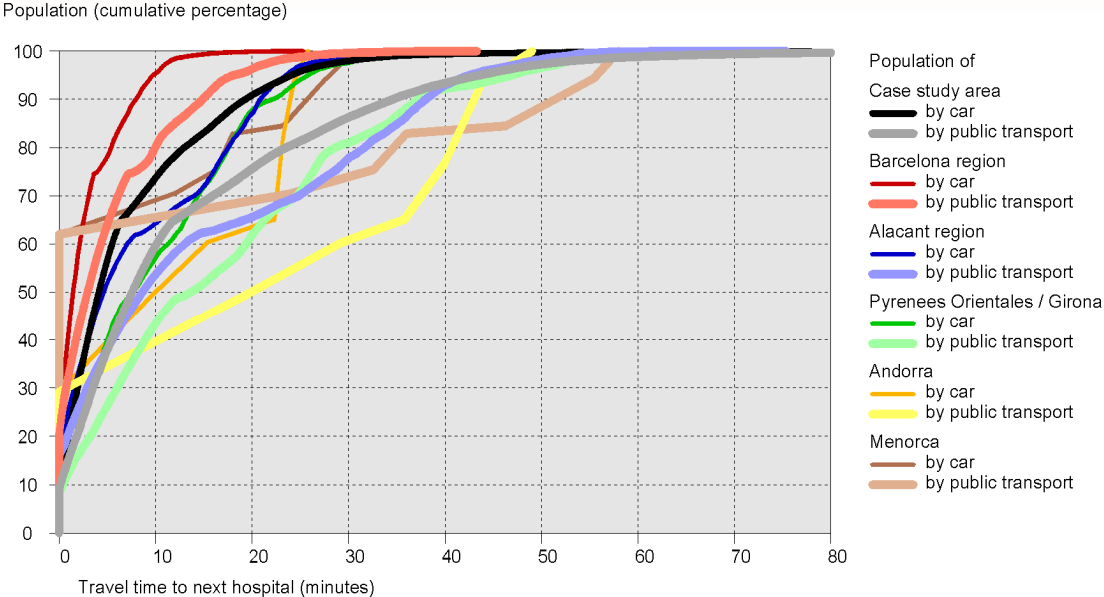


Figure 38. Travel time to next hospital, cumulative distributions by zoom-in region

The analysis of the number of schools accessible within 30 minutes travel time from the different regions under study reveals a high contrast between the capacity of Barcelona to offer a wide diversity of school services and the rest of the regions in the case study area, especially by car. The reason for this is that most municipalities within the metropolitan region of Barcelona, many of them of 100.000 inhabitants or more, are accessible to each other in less than 30 minutes drive. This provides a very important potential for educative infrastructure in the region. However, if congestion had been considered in the analysis of this specific indicator, implying larger travel times during peak hours, the scoring of the Barcelona region would be much lower than presented below, as the traffic conditions during school start hours are substantially poorer than during the rest of the day.

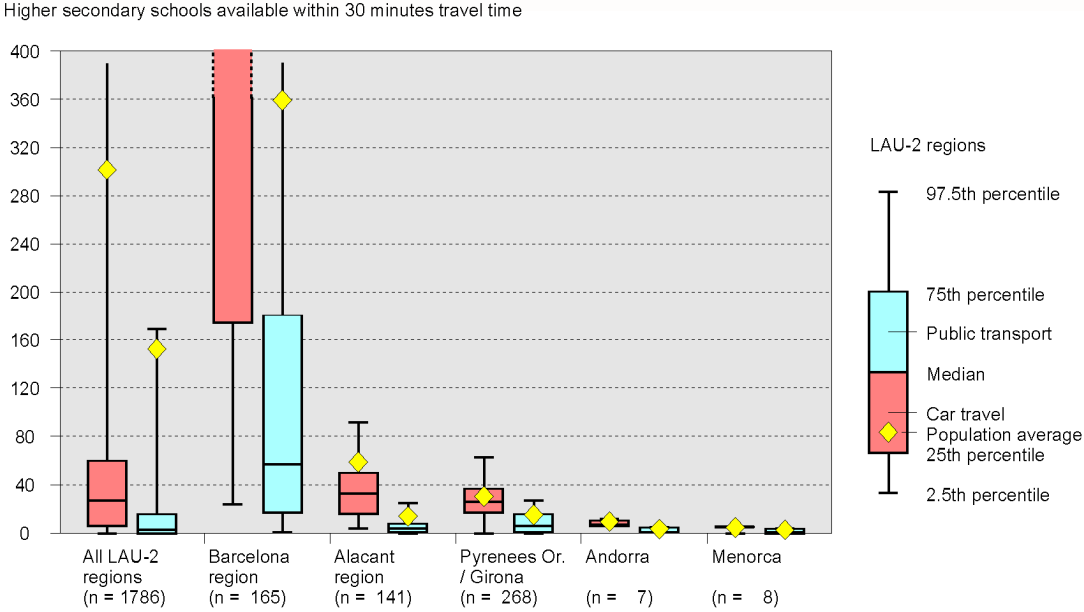


Figure 39. Higher secondary schools within 30 minutes travel time, by zoom-in region

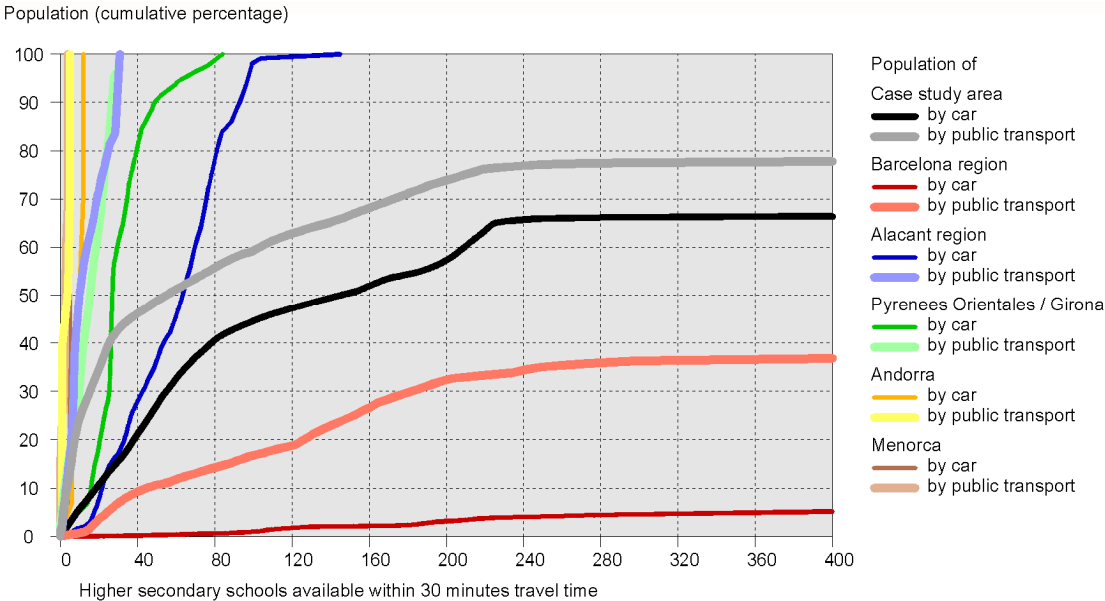


Figure 40. Higher secondary schools within 30 minutes travel time, cumulative distributions by zoom-in region



The indicator of potential accessibility to medical doctors reveals a pattern similar to population potential accessibility, as expected.

