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Mapping Small and Medium Sized Town in Europe: Classifications, Spatial Trends and Ontological Issues

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Mapping Small and Medium Sized Town in Europe: Classifications, Spatial Trends and Ontological Issues

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Abstract

This paper presents the various analytical steps and methods which have led to the creation of a geodatabase of urban settlements in Europe based on the integration of contiguous 1x1 square km. grid cells with specific population thresholds, and the delimitation and classification of those among them that are considered 'small and medium-sized towns' (SMST) in coherence with the standard classification already produced by organisms such as DG Regio and OECD. This exercise has been one of the key analytical dimension of the ESPON 2013 project 'TOWN' on the role and performance of small and medium sized towns , and is meant to define and organise what is 'urban' – and what, in this context, is a small and medium sized town.

However functional to subsequent tasks, this geomatic exercise is per se a relevant legacy of this project: from a methodological point of view, because it contributes towards the generation of a geodatabase at the finest spatial scale beyond the limitations of unevenness in scale, nomenclature, and political status, which is known to affect spatial analysis carried out at the 'traditional' administrative levels of NUTS2/3 or even LAU2. From a scientific point of view, because it provides a first impression of territorial structures of urbanisation throughout Europe, at different scales: the pan-European, illustrating the diversity of the European space in terms of the prevailing settlement types and their territorial distribution; the regional, especially in relation to urban and metropolitan systems, their compactness and nuclear form; and the local, which looks at the inner structure of urban settlements.

This paper will focus especially on such scientific results. It will present different typologies of Small and medium-sized town which challenge established notions (from an administrative and an employment-based perspective) of what in fact *is* a town, and will attempt at a synthesis between these perspectives based on the degree of matching between morphologically defined towns and other 'urban nomenclatures' in a number of case studies, carried out within the TOWN project.

Keywords

Urban areas, geomatic methods, urbanisation morphology, ESPON

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1. Introduction

This paper provides scientific and methodological details on the development of the basic throughput of the ESPON 'TOWN' project¹, that is the identification of urban settlements in the ESPON space (the 27 EU member countries at 2012, plus four partner countries) according to a morphological approach, and the delimitation and classification of those among them that are considered small and medium-sized towns (SMST) as according to the terms of reference and conceptual framework of that project. It then sets on to explore several dimensions of the geo-base so obtained.

Thus the paper addresses two main fundamental theoretical and empirical problems which have been central to the development of the TOWN project: first, the proper geographic identification of urban settlements; and second, the specification of a set of criteria for the classification of urban types and their analysis, bringing to the fore the specific status of small and medium-sized towns. While the former is generally dealt with through geomatic methods (Guerois et al., 2012), the latter has been mostly addressed through the identification of meaningful thresholds of population within a predefined jurisdictional unit (Bloom et al., 2010; Montgomery, 2010). Critiques of such purely population-based approach can be traced back to the work of Wirth (1969, quoted by Brenner and Schmid, 2013), whose theory of urbanism paid attention to the role of urbanisation in intensifying interspatial interdependencies and reorganising territorial organisation. Another important critique of this approach identified by Brenner and Schmid (ibid) refers to the univocal distinction between urban and rural areas. The reduction of territorial complexity to an urban-rural dichotomy leaves the rural territory as residual with respect to the urban dimension without any further meaningful connotation. Yet, in an increasingly globalised context, 'many rural areas have as many links to distant regions across Europe or the rest of the world as they do to adjacent urban areas.' (Copus et al., 2011: 11). This implies that the complex relationships between activities and socio-spatial organisation, the labour structure and economic bonds should be part of the interpretative process of understanding the urban phenomenon and its territorial complexity.

The adoption in this paper of a population-based, 'territorialist' method to identify urban areas has been a pragmatic choice determined by the necessity to dispose of a first broad outlook of the dimension of the small-sized urban phenomena across Europe. At the same time, though, the TOWN project has developed its analysis of urban areas further and in full acknowledgement of such critical voices, for instance addressing the issue of functional roles played by small and medium-sized towns within their urban systems. As a rejoinder of the pure territorialist approach with the wider project ambitions, the method developed and illustrated in this paper has overcome the limitation of data inaccuracy due to different national and regional statistical units and procedures, drawing on a methodology elaborated by the joint initiative of OECD and the EU (Directorate for Urban and Regional Policy). In this sense, we refer throughout the paper to a 'morphological' approach to the identification and mapping of urban settlements.

However functional to subsequent tasks, this geomatic exercise is per se a relevant legacy of this project: from a methodological point of view, because it contributes towards the

¹ The TOWN project, a collaborative research project funded by the ESPON 2013 programme, has investigated the status, role and potentials and barriers for development of small and medium-sized towns in their functional territorial context, and provided insights for a new urban and regional strategy focusing on this type of urban settlements as an instrument for achieving the EU policy objective of territorial cohesion. In this sense, the project has filled the gap left by more traditional approaches in which larger metropolitan areas have been situated at the centre of the research (and political) agenda.

creation of a geo-database at the finest spatial scale beyond the limitations of unevenness in scale, nomenclature, and political status, which is known to affect spatial analysis carried out at the 'traditional' administrative levels of NUTS2/3 or LAU2. From a scientific point of view, because it provides a first impression of territorial structures of urbanisation throughout Europe, at different scales: the pan-European, illustrating the diversity of the European space in terms of the prevailing settlement types and their territorial distribution; the regional, especially in relation to urban and metropolitan systems, their compactness and nuclear form; and the local, which looks at the inner structure of urban settlements.

This material is so organised. Section 2 informs about the process and criteria followed to obtain a geo-base of urban settlements through aggregation of spatial grids of 1 sq.km. covering the ESPON space into polygons. Section 3 introduces one basic and two advanced typologies of urban settlements and classifies the urban polygons accordingly. It then provides details of the geographical structures so obtained. Section 4 analyses comparatively territorial performances with a comparative analysis of the NUTS3 regions fitting the urbanisation type identified above, and Section 5 concludes.

2. Points of entry and delimitation procedure of SMST

The first fundamental step in the definition of urban settlements from a morphological point of view has been the conceptualisation of the distinction between the built-up and open-space areas. In general, an urban settlement is considered to be an area in which buildings are not too sparse and contain a concentration of population that creates the sense of an urban agglomeration. From this perspective, two parameters are most commonly used: first, the distance between buildings must be inferior to a given threshold; second, the total population of the built-up area must exceed a certain level.

While the use of these parameters is commonly accepted in official definitions, there are significant differences between thresholds applied in each country. The United Nations recommends that for the identification of urban areas, a threshold of 200 metres as the maximum distance between houses should be used (Le Gléau et al., 1997), although in some European countries the official criteria shift this threshold from 50 metres, as in the cases of the UK and Norway, to 250 m as in Belgium. In addition, there are different interpretations for areas used for public, commercial and industrial purposes (Le Gléau et al., 1997).

For the second parameter, the continuous built-up area can only be considered 'urban' if its aggregated population exceeds a certain threshold that also varies among different countries (e.g. 200 inhabitants in Belgium and the Nordic Countries), but can also have forms of approximation (e.g. 50 occupied dwellings is the threshold adopted in Ireland). Besides, when built up areas approximate administrative or statistical boundaries, the criterion adopted for the identification of the urban settlement is population density (as for instance in the Netherlands, which considers a threshold of 1.000 inhabitants per sq. km).

The method used to build a geo-database of small and medium towns as well as other urban settlements properties in the TOWN project has, of necessity, been constrained by data availability and harmonisation. It thus followed the procedure implemented by the EC Directorate for urban and Regional Policy in the document 'The New Degree of Urbanisation' (DEGURBA) (Dijkstra and Poelman, 2014), which uses as a spatial base unit a database of more than 2,000,000 grid cells of 1 km² produced by GEOSTAT and the associated population data in year 2006. This methodology allows a greater accuracy of population estimation than others also employed by European Union agencies (Gallego and Peedell, 2001), and minimises the problem related to the pycnophylactic interpolation (Tobler, 1979), common in dasymetric mapping.

Elaborating data on population size and density in contiguous cells according to a method approved by the Eurostat Labour Market Working Group in 2011, the DEGURBA document has identified a number of urban settlement structures classified into three 'degrees of urbanization', in a similar way that OECD (using the same geodatabase) has classified urban areas in its recent 'Redefining urban areas in OECD countries' report (OECD 2012):

- High-density urban clusters: settlements formed by a continuous agglomeration of grid cells of 1 km² with a population density of at least 1,500 inhabitants per km² and a minimum population of 50,000.
- Urban clusters: clusters of contiguous grid cells of 1 km² with a density of at least 300 inhabitants per km² and a minimum population of 5,000.
- Rural grid cells: grid cells outside urban clusters

On the basis of this classification, the DEGURBA document has generated a three-way classification of LAU2s as follows:

- (1) Densely populated area: (alternate name: cities or large urban area): At least 50% lives in high-density clusters.
- (2) Intermediate density area (alternate name: towns and suburbs or small urban area): Less than 50% of the population lives in rural grid cells and Less than 50% lives in a high-density cluster.
- (3) Thinly populated area (alternate name: rural area): More than 50% of the population lives in rural grid cells.

DEGURBA also looked into the inner structure of urban settlements, distinguishing 'cores' from 'peripheries' and sprawling urbanised areas around the cores within municipal delimitations. The approach of DEGURBA, as well as its validation procedures (p.8 and following), has been mainly focusing on the structure of urbanisation for the larger European urban areas identified by cores that are 'High Density Urban Clusters'. It did not develop the same methodology at the lower urban scale in terms of less dense urban clusters, which is the focus of the TOWN project. In the TOWN project, Small and Medium Towns (SMST) have been identified according to a differential approach with respect to the DEGURBA document: hence, urban settlements which are neither 'High-density urban clusters', nor 'Rural grid cells' according to Dijkstra and Poelman's classification. The following procedure has been implemented in order to identify urban clusters and SMST within them:

- a) Selection of contiguous cells of at least 300 inh./km²;
- b) Creation of polygons by aggregation of the selected grid cells.²

² The procedure might have included the following additional geomatic manipulations carried out in the DEGURBA document:

- contiguity at diagonal level could be considered; in this case, a larger number of grid cells could fall within urban areas and so larger polygons could be created
- empty gaps inside the polygons could be filled; they may identify empty spaces which nevertheless represents element of urban continuity (a lake, a large park, etc.), and including them in the polygons that surround them would seem appropriate, but from a merely geo-statistical point of view it is better at this stage to leave them out.

The TOWN project did not eventually carry out these manipulations, having considered that they would have extended the dimension and complicated the morphology of urban area units beyond the analytic needs of the TOWN project; besides, it has been considered that at the relatively smaller scale of SMST settlements, including 'gaps' could lead to a misrepresentation of their morphology.

- c) From the resulting polygons, High-Density Urban Clusters (i.e., polygons having at least 1,500 inh./km² and a population size of more than 50,000) and other urban settlements (thus with a density of less than 300 inh./km² and a population of less than 5,000) have been separated out.
- d) the remaining polygons, fitting the condition of a population size between 1,500 and 50,000 inhabitants (whatever their population density, provided it is greater than 300 inh./km²) OR a density between 300 and 1,500 km² (whatever their population size provided it is greater than 1,500) are identified as SMST.

Thus, our first basic morphological classification defines SMST as continuous urban clusters with a population above 5,000 and a density above 300 inh. per square kilometre that are not 'High Density Urban Clusters' (HDUC) as according to the DEGURBA definition; therefore, these include:

- a. Polygons with a total density (average density of all cells included) between 300 and 1,500 inh./kmq and a population between 5,000 and 50,000 inhabitants;
- b. Polygons with a total density of more than 1,500 inh./kmq but a total population of less than 50,000
- c. Polygons with a total population of more than 50,000 but a total density of less than 1,500 inh./kmq.

By elimination, we then identify another class of urban areas that are smaller than SMST. Our basic classification of urban settlements (TOWN Typology 1) thus includes also those settlements that are characterised by a population density superior to 300 inh. per square km but a population lower than 5,000 and therefore insufficient to be considered SMST, hence classified as 'Very Small Towns' (VST).

The remaining urban phenomena are defined, by exclusion, as 'other settlement types' and include unpopulated areas, sprawling urbanisations, or settlements that are too sparsely populated to be even considered VST. Figure 1 illustrates this classification, with nomenclatures and colours corresponding to the maps that will be introduced below.

Figure 1 - Basic urban settlements typology

		DENSITY (inh. / kmq)		
		≤ 300	> 300 and ≤ 1500	> 1500
POPULATION (inh.)	≤ 5000	OTHER SETTLEMENTS	VST (Very Small Towns)	
	> 5000 and ≤ 50000		SMST (Small and Medium-Sized Towns)	
	> 50000		HDUC (High-density Urban Clusters)	

A first simple run of this procedure of geomatic manipulation of the grid-based dataset provided by Geostat and the classification of the resulting polygons, yielded the following structure:

- 8,350 urban settlements classified as SMST;

- 846 urban settlements classified as HDUC;
- 70,480 urban settlements classified as VST.

However, other intermediate steps have been necessary in order to obtain a sufficiently accurate representation of the morphological settlement structures in the European space. The main issue has been the revision of the geomatic procedure, which inevitably was likely to lead to a number of ‘errors’ in the coherent delimitation of urban areas. Such errors depended to the ill capacity of grid surfaces, albeit at the 1km² scale, to capture every type of continuity or gaps of the urban fabric, and are inherent to any grid-based analysis (De Mers, 2009). Areas that appear separated may be so ‘by accident’ mostly because of the imperfect superimposition of the grid geography with natural features; or, conversely, elements that the mere geomatic procedure has bundled together in one urban settlement, are in fact different ‘entities’ – for example, if separated by a watercourse, a national border, or other elements of discontinuity not captured at the 1km² scale – that should be kept separated for analytic purposes. A number of other ‘accidents’ of this type may occur, and systematic detection and revision – which could be carried out, for instance, in the DEGURBA project because of the relatively limited number of high density urban clusters involved – becomes problematic in this project that deals with more than 79,000 urban settlements.

Thus, the project has revised the original procedure in 10 case study areas included in the TOWN project³, where the precision of this geography was critical to the accuracy of the analysis and thus the soundness of the scientific results from this project. In these areas, the morphological structure has been carefully and systematically revised on the basis of local knowledge, leading to the re-configuration and re-classification of urban settlements.⁴

After implementing the ‘acceptable’ revisions as illustrated above and integrated the database with the spatial information in Cyprus, the procedure of classification of urban settlement polygons was repeated, yielding the following results:

- **8,414** urban settlements classified as **SMST**;
- **850** urban settlements classified as **HDUC**;
- **69,043** urban settlements classified as **VST**.

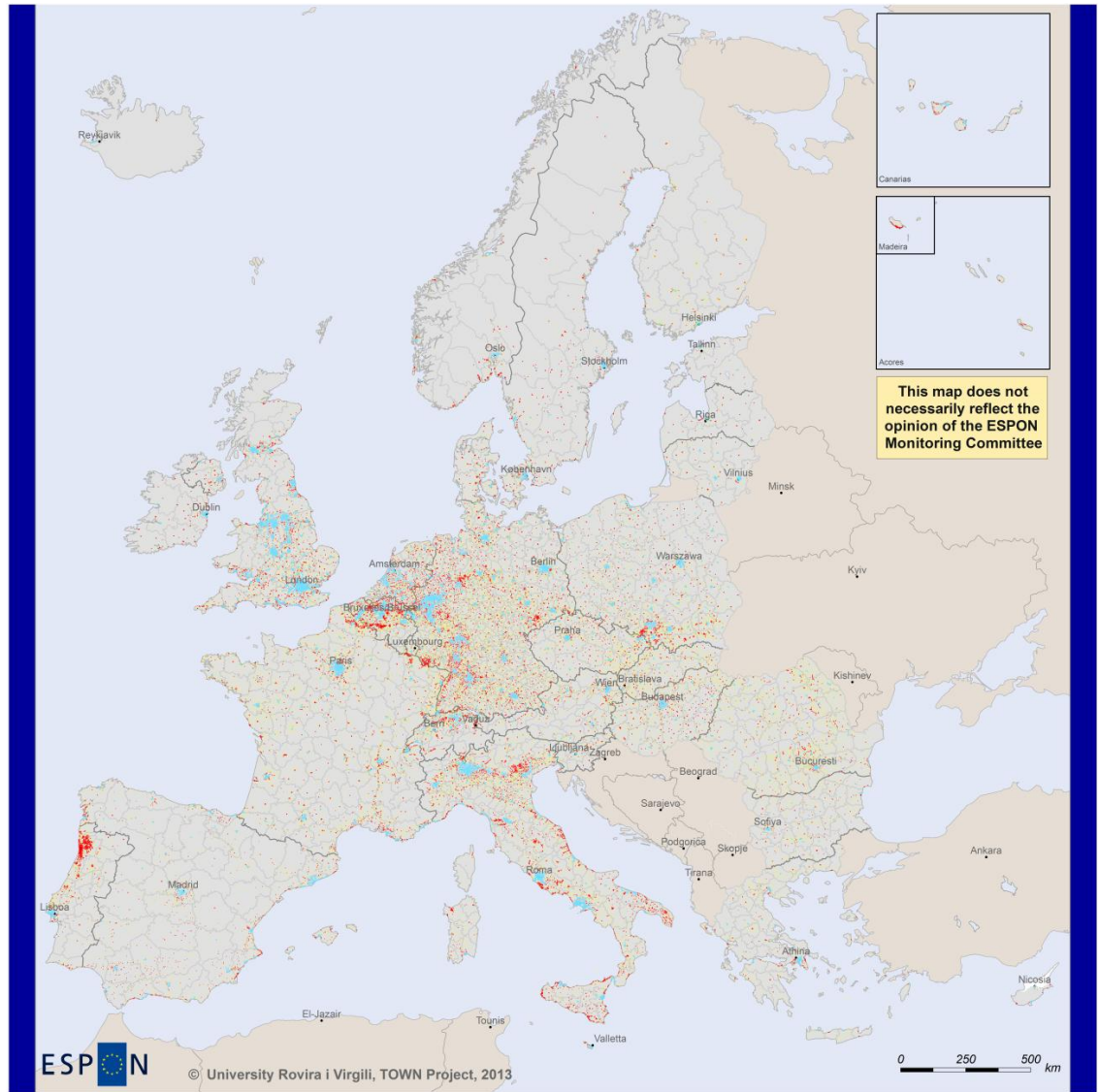
In Figure 2, SMST are mapped out as red polygons, together with the HDUC in light blue and VST in yellow. At a first glance, SMST can barely be distinguished within the wider scale of the ESPON space. In order to achieve a better visualisation of macro-trends, Figure 3 ‘zooms in’ on the pentagon area, which is the one that presents a higher complexity of morphological urban clusters. This map reveals a richness of SMST on a sector that goes

³ These were three individual countries and (mostly) NUTS1 regions in seven other different EU member countries, which have been the object of close scrutiny and analysis by TOWN partners and subcontractors: the region of Flanders in Belgium, the Czech Republic, the region of Catalonia in Spain, the Central Region of France, the region of Piedmont in Italy, the region of Mazovia in Poland, Northern Sweden, Slovenia, Wales, and Cyprus.

⁴ A second issue had to do with the fact that the source geodata did not include raster data on Cyprus’ population. In order to include the Cyprus ESPON space in our analysis, some further operations needed to be carried out, combining data from the CORINE land-cover map (version 16 [04/2012], including data from 2006) and the Cyprus demographic census (2011) at zip-code level. This methodology yielded the geomatic identification of 3 HDUC, 2 SMST and 6 VST in the Cyprus ESPON territory. In order to verify the goodness of this approach, an expert opinion was asked to the subcontracted Cyprus case study team. Following their advice, some arrangements on the number and shape of final delimitations were made, establishing 3 HDUC, 10 SMST and 1 VST.

from the south of England throughout the Benelux and the West of Germany to Italy, with other ‘clusters’ in the industrial belt of South-Eastern Germany and Poland, and along the whole Western Mediterranean arc from Spain to Italy; moreover it illustrates the relative sparseness of SMST in the interior of France, north-eastern Spain, the Alpine arc, and the eastern side of the pentagon area.

