

DELIMITATION AND CHARACTERIZATION OF NEW URBAN SPACES IN VALENCIA¹

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Urban expansion, along with the widespread of residential and economic decentralization processes, has created a new model of low density city characterized by the difficulty of establishing its precise boundaries. This makes difficult measuring and analyzing the urban phenomena, and thus the establishment of typologies and interpretations of the predominant processes in different types of cities, aspects that are relevant for developing well supported management and planning proposals. In this paper we applied a method of delimitation with a morphological basis that is especially suited to capture this type of urbanization, as it takes into account both continuous urban spaces as discontinuous. The method is based on the density of roads taken from a commercial source, and therefore easily upgradeable.

Assuming that urban growth has a close inter-relationship with communication networks, we make an approach to the delimitation of urban areas using a series of indices related to the density of these networks. It is considered that spatial interactions defined by different types of network, including the road network infrastructure, are in the core of the definition of the new concept of the city. Therefore, this would be a morphological delimitation method, but more adapted to the new city model given that indirectly it refers to the functional relationship between spaces.

The proposed method is based on developed by Salom and Albertos (2010), which in turn was inspired by the work of Borruso (2003) for the delimitation of urban areas in the UK and Italy. The hypothesis is that density of streets and roads, measured from the number of intersections (nodes) of the network is an indicator of the volume of flows and is closely related to the existence of an specific urban morphology. That is, urban areas are characterized by a communications network with a higher density of intersections than non-urban areas. According to this hypothesis, it would be possible to use density ratios of network intersections to define the boundaries of the urban areas and therefore analyze their evolution and growth dynamics.

In order to evaluate the utility of this method and its ability to capture and characterize the urban reality, it has been applied to a Spanish region, -Valencian Community-, which showed a particularly intense increase of its urban spaces in recent years. In this region, the process of suburbanization has affected not only major cities but also

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medium-sized cities and other interstitial spaces. Between 1987 and 2000, according to data from the Corine Land Cover project, increasing sealed soil, -built or artificialised- was 52.1%, well above the national or European average-. 41.4% of this growth came from urban areas, especially those characterized by dispersed and low density patterns; so the discontinuous urban fabric (scattered or green urban areas) grew by 48% and sparse urban structures 103.5% while the compact urban fabric only increased by 8.5% (Observatory of Sustainability in Spain, 2006: 345 and 346).

The primary data we have used is the intersections (junctions) included in the cartography of the road network database Teleatlas elaborated by the company Multinet Spain, which contains information updated to July 2007 in a shape-format usable by both major GIS. The road network is classified into eight levels, from major intercity links to the streets of urban centers. We believe that this database, given to its business purpose, intended to be exhaustive and is constantly being updated, so it may be useful to periodically review the results of the delimitation, allowing comparisons over time and monitoring the urbanization process. Information from this source was contrasted with land use mapping from satellite images (Corine Land Cover Spain, 2000) to determine the most appropriate junction density indices for delimitation.

The methodology consists of four steps: a) Selection and calculation of indices of network density. b) Definition of thresholds associated with each type of land use. c) Definition of urban spaces from the thresholds identified in the previous step and aggregation of neighboring spaces², and d) Characterization of the resultant urban spaces and detection of processes associated with different types of urban growth. The analysis was performed using geographical information systems³. In previous work, the application of this methodology to the delimitation of eight Spanish metropolitan urban areas⁴ concluded that the network density index allowed to show very accurately the continuous urban fabric even in small towns and villages which, given its small surface, were poorly reflected in the land use map produced by remote sensing. The index also allowed, although not so well, to delimitate the discontinuous urban fabric identified from the land use mapping. On the contrary, it was not considered suitable for the detection of all industrial and commercial spaces, unless they are attached or in close proximity to the urban continuous.

The application of this method to Valencia allowed us to define two types of urban spaces: the "*Urban Area*" –properly speaking-, defined by an index of network density exceeding 100 intersections/Km², and what we call "*Urban Continuum*" defined by the isoline of 40 intersections/Km². The first mentioned index (100) includes almost all continuous urban spaces, but leaves out an important part of discontinuous urban spaces. The second includes urban spaces both continuous and discontinuous, and a significant part of the industrial and commercial spaces adjacent to these. That is, the application of the index 100 results in an urban area better adjusted to the traditional

² We have aggregated neighboring areas when the non-urban interstitial separation between peripheries (residential, industrial and services) implies a distance of less than 1 km, distance usually considered coincident with the isochrone of 15 minutes walking trips, quintessential exponents of urban mobility (Conselleria d'Obres Públiques, 1995, p.3).