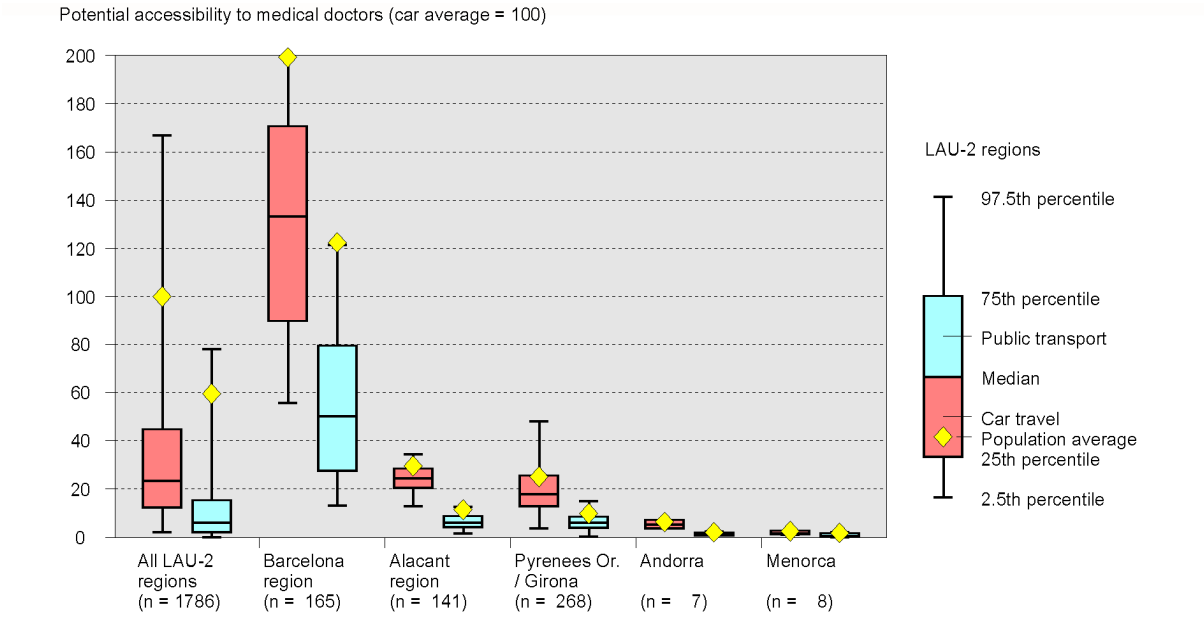


Figure 41. Potential accessibility to medical doctors, by zoom-in region

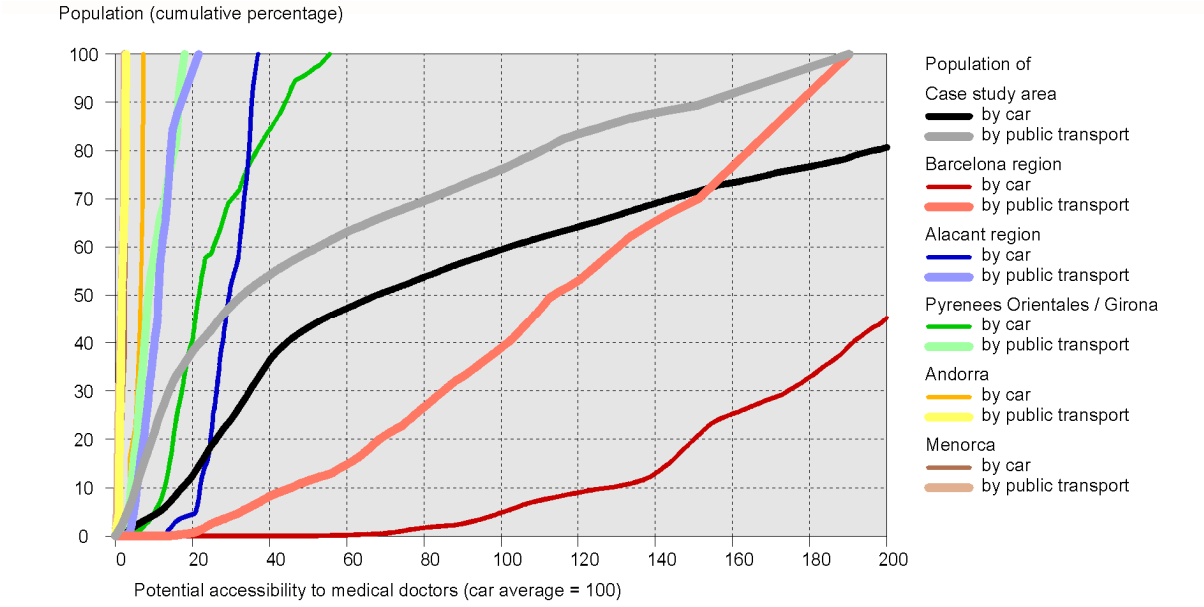


Figure 42. Potential accessibility to medical doctors, cumulative distributions by zoom-in region

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 60 minutes		Potential accessibility to medical doctors
	Minutes	Index	In 1,000	Index	Index	Minutes	Index	Number	Index	Index
Andorra	89	264	62	7	28	17	87	9	10	16
Barcelona	14	41	2.549	278	278	8	38	511	607	364
Perpignan / Girona	27	80	501	55	71	16	82	27	32	54
Menorca	>200	590	32	3	4	16	80	4	5	5
Alacant	21	61	665	72	91	17	87	37	44	66
<b>Case study region</b>	<b>34</b>	<b>100</b>	<b>917</b>	<b>100</b>	<b>100</b>	<b>20</b>	<b>100</b>	<b>84</b>	<b>100</b>	<b>100</b>

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 60 minutes		Potential accessibility to medical doctors
	Minutes	Index	In 1,000	Index	Index	Minutes	Index	Number	Index	Index
Andorra	153	265	42	12	12	31	88	3	11	13
Barcelona	23	40	1.592	472	340	14	39	144	636	428
Perpignan / Girona	42	72	175	52	68	28	80	9	38	48
Menorca	>200	344	16	5	6	32	90	2	8	9
Alacant	39	67	150	44	70	32	93	5	23	50
<b>Case study region</b>	<b>58</b>	<b>100</b>	<b>337</b>	<b>100</b>	<b>100</b>	<b>35</b>	<b>100</b>	<b>23</b>	<b>100</b>	<b>100</b>