Figure 2 - Basic TOWN typology of urban settlements



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		DENSITY (inh. / kmq)		
		≤ 300	> 300 and ≤ 1500	> 1500
POPULATION (inh.)	≤ 5000	OTHER SETTLEMENTS	VST (Very Small Towns)	
	> 5000 and ≤ 50000		SMST (Small and Medium-Sized Towns)	
	> 50000		HDUC (High-density Urban Clusters)	

NO DATA

Regional level: NUTS 3 and 1 kmq grid cells
Source: Own elaboration on GEOSTAT data
Origin of data: DG Regio
Authors: F. Brandajs, A.P. Russo, D. Serrano Giné
© EuroGeographics Association for administrative boundaries
Overseas territories not shown on map because of missing cover in GEOSTAT grid database

This classification includes among SMST urban areas which would not normally be considered 'medium-sized' towns, as is the case of large sprawling conurbations in north-eastern Italy, Belgium, and the German-French border which can be easily spotted in the map of Figure 3. In part, this is the result of the method deployed, which does not allow for 'separations' within continuously built-up settlements, and it is problematic due to the fact that in most of the subsequent streams of analysis carried out in the TOWN project very large urban areas are pooled together with smaller and compacter settlements (and particularly so where the morphology of such areas is complex, as in the ribbon-shaped configuration of many Belgian and German settlements). Yet it does make some sense from the point of view of the 'morphological' interpretation, because this continuity also produces a certain commonness of urban issues and performances throughout these areas. This problem anyway has been dealt with through classifications of SMST (see next section), which single out specific 'dimensions' of SMST, and in subsequent analytic stages of the TOWN project as the functional classification of urban centres.

Figure 3 - Basic TOWN typology of urban settlements, pentagon-area zoom-in

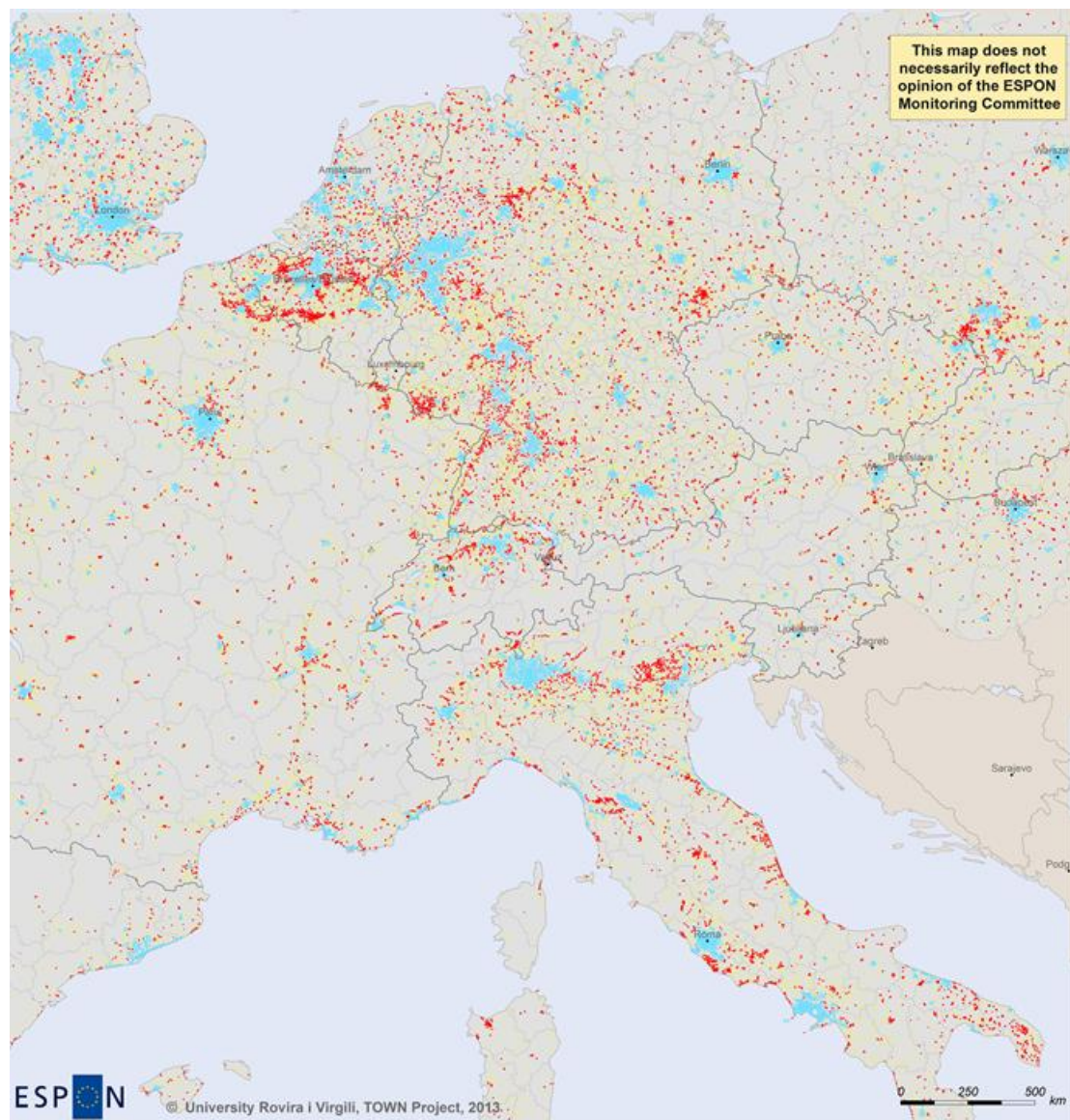


Table 1 offers some key descriptors of the polygon classes in Typology 1. At country level, we can distinguish three main types of national urban settlement structures:

- Countries with a neat prevalence of urbanised population, clustered in high-density urban centres, as Belgium, Switzerland, Greece, the Netherlands, Spain, the UK, as well as smaller island states as Iceland and Malta;
- Countries with an overrepresentation of population living in smaller settlements, like Finland, France, Ireland, Lithuania, Luxembourg, Norway and Slovakia.
- All other countries have a more balanced repartition of population between classes of high-density urban clusters and small and medium towns.

Table 1 - Typology 1 polygons: key statistics

Classes	Delimitation criteria	Count	Av. Pop	Av. Sq.km	Av. Density
High-density Urban Clusters (HDUC)	Pop. > 50,000, AND Pop. Density > 1,500 inh/km ²	850	275,476.1	92.3	2,927.1
Small and Medium-sized Towns (SMST)	Pop. > 5,000 AND Pop. Density > 300 inh/km ²	8,414	14,553.7	10.1	1,535.9
Very Small Towns (VST)	Pop. < 5,000 AND Pop. Density > 300 inh./km ²	69,043	1,193.1	1.7	699.3

To conclude this section, we stress that the method of obtaining a delimitation and classification of urban settlements, involving a sequence of elaborations on the original grid-based database and further manipulations as illustrated above, is not without limitations. We can point to three orders of problems in this sense.

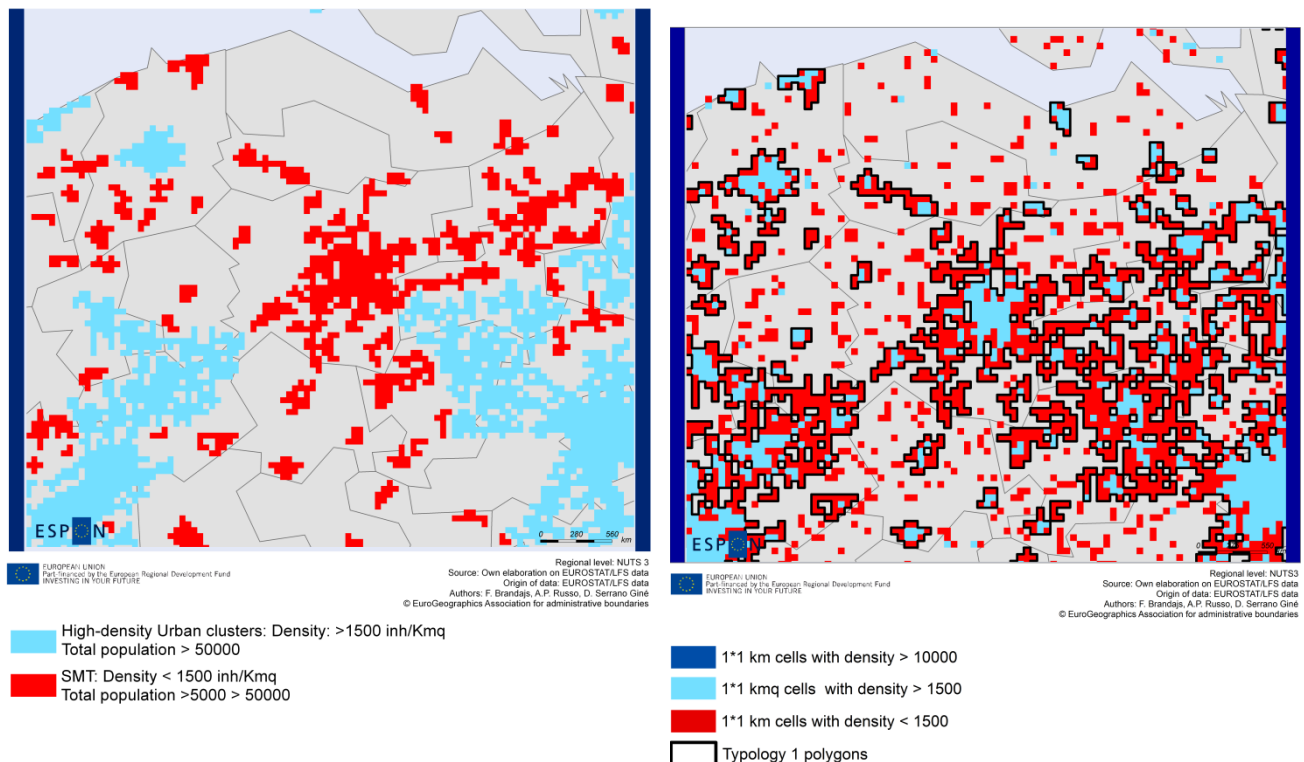
Firstly, the method employed to create SMST polygons by aggregation of contiguous grid cells that are *all* superior to 300 inh./kmq, produces aggregate SMST densities that are in general well above the 300 inh./kmq threshold. A more sophisticated method that generates clusters of contiguous grid cells whose *aggregate* density is superior to the 300 inh./kmq threshold would return different results, specifically it would extend the number and morphology of urban settlements to include lower density grid cells generally at the fringes of urban areas. However, its application would be technically complex and subject to a certain degree of discretion in the delimitation of the resulting polygons. Moreover, it would be inconsistent with the method adopted by the EC and OECD, making our respective approaches incomparable.

An opposite problem comes up with the construction of HDUC polygons ‘by elimination’ from the set of polygons created that are to be considered SMST. The method used is substantially different from the one that identifies SMST: in fact, if HDUC were built by aggregation of contiguous cells that were *all* superior to 1,500 inh./kmq, as in the DEGURBA document, some ‘fringe’ areas whose overall density is likely to be lower than 1,500 inh./kmq would have been left out (maybe resulting as SMST or VST ‘attached’ to HDUC). This means that our approach ‘over-represents’ HDUC – there are parts of HDUC polygons which have the characteristics of SMST in terms of their density and population dimensions. From the functional point of view (that we are privileging in our approach, because the main focus of this project is on the ‘role’ of SMST, which is addressed primarily through a functional analysis at urban system level – and not on the shape or role of HDUC, as in the

DEGURBA study) separating these areas would make little sense because they indicate a sort of ‘functional continuity’ that should be taken into account. Yet from a purely morphological one it does create problems in specific contexts of high urban sprawl and dense urbanisations according to a ‘ribbon development’, problems which have only been dealt with in the stages of verification and revision of the geo-database in case study regions. In order to address this issue, and further fine-tune the morphological identification and representation of SMST to the one carried out in the DEGURBA document, we proceed to investigate the inner structure of SMST polygons.

Thus, we have gone back at the grid level to pick those 1km² cells within SMST polygons and classify them by their individual density. In this way we have a grasp of the ‘underlying’ structure of urban polygons. This method allows distinguishing, within one polygon, the existence of a ‘core’ and a ‘fringe’, and even, possibly, of high-density urban nuclei within the core. Clearly, this method does not lend itself to visualisation and representation at the global EU scale; for this reason it is more useful to show a number of examples of the underlying urban settlement structure in the case of ‘exemplary’ SMST polygons.

Figure 4 - Urban agglomeration of Gent, Belgium. (left): SMST and HDUC polygons; (right): grid cells of 1 km², classified in three density ranges

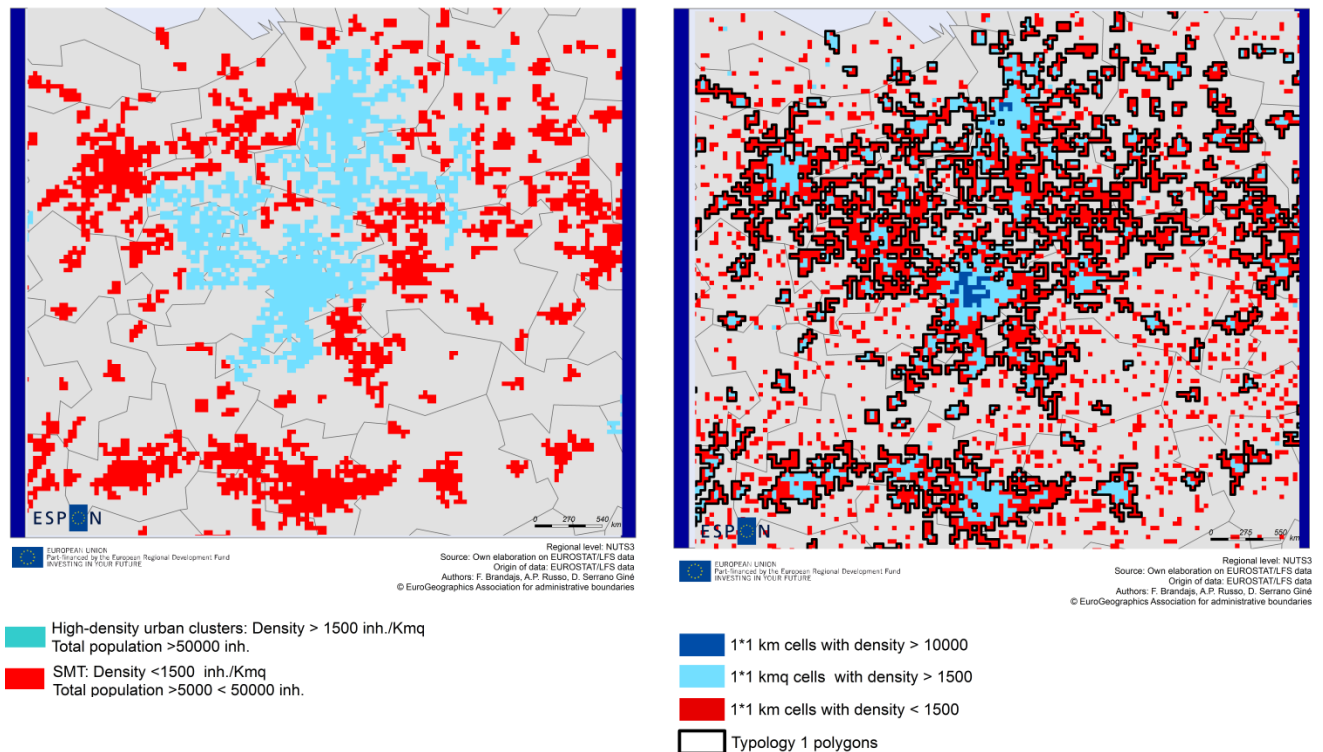


In Figure 4 we have mapped the resulting settlement structure in the urban area of Gent, a municipality of approx. 240,000 inhabitants and a density of 1,550 inh./kmq, which would therefore classify it as a HDUC; yet, because of the sprawling morphological structure at its edges, and of the aggregation method employed, the polygon that includes it sprawls counts 382,425 inhabitants and a density of 1,400 inh./kmq, thus qualifying as a ‘large SMST’ in Typology 3 below (map on the left side) in spite of the existence of a higher density ‘core’ – as can be seen from the map on the right side.

Conversely, the maps in Figure 5 illustrate the situation of the HDUC polygon of Brussels, a HDUC of 1.84 M inhabitants with a global density of 2,225 inh./kmq characterised by a sprawling lower-density ‘ribbon development’ into surrounding areas, especially to the

Flanders territory in the north-west (left side); in the map on the right we can again see that the 'high density core' would exclude the larger parts of these ribbons.

Figure 5 - Urban agglomeration of Brussels, Belgium. (left): SMST and HDUC polygons; (right): grid cells of 1 km², classified in three density ranges



These maps make evident that the focus of this study on SMST produces a delimitation of urban settlements which may differ from that of DEGURBA, as argued in the previous section. In order to pick systematically such internal structures, we have used a common threshold of 1,500 inh./km² to characterise high-density grids within urban settlement polygons and produced a mapping of the overall ESPON space.

Thirdly, the 1x1 km dimension for the original raster database on which the construction of this geo-database is based is relatively 'rough' – small discontinuities in the urban fabric could be significant in the process of 'isolating' urban settlements for the analysis also at distances that are far inferior to 1 km. In fact, our polygons could be compared to the work recently conducted by the M4D project in the creation of a geodatabase of Urban Morphological Zones or UMZ which elaborated Corine based urban cover grids at a much finer definition of 200m grid cells (Guerois at al. 2012).

3. Typologies of SMST

SMST polygons have been further classified, considering different values of population and density of inhabitants.

3.1. Population thresholds

A first enhancement oriented at a better understanding of population settlements introduces the subcategory of 'large SMST' as those SMST that have more than 50,000 inhabitants, though having a total population density below the 1,500 inh./km² threshold of large urban areas. This typology (TOWN Typology 2) subdivides SMST into a class of 8,253 'normal' and 100 'large' SMST polygons across Europe. The latter correspond to a number of

sprawling medium-density regions across Europe. The most evident cases in our geo-database refers to the metropolitan region of Porto (a ribbon shaped metropolitan area of 2.5 million inhabitants, with an overall population density of 1,330 inh./km²), the Saar region and the region of Gent, both above half million inhabitants, and other 29 urban areas of more than a 100,000 inhabitants. A more sophisticated refinement of this SMST typology subdivides them further also including ‘small SMST’ as SMST with a population below 25,000 (TOWN Typology 3). As a result (See Figure 6), we now include among SMST:

- 7,348 small SMST**, with a population density of more than 300 inh./kmq and a population of less than 25,000;
- 966 medium SMST**, with a population density of more than 300 inh./kmq and a population between 25,000 and 50,000,
- 100 large SMST**, with a population density of more than 300 inh./kmq (but smaller than 1,500 inh./kmq) and a population of more than 50,000.

