SPATIALIZATION OF TOURISM DATA AT DETAILED SCALES (ANDALUSIA, SPAIN)

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In Spain, due to technical and legal reasons, the municipality is the maximum level of disaggregation of socioeconomic data. This is an important constraint for tourism and geographic research, especially for those which deal with detailed scales. The aim of the work is to develop a method to spatialize tourism parameters: regulated places and residential capacity. This has been implemented on the Coast of Andalusia (Spain). For regulated offer a semi-automatic process has been developed, locating every facility and their main characteristics (nº of places). In the other hand dasymetric-mapping tools have been implemented to estimate the residential capacity of every building. As immediate results a high detailed spatialization of tourist places (hotels, campings, etc.) and residential capacity is presented. As conclusion, once these data bases are spatialized applied studies can be developed: beach attendance and carrying capacity research, assessment on sea level rise impacts, etc.

1. Introduction

Studies of vulnerability, developed by International, National and Regional institutions (Intergovernmental Panel on Climate Change, National Plan for Adaptation to Climatic Change, etc.) frequently are not performed to detailed scale. It carries limitations to assess the impacts linked to climate change. By

other hand, in absence of detailed data, carrying capacity studies often rely on indirect indicators to calculate the occupation of certain tourism resources.

The Spanish Law of protection of data does not allow disaggregating socioeconomic data, limiting the studies to the scale level of administrative entities. In the case of tourism -a very important sector in Andalusia (S of Spain) where a remarkable development of tourism have been experienced in the last decades- the municipality is the maximum disaggregation entity for regulated tourist places. Moreover, unregulated spaces (holiday homes) have not even been calculated nor estimated. This legal limitation involves an important disadvantage in most of the tourism analysis, and especially in those works dealing with high detailed scales.

The aim of this work is to develop a methodology to spatialize regulated and unregulated offer at detailed level in the Andalusian Coast. The analysis is performed by the use of geocoding software and dasymetric mapping. The obtained result might improve various studies including: the input of data for vulnerability to climate change and sea level rise, or the estimations of beach attendance and tourism carrying capacity works.

2. Study Area: The Coast of Andalusia

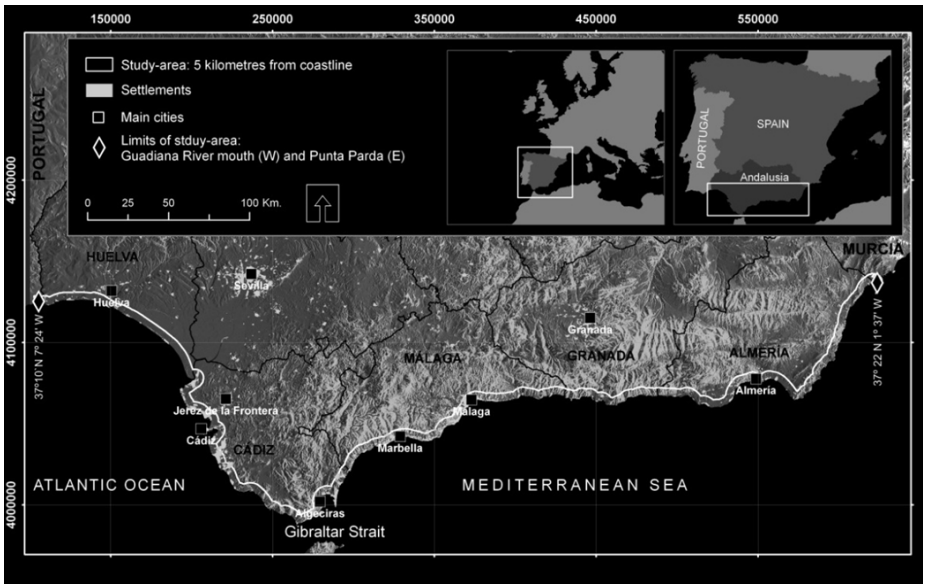
The Study-area is the Coast of Andalusia (Spain). This area is limited by Guadiana river mouth at West (37º10`N 7º 24' W) as the natural boundary with Portugal, and Cala Cerrada at East (37º 22 N 1º 37' W) as an administrative division with the region of Murcia (Figure 1). It extends along 917 km, a 17,5% of the total Spanish coastline. Beaches, essential element of coastal tourism and central object of this work, represent a large percentage of its littoral (67,4%) (Díaz *et al.,* 2012).