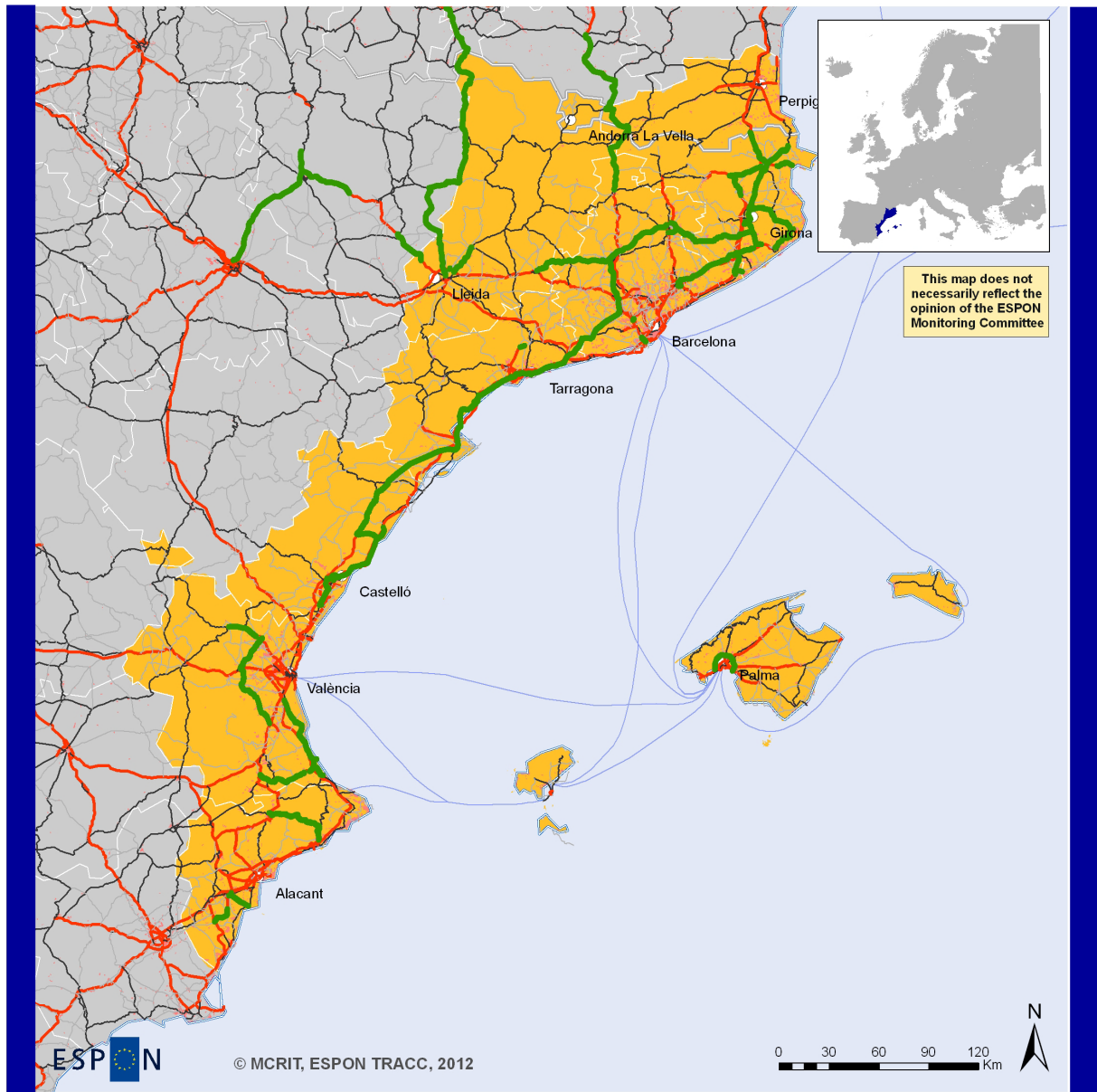
## 5 Accessibility effects of future TEN-T developments

The long distance road corridors of the West Mediterranean region comprise essentially the Eix Mediterrani all along the coast (constituted by two parallel motorways: AP-7 // A-7), the Eix de l'Ebre linking Madrid and Zaragoza to Barcelona (constituted by the AP-2 // A-2 motorways), the Valencia - Zaragoza corridor (A-23) and the route from the Valencia to Madrid (A-3 // A-31).

All these corridors belong to the TEN-T road network, sometimes in the core network and others in the comprehensive. Additionally, the TEN-T comprehensive network considers the upgrading of 3 trans-Pyrenees international crossings linking Toulouse to Barcelona, to Lleida and to Zaragoza (from east to west). The West Mediterranean case study has integrated all planned upgrades on any TEN-T road corridor in the region to constitute the future scenario to be tested. These projects are shown in figure 43a.

There are many new sections of rail being built across the Iberian Peninsula and in particular in the West Mediterranean region. Most of the projects have been slowed down due to the economic crisis, and some of them may only be constructed in the very long term. All high speed rail lines in Spain are included in the TEN-T rail network.

Following the inauguration of the Barcelona-Madrid line in 2008, and the Valencia-Madrid line in 2010, the high speed rail link from Barcelona to Perpignan is expected to enter in service by 2014, and the stretch from Perpignan to Montpellier necessary to connect the Spanish network with the rest of Europe will most likely be upgraded in the mid term. In the Autonomous Community of Valencia, the three provincial capitals (NUTS3 capitals) are planned to be interlinked and also connected to Madrid in the mid term, but projects are uncertain now due to the economic crisis. The corridor from Valencia to Zaragoza is also to be upgraded to high speed standards in the future. The continuity of the high-speed Mediterranean corridor between Valencia and Barcelona requires in the short term the upgrading of a 30 km link right south of Tarragona, already under construction before the crisis but works being stopped now due to funding shortage. This stretch should allow trains to reduce present travelling time by some 45 minutes between Barcelona and Valencia (from 3h to 2h15). The West Mediterranean case study has integrated all planned upgrades on any TEN-T rail corridor in the region to constitute the future scenario to be tested. These projects are shown in figure 43b.