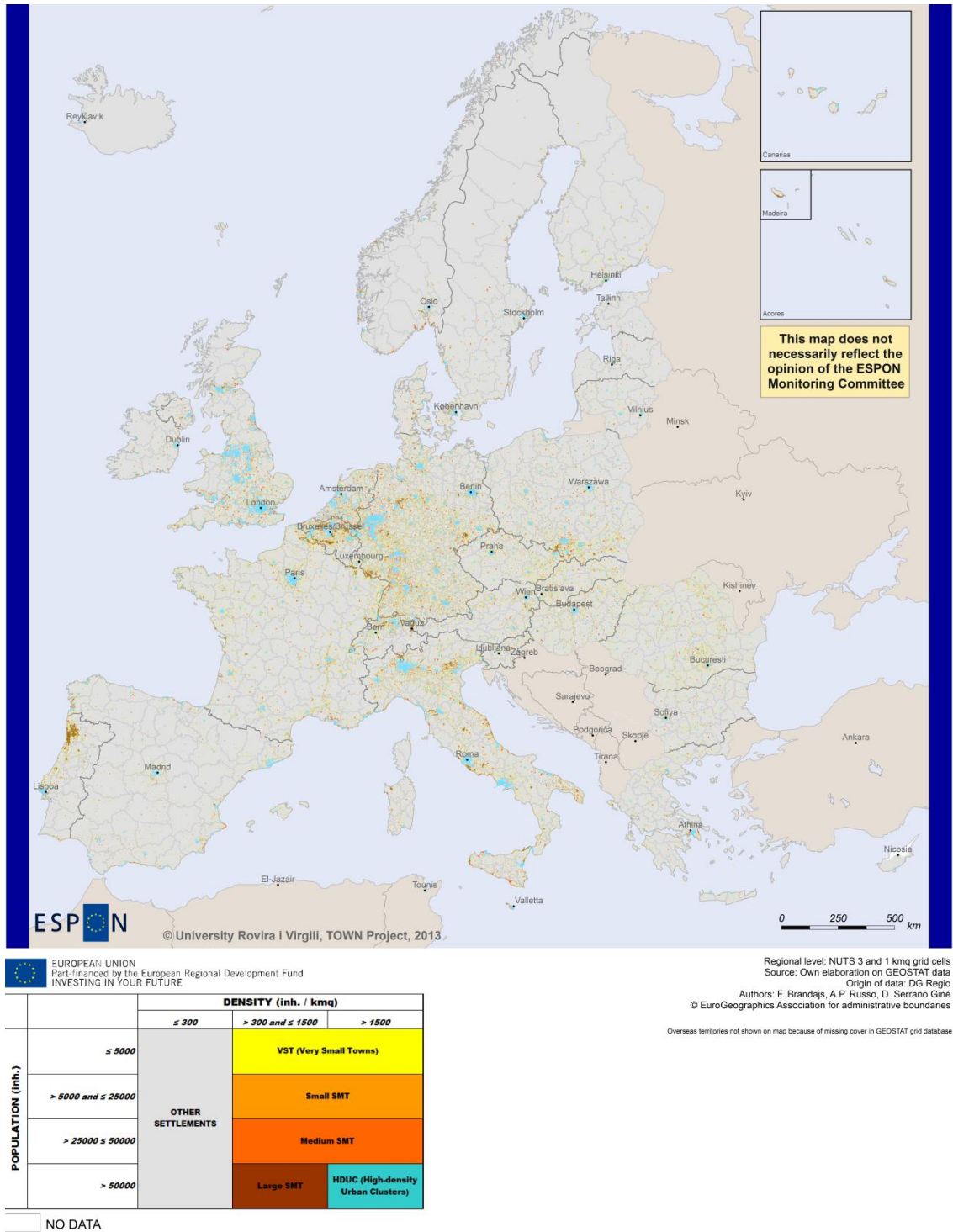
Figure 6. TOWN typology 3 with three SMST classes by population size

		DENSITY (inh. / kmq)		
		≤ 300	> 300 and ≤ 1500	> 1500
POPULATION (inh.)	≤ 5000	OTHER SETTLEMENTS	VST (Very Small Towns)	
	> 5000 and ≤ 25000		Small SMT	
	> 25000 ≤ 50000		Medium SMT	
	> 50000		Large SMT	HDUC (High-density Urban Clusters)

Table 2 - Typology 3 polygons: key statistics

Classes	Delimitation criteria	Count	Av. Pop	Av. Sq.km	Av. Density
High-density Urban Clusters (HDUC)	Pop. > 50,000, AND Pop. Density > 1,500 inh/km2	850	275,476.10	92.3	2,927.10
Small SMST	Pop > 5,000 < 25,000, AND Pop. Density > 300 inh/km2	7348	10,241.50	7.6	1,470.09
Medium SMST	Pop > 25,000 < 50,000, AND Pop. Density > 300 inh/km2	966	35,162.90	19.7	2,060.59
Large SMST	Pop > 50,000, AND Pop. Density > 300 < 1,500 inh/km2	100	132,331.42	101.8	1,299.64
Very Small Towns (VST)	Pop. < 5,000 AND Pop. Density > 300 inh./km2	69,043	1,193.10	1.7	699.3

Figure 7 - TOWN Typology of urban settlements based on 3 population classes (TOWN typology 3)



The corresponding classification is mapped out in Figure 7, while Table 2 provides the key stats of this typology. Large SMSTs are generally sprawling conurbations which in spite of a medium-sized compact city centre or a constellation of smaller centres, do not achieve globally sufficient density to be considered HDUC in the terms of our classification. Among them, the most surprising examples are provided by the Porto metropolitan area in Northern Portugal (2.5 M inhabitants), and setting around a population of half million, the Saar area in Western Germany, many ribbon-shaped intermediate systems at the edge of the Brussels metropolitan region in Flanders and Wallonia, and multi-polar small towns’

system in the western Veneto region. ‘Zoom-in maps’ of Northern Portugal and Western Veneto regions are provided in Figure 8 (a) and (b).

Figure 8 – Zoom-in maps of Typology 3 urban settlements in (a – left side) Northern Portugal (Porto metropolitan region) and (b –right side) Western Veneto (Vicenza and Verona provinces)

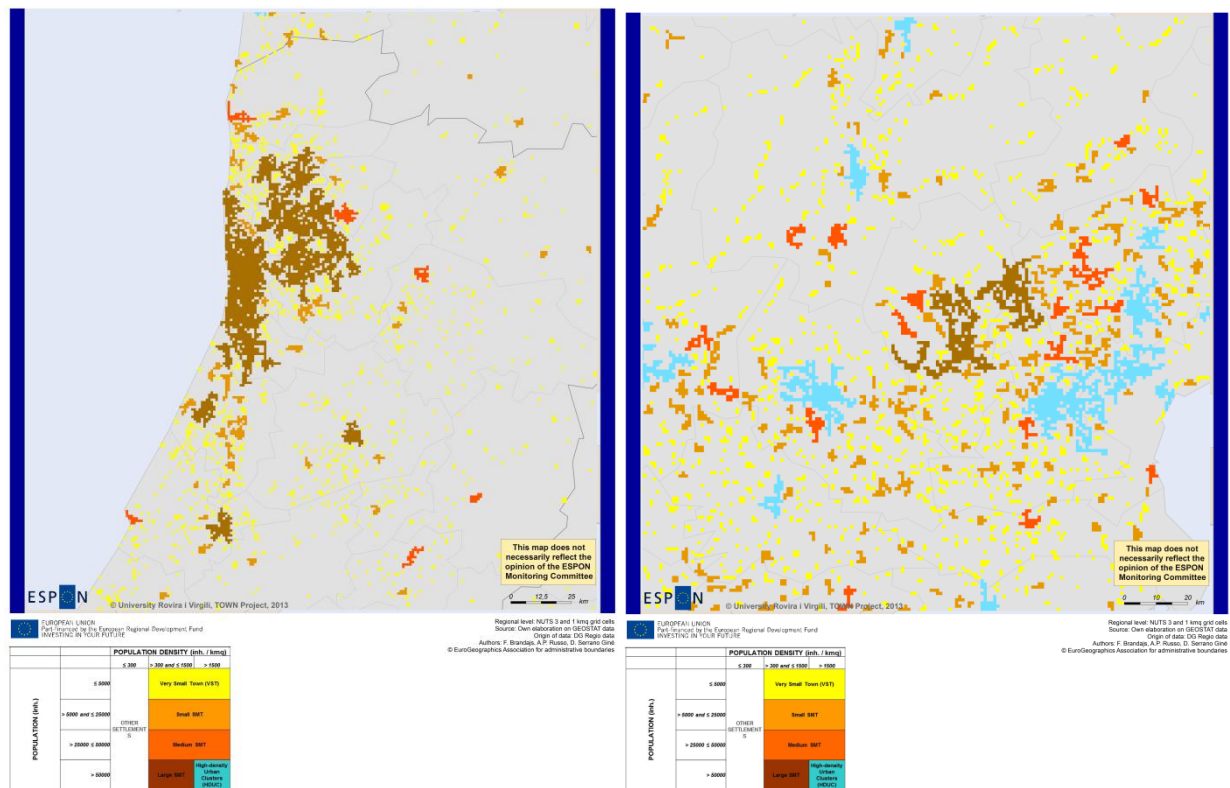
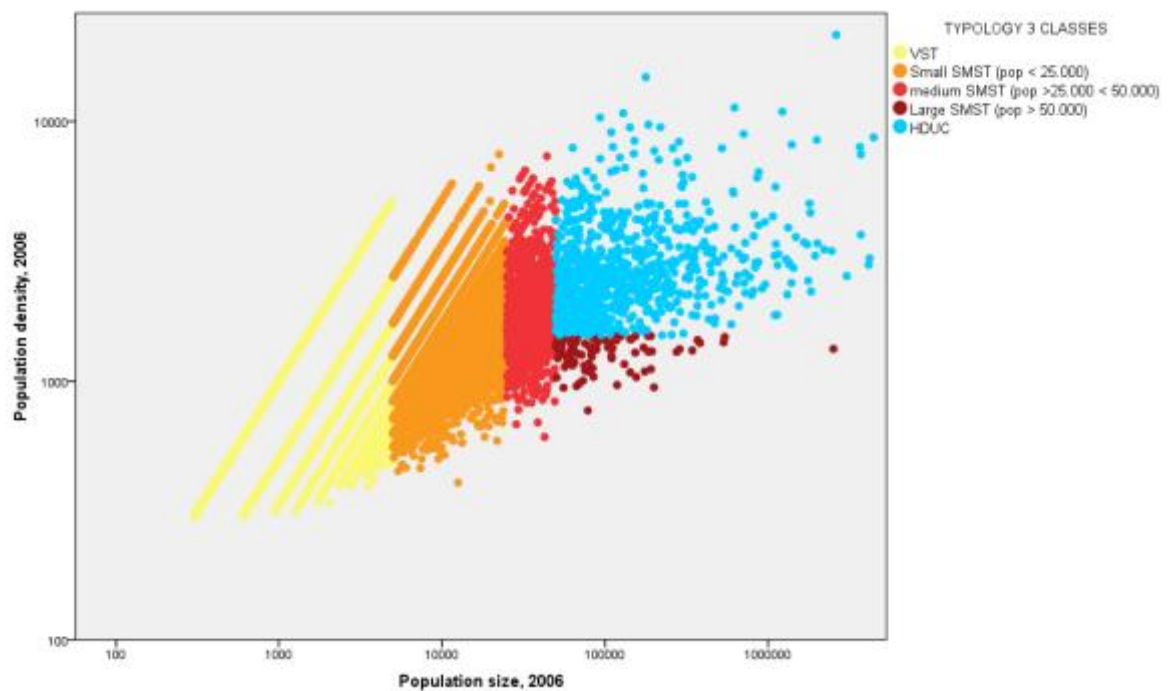


Figure 9 - Cross-plot of populations and densities of SMST in TOWN typology 3



The distribution of the three classes is captured by Figure 9, which cross-plots the various classes in this typology in terms of their population size and density (in logarithmic scales). The ribbon-shaped configuration is due to the discrete nature of surface values which produce discontinuous values of density. This figure shows the relative dimensions and distributions of the various urban settlement classes in this typology along the two defining dimensions. It highlights the relatively large number of small-sized towns (below 25,000 inh.), compared to medium-sized towns above 25,000, and, within which, the ‘anomaly’ of large SMST with a population of more than 50,000 but a density lower than 1,500 inh./km².

3.2. Density thresholds

A second advanced typology of urban settlements, or **TOWN Typology 4** (see Figure 10) introduces an intermediate density threshold of 1,000 inh./kmq and identifies:

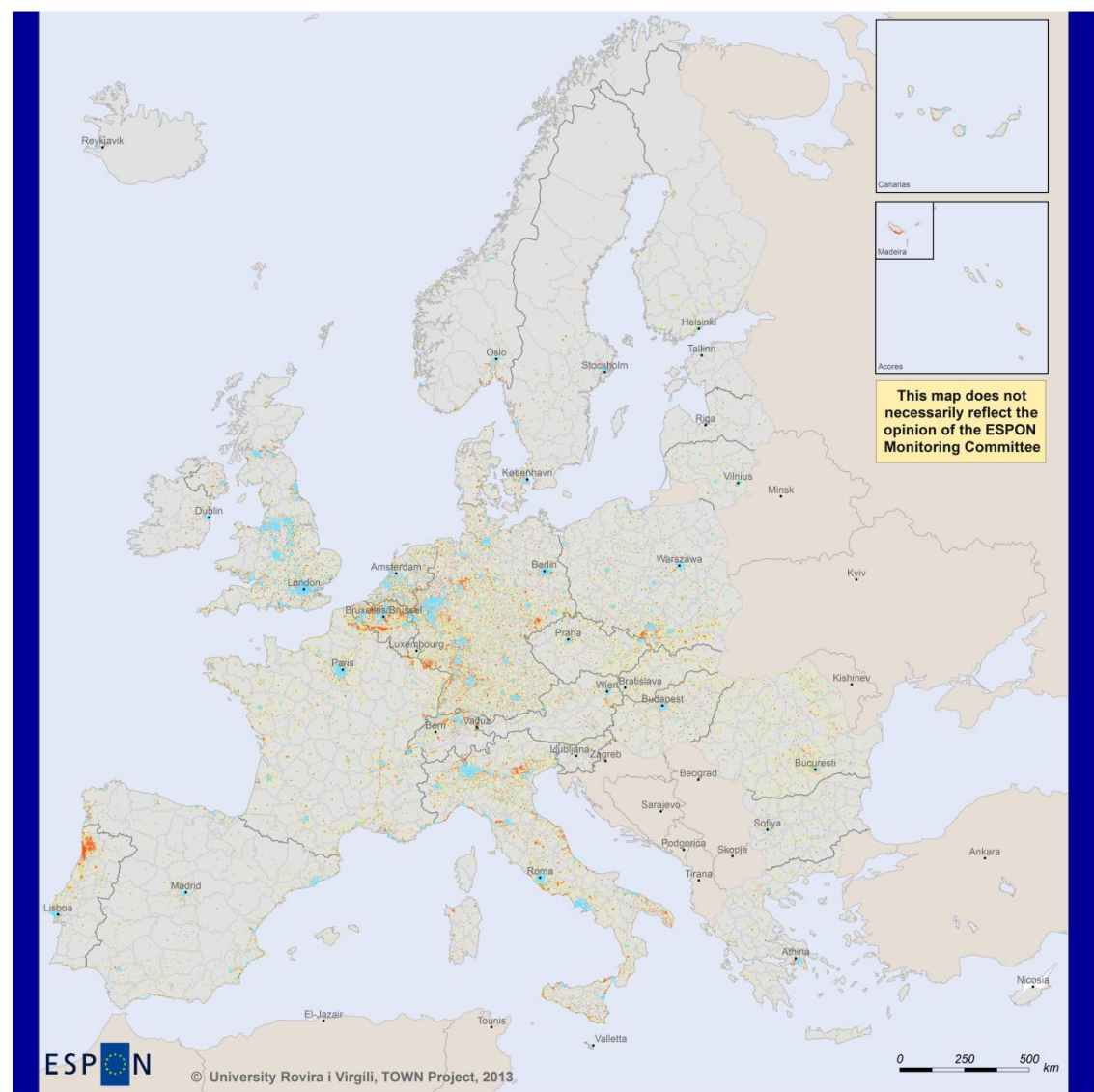
- 1,606 low-density SMST**, with a population of more than 5,000 and a population density between 300 and 1,000 inh./kmq;
- 3,382 medium-density SMST**, with a population of more than 5,000 and a population density between 1,000 and 1,500 inh./kmq;
- 3,426 high-density SMST**, with a population of more than 5,000 (and less than 50,000) and a population density of more than 1,500 inh./kmq.

Figure 10 - TOWN typology 4 with three SMST classes by population density.

		DENSITY (inh. / kmq)			
		≤ 300	> 300 and ≤ 1000	> 1000 and ≤ 1500	> 1500
POPULATION (inh.)	≤ 5000	OTHER SETTLEMENTS	VST (Very Small Towns)		
	> 5000 and ≤ 50000		Low density SMT	Medium density SMT	High density SMT
	> 50000				HDUC (High-density Urban Clusters)

The correspondent classification is mapped out in Figure 11, and key stats of this typology are offered in Table 3. In this map, the majority of SMST in most countries belong to the higher density class, coinciding with traditional market towns and secondary poles in metropolitan regions, but we can also devise the presence of low-density SMST clusters around large metropolitan areas like Paris, Athens or Rome, and more diffused medium-density SMST networks in industrial areas in the Flanders, Northeast Italy, and Southern Poland, as well as on Italian coasts and along the main communication arteries in the European core.

Figure 11 - TOWN Typology of urban settlements based on three population density classes (TOWN typology 4)



		DENSITY (inh. / kmq)			
		≤ 300	> 300 and ≤ 1000	> 1000 and ≤ 1500	> 1500
POPULATION (inh.)	≤ 5000	OTHER SETTLEMENTS	VST (Very Small Towns)		
	> 5000 and ≤ 50000		Low density SMT	Medium density SMT	High density SMT
	> 50000				HDUC (High-density Urban Clusters)
		NO DATA			

Regional level: NUTS 3 and 1 kmq grid cells
Source: Own elaboration on GEOSTAT data
Origin of data: DG Regio
Authors: F. Brandajs, A.P. Russo, D. Serrano Giné
© EuroGeographics Association for administrative boundaries

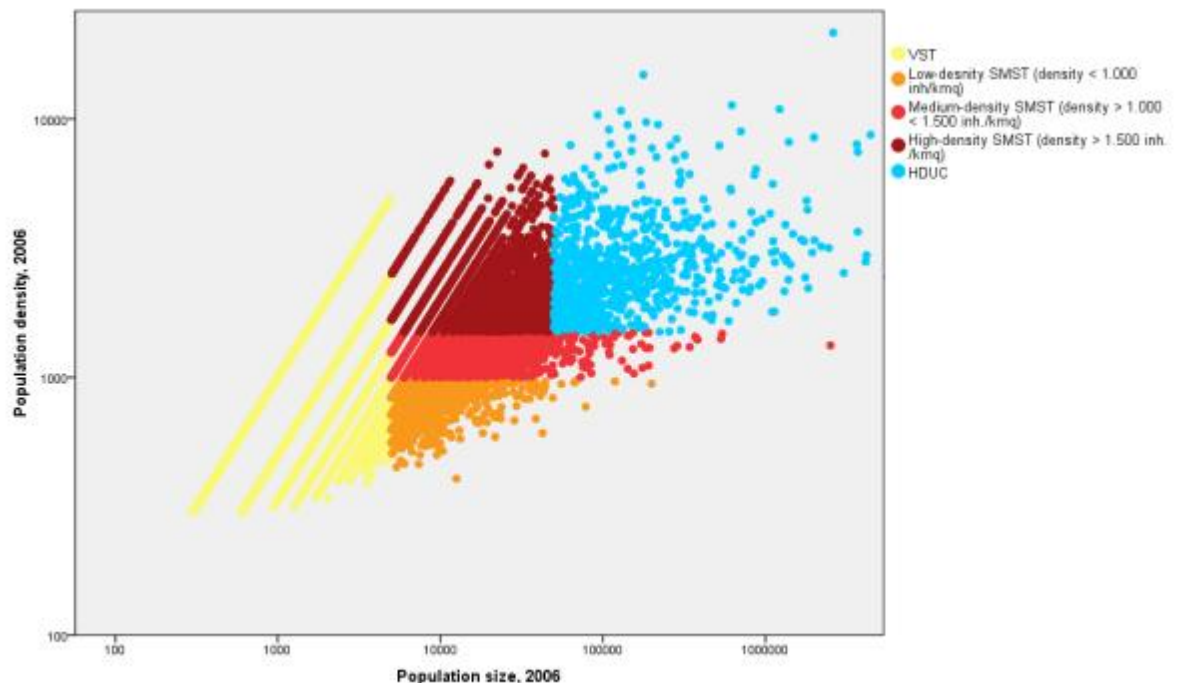
Overseas territories not shown on map because of missing cover in GEOSTAT grid database

Table 3 - Typology 4 polygons: key statistics

Classes	Delimitation criteria	Count	Av. Pop	Av. Sq.km	Av. Density
High-density Urban Clusters (HDUC)	Pop. > 50,000, AND Pop. Density > 1,500 inh/km ²	850	275,476.10	92.3	2,927.10
Low-density SMST	Pop > 5,000, AND Pop. Density > 300 < 1,000 inh/km ²	1606	8,947.97	10.7	837.43
Medium-density SMST	Pop > 5,000, AND Pop. Density > 1,000 < 1,500 inh/km ²	3382	14,994.13	11.9	1,242.96
High-density SMST	Pop > 5,000 < 50,000, AND Pop. Density > 1,500 inh/km ²	3,426	16,746.76	8.1	2,152.39
Very Small Towns (VST)	Pop. < 5,000 AND Pop. Density > 300 inh./km ²	69,043	1,193.10	1.7	699.3

Figure 12 cross-plots the values of population and density of the three SMST classes so obtained. Differently from Figure 8, this plot returns an image of a more balanced membership of the three classes of SMST, distinguishing neatly low density urban settlements (in orange), arguably identifying sprawling sectors at the fringe of metropolitan areas and other higher density nuclei, with the 'core' groups of average density SMST (in darker orange) and high-density SMST, having a comparable urban fabric but a lower population size than larger cities.