This area is clearly divided in 2 parts: Atlantic Coast (open, flat and mesotidal) and Mediterranean Coast (narrow, steep and microtidal). The Atlantic coast corresponds to post-orogenic formations filling of the great depression of the Guadalquivir River, which results in a very flat and extensive coastline with sandy beaches and a powerful natural drift (that generates other coastal physiographies as barrier islands, sand spits and

marshes behind them. The Mediterranean coast is conditioned by the presence of large entity reliefs very close to the coastline. The immediacy of the coastal mountains causes enormous erosive and irregular, spasmodic contribution of large volumes of sediment to the coastal system, with consequent physiographies as gullies, deltas or coarse grained beaches (Ojeda, 2003).

In terms of administration and governance, this space is compartmentalized into 5 provinces (Huelva, Cadiz, Malaga, Granada and Almeria), which in turn are fractionated in 78 coastal municipalities, of which 21 are located on the Atlantic coast and 57 in the Mediterranean. This is an area of high concentration of population: the population of the coastal strip amounts to 3,019,042 inhabitants (2011), which means about 37% regional, while its extension represents only 20% of the area of Andalusia (Own from INE, 2013).

Figure 1: The Coast of Andalusia



Finally, with respect to the human occupation of the territory, the study area is noted for its significant role in the biggest wave of urbanization in Spain, called as the "Spanish urban tsunami" (Garcia Bellido, 2005). As in the whole Mediterranean coast, urbanized land increased just been based on the demographic dynamism, but, among others, in the generation of large production of residential and tourist spaces, where the increasing

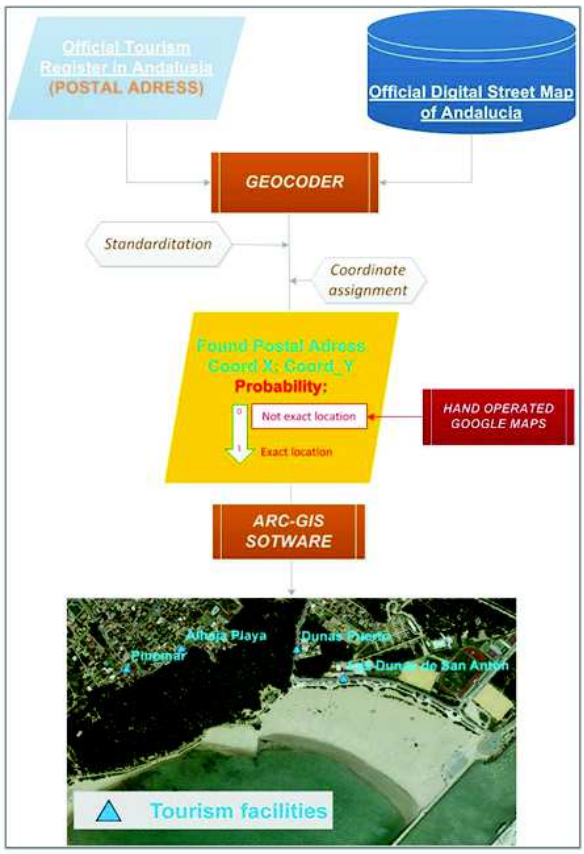
value of coastal land and real estate speculation have dominated the phenomenon (Fernández Durán, 2006; Vera and Rodriguez, 2010; Naredo and Montiel, 2011).

3. Methods

Spatialized regulated tourism data in the coast of Andalusia at detailed scale were obtained using the Software "Geocoder" performed by Junta de Andalucía (Zabala et al., 2010).

The Official Registry of Tourism of Andalusia provide with the address of every regulated accommodation facility: Hotels, Tourist Apartments, Campings, Rural Houses, among others. Geocoder application works mainly in 2 steps (Figure 2): 1. Standardization of postal addresses of each tourism facility and 2. Assignment of their coordinates through a comparison of their addresses to existing adresses in the Official Digital Streets Map in Andalusia (Moreno, 2011).