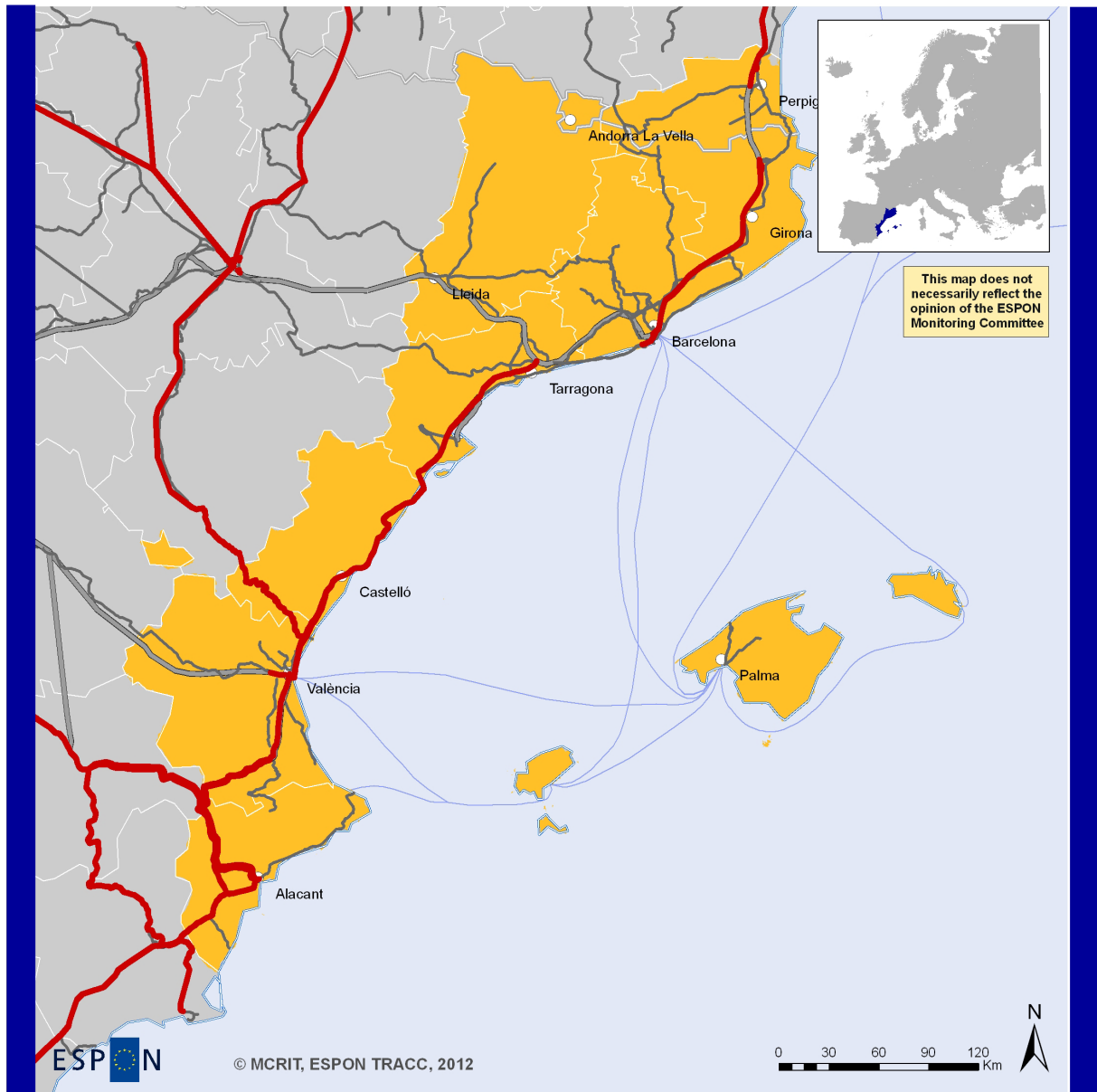
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### West Mediterranean Regions Road infrastructure projects

- Motorways + Expressways
- 1st class roads
- 2nd class roads
- TEN-T road projects (upgrading from current network)
- NUTS 3 Capital

Figure 43a. TEN-T road infrastructure projects



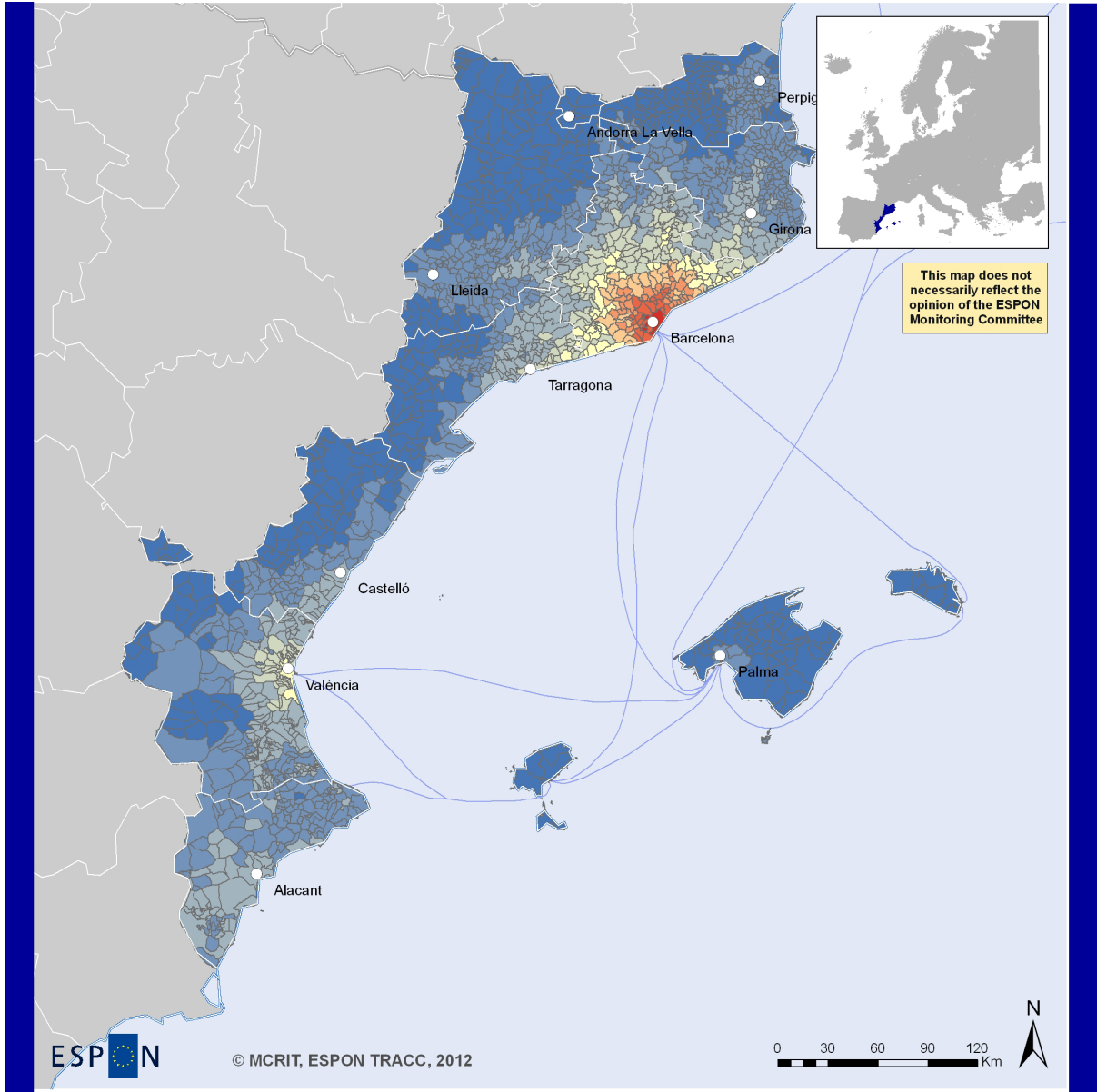
Source: MCRIT, 2012  
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### West Mediterranean Regions Rail infrastructure projects

- High Speed Network
- Conventional Network
- TEN-T rail projects (upgrading from current network)
- NUTS 3 Capital

Figure 43b. TEN-T rail infrastructure projects

The following 2 maps show the potential accessibility maps for car and public transport in a future scenario where all TEN-T are executed. Although potential accessibility is calculated to population, this indicator also reflects approximately the shape of the labour markets in the Western Mediterranean region.