Figure 12 - Cross-plot of populations and densities of SMST in TOWN Typology 4



4. Territorial trends in the ESPON space

The previous sections outlined how the TOWN team derived morphological polygons across the 27 member-states of the European Union (prior to 2013). We now have an objective 'urban geography' at the EU scale which allows some visual and even analytical inspection of the prevailing territorial structures of urbanisation, across the EU space in a geographical sense, but also involving nation-specific factors (some countries or regions having a more or less distributed structure of urbanisations than others as the result of different historical and institutional arrangements) and within urban systems.

However in order to analyse how different urbanisation patterns are related to specific territorial phenomena, which is one of the main questions of the TOWN project, it is necessary to combine the information on morphological structures derived in the previous sections to information that is generally available at administrative levels. This analysis combining different geographies is indeed the most complex research we are faced with and involves the attribution of values derived from secondary regional (NUTS3) and smaller area data as LAU2 (mainly but not exclusively derived from the various national censuses) as estimated at the level of the morphological settlement.

The attribution of data that are available at administrative levels to morphological units is one of the most problematic tasks in cartographic methods, facing two main problems:

- Infer urban settlement polygons' attributes from NUTS3/LAU2 attributes, which are generally available from traditional statistical sources. Here there are two orders of problems in the way. First, the attributes of one NUTS3/LAU2 delimitation (for instance, its unemployment rate) not necessarily holds in the smaller part of the region that is occupied by a SMST: considering that socio-economic indicators are generally different in metropolitan, mid-size urban and rural areas, it is very likely that some NUTS3/LAU2, especially the larger ones, will have a sizeable internal variation of these values which makes it difficult to even estimate the values for its portions delimited as SMST. Secondly, the fact that SMST spread over more NUTS3/LAU2 delimitations, which may be characterised by different socioeconomic indicators, make it technically cumbersome to 'reconstruct' the values of such indicators at SMST level.
- Transfer information available at SMST level to the NUTS3/LAU2 level. We have this problem, for instance, when we try to estimate how much of the area of a NUTS3 (known) is occupied by SMST (possibly many different polygons, and spreading over different NUTS3) or the share of the NUTS3 population which lives in SMST. The problem is essentially of technical nature: SMST have been built by aggregation of square grid cells, while NUTS3/LAU2 polygons have 'exactly' shaped frontiers (political or geographical, such as coastlines), which generates a certain level of inaccuracy in the values generated overlapping these two geographies.

Thus, inevitably, there is a certain margin of inaccuracy when grid-based settlement polygons values (population size and density) are mapped onto the level of territorial administrative units of analysis (NUTS3 or LAU2) and vice versa, when their attributes are inferred from the values of indicators calculated at the overlapping administrative geography. Having acknowledged this, we had to realistically take into account that most socioeconomic indicators that need to be considered for a comprehensive analysis of the territorial systems of SMST are only available at the level of territorial administrative units, and so difficulties of the first type indicated above have arisen, and in some cases have required a case-by-case analytical approach to be solved.

In this paper we work at the level of NUTS3 and analyse how the grid-based geography of polygons of urban settlements maps over the established NUTS3 geography, which is a

relatively less problematic task given the difference in scales globally involved (NUTS3 are generally much larger than urban settlement polygons, and so the procedure of attribution to NUTS3 regions of values based on urban morphological patterns is relatively easier). The connection between morphological structures and the finer scale of municipal (LAU2) areas is more complex and is treated by other contributors to this session.

Thus, we first characterise and classify the different NUTS3 according to the typology of settlements that they include. Secondly, we cross-tabulate these typologies with established territorial typologies and 'performance' indicators. The identification of regions that are predominantly characterised by smaller settlements cannot depict the precise role of an individual SMST, but it indicates the general performance (measured in the timespan of the first decade of 2000s) of a regional context characterised by smaller urban settlements areas as the predominating type) as opposed to regions that are characterised by a higher degree of urbanisation).

4.1. Population settlement classes at the scale of NUTS3 regions

A first question that arises from the resulting construction of SMST polygons is the following:

Can we identify general territorial patterns regarding the presence, distribution and type of SMST throughout the ESPON space?

To sort out this question, we have 'transferred' the information regarding grid-based urban settlement polygons to the NUTS3 geography, with the inevitable elements of inaccuracy described above. The calculation of these data involved a rather complex process of estimation using GIS tools, which is subject to an inevitable margin of error. Indeed, we have verified that there is a certain difference between the estimated population of the grids included (completely or in part) in NUTS3 areas and the real population as provided by EUROSTAT. This difference is generally around 1-2% top but in some cases – especially in cases of small NUTS3 areas where there are 'more borders' cutting through grid cells and thus a greater estimation error due to the approximation in attributing to bordering NUTS3 areas values of grid cells that are 'split' (as in the case of Germany and the UK most notably). Thus they may take on larger values, leading to a sensible under- or over- estimation of the population and population density of polygons (and thus their attribution to one of the different classes that were created). In Figures 13 and 14 we have mapped NUTS3 regions according to the percentage of, respectively, population living in SMST and surface area occupied by SMST polygons in NUTS3 regions.

Figure 13 - Share of regional (NUTS3) population living in SMST polygons

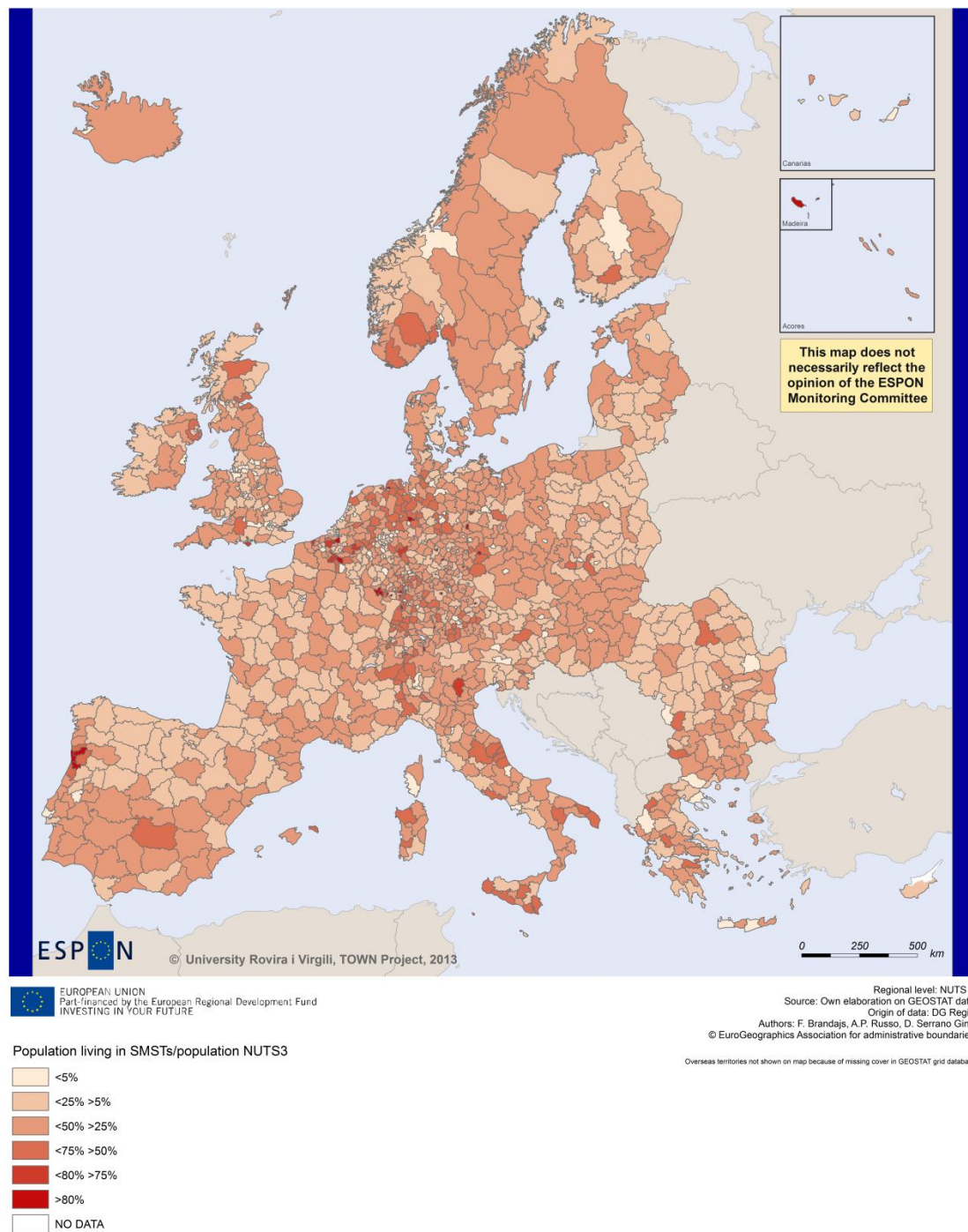
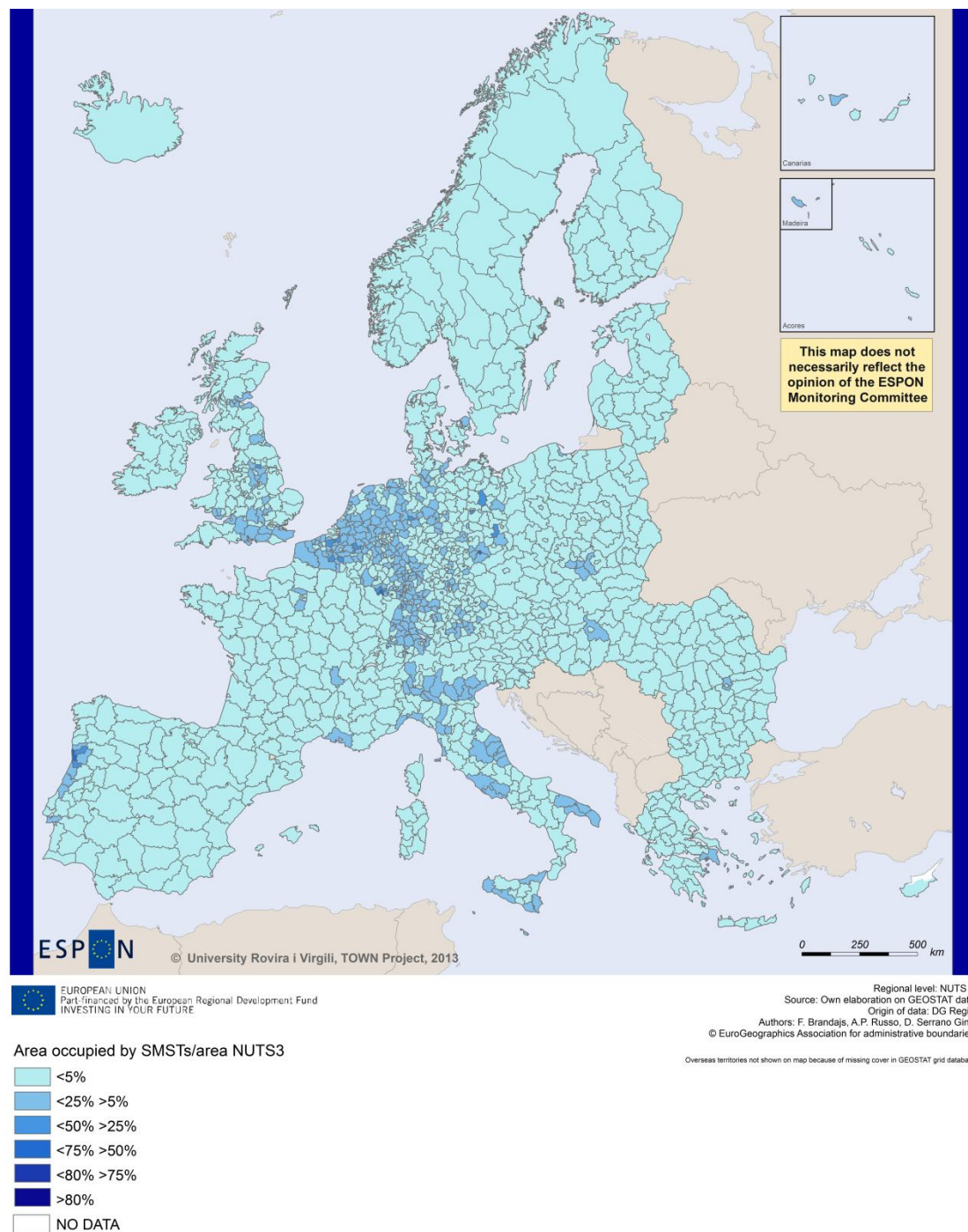


Figure 14 - Share of regional (NUTS3) surface occupied by SMST polygons

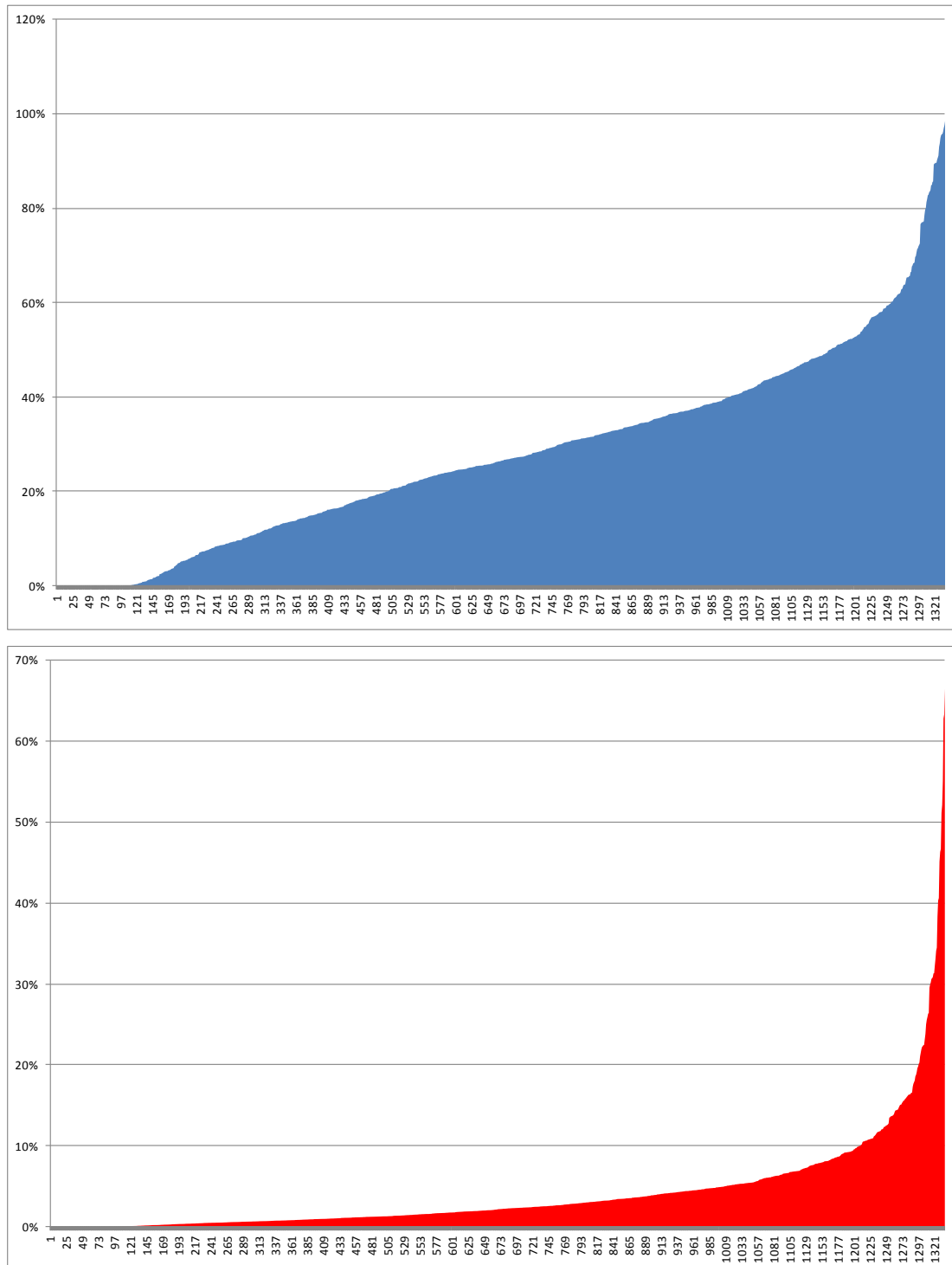


As we can see in the diagrams of Figure 15(a) and (b), the distribution of population shares in SMST is more evenly distributed than that of areas occupied by SMST (urban settlements are relatively 'compact' with respect to lower-density and rural settlements but they can accommodate a large share of the population). It must be noted that regions with low values of these indicators should not be understood as relatively de-urbanised, because they may account for larger or lower shares of both HDUC and VST. Thus, high values of the indicators only return geography of regions where the role of SMSTs in urban structures is relatively prominent.

Charting the distribution of such indicators as in Figure 15(a) reveals that there are 98 NUTS3 regions in Europe that do not include any SMST, and that there are 173 of them where the

population living in SMSTs is more than the 50% of the total population; conversely, as can be seen in Figure 15(b), only in six of them (five German NUTS3 regions: Passau, Saarbrucken, Kaufbeuren, Wismar, and Chemnitz, as well as the larger Oporto area) the region is occupied by SMST polygons for more than the half of its surface.

Figure 15 (a) (above): distribution of percentage of NUTS3 population living in SMST; (b) (below): distribution of percentage of surface of NUTS3 population occupied by SMST



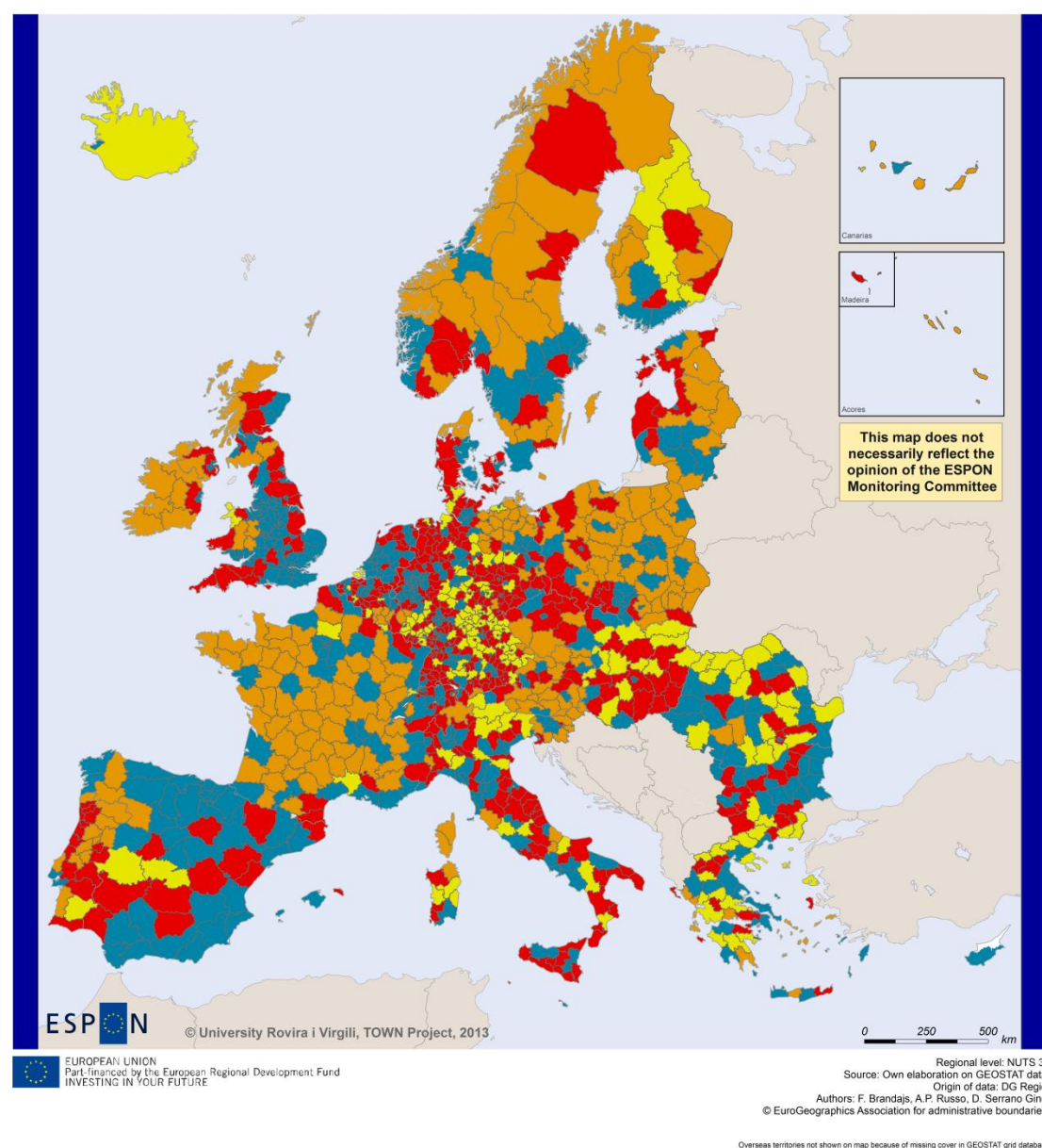
The two synthetic maps that follow chart regional typologies that classify regions according to their prevailing types of settlements distinguishing between 1: SMST; 2: HDUC; 3: VST; 4: other types of settlements. Figure 16 refers to population, indicating the type of settlements

where the relative majority lives, and Figure 17 to surface, indicating which type of settlement occupies the larger share of the regional surface in relative terms.