³ We used the 9.2 version of ArcGIS (ESRI), and in particular the Spatial Analyst module for calculating Kernel density indices, interpolation and manipulation of the density contours and the zonal calculation needed for statistical analysis of the results. The methodology is described with more detail in Salom and Albertos (2010).

⁴ Salom Carrasco, J. y Albertos Puebla, J. M. (2010).

compact city, while the benchmark 40 allows defining continuous urban sprawl areas including mostly residential, but also some industrial and commercial uses and the conurbations derived from the coalescence of small and medium nuclei close to the metropolitan areas. We have detected 603 *Urban Areas*, 122 of them supramunicipal, which includes a total of 88,500 hectares, ie, 3.8% of the regional surface of the region total area of the region, and 631 *Urban Continuums*, 107 of them in supramunicipal, occupying the 12'8% of the regional area (297,640 ha.).

The analysis of the distribution of land uses according to CORINE in each one of the above defined urban spaces (*Urban Areas* and *Urban Continuums*) has showed some evidences. In the case of *Urban Areas* there is a high degree of silting, since artificial surfaces occupy very high percentages of delimited space, often above 70%. The level of artificiality is particularly high in the case of coastal urban areas, with a strong presence of tourism and second homes, reaching the artificial surface levels close or above to 90%. In these coastal urban areas there are also, as in the case of major metropolitan areas (Valencia, Alicante ...), a greater presence of discontinuous urban fabric, coming to sum up more than 70% of artificial soil.

Moreover, the defined *Urban Continuums* show larger territorial structures; they are less dense than previous *Urban Areas*, but despite this they do not lack cohesion. They also offer a view of the extent has reached diffuse urbanization, which in the Valencian Community affects 13% of the whole territory. Despite their large number, the eleven largest account for 80% of the total urban space and 90% of the population living in the region. The most important is that of Valencia, with over 2 million people and 1083 square kilometers, followed by the Elx-Orihuela, (609 000 inhabitants and 415 km², extending beyond regional boundaries and entering the region of Murcia), and the Gandia case (401 000 inhabitants and 405 km²). As in the case of *Urban Areas*, this scale of analysis makes possible to observe the vastness reached by discontinuous urban fabrics in the southern coast of Valencia: Santa Pola (40%), Elx-Orihuela (46%), Benidorm (64%), Xàbia-Altea (89%). The figures obtained by the *Urban Continuums* in the south of the region are always above the average for this type of space and quite higher than the rates achieved by both major agglomerations (Valencia, 31%), and urban spaces of the interior and north of the Community (Alcoi, 16%; Borriana-Nules, 18%; Elda-Petrer, 31%; Castelló, 31%).

Finally, we have proposed a characterization of these urban spaces taking into account the calculated density index of the communications network and assuming that index is a good and effective indicator to compare the morphology of different areas. The resulting broad territorial pattern is showing a double dichotomy inland/coastal and north/south; the inland and northern towns of the region have higher average densities and, therefore, a more dense model, while urban areas located on the coast and/or in the southern half of the region show smaller average densities and therefore a predominance of low density morphological models. From the main statistical indicators, it was possible to distinguish four types of urban regions (see fig. 10):

- a) *Urban Continuums* showing a homogeneously dispersed character, including low density *Urban Areas* as well as sparse and scattered urbanizations (touristic or second home areas) For the most part, they are located in the coastal areas of the provinces of Alicante and Castellón.

- b) *Urban Continuums* showing a dispersed character, but with significant internal differences. These spaces are dominated by urban sprawl processes, but also include relatively compact urban centers. This group includes both urban spaces that have potent central towns like Valencia or Elx-Orihuela, and inland spaces with small and compact urban centres affected by suburbanization processes in their peripheries.
- c) *Urban Continuums* showing a homogeneously compact character. It includes relatively compact urban cores that have not experienced significant suburbanization processes: Alicante, Alcoy, Castellón...
- d) *Urban Continuums* showing a compact character, but with some internal inequalities generated by some low density urbanization processes. For the most part, these urban regions are built around medium-sized cities of Castellon and Alicante which have experienced suburbanization processes in its neighborhood.

The results of this work demonstrates that the proposed methodology based on the road network density is feasible to carry out the analysis and measurement of the urban growth processes linked to the extension of the sprawling city, such as the extension of the urban discontinuous fabric or the suburbanization of productive and service functions. It is also proposed a first characterization of the delimited spaces (*Urban Areas* and *Urban Continuums*) depending on these network density indicators and making possible to differentiate between territories where low density urbanization dynamics dominate, territories having clearly denser morphologies, and those of a mixed character. Therefore, we think that, after adjusting the density ratios considering different land uses and territorial realities, and always relying on updated information of the road network, this tool could allow real-time monitoring of urban sprawl processes without having to wait updating the land use cartography.