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**West Mediterranean Regions**  
**Potential accessibility to population by car (TEN-T Scenario)**  
**Regional average=100 (standardised on road average 2010)**

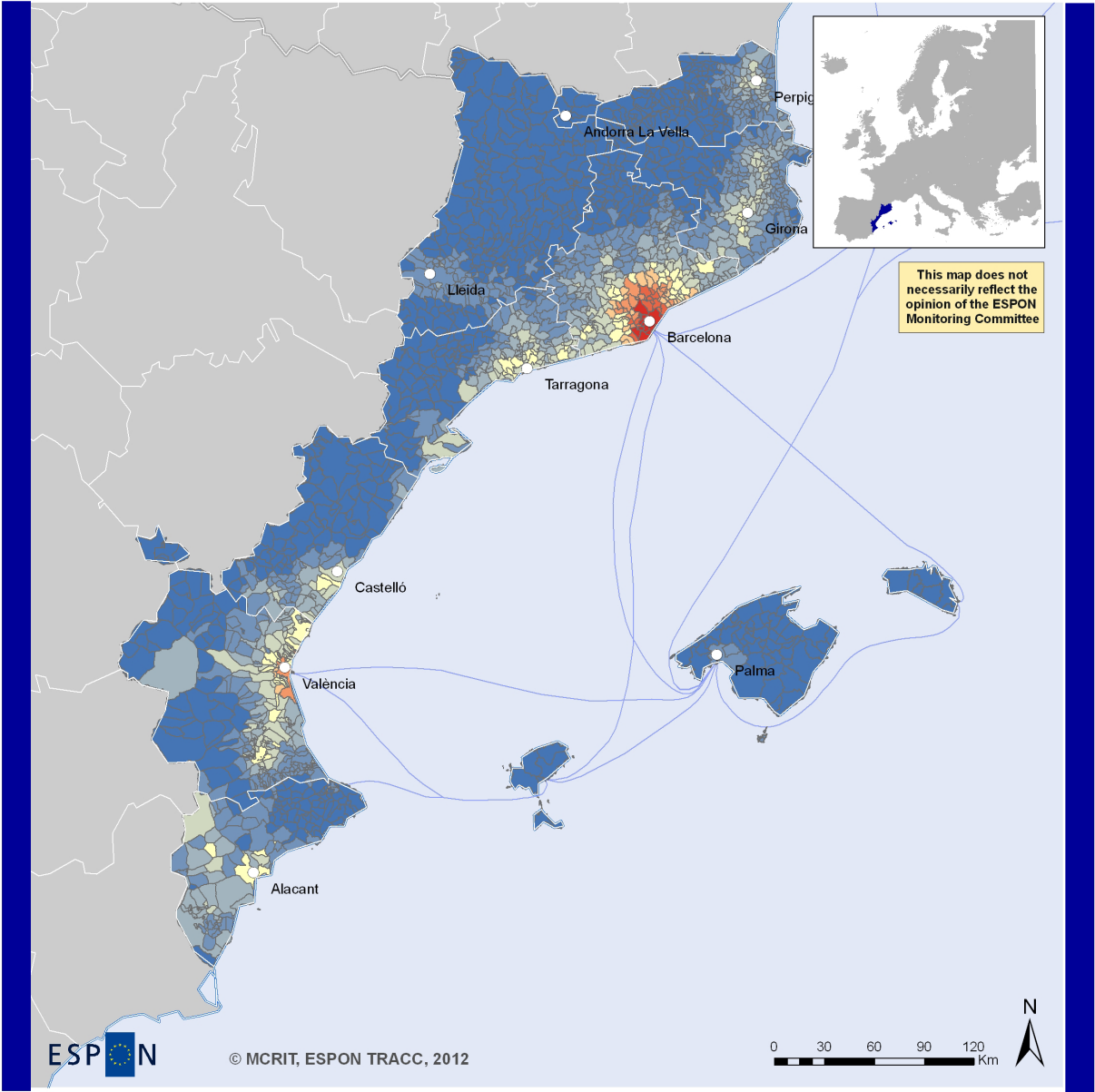
0,0 - 25,0	125,1 - 150,0
25,1 - 50,0	150,1 - 175,0
50,1 - 75,0	175,1 - 200,0
75,1 - 100,0	200 <
100,1 - 125,0	○ NUTS 3 Capital

Figure 44. Potential accessibility to population by car with TEN-T projects

Impacts of the TEN-T are especially important in rail. Figure 45 shows the trace of the future high speed rail lines in the new potential accessibility pattern. High values of accessibility to population



are recorded in all the cities having stations of the train: from north to south, Perpignan, Figueres, Girona, Barcelona, Tarragona, Tortosa, Castelló, Valencia and Alacant, and in the interior, Lleida. The largest void remains located between Tortosa, in the southern edge of Catalonia, and Castelló, which being a sparsely populated area has no high speed rail station planned.