Figure 2: Spatialization method for regulated places



In order to accurate the results, this tool returns a probability value -which ranks between 0 and 1- for each record it, where “1” means exact location and value “0” means not found. Intermediate values represent any coincidence between address searched and address found. In these cases locations were manually assigned (Google Maps, Google Street View, Field Work).

Once all the locations were obtained, each record were filled with thematic data (Name, type of accommodation, category, number of places, etc.) Particularly Total Tourist Places was assigned to every facility.

Regulated places and its spatialization is an essential parameter to calculate vulnerability indicators of the Coast at detailed scales. However the major part of Tourism in the Andalusian Coast corresponds with unregulated places. Thus, spatialization of this data is basic to fully understand the tourism activity and its impact on our coastal environments.

As the first source it was provided, by the Regional Government, the buildings footprints of the study area in 2007. No data apart from geometric characteristics as shape and surface were included. It should be complemented by a second source: An urban land use geodatabase (GDB), owned and developed by the Research Group since 2002. Nowadays this GDB contains geometric and thematic data about the evolution of urban land uses along 9 years of reference, since 1956 to the present. This geodatabase also contains a deep classification of urban typology, from general land uses (residential, industrial, infrastructures, vacant and construction sites, leisure areas) to concrete types of occupation.

The process has been developed into 2 steps (Figure 3): At first, it has been selected only the residential areas in 2007, in order to intersect them with the building footprints, just available for that date. At this moment every building of the study area contains not just geometric information, but also the residential type.

Secondly, based on dasymetric demographic mapping formulas, the residential capacity was estimated following diverse references (Lwin and Murayama, 2009, 2010; Qiu, Sridharan and Chun, 2010; Ural, Hussain and Shan, 2011). According to literature there are 2 methods: areametric, where the only parameter is the area of the building footprint; and volumetric,

which takes into account variables such as the height or the number of plants. This research has used the areametric method for single-family types using the weighting value of 0.4, ie 4 people per 100 square meters. In absence of sources of high accuracy such LiDAR, volumetric method has been implemented in multi-family types using an average coefficient linked to the number of floors (Table 2).