Thus, in a 'representative' NUTS3 region, taking the average values of these two indicators observed across the ESPON space, the SMST, HDUC, VST and the residual 'other settlements' morphological units will respectively host the 28.0%, 31.7%, 19.5%, and 20.8% of the population, and occupy the 4.2%, 10.5%, 3.8%, and 81.4% of the regional surface; that 'average' region will therefore be classified as a region with 'HDUC as predominant population settlement type' (coloured blue) in Figure 16 and one with 'Other population settlements as prevailing types' (coloured orange) in Figure 17. This is a perfectly plausible situation, given the uneven population densities involved within each class and shown in Figure 15. Indeed, Table 4 below reports the observed dimension of the combinations of the two classification criteria employed in the two maps.

The comparison of the two maps and the observation of data in Table 4 confirms that while the population settlements models vary considerably throughout the ESPON space, there is only a very limited number of NUTS3 regions where urban settlements (either of the SMST or of the HDUC type) occupy the larger share of the regional space. It must be highlighted that the regional scale influences these results and the degree of correspondence between the two regional typologies illustrated: a very small NUTS3 region occupied almost in its entirety by a HDUC (as it is the case with most capital-city regions) will be classified as HDUC-dominated in terms of both indicators, while if the same HDUC settlement is in a wider NUTS3 region, concentrating most of the regional population in a metropolitan area, that region is likely to be classified as HDUC-dominated in population terms but not in surface terms, as most probably the greater share of the regional area will be taken up by areas that are outside of the metropolitan settlement.

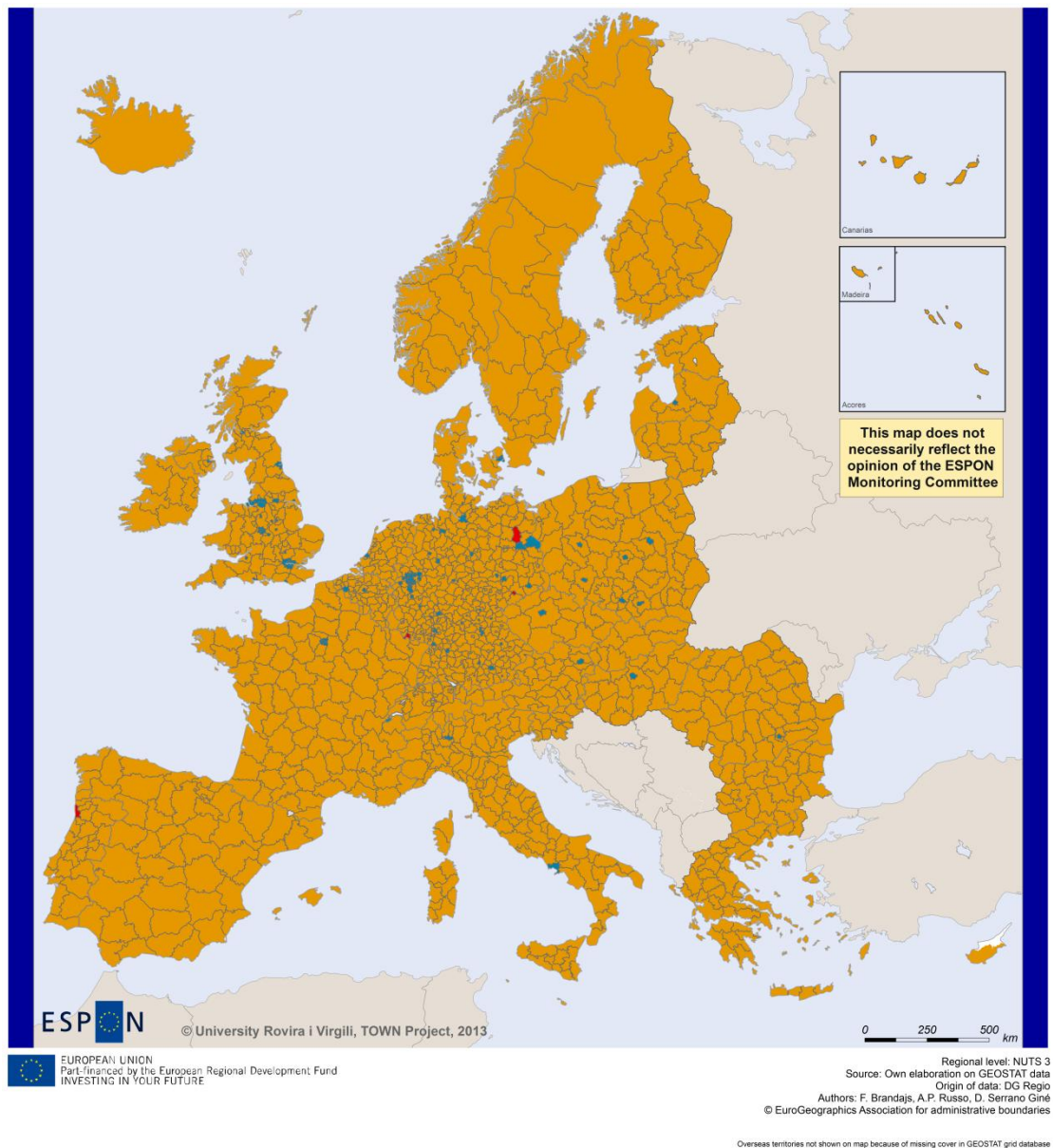
Figure 16 - Prevailing type of settlements in terms of population shares in NUTS3 regions



Prevailing population settlement type

- High Density Urban Clusters as the prevailing type of population settlement
- Small and Medium Towns as the prevailing type of population settlement
- Very Small Towns as the prevailing type of population settlement
- Other population settlements as prevailing type
- NO DATA

Figure 17 - Prevailing type of settlements in terms of occupied surface in NUTS3 regions



- Prevailing area settlement**
- High Density Urban Clusters as the prevailing type of area settlement
 - Small and Medium Towns as the prevailing type of area settlement
 - Very Small Towns as the prevailing type of area settlement
 - Other population settlements as prevailing types
 - NO DATA

Table 4 - Observed NUTS3 regional classes in terms of settlement types hosting the relative majority of the regional population and occupying the relatively larger share of regional surface

			Predominant settlement type in terms of area covered				TOTAL
			HDUC	SMST	VST	other settlements	
Predominant settlement type in terms of population hosted	HDUC	Count	6	0	0	411	417
		% of Total	.4%	.0%	.0%	30.7%	31.2%
	SMST	Count	1	121	0	397	519
		% of Total	.1%	9.0%	.0%	29.7%	38.8%
	VST	Count	0	0	0	164	164
		% of Total	.0%	.0%	.0%	12.3%	12.3%
	other settlements	Count	0	0	0	238	238
		% of Total	.0%	.0%	.0%	17.8%	17.8%
TOTAL		Count	7	121	0	1210	1338
		% of Total	.5%	9.0%	.0%	90.4%	100.0%

The classification criteria used in the previous set of maps provides a broad illustration of the overall territorial trends associated with the structure of population throughout the ESPON space, highlighting the diversity of degrees of concentration in population structures (and also in physical terms) in different areas. Yet they are not particularly useful in analytic terms because they hardly allow to grasp what is the overall weight of small and medium sized towns within NUTS3 and thus to assess the performance of regions characterised in this sense compared to others, and most significantly those in which the population is mainly concentrated in High Density Urban Clusters.

Thus, we now introduce a more simplified, 'operational' classification of regions by prevailing settlement types, in line with the 'degree of urbanisation' criterion used by DG Regio and OECD (cf. Chapter 2 of this Scientific Report). This classification identifies which regions are definitely 'non urban'; we have used an arbitrary threshold in this sense, dividing regions in three classes:

- Regions where **less than the 30% of the population lives in HDUC**; thus, they live in smaller population settlements, including – but not exclusively – SMST;
- Regions where **more than the 70% of the population lives in HDUC**, thus they are mostly 'urban';
- Regions where the **HDUC population is between 30% and 70%** - thus regions that do not have a well-defined population structure by type of settlement.

This classification, in other words, allows us to focus on regions that are more likely to be characterised by a prevalence of smaller settlements; assess them in terms of their correspondence with established ESPON typologies, so as to gauge more insights on geographical and socioeconomic types that are more likely to be associated with this kind of population structure; and eventually assess their performance (also along ESPON typology classes) comparing it with that of regions that are characterised by a higher degree of urbanisation.

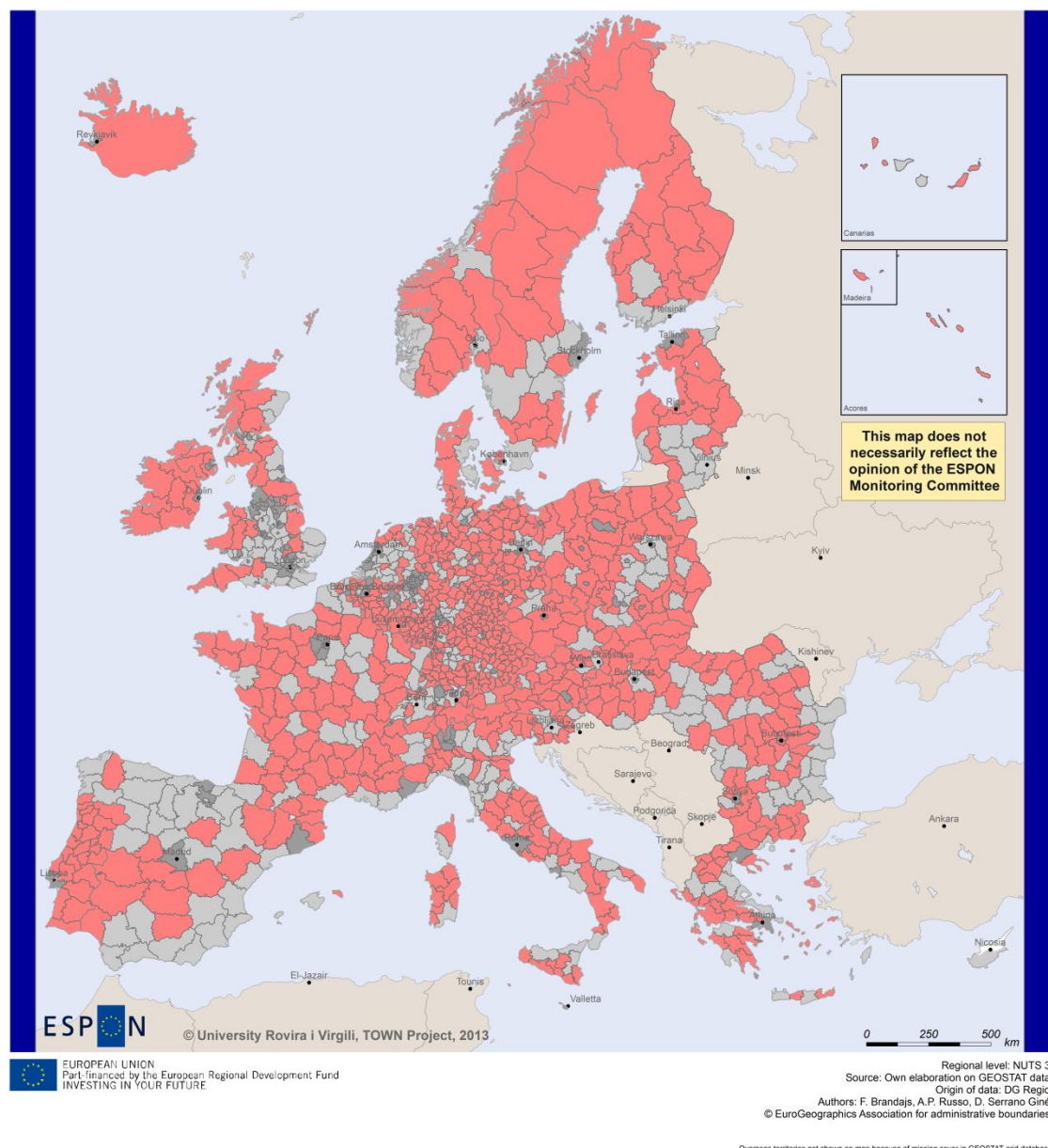
As we see in Table 5, the majority of NUTS3 regions are included in the category of having less than the 30% of the population in 2006 living in urban settlements that are not HDUC. The country data illustrate how many of the NUTS3 regions within that country have a

population structure fitting the three classes introduced here; only in Cyprus, Spain, Lithuania, the Netherlands and the UK most NUTS3 regions have a higher degree of urbanisation than that of our basic 'less urban' type. Figure 18 maps out this regional classification. We purposefully highlight Class 1 regions characterised by a prevalence of smaller population settlements.

Table 5 - Degree of urbanisation at NUTS3 level

Country	Predominant settlement type in terms of population hosted						
	Pop in HDUC 2006 < 30%		Pop 2006 in HDUC 30%-70%		Pop 2006 in HDUC > 70%		Total
	Count	Country %	Count	Country %	Count	Country %	Count
AT	27	77.1%	6	17.1%	2	5.7%	35
BE	31	70.5%	7	15.9%	6	13.6%	44
BG	14	50.0%	13	46.4%	1	3.6%	28
CH	13	50.0%	9	34.6%	4	15.4%	26
CY	0	.0%	1	100.0%	0	.0%	1
CZ	10	71.4%	3	21.4%	1	7.1%	14
DE	260	63.1%	50	12.1%	102	24.8%	412
DK	6	54.5%	3	27.3%	2	18.2%	11
EE	3	60.0%	1	20.0%	1	20.0%	5
EL	37	72.5%	12	23.5%	2	3.9%	51
ES	20	33.9%	33	55.9%	6	10.2%	59
FI	15	78.9%	4	21.1%	0	.0%	19
FR	63	65.6%	25	26.0%	8	8.3%	96
HU	15	75.0%	4	20.0%	1	5.0%	20
IE	7	87.5%	0	.0%	1	12.5%	8
IS	1	50.0%	0	.0%	1	50.0%	2
IT	62	56.4%	37	33.6%	11	10.0%	110
LI	1	100.0%	0	.0%	0	.0%	1
LT	4	40.0%	6	60.0%	0	.0%	10
LU	1	100.0%	0	.0%	0	.0%	1
LV	5	83.3%	0	.0%	1	16.7%	6
MT	1	50.0%	0	.0%	1	50.0%	2
NL	11	27.5%	18	45.0%	11	27.5%	40
NO	14	73.7%	4	21.1%	1	5.3%	19
PL	40	60.6%	16	24.2%	10	15.2%	66
PT	28	93.3%	0	.0%	2	6.7%	30
RO	26	61.9%	15	35.7%	1	2.4%	42
SE	14	66.7%	6	28.6%	1	4.8%	21
SI	9	75.0%	3	25.0%	0	.0%	12
SK	7	87.5%	1	12.5%	0	.0%	8
UK	33	23.7%	38	27.3%	68	48.9%	139
ESPON SPACE	778	58,1	315	23,5	245	18,3	1338

Figure 18 - NUTS3 Typology based on degree of urbanisation



Thus this map indicates the regions in which there is a prevalence of population living in 'smaller settlements'. When compared to Figure 16, it includes under this broad category almost precisely the three types of regions in which the prevailing population settlement was not HDUC: SMST, VST and 'Other' ones. The aggregation of these categories offers the opportunity to compare them with other ESPON types, and their relative performance in terms of basic indicators such as population growth and GDP. Of course, it shows also the approximation of this aggregation. For instance, a region with prevailing smaller settlements of about 500,000 inhabitants may be constituted by 150,000 inhabitants living in one or two HDUC (e.g. 1 cities of 90,000 inh. and another of 60,000 inh.) integrated in a regional context in which 350,000 inhabitants may live in 7-8 SMST (e.g. amounting to 250,000 inh.), and in

about 100 VSTs or other settlements (about 100,000 inhabitants). In this case, the roles of smaller settlements - or of the two large cities (HDUCs) - within the general regional data would not be ascertained. Still, the prevalence of SMSTs and VSTs offers a good approximation of the general urbanisation pattern in that region.

A few broad trends in the EU territory could be highlighted. Spain and Romania are characterised by NUTS3 regions in which the population has a higher degree of concentration in HDUC. In general, there is a higher percentage of HDUC-dominated regions along the coasts, in particular the Mediterranean arc (and Spain in particular), the south-east of England, and along the Black Sea, and of course in the metropolitan regions, especially in large parts of England, Flanders in Belgium, the Netherlands, and Northern Italy. On the contrary, in France, most of the central and eastern regions are characterised the dominance of the smaller urban scales. The Scandinavian regions present similar and even more radical conditions, with their sparsely populated and very large NUTS2 regions.