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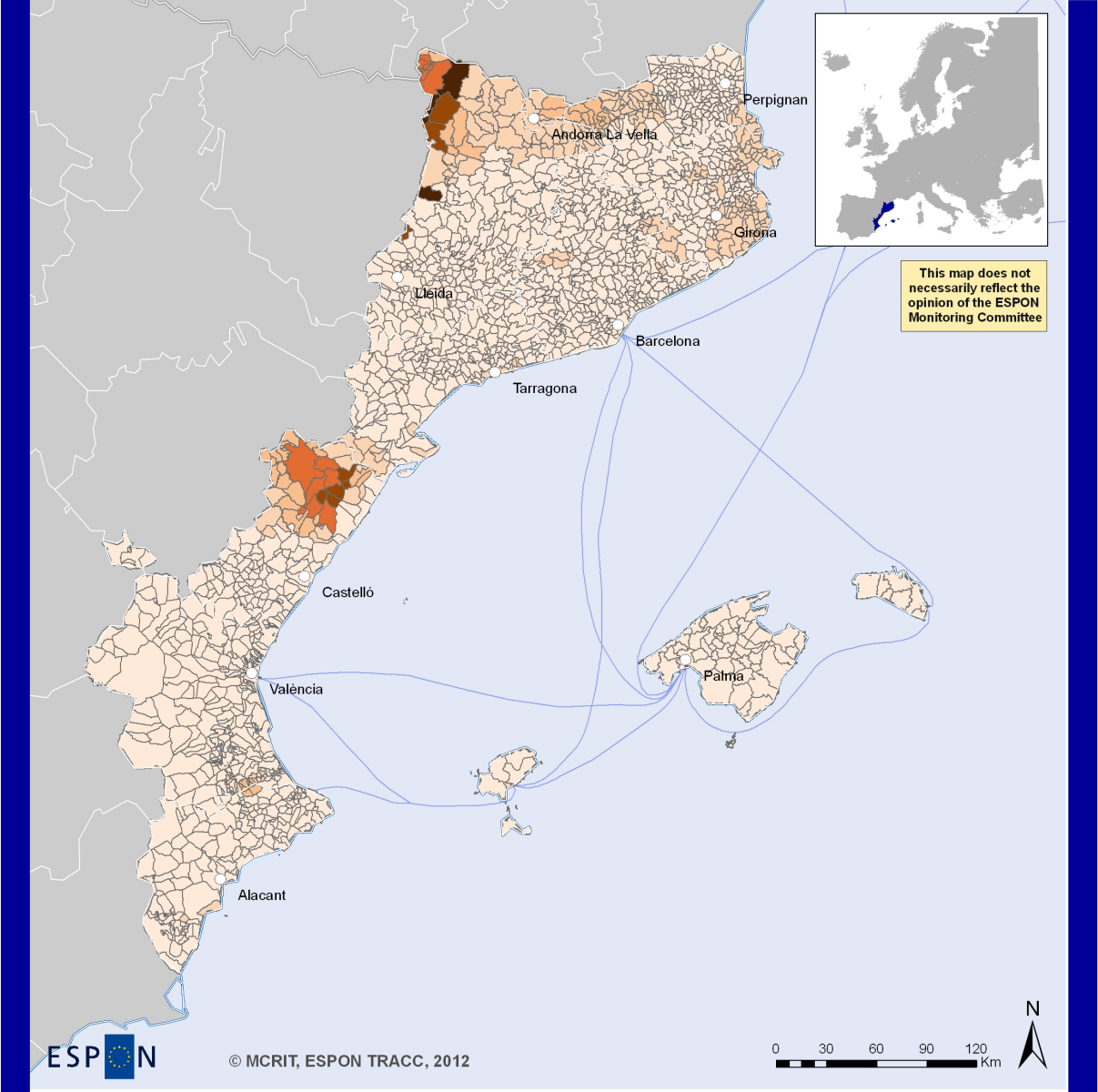
Source: MCRIT, 2012  
Origin of data: INE (Spain), INSEE (France),  
Statistics Department of Andorra, 2011  
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**West Mediterranean Regions**  
**Potential accessibility to population by public transport (TEN-T Scenario)**  
**Regional average=100 (standardised on public transport average 2010)**

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

Figure 45. Potential accessibility to population by public transport with TEN-T projects

The car scenario doesn't introduce drastic changes in current patterns of potential accessibility, but locally it can be observed the impact of new transport infrastructure like the upgraded Lleida-Toulouse road axis through Vielha, allowing western Pyrenees' communities to reach the Toulouse metropolitan region, or even making the tourist offer of Val d'Aran more accessible to the Toulouse agglomeration. In Castelló, the upgrading of the interior Mediterranean corridor (A-7 motorway) allows for interior municipalities to reach both the coastal corridor, and even the Catalan population (labour market) to some extent.



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**West Mediterranean Regions**  
**Potential accessibility to population by car (relative change, %)**  
**(standardised on road average 2010)**

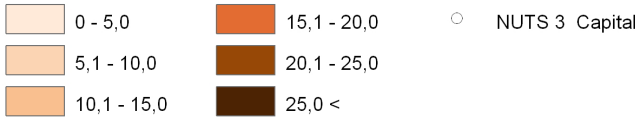
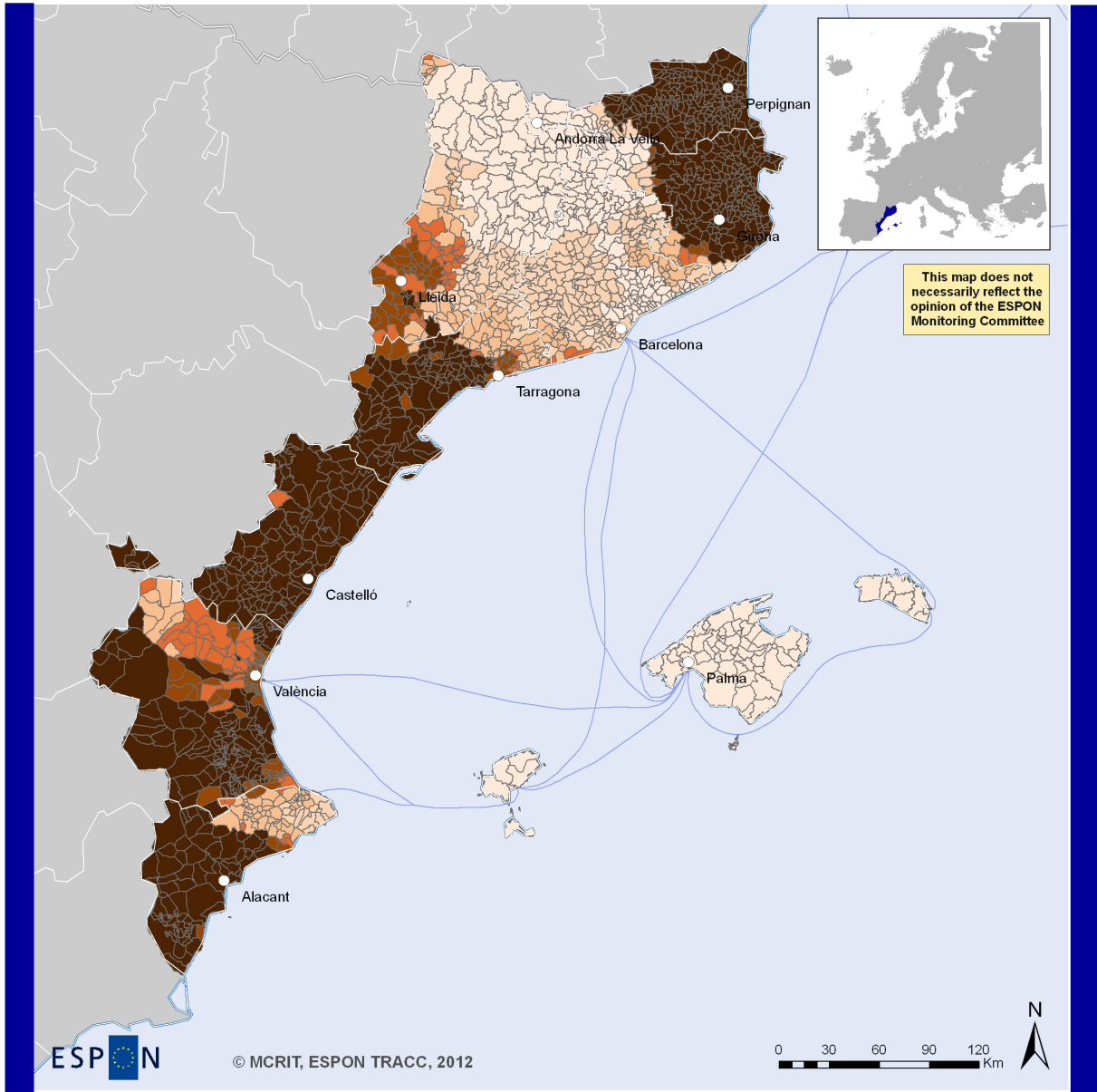