Figure 3: Spatialization method for residential capacity

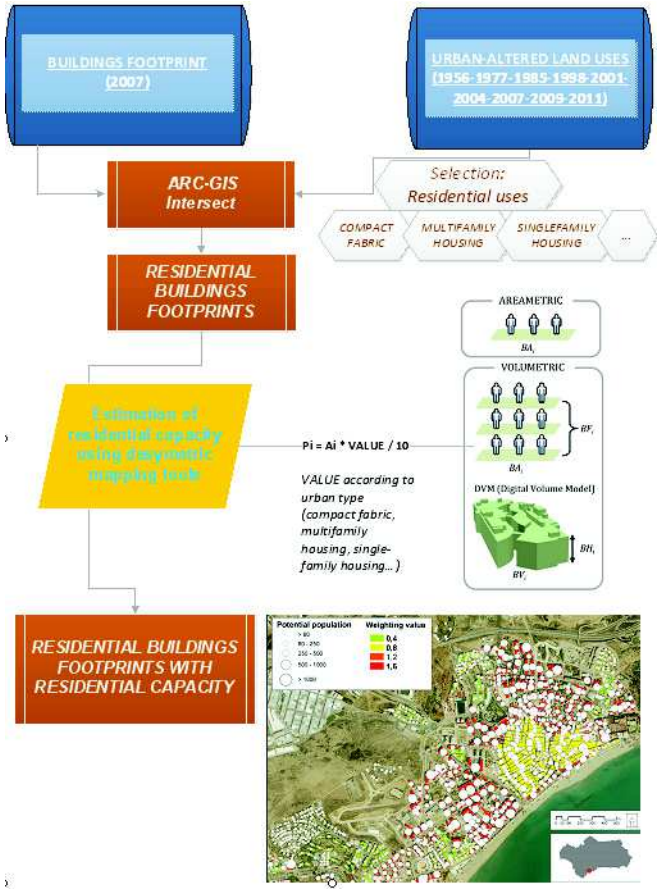


Table 2: Residential types, method and implemented formulas

BUILDING USE TYPE	METHOD	FORMULA
Compact urban fabric - Towns	Areametric	$P_i = A_i * 0.4/10$
Compact urban fabric - Cities	Volumetric	$P_i = A_i * 0.8/10$
Compact urban fabric - Capitals	Volumetric	$P_i = A_i * 1.2/10$
Detached single-family house	Areametric	$P_i = A_i * 0.4/10$
Attached single-family house	Areametric	$P_i = A_i * 0.4/10$
Single family houses in rural areas	Areametric	$P_i = A_i * 0.4/10$
Blocks multi-family	Volumetric	$P_i = A_i * 1.6/10$

4. Results

The immediate result of this research is the spatialization of both parameters at detailed scale: the regulated places (Figure 4) and residential capacity or potential population. Despite the broad area of study, these parameters have a high degree of detail. This allows the display to represent any scale of work, local to regional. In addition, incorporating historical values in the database (both regulated and residential tourism) allows diachronic studies.

Figure 4: Spatialization of regulated places (Torremolinos, Costa del Sol)

A total of 1,666 accomodation facilities and 286,529 regulated places have been spatialized along the coastal area (which means a 63% from a total of 457,534 beds in Andalusia). Hotels, *campings*, apartments and hotel-apartments are, in this order, the main types of accommodation. The resulted average capacity is 53 rooms and 178 beds per facility (excluding campings).

The georeferencing of this variable, performed in this paper, makes possible to obtain more specific locational references, as the average distance between hotels and the distance of these and the sea (the average distance to the sea is 159 m).

By the other hand a total of 6,774,716 would be the potential population of the Coast of Andalusia according to its residential capacity. To validate the method, and the weights used, the calculated total potential population for 2007 was compared with the official population according to the list for this year (INE, 2013). This comparison results in an over-estimation for the potential population of 133% as an average (residential capacity exceeds 133% of the census population). This figure is significant support in other studies where, using various methods, the residential capacity often doubles people officially registered in coastal tourist areas (Navarro, 2005; Geoconyka, 2008).

Table 3: Estimated potential population and census population

Years	a.Estimated Potencial Population	b.Census Population	c.Estimated Floating Population (a-b)
1977	3.703.935	1.705.743	1.998.192
1985	4.242.606	2.184.855	2.057.751
2001	6.057.328	2.516.880	3.540.448
2007	6.774.716	2.905.484	3.869.232

The role of the Andalusian Coast as a tourist destination and holiday explains the gap between official and estimated. Firstly should be considered the significant weight of the floating population, with semi-abandoned villages in winter but collapsed during the summer. Secondly, it has to be regarded the pace in building new homes until 2007 -well above the local and holiday demand- has resulted in thousands of vacant homes (Vinuesa, 2008). Third and last it should be mentioned the permanent residents who are not registered, specifically the “climate immigrants” (Requejo, 2007).

5. Research Perspectives

The work can improve those research framed within the geography of tourism. This discipline set the geographical environment as a condition of this activity, establishes territorial factors of tourism development and destinations spatial models. In an area of high concentration of tourism, as the Coast of Andalusia, municipal disaggregation data remarkably limited such studies. From now on, more precise analysis can be applied to understand the territorial patterns of tourism.

Secondly, this work provides a new dimension to studies of tourism carrying capacity. So far these investigations accepted municipal unbunding, did costly direct accountings of beach-attendance (Hanemann, 1996; Jurado et al., 2009; Wallmo, 2003), or used indirect variables (Tejada et al., 2009) to assess the human pressure on the coastal area. The detailed scale spatialization allows a deeper analysis of the relationship between the resource and the use, e.g., by modeling the population flows to the beaches.

A third alternative would focus on the assessment of the vulnerability of the Andalusian coast to climate change and the potential sea level rise. Together with the spatialization of other environmental variables the futurible impact of this phenomenon can be measured, not just for the tourism facilities but also for the whole residential areas.

Acknowledgements

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