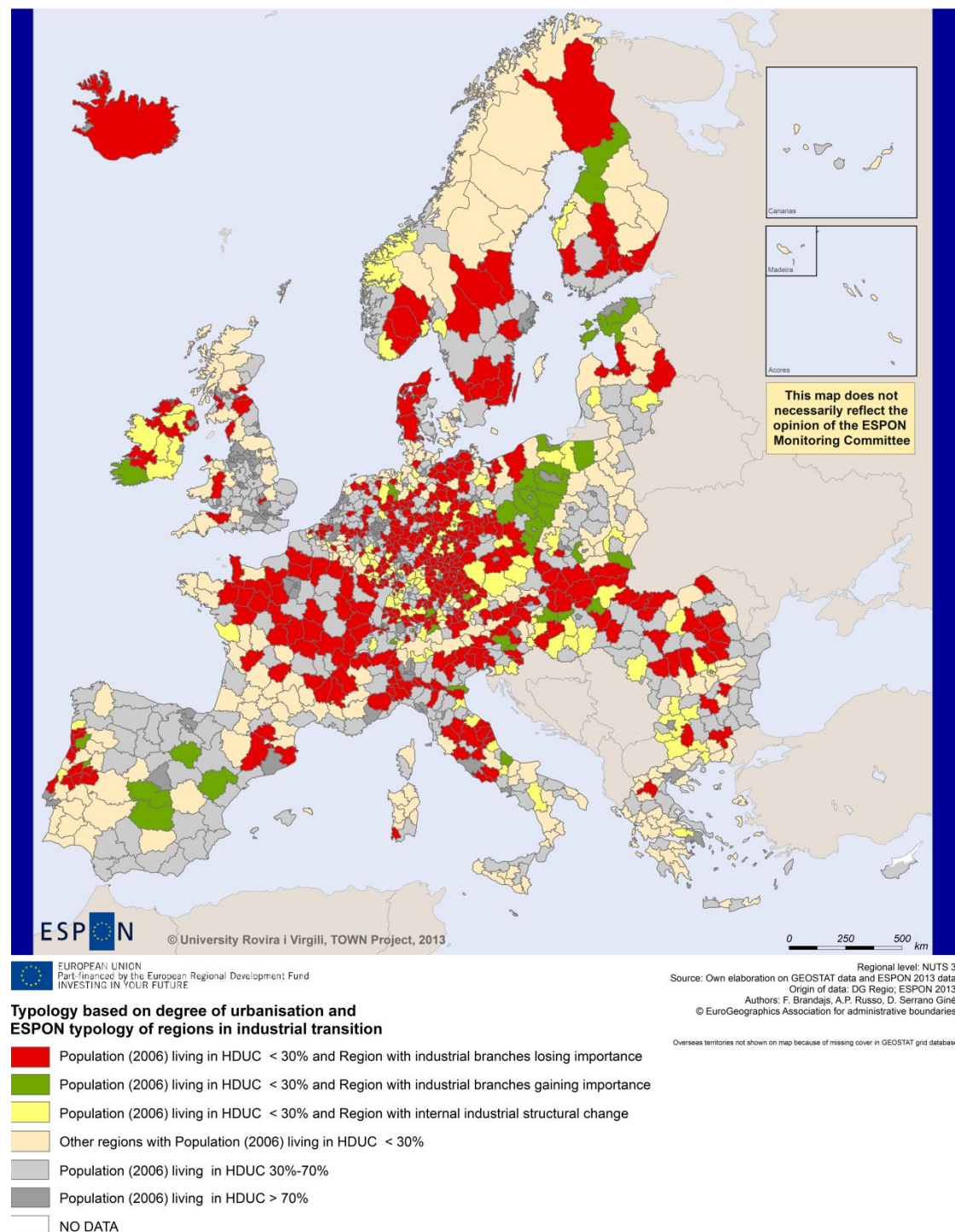
In this respect, the different historical circumstances of the urbanisation process in each country in the last century – associated to each different socio-administrative institutional framework – prove to be relevant. It is the case of the different structures in neighbouring countries such as France, Belgium (and its difference between Flanders and Wallonia) and Germany at the core of Europe.

4.2. Socioeconomic performances of NUTS3 regions characterized by different structures of urban settlements

Next, we further explore the urban settlement structure of Europe. A first question regards the relation between a low degree of urbanisation and an ESPON typology of economic performance such as that of regions in industrial transition. Figure 19 maps out the association of such typologies, and Tables A1-2 in the Annex the analytics. The association proves to be significant, however while it might be expected that lower degrees of urbanisation would go inversely hand in hand with industrial strength, closer inspection of the statistical tests in Tables A1-2 show a slight underrepresentation of regions characterised by a lower degree of urbanisation among ‘regions with industrial branches losing importance’, and, conversely, their overrepresentation among ‘regions with industrial branches gaining importance’.

This result provides an interesting insight regarding the flexibility of industrial structures in less urbanised regions. This phenomenon is also (as to be expected) a prerogative of more urbanised regions as centres of innovation and cores of economic change. However, in this respect, less urbanised regions seem to perform better than ‘mixed’ regions (in terms of urbanisation), which could be interpreted as an interesting trade-off effect between economic and population factors behind the viability of industrial transformation processes. It also emerges how the positive association with industrial change regards especially less urbanised regions in the periphery of Europe, and specifically some regions in Portugal and Spain, the whole west of Poland, some region of Hungary, Slovakia, Estonia, central Finland, and central Italy.

Figure 19 - Typology based on degree of urbanisation and ESPON typology of regions in industrial transition



The next step in this analysis focuses on the performance in terms of growth rates of population and per capita GDP in regions characterised by different 'degrees of urbanisation' as set out in the typology of Figure 18. The growth rates are generally calculated over the 2001-2011 period, and p.c. GDP is considered in current market prices⁵. Performances are

⁵ Using Purchase Parity Standard (PPS) per capita GDP would have produced more significant and comparable results especially at the global EU level. However, the possibility of using the EUROSTAT PPS data sets (as we did in intermediate deliveries) is compromised by the existence of important

expressed both in terms of deviations from the EU average (in order to capture macro-trends over the ESPON space) and in terms of deviations from the national average, in order to capture finer scale phenomena independently from the overall national scores.

This analysis complements the one that has been carried out using LAU2 performance data in the TOWN project, in that it picks ‘scores’ of regions characterised by specific urbanisation structures, albeit at a grosser scale (urbanisation structures are being ‘roughed up’ at the regional level as illustrated earlier, similarly to performance data which are also regional), but making it possible to analyse the whole ESPON space and not just the area covered at case study level in our project.

Population growth in comparison with EU and national averages

Starting with Figure 20, this nuances the dominance of a territorial trend characterized by a shift of population from the East and the North to South and the West of Europe (or high out-migration rate of the former, and high in-migration rate of the latter) that affects all types of regions. This trend, already identified in the ESPON ATTREG project (ESPON, 2012) for the period 2000-2006, is thus confirmed, albeit a more moderate effect emerges in the last part of the decade. It is possible to imagine that the financial crisis that affected in particular some of the booming – and most attractive – regions played a role in smoothing down such strong migratory trend (see also the recent ESPON Evidence Brief ‘Migration keeps Europe moving’). In fact, the general trend of population growth in most of the EU-15 countries has few exceptions such as those areas affected by long-term economic downturns.

Table 6 illustrates how regions characterised by a lower degree of urbanisation grew at an average rate of 0.55%, which is a much lower rate lower than that of both highest urbanised regions (3.38%) and intermediate regions (3.84%). In terms of deviations from the EU-27 average, they grew significantly less than the two other groups, as proved through a one-way ANOVA test of differences (Table A3 in the Annex). This also got combined with the decrease of intensity of the exceptional interregional migration within the EU that took place after the EU enlargement in 2004. Thus if counter-migration has been triggered by the crisis in some ‘overheated’ areas, it is a process that in most regions has not been able to invert the overall balance in the whole 2001-2011 period.

Table 6 – Average population growth of NUTS3 regions as classified by degree of urbanisation, in EU and national contexts

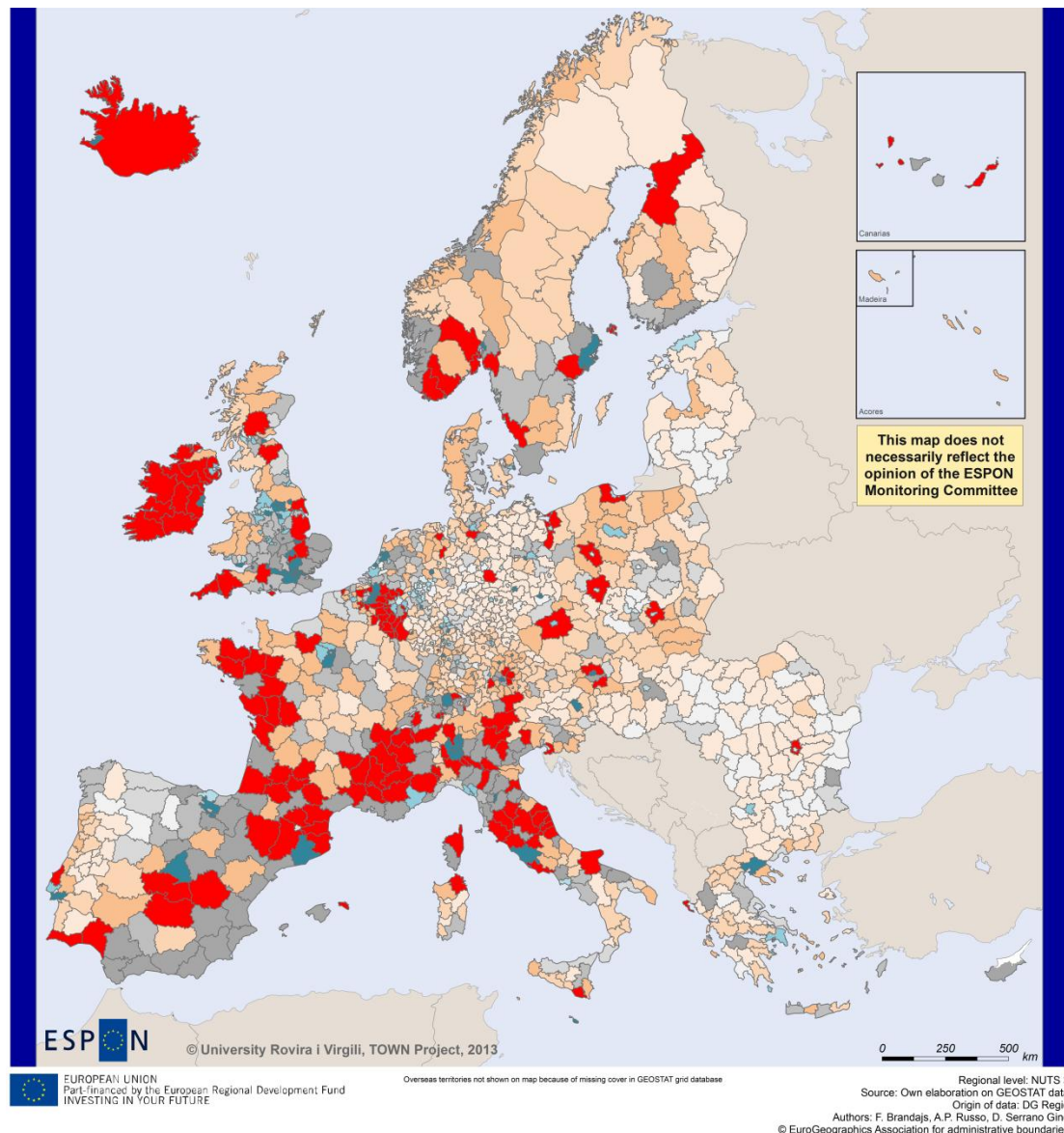
Typology based on degree of urbanisation	Population growth in NUTS3, 2001-2011 (mean)	Dev. of population growth rates from EU-27 average (mean)	Dev. of population growth rates from national average (mean)
Pop in HDUC 2006 < 30%	0.55%	-2.92%	-1.55%
Pop 2006 in HDUC 30%-70%	3.84%	0.40%	0.64%
Pop 2006 in HDUC > 70%	3.38%	-0.02%	0.74%
TOTAL	1.84%	-1.61%	-0.62%

A clearer picture of the macro-trends of population growth performances of regions characterised by a lower degree of urbanisation is provided by the hotspot map included as Figure A1 in the Annex to this chapter. This hotspot map, like the following ones, reflects the

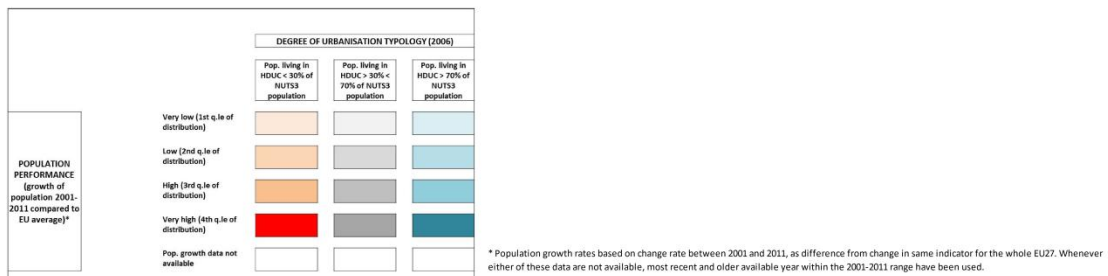
data gaps in the time series 2001-2011, and the difficulty of recalculating such indicator to account for NUTS3 boundary shifts that were introduced with the 2010 NUTS3 edition.

variation of performance scores over regions with a lower degree of urbanisation, ‘masking’ the rest.

Figure 20 – Population growth scores in regional types by degree of urbanisation (dev. from EU average)



Typology based on population change rates 2001-2011 as a difference from the EU-27 average



It is thus possible to recognise a large ‘hot spot’ ranging, north to south, from the British islands to the centre of Italy, and from southeast to northwest, from southern Portugal to south-central Europe, with appendices in southern Scandinavia and Poland; while there are three ‘cold spots’: the major one ranges from eastern Germany through Bulgaria cutting

through the 'rust belt' of southern Poland and Slovakia, towards the eastern EU border. Then there are two local cold spot phenomena over Latvia and Lithuania, and in Northern Portugal.

Altogether, the inspection of such maps and the related statistics provide us with the following information: there has been indeed a quite large population shift from 'grey' to 'sunny' Europe in the 2000s, partly moderated and in some cases reversed in the aftermath of the crisis in the last part of the decade, and most remarkably, this has produced a partial shift of population towards non-core regions especially in the South West. In this picture, while globally the bulk of population has grown more in more urbanised regions, it can't be argued that the shift has also been one from 'rural' to 'urban'; on the contrary, it seems that at least in a large part of the EU core, less urbanised regions had a protagonist role in retaining or attracting population, and a decidedly important one as far as the Mediterranean Arc (extending to inland regions in Spain, France and Italy) is concerned.

This overview of population performances becomes richer when the variation of the population is compared to each national average as in Figure 21. This perspective takes into consideration a factor of contextualization, highlighting phenomena occurring within countries, and picking spatial differences in more detail. Again the mean values of population growth across the three urbanisation classes differ significantly (see Table A4 in the Annex). On average (third column of Table 6), regions characterised by a lower degree of urbanisation grow less than others within countries, while more urbanised regions grown more.

There are no great geographical variations over this general pattern: only in Ireland and Poland did population grew significantly more in regions with lower degrees of urbanisation; in Austria, Bulgaria, Denmark, Greece, Norway and Sweden the shift of population favours more significantly more urbanised areas, while in the rest of the countries difference are not significant, and France presents a perfectly balanced trend between urbanisation types.

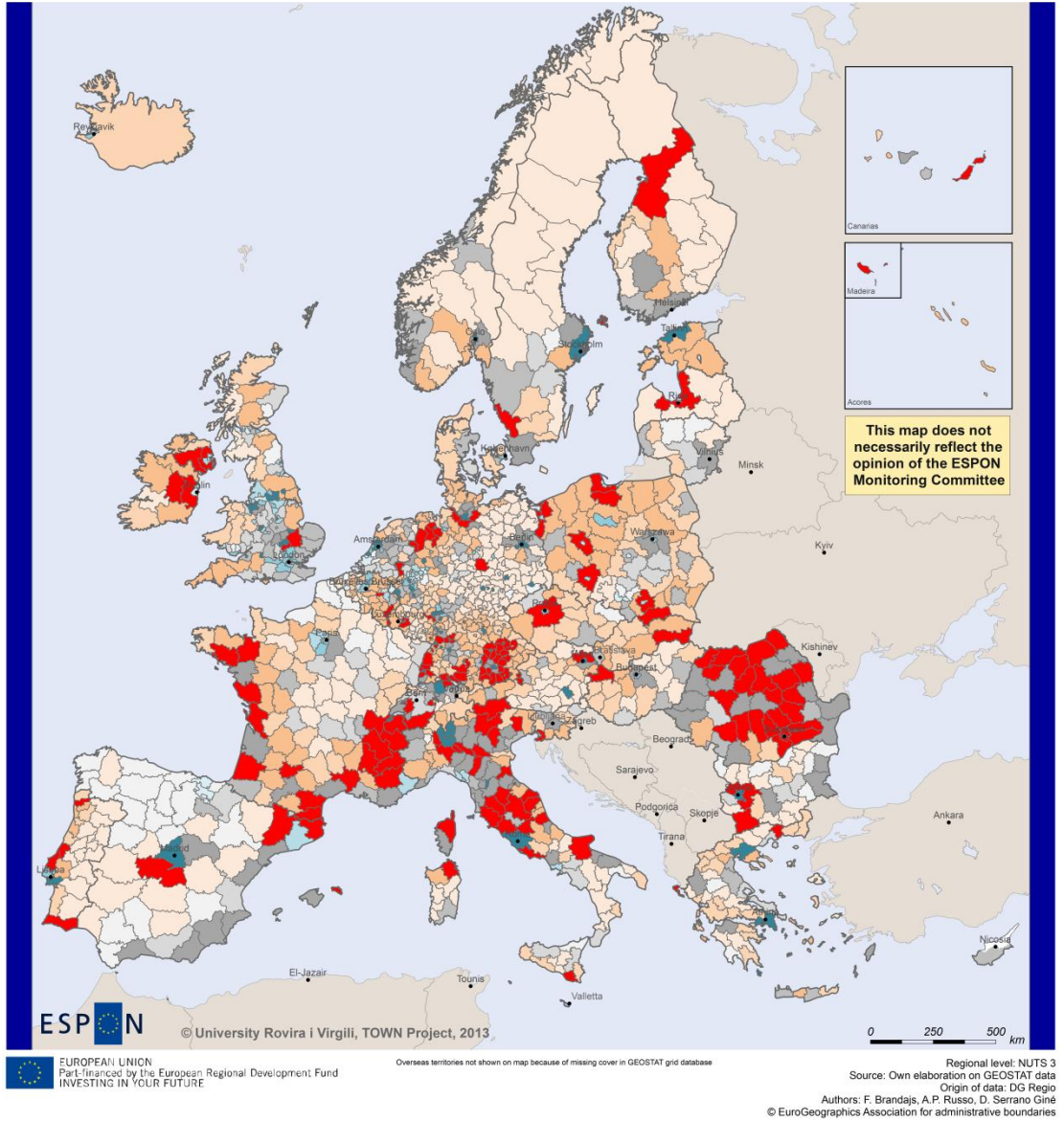
Looking at the broader continental trends, it thus appears the larger growth rates are achieved by the 'intermediate' class by degree of urbanisation, whereas at national level we get the more intuitive result of higher growth in more urbanised regions. Crossing this analysis with another regional typology considered in this chapter, we learn that at national level it's the 'predominantly urban region' variety of regions with a low degree of urbanisation that register positive growth rates, while growth rates plunge going from intermediate to remote and from urbanised to rural region, confirming the pattern that the urban-rural breach seems to have been widening throughout the ESPON space in the study period.

Recurring again to the hotspot map (Map A2 in the Annex), which should be read country by country to pick this time intra-national nuances, important hot spots are found in France, where regions characterised by lower degrees of urbanisations in the south and west score significantly better than regions in the centre; in a vast stretch from southern Germany to Northern-Central Italy; in Eastern England; the East of Ireland around the Dublin region; northern Poland regions closer to the coast; and the central regions of Romania. Balancing this, cold spots affect particularly large parts of the West of the Iberian peninsula, central France, Western Austria, Eastern Germany, Western Latvia, and Bulgaria.

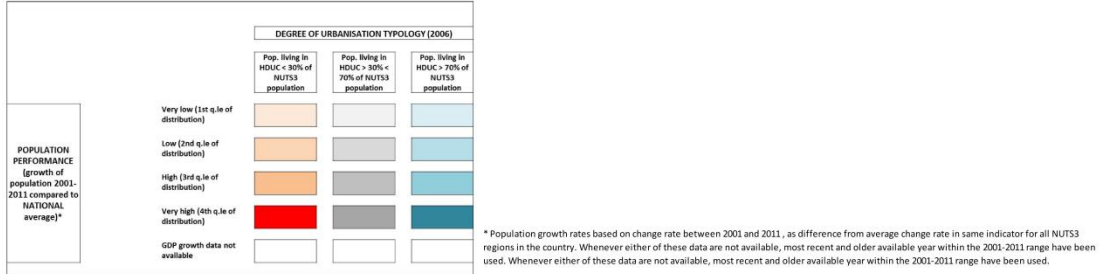
Thus, only a few countries present the same distribution of above and under-average growth. On the contrary, Portugal, Spain and France show a polarization trend: on the one hand, the growth of their capital region and urbanised regions on the coast; on the other hand, a general depopulation of central regions. At the same time, the growth of population in regions characterised by small settlements in the French western and southern costs is

substantial, which suggests that an interesting process is going on in France (possibly related to decentralization policies carried out in France in recent years).