Figure 46. Relative increase of potential accessibility to population by car with TEN-T projects



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**West Mediterranean Regions**  
**Potential accessibility to population by car (relative change, %)**  
**(standardised on public transport average 2010)**

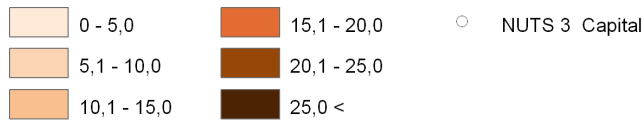
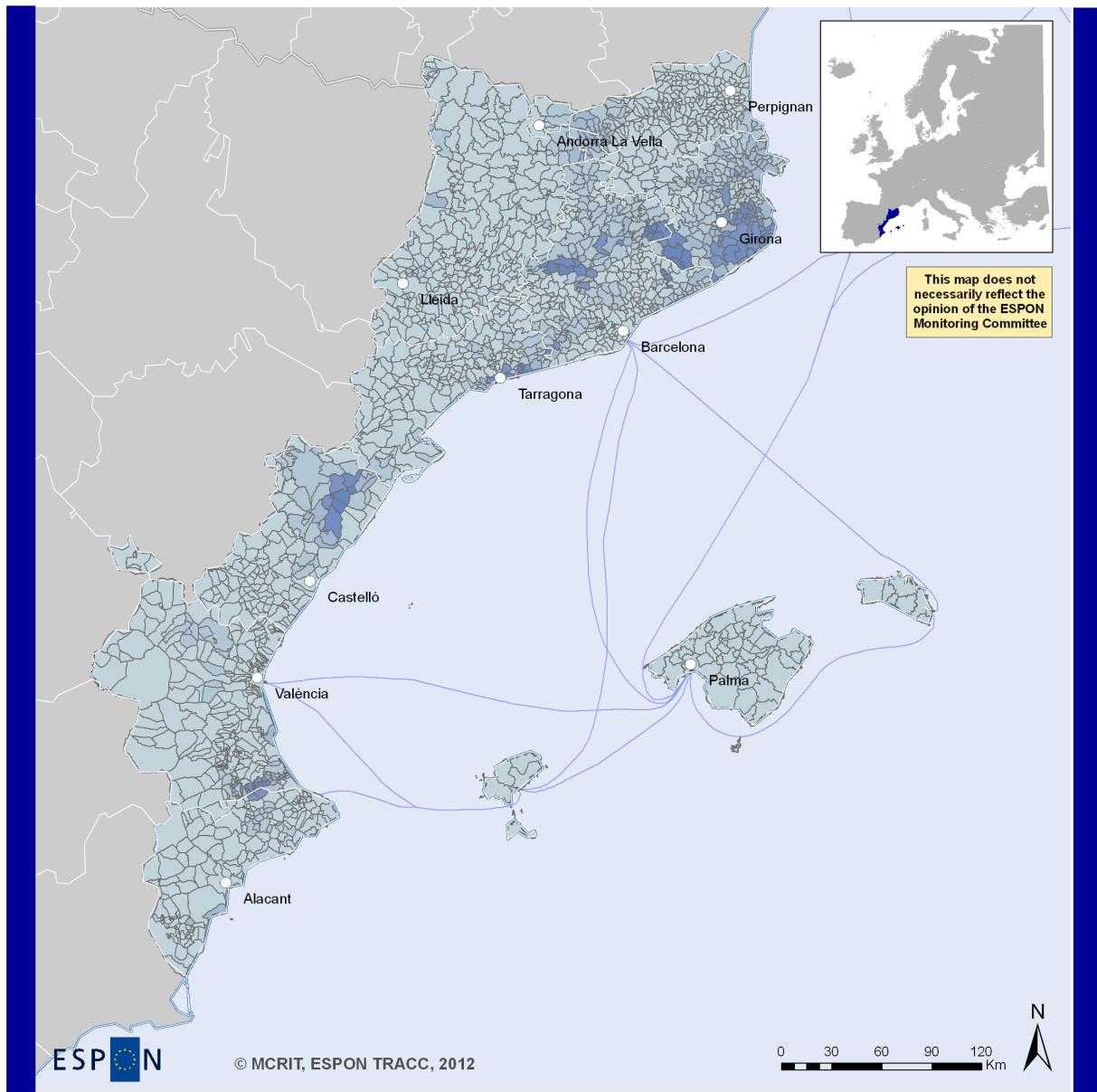


Figure 47. Relative increase of potential accessibility to population by public transport with TEN-T projects



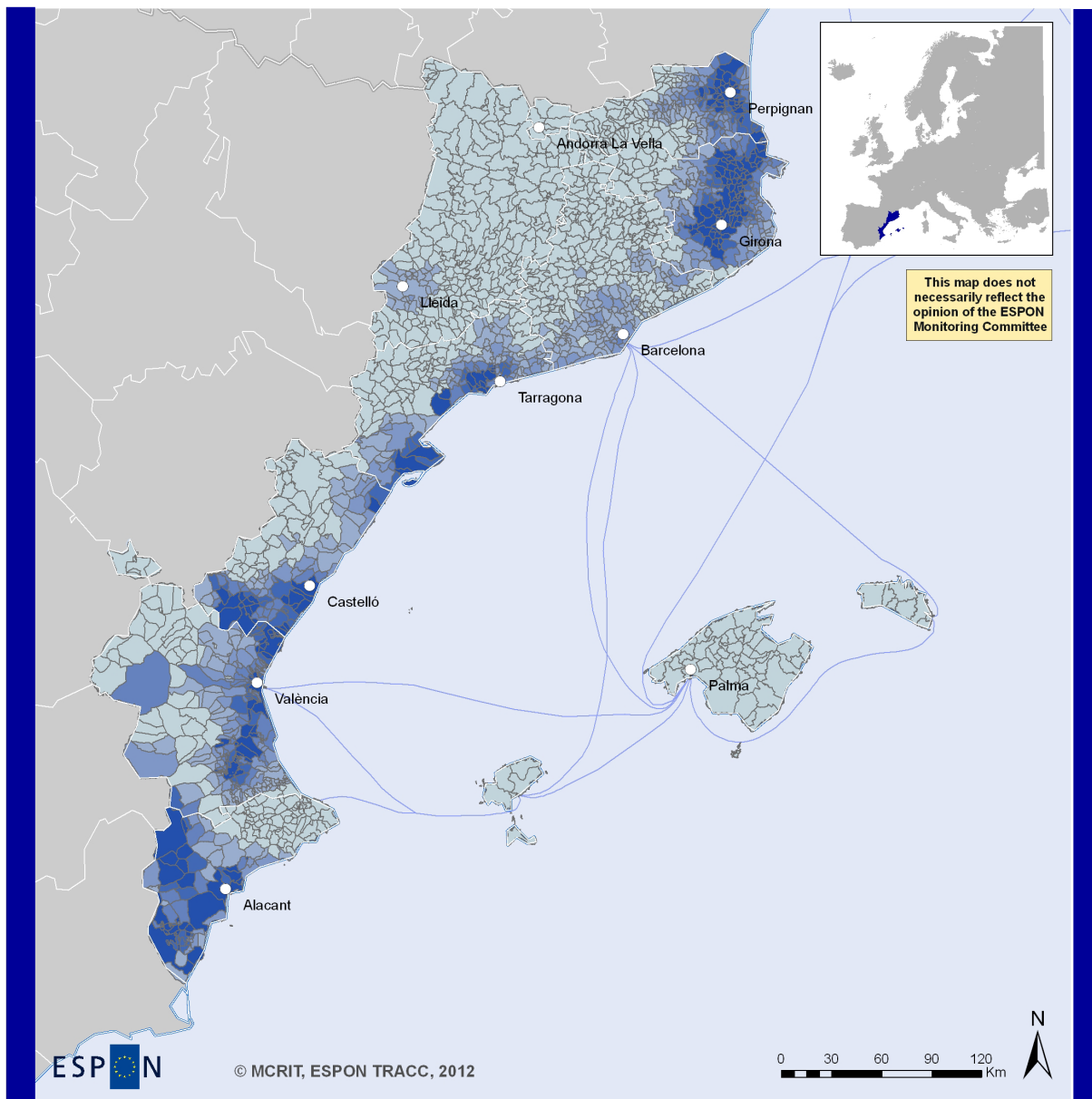
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**West Mediterranean Regions**  
**Potential accessibility to population by car (absolute change)**  
**(standardised on road average 2010)**



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



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**West Mediterranean Regions**  
**Potential accessibility to population by public transport (absolute change)**  
**(standardised on public transport average 2010)**

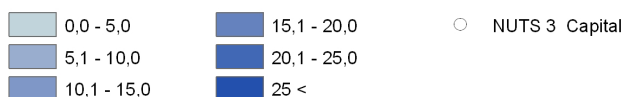


Figure 49. Absolute increase of potential accessibility to population by public transport with TEN-T projects



## 6 Conclusions

The accessibility patterns in West Mediterranean region follow approximately the geographic constraints of the region, which being a narrow coastal corridor for most of the territory, it concentrates most of the population and activities next to the sea side. The backcountry is substantially less populated, especially in mountain areas; infrastructure endowment is more limited giving place to poorer accessibility patterns in comparison.

In terms of accessibility, the region is dominated by the two big metropolitan agglomerations of Barcelona and Valencia. Most of the maps show that the influence of Barcelona's agglomeration at large reaches approximately all NUTS3 capitals in Catalonia, and in some cases even Perpignan in France. In the south, the metropolitan agglomerations of Valencia and Alacant tend to merge one with each other in most of the cases, despite the fact that abrupt topography in the areas in between both agglomerations provides locally some areas of low accessibilities.

There is a clear difference in terms of accessibility between private car and public transport, the latter performing worse than the former, as expected. In this issue, it is especially relevant the impact of the new high speed rail lines all over the region (planned lines are all included in rail TEN-T), increasing the opportunities of medium cities in between largest agglomerations. These cities may be in position to offering better live standard conditions while allowing for everyday commuting onto main labour markets, but may also be threatened to become mere residential economies due to rising competition by more robust markets.

All over the region, accessibility to public services is more homogenous than accessibility to population and jobs, reflecting the fact that public services are relatively decentralised in the Western Mediterranean regions, being the rations of hospitals or schools per 1000 inhabitants higher in areas with relatively low populations than in largest agglomerations.

The case of the Balearic Islands shows the impact of insularity on accessibility patterns. Each island remains somehow an isolated region, despite the existence of fast ferries linking some of the islands to each other and frequent internal flights.



## Annexes

### Annex 1 References

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### Annex 2 Database

The next table shows the main databases used to compute accessibility indicators in the West Mediterranean region case study:

Transport Networks	Socioeconomic data
<p><i>Contents:</i> Networks for 2011 for road, rail, ferries, airports and seaports. Foreseen infrastructure networks with 2030 time horizon according to TEN-T.</p> <p><i>Source:</i> TRANS-TOOLS database, updated with interconnecting links between transport networks.</p> <p><i>Data format:</i> ArcGIS shapefile, Bridges</p>	<p><i>Contents:</i></p> <ul style="list-style-type: none"> <li>- Population by LAU2, 2011</li> <li>- Number of jobs by LAU2, 2011</li> <li>- Number of hospitals by LAU2, 2011</li> <li>- Number of secondary schools by LAU2, 2011</li> <li>- Number of medicine practitioners by LAU2, 2011</li> </ul> <p><i>Sources:</i></p> <ul style="list-style-type: none"> <li>- Population: INE (Spain), INSEE (France), Statistics Department of Andorra</li> <li>- Labour market: INSS (Spain), INSEE (France), Statistics Department of Andorra</li> <li>- Hospitals database: Ministerio de Sanidad (Spain), Agence Régionale de Santé du Languedoc-Roussillon (France), Govern d'Andorra</li> <li>- Schools: Generalitat de Catalunya, Generalitat Valenciana and Govern de les Illes Balears (Spain), Conseil Général Pyrénées Orientales (France), Govern d'Andorra</li> <li>- Physicians database: estimated based on INE, INSEE and Eurostat ratios per 1000 inh.</li> </ul> <p><i>Data format:</i> MSAccess, Excel</p>

### **Annex 3 Accessibility model used**

The accessibility model used to compute travel times and costs for the accessibility indicators is a network model developed by MCRIT in C++ on the BRIDGES platform. The model allows for the assignment of Origin-Destination matrices at the LAU2 level of detail for both road and rail.

Bridges was developed within the Strategic Transport element of the 4th Framework Programme, between 1997 and 1999. The main goal of developing BRIDGES software technology was to empower policy-makers - in particular those responsible for European transport policies - with friendly and productive access to advanced decision-making tools, such as transport models and harmonised databases. BRIDGES research was defined in the context of the ideal user requirements for a European Transport policy Information System (ETIS) and the problems and opportunities presented by already existing or expected software applications, data formats and transport strategic models needed to fulfil the user requirements of an ideal ETIS.

Transport supply is modelled by means of the road and rail networks introduced in Annex 2. The key attributes of network links are speed. For the rail network, speed does not reflect only the physical features of the link but also the commercial speed of services operating (i.e. speed takes into account the train timetable).

The model does not take into consideration the effects of road congestion, which is only relevant for some indicators referring to trips happening mostly during peak hours (e.g. accessibility to schools) and in some areas of the case study (e.g. Barcelona and Valencia metropolitan areas).

Each LAU2 zone is represented by a centroid connected to the road and when available to the rail networks. The route between each zone pair is computed with an assignment algorithm based on shortest generalised cost paths. The model assumes for this analysis a unique value of travel time.

The model is used to estimate accessibility for car and for public transport. As detailed schedules and routes are not available for bus services in the whole of the case study region (services are provided in Spain by multiple private operators and no centralised record of all of them is available), bus services have been simulated by introducing reduced speeds on the road network leading towards closest rail stations. These reduced speeds take into account the average commercial speed of bus services in the West Mediterranean region, as well as average frequency for these services.

[www.espon.eu](http://www.espon.eu)

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