Figure 21 – Population growth scores in regional types by degree of urbanisation (dev. from nat. average)



Typology based on population change rates 2001-2011 as a difference from the national (NUTS0) average



The core of Europe, consisting of Belgium, western Germany and the Italian north-eastern regions, shows a general growth both in the strongly urbanized regions and in those characterized by smaller settlements, with few and patchy exceptions. It can be argued that the general growth trend and suburbanisation processes have strongly affected the regions

with smaller settlements. On the contrary, a strong metropolisation process has taken place in Germany's eastern regions, in Austria and in the Scandinavian countries, where an important shift of population emerges from regions with smaller settlements toward the capitals and other larger urban areas.

In this framework, the eastern European regions present a rather different picture. While we notice a general declining trend of population except for the metropolitan areas, the picture of population growth in comparison with national average shows the importance of regions with smaller settlements. Again, there is interdependency between metropolitan areas and urban regions (e.g. Riga, Warsaw, Cracow, Prague, Brno, Bratislava, Budapest, Bucharest, Sofia) and their surrounding regions characterised by smaller settlements (for an extension that goes much beyond a possible functional region).

These phenomena suggest the presence of saturation effects in the metropolitan areas that, together with the enhancement of mobility systems (mainly on road), has determined a delocalization shift of firms and population. Moreover, it is possible that the activities rooted in areas characterized by smaller settlements have been able to resist better and strengthen their autonomy in those areas in which networks with bigger urban areas have been established. It is a sort of long wave of 'borrowing-size' effects, according to which towns that are close to bigger urban areas manage to achieve a virtual critical mass in terms of accessibility to services and other urban characteristics.

Furthermore, it can be noted that while population growth in 2001-11 has been significantly larger in regions characterised by a higher degree of urbanisation, the only regions with a lower degree of urbanisation where population grows on average are regions with industrial branches gaining importance, but with a lower rate than in regions with a higher degree of urbanisation. Population decreases at a lower rate in regions characterised by a lower degree of urbanisation than in regions characterised by a higher degree of urbanisation when they are regions undergoing structural change. Finally, regions with a lower degree of urbanisation with industrial branches losing importance register a population decrease almost three times higher than regions with a higher degree of urbanisation.

Per capita GDP growth in comparison with EU and national averages

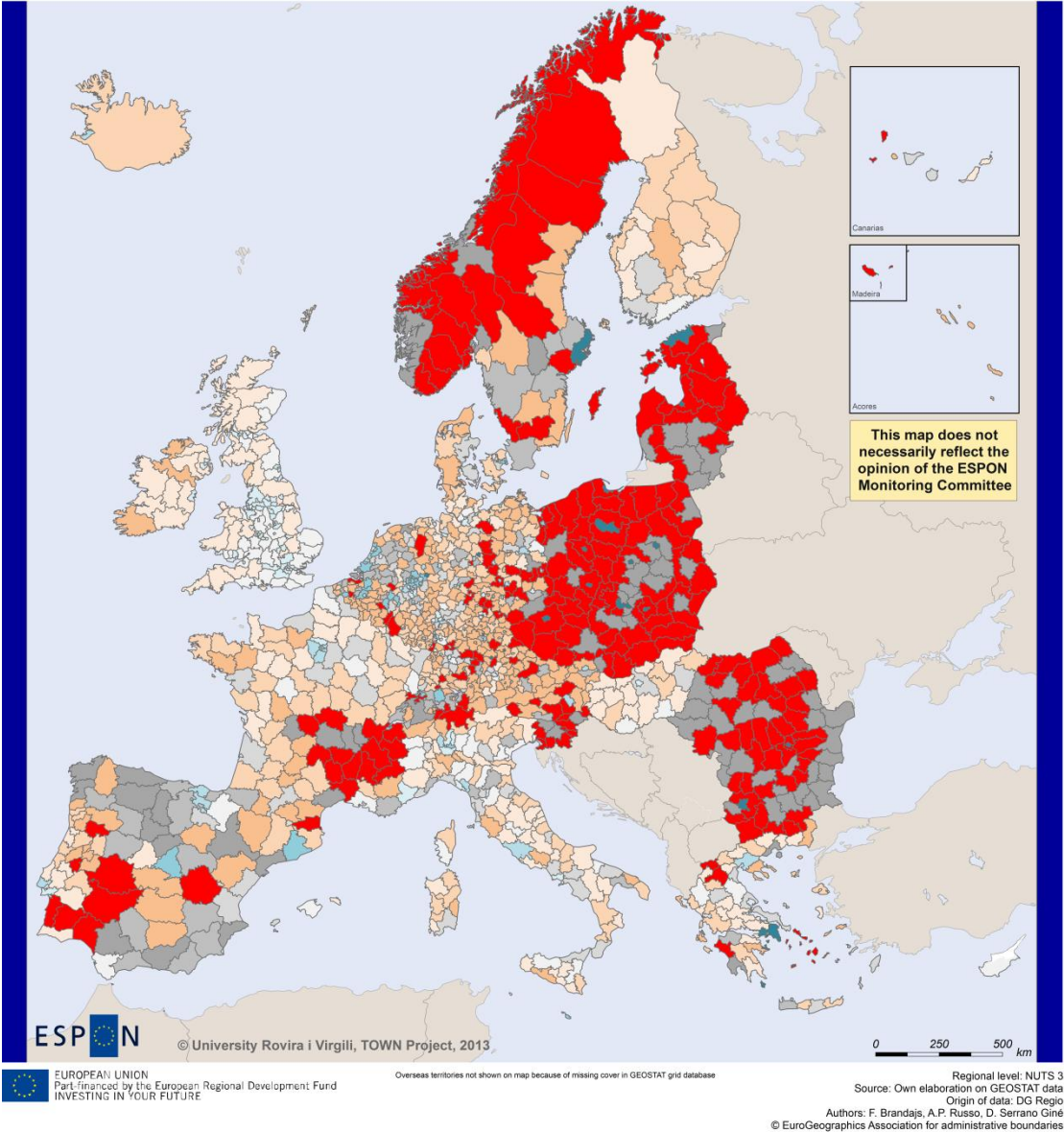
When taking in consideration the distribution of per capita GDP growth rates in the same way we did for population, the picture presented varies significantly. Table 7 provides the main average values across the ESPON space. It now appears that less urbanised regions have grown in 2001-2011 on average more than those with a high degree of urbanisation (though less than regions in the 'intermediate' class), and significantly so, and this is the case both in terms of deviations from the EU average (Table A.5 in the Annex) and within countries (Table A.6).

Table 7 – Average p.c. GDP growth of NUTS3 regions as classified by degree of urbanisation, in EU and national contexts

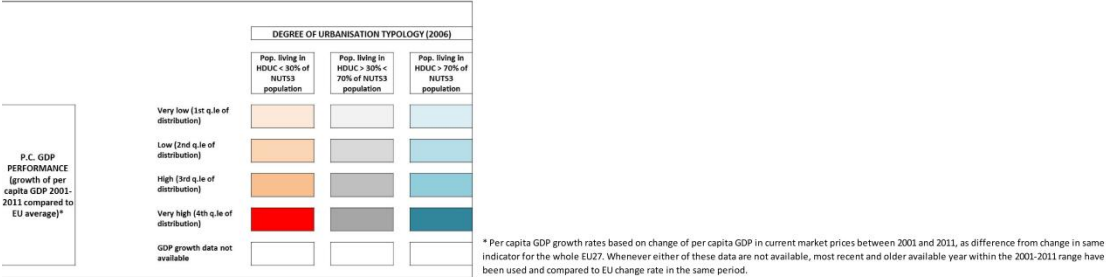
Typology based on degree of urbanisation	P.c. GDP growth in NUTS3, 2001-2011 (mean)	Dev. of P.c. GDP growth rates from EU-27 average (mean)	Dev. of P.c. GDP growth rates from national average (mean)
Pop in HDUC 2006 < 30%	41.63%	31.71%	1.38%
Pop 2006 in HDUC 30%-70%	42.46%	32.86%	1.13%
Pop 2006 in HDUC > 70%	20.74%	11.18%	-3.02%
TOTAL	38.00%	28.22%	0.51%

This information, together with the previously illustrated result that globally more urbanised regions have gained population relatively to the less urbanised ones, indicates that the former regional types have had lost some of their wealth to the ‘periphery’ at least at the national scale; or in other words, de-urbanisation has mostly interested the wealthier classes.

Figure 22 – P.c. GDP growth scores in regional types by degree of urbanisation (dev. from EU average)



Typology based on p.c. GDP change rates 2001-2011 as a difference from the EU-27 average



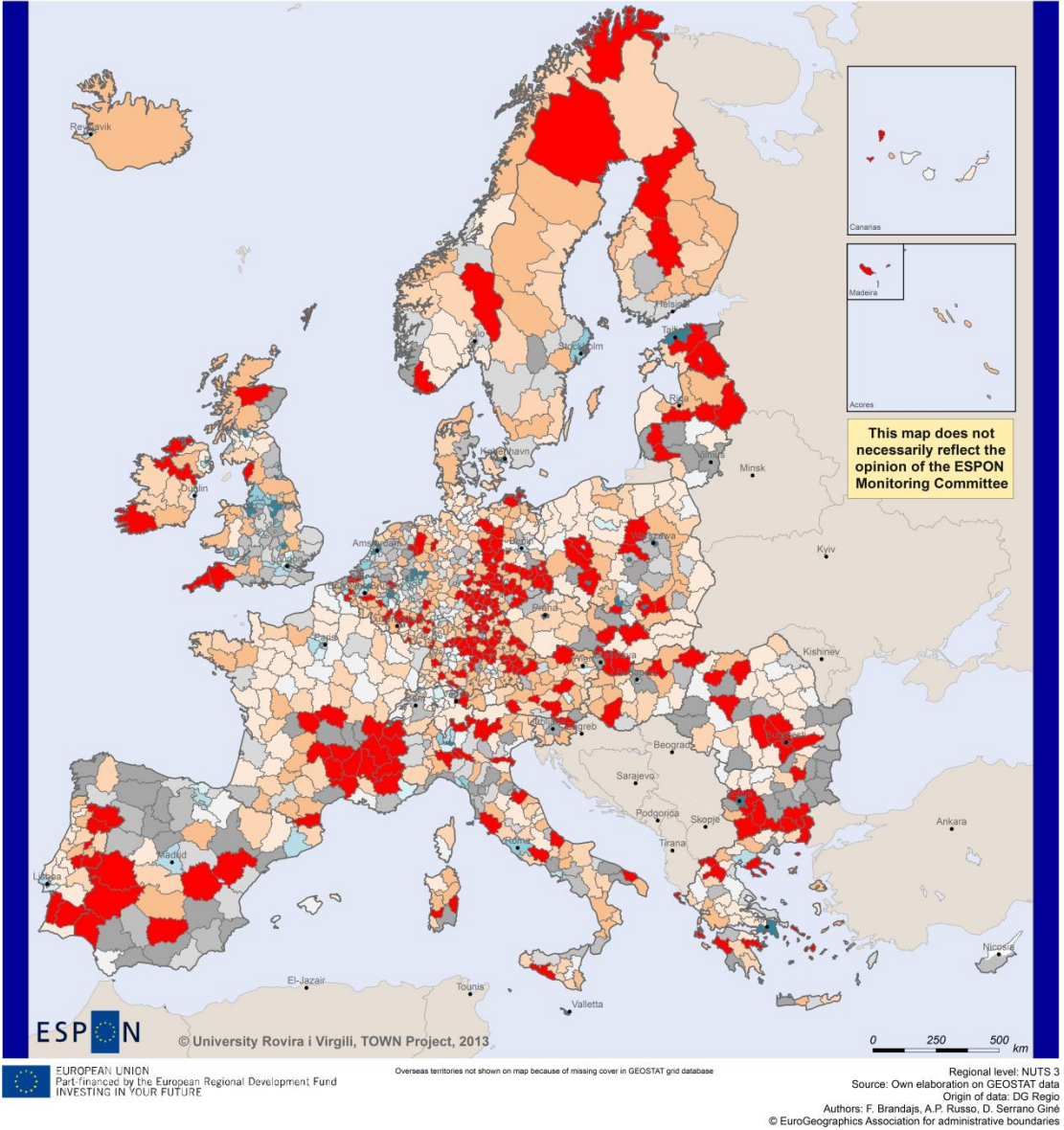
There are notable regional variations in the pattern described in Figure 22. In three countries at the EU core, like Germany, France, and Austria, as well as in some countries at the periphery (Ireland, Latvia, Norway, Portugal) less urbanised regions have grown significantly more than others in this period, while in Bulgaria, Romania and Denmark p.c. GDP growth has become significantly higher in more urbanised regions; the rest of the countries exhibit non-significant correlations between these two dimensions.

Again we look at a hotspot map (Figure A3 in the Annex) to capture some of the more general EU trends. The picture indeed results quite different from that nuanced in Figure A1 indicating EU trends of population growth; except from Scandinavia, the two maps are almost the 'negative' of one another. Thus a cold spot of relatively decreasing per capita GDP traverses the core of Europe from Ireland and Denmark to Greece and the Italian south, while there are hot spots at the eastern periphery in Romania, Latvia and central Poland, plus a local hotspot in central-southern France and a general above-average growth in some sparsely populated regions in Sweden and neighbouring Norway. The macro-trend of the 2000 decade is thus one of convergence, by which the eastern European regions, and 'Objective 1' regions in the west have done much better in terms of per capita wealth than the EU core; regions with a lower degree of urbanisation have gone along.

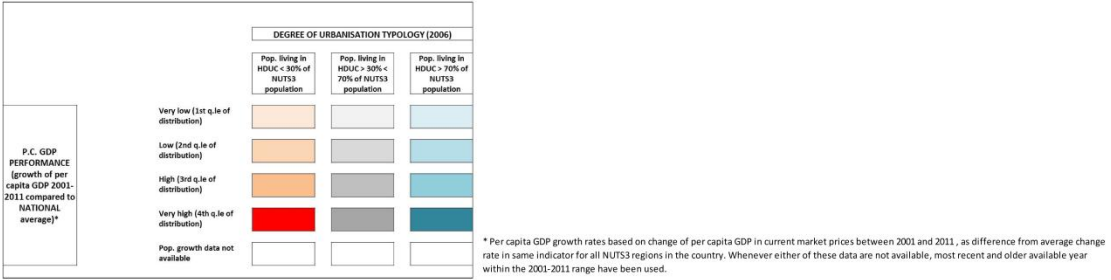
Again, the general picture changes significantly when GDP growth is compared to each country's average (Figure 23). Per capita GDP growth 2001-11 is on average positive in regions with a lower degree of urbanisation and negative in those with a higher degree, and the difference is significant (see Table A6 in the Annex). This map evidences that the growth in per capita wealth of regions with a lower degree of urbanisation in Belgium, Germany and Austria is at the expenses of metropolitan regions in the same countries including the neighbouring 'intermediate' regions. In Spain and Portugal, 'intermediate' regions are those that do worst. Conversely, the growth in less urbanised regions in Slovakia, Hungary, Poland, Bulgaria and Greece occurs at the expenses of remote rural areas. The UK is characterised by polarization of growth in the extreme opposite regional types, i.e. in both the main urban areas and in the smaller settlements regions, at the expenses of those regions in which the population is evenly distributed in high urban clusters and smaller settlements. France comes out patchy to this respect, with a strong role of the second-tiers urban poles. In any case it should be pointed out how peripheral regions that are tourist destinations (especially domestic) in core areas do particularly well: it is the case of Cornwall and the Lake District in the UK, the Southern Central region in France, the West of Germany, some provinces in Sardinia and Sicily as well as the Alpine regions in Italy.

Figure A4 in the Annex provides hotspot values in this complex territorial pattern; the general trend is that of a re-equilibrium of wealth in many countries in the West and the Centre, where the rural periphery does better than the core and less urbanised regions are at the forefront of this trend; conversely, the breach seems to widen at the south-eastern edge of Europe, where regions characterised by lower degrees of urbanisation are left behind in a typical ongoing metropolisation process of these economies. Significant 'national' hotspots are thus found in the south of France, Eastern Germany through the Polish west, the south of Norway, Estonia and Western Bulgaria; interesting local phenomena regard areas in Spanish Galicia, Apulia, central Sardinia, southern Greece and northern Scotland.

Figure 23 - P.c. GDP growth scores in regional types by degree of urbanisation (dev. from nat. average)



Typology based on p.c. GDP change rates 2001-2011 as a difference from the national (NUTS0) average



CONCLUSIONS

This long paper provided information on the process and outcomes of obtaining an 'objective' geography of urbanization in the EU and partner countries as carried out within the ESPON 2013 'TOWN' project, identifying typologies of urban areas consistently with previous efforts by DG Regio and OECD but focusing on the smaller urban size.

This has allowed a preliminary global analysis of territorial trends, which looks at regions characterised by different degrees of urbanisation (and typified accordingly) and measures their comparative performances throughout the 2000 decade, first considering the macro European patterns and thus providing insight on general trends regarding the role of less urbanised regions in some of the macro-phenomena which took place in that decade (and which are beginning to reverse, at least in part, near the end of the decade as a consequence of the economic downturn produced by the global financial meltdown of 2007): namely, the general shift of population from 'grey' to 'sunny' Europe, the suburbanisation trends in the west and the metropolisation in the east, as well as the uneven wealth redistribution between metropolitan areas and other regions. Moreover our comparative analysis within national contexts allowed us to pick 'local' phenomena and notable national variations on such global patterns.

This research is but a first step of a more thorough analysis of the roles and performances of small and medium sized cities within their territorial contexts as carried out by TOWN at the finer scale of 'urban settlements' through a manipulation of local (LAU2) data, however it provides the main input (the identification and classification of such polygons) and a broader outlook which TOWN could not perform but in a limited number of case study regions. Moreover this 'morphological' approach needs to be complemented by thorough analysis of the functional relations between urban centres.

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ANNEX

Table A1 – Statistical analytics: Predominant settlement type in terms of population hosted * typology of regions in industrial transition membership

		Predominant settlement type in terms of population hosted			Total
typ_indtrans		Pop in HDUC 2006 < 30%	Pop 2006 in HDUC 30%-70%	Pop 2006 in HDUC > 70%	
A1 Region with industrial branches losing importance	Count	361	161	106	628
	% within typ_indtrans	57.5%	25.6%	16.9%	100.0%
A2 Region with industrial branches gaining importance	Count	38	10	2	50
	% within typ_indtrans	76.0%	20.0%	4.0%	100.0%
A3 Region with internal industrial structural change	Count	116	35	11	162
	% within typ_indtrans	71.6%	21.6%	6.8%	100.0%
B Area not covered by typology	Count	263	109	126	498
	% within typ_indtrans	52.8%	21.9%	25.3%	100.0%
Total	Count	778	315	245	1338
	% within typ_indtrans	58.1%	23.5%	18.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	43,875 ^a	6	.000
Likelihood Ratio	48.348	6	.000
N of Valid Cases	1338		

Table A2 – Statistical analytics: Predominant settlement type in terms of population hosted * typology of regions in industrial transition membership (association analysis)

typ_indtrans * TYP_NUTS3_A1 Crosstabulation						
			TYP_NUTS3_A1			Total
			1	5	6	
typ_indtrans	A1	Count	361	161	106	628
		Expected Count	365.6	147.4	115.0	628.0
		% within typ_indtrans	57.5%	25.6%	16.9%	100.0%
		% within TYP_NUTS3_A1	46.3%	51.3%	43.3%	46.9%
		% of Total	27.0%	12.0%	7.9%	46.9%
	A2	Count	38	10	2	50
		Expected Count	29.1	11.7	9.2	50.0
		% within typ_indtrans	76.0%	20.0%	4.0%	100.0%
		% within TYP_NUTS3_A1	4.9%	3.2%	.8%	3.7%
		% of Total	2.8%	.7%	.1%	3.7%
	A3	Count	116	35	11	162
		Expected Count	94.3	38.0	29.7	162.0
		% within typ_indtrans	71.6%	21.6%	6.8%	100.0%
		% within TYP_NUTS3_A1	14.9%	11.1%	4.5%	12.1%
		% of Total	8.7%	2.6%	.8%	12.1%
	B	Count	264	108	126	498
		Expected Count	289.9	116.9	91.2	498.0
		% within typ_indtrans	53.0%	21.7%	25.3%	100.0%
		% within TYP_NUTS3_A1	33.9%	34.4%	51.4%	37.2%
		% of Total	19.7%	8.1%	9.4%	37.2%
Total		Count	779	314	245	1338
		Expected Count	779.0	314.0	245.0	1338.0
		% within typ_indtrans	58.2%	23.5%	18.3%	100.0%
		% within TYP_NUTS3_A1	100.0%	100.0%	100.0%	100.0%
		% of Total	58.2%	23.5%	18.3%	100.0%

**Table A3 – Statistical analytics: Predominant settlement type in terms of population hosted *
population growth in NUTS3 regions as deviation from EU average**

Deviation of population growth rates from EU-27 average

	95% Confidence Interval for Mean		Minimum	Maximum
	Lower Bound	Upper Bound		
Pop in HDUC 2006 < 30%	-,0353223	-,0230233	-,59037	,95731
Pop 2006 in HDUC 30%-70%	-,0056481	,0136180	-,29846	,39755
Pop 2006 in HDUC > 70%	-,0077142	,0072951	-,20022	,18615
Total	-,0205822	-,0115441	-,59037	,95731

ANOVA test

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,322	2	,161	23,428	,000
Within Groups	9,171	1335	,007		
Total	9,493	1337			

Multiple Comparisons

(I) Typology based on degree of urbanisation	(J) Typology based on degree of urbanisation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Pop in HDUC 2006 < 30%	Pop 2006 in HDUC 30%-70%	-,03315774*	,00553522	,000	-,0440164	-,0222991
	Pop 2006 in HDUC > 70%	-,02896323*	,00607204	,000	-,0408750	-,0170515
Pop 2006 in HDUC 30%-70%	Pop in HDUC 2006 < 30%	,03315774*	,00553522	,000	,0222991	,0440164
	Pop 2006 in HDUC > 70%	,00419451	,00706033	,553	-,0096560	,0180451
Pop 2006 in HDUC > 70%	Pop in HDUC 2006 < 30%	,02896323*	,00607204	,000	,0170515	,0408750
	Pop 2006 in HDUC 30%-70%	-,00419451	,00706033	,553	-,0180451	,0096560

*. The mean difference is significant at the 0.05 level.

Table A4 – Statistical analytics: Predominant settlement type in terms of population hosted * population growth in NUTS3 regions as deviation from national average

Deviation of population growth rates from national average

	95% Confidence Interval for Mean		Minimum	Maximum
	Lower Bound	Upper Bound		
Pop in HDUC 2006 < 30%	-,0205734	-,0104534	-,54938	,99830
Pop 2006 in HDUC 30%-70%	-,0009372	,0137106	-,20108	,27943
Pop 2006 in HDUC > 70%	,0006308	,0141475	-,15923	,22714
Total	-,0098317	-,0024961	-,54938	,99830

ANOVA test

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,163	2	,081	17,823	,000
Within Groups	6,091	1335	,005		
Total	6,253	1337			

Multiple Comparisons

(I) Typology based on degree of urbanisation	(J) Typology based on degree of urbanisation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Pop in HDUC 2006 < 30%	Pop 2006 in HDUC 30%-70%	-,02190014*	,00451086	,000	-,0307493	-,0130510
	Pop 2006 in HDUC > 70%	-,02290255*	,00494833	,000	-,0326099	-,0131952
Pop 2006 in HDUC 30%-70%	Pop in HDUC 2006 < 30%	,02190014*	,00451086	,000	,0130510	,0307493
	Pop 2006 in HDUC > 70%	-,00100242	,00575373	,862	-,0122898	,0102849
Pop 2006 in HDUC > 70%	Pop in HDUC 2006 < 30%	,02290255*	,00494833	,000	,0131952	,0326099
	Pop 2006 in HDUC 30%-70%	,00100242	,00575373	,862	-,0102849	,0122898

*. The mean difference is significant at the 0.05 level.

Table A5 – Statistical analytics: Predominant settlement type in terms of population hosted * p.c. GDP growth in NUTS3 regions as deviation from EU average

Deviation of per capita GDP growth rates from EU-27 average

	95% Confidence Interval for Mean		Minimum	Maximum
	Lower Bound	Upper Bound		
Pop in HDUC 2006 < 30%	,2874065	,3468089	-,22658	3,18747
Pop 2006 in HDUC 30%-70%	,2744701	,3826848	-,22130	2,61671
Pop 2006 in HDUC > 70%	,0718684	,1517982	-,33615	2,64671
Total	,2591908	,3052499	-,33615	3,18747

ANOVA test

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8,737	2	4,368	24,524	,000
Within Groups	237,797	1335	,178		
Total	246,534	1337			

Multiple Comparisons

(I) Typology based on degree of urbanisation	(J) Typology based on degree of urbanisation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Pop in HDUC 2006 < 30%	Pop 2006 in HDUC 30%-70%	-,01146978	,02818564	,684	-,0667627	,0438232
	Pop 2006 in HDUC > 70%	,20527433*	,03091917	,000	,1446189	,2659298
Pop 2006 in HDUC 30%-70%	Pop in HDUC 2006 < 30%	,01146978	,02818564	,684	-,0438232	,0667627
	Pop 2006 in HDUC > 70%	,21674411*	,03595163	,000	,1462163	,2872719
Pop 2006 in HDUC > 70%	Pop in HDUC 2006 < 30%	-,20527433*	,03091917	,000	-,2659298	-,1446189
	Pop 2006 in HDUC 30%-70%	-,21674411*	,03595163	,000	-,2872719	-,1462163

*. The mean difference is significant at the 0.05 level.

Table A6 – Statistical analytics: Predominant settlement type in terms of population hosted * p.c. GDP growth in NUTS3 regions as deviation from national average

Deviation of per capita GDP growth rates from national average

	95% Confidence Interval for Mean		Minimum	Maximum
	Lower Bound	Upper Bound		
Pop in HDUC 2006 < 30%	-,0002862	,0279321	-,65172	2,47315
Pop 2006 in HDUC 30%-70%	-,0095327	,0320381	-,55648	1,13114
Pop 2006 in HDUC > 70%	-,0529811	-,0074961	-1,05048	1,52946
Total	-,0052849	,0155845	-1,05048	2,47315

ANOVA

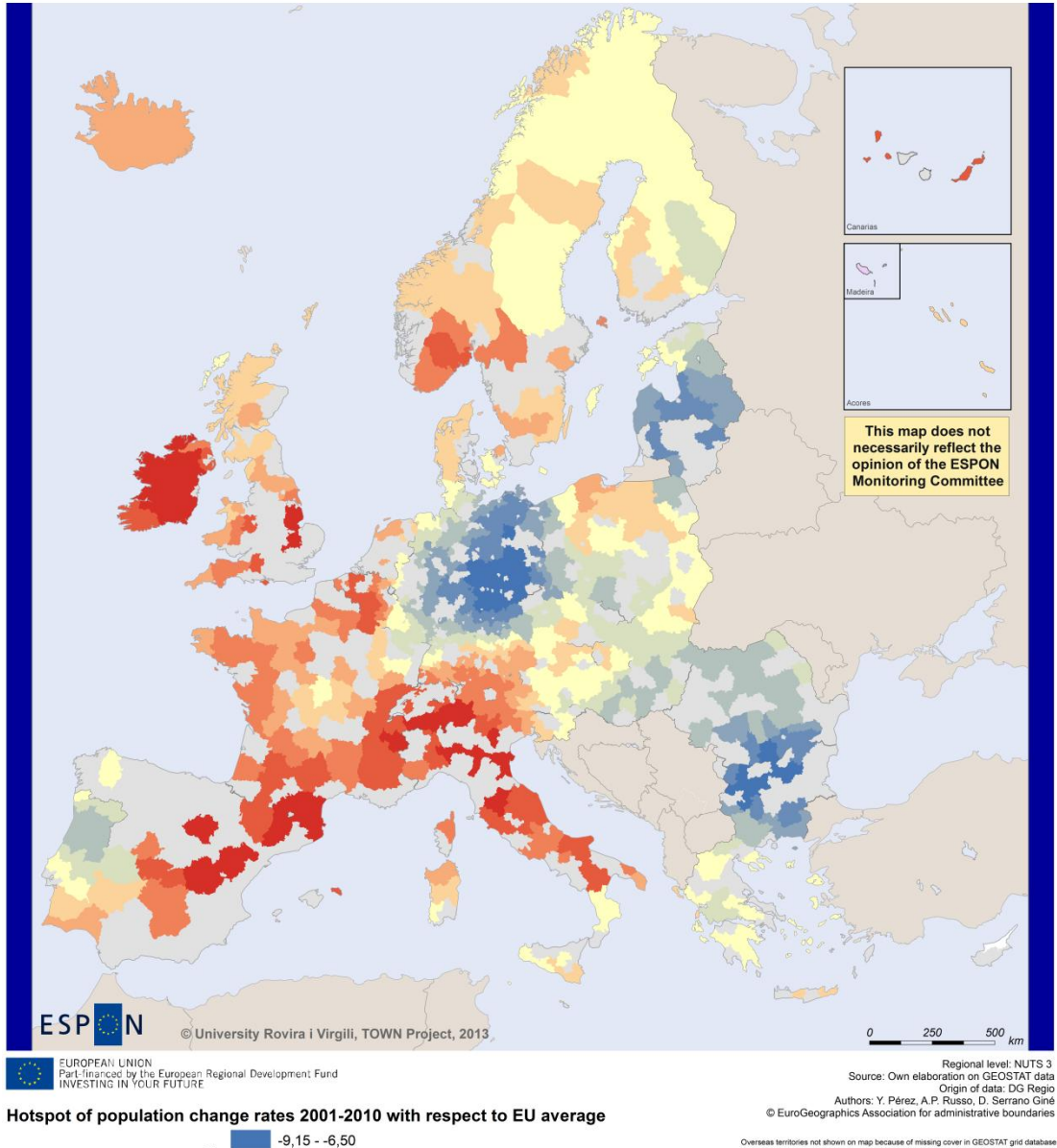
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,377	2	,189	5,010	,007
Within Groups	50,236	1335	,038		
Total	50,613	1337			

Multiple Comparisons

(I) Typology based on degree of urbanisation	(J) Typology based on degree of urbanisation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Pop in HDUC 2006 < 30%	Pop 2006 in HDUC 30%-70%	,00257028*	,01295488	,843	-,0228438	,0279844
	Pop 2006 in HDUC > 70%	,04406156*	,01421128	,002	,0161827	,0719404
Pop 2006 in HDUC 30%-70%	Pop in HDUC 2006 < 30%	-,00257028	,01295488	,843	-,0279844	,0228438
	Pop 2006 in HDUC > 70%	,04149128*	,01652433	,012	,0090748	,0739078
Pop 2006 in HDUC > 70%	Pop in HDUC 2006 < 30%	-,04406156*	,01421128	,002	-,0719404	-,0161827
	Pop 2006 in HDUC 30%-70%	-,04149128*	,01652433	,012	-,0739078	-,0090748

*. The mean difference is significant at the 0.05 level.

Figure A1 – Hot and cold spots of population change (as dev. from EU average) for regions characterised by a lower degree of urbanisation



Hotspot of population change rates 2001-2010 with respect to EU average

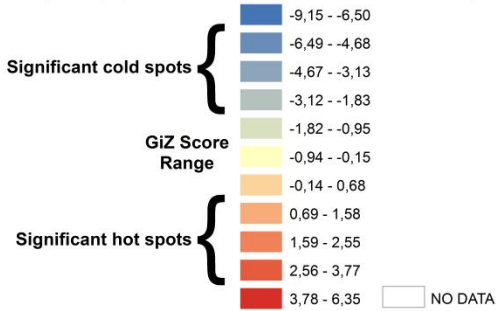
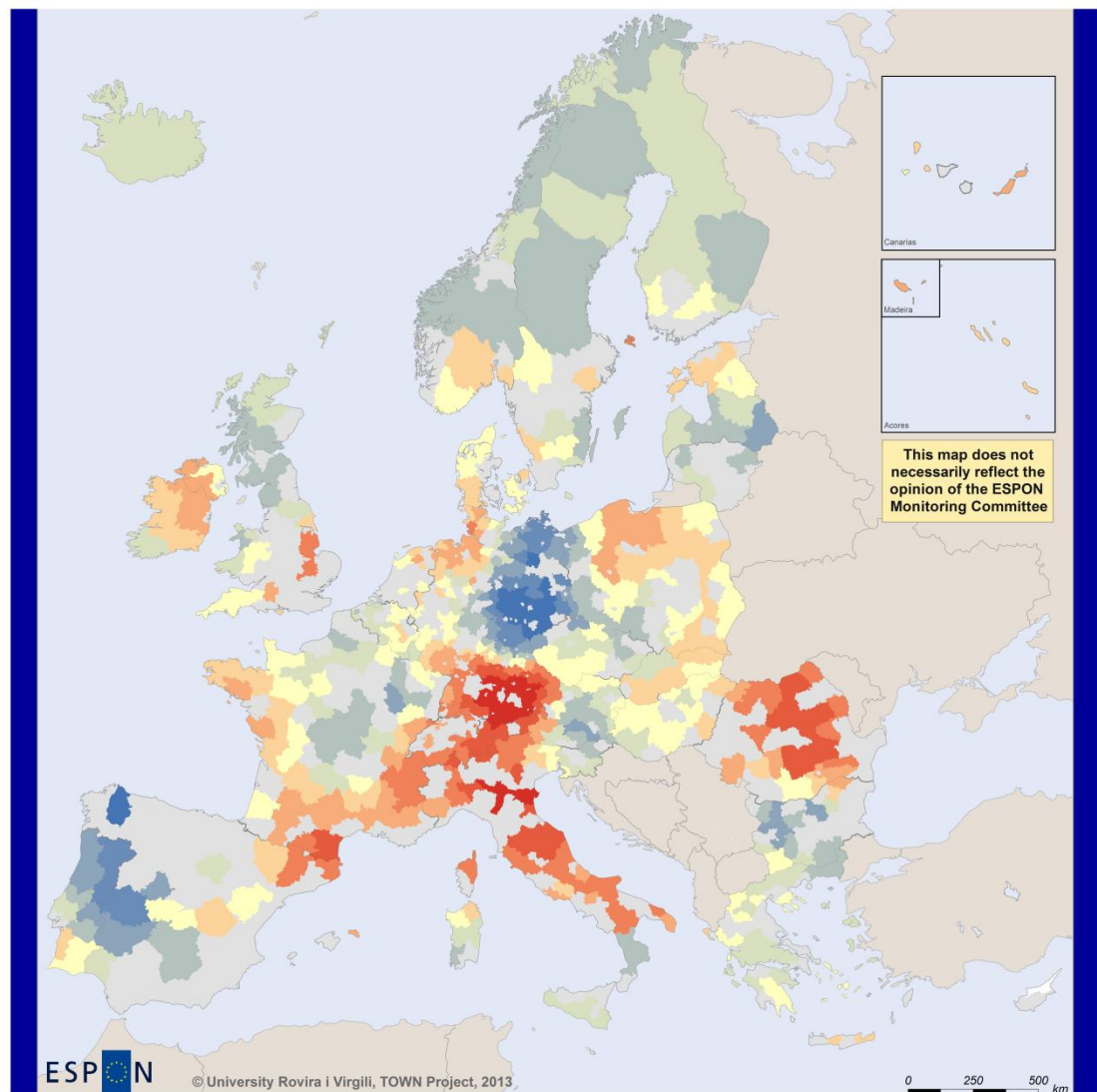
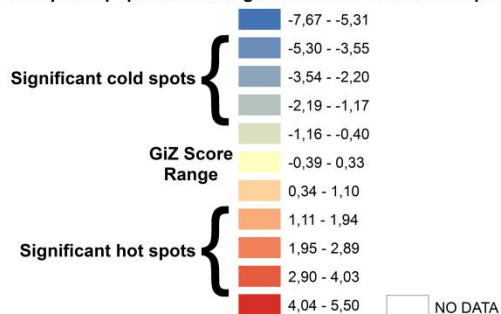


Figure A2 – Hot and cold spots of population change (as dev. from national average) for regions characterised by a lower degree of urbanisation



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Hotspot of population change rates 2001-2010 with respect to national average



Regional level: NUTS 3
Source: Own elaboration on GEOSTAT data
Origin of data: DG Regio
Authors: Y. Pérez, A.P. Russo, D. Serrano Giné
© EuroGeographics Association for administrative boundaries
Overseas territories not shown on map because of missing cover in GEOSTAT grid database

Figure A3 – Hot and cold spots of p.c. GDP change (as dev. from EU average) for regions characterised by a lower degree of urbanisation

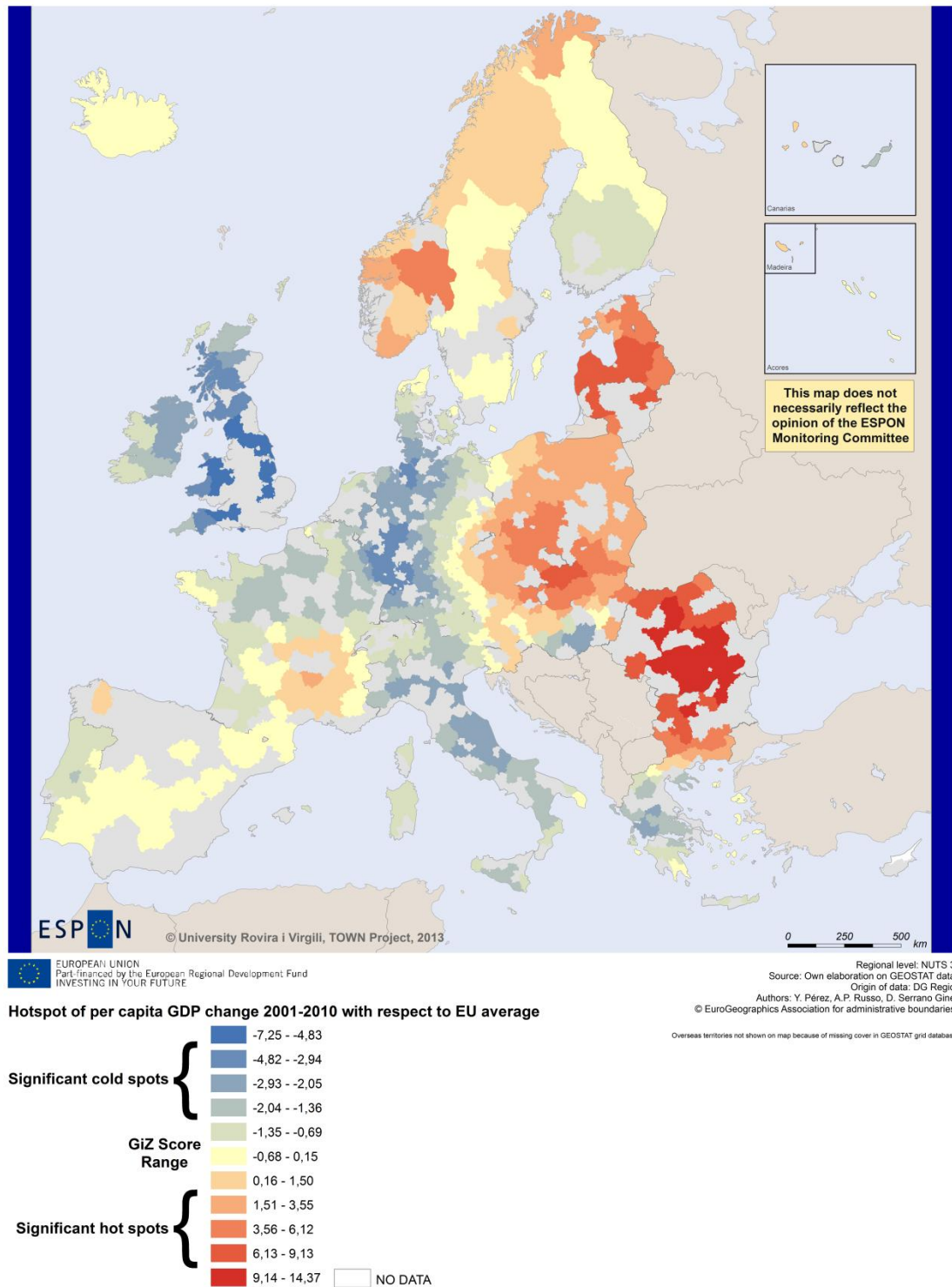


Figure A4 – Hot and cold spots of p.c. GDP change (as dev. from national average) for regions characterised by a lower degree of urbanisation

