The Spatial Distribution of Floating Population in the Coast of São Paulo, Brasil: a New Approach

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Abstract

The purpose of this study is to estimate the volume and analyze the spatial distribution of the floating population in the coastal area of São Paulo, checking for spatial patterns.

The concept of floating population adopted herein refers to the population that remains temporarily at a specific location, usually for recreational reasons. The floating population can be divided into two groups. The first group corresponds to the population that stays in lodging establishments and the second group corresponds to the population that stays in second homes in the classification of census surveys (GODINHO, 2000). To quantify the first group we considered the average number of people per second home counted by the 2010 Census. The number of persons staying in lodging establishments was estimated using an average number of accommodation units. The spatial data analysis was performed using spatial statistics tools available in ArcMap (ESRI). The selected tool was Hot Spot Analysis, which allows the identification of areas with event concentration.

The results allow the performance of quantitative and qualitative assessments about the seasonal mobility toward the coast of São Paulo, and also open new pathways to explain the occurrence of the spatial distribution pattern found.

Keywords: floating population; second home; coastal zone; spatial analysis.

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Introduction

The objective of this study is to analyze the spatial distribution of the floating population in the coastal area of São Paulo. By doing so, it aims to verify and clarify spatial patterns.

For census purposes, floating population is defined as that which usually lives in a place without a legal basis for this. It includes those who live in a city for some months in the year, despite having a place of usual residence in another city (UN, 2008).

In this study, the focus will be on the population that remains temporarily in a particular location, usually for recreational reasons, family visits or business (GODINHO, 2000). This population is also known as second home population, seasonal population, or tourist population.

Our choice for this specific population is due to our interest in the potential impacts it may cause. That population can affect the services provided by local government, such as water supply, sewerage, solid waste management, transportation, health and safety (MULLER and HALL, 2003). In addition, the fast and unplanned urban growth, arising from real estate development, may cause environmental degradation (PEREIRA et al., 2009).

The coastal region is characterized by a wide variety of environments. Many of them are extremely fragile and particularly vulnerable to the degradation processes caused by the increasing occupation of the coast. The Brazilian coast concentrates 16 metropolitan areas and about 25% of the population in only 7% of the municipalities of the country (MMA, ?).

From the creation and consolidation of the main roads linking the interior and the coast, there was an increase in the population flow between these regions and a great increase in the floating population. The coastal area has suffered with the tourism industry, as second homes encourage urban sprawl and disrupt the social structure of coastal cities (SATO et al., 2010).

In the coastal zone, different types of development drivers and pressures, coupled with the population growth, cause significant environmental changes. Such problems are magnified when considering the effects of climate change,

such as the sea level rise and increased extreme events along the coast (MMA, 2011).

The method developed herein enables the analysis of second home population and provides useful information for urban planning.

Study Area

The coastal region of São Paulo is about 700 km long. It includes 16 municipalities and great part of the remaining Atlantic Forest vegetation in the state.

Historically, the coastal zone of São Paulo was one of the most widely explored and occupied regions in the entire state. It has been the house for many rural communities of settlers and traders since the early colonization times. In the twentieth century, there were several improvements in the region, mainly in the surroundings of Santos. The port infrastructure was expanded in Santos and São Sebastião, a petrochemical and industrial zone was created in Cubatão and several highways were constructed. At this time, many migrants moved to the region, mainly to Santos, due to the opportunities of employment (JAKOB et al., 2006; JAKOB, 2001). These improvements also attracted tourists, who, in turn, boosted the housing market. The market expansion led to an irregular and unplanned urban growth, causing huge environmental impacts in the region (MMA, 2006).

The population of São Paulo increased by approximately 23 million or 230% from 1970 to 2010, from 18 million to more than 40 million inhabitants. The increase in coastal municipalities in the same period was 1.3 million or 275%, from slightly above 700,000 to nearly 2 million inhabitants. That population growth was not accompanied by a well-planned urban infrastructure in many municipalities of São Paulo. Thus, they had to cope with several pressures arising from disordered space occupation. The environmentally protected areas were mostly affected (SÃO PAULO, 2006).

In Figure 1 we can see the coast of São Paulo, with the set of municipalities divided in three regions: the North Coast (Caraguatatuba, Ilhabela, São Sebastião and Ubatuba), the Metropolitan Region of Santos (Bertioga Cubatão,

Guarujá, Itanhaém, Mongaguá, Peruíbe, Praia Grande, Santos and São Vicente) and the South Coast (Cananéia, Iguape and Ilha Comprida).

According to the 2010 Population Census, the Metropolitan Region of Santos is the most populous area of São Paulo coast with 1,664,136 inhabitants. It is followed by the North Coast with 281,779 and the South Coast with 50,092. The whole coastal region of Sao Paulo has 1,996,007 inhabitants.

Figure 1 – Coastal Region of São Paulo, Brazil

Source: Municipal Boundary 2010 – IBGE. Design: authors.

Methodology

In order to perform a quantitative and spatial analysis of the floating population in the study area, we used data from the 2010 Population Census (IBGE, 2011) organized in a Geographic Information System. The territorial units of analysis were the municipality, for the temporal comparison, and the census tract, for the spatial analysis.

The floating population can be divided into two groups: one that stays in lodging establishments and another that stays in households classified as second home in census surveys (GODINHO, 2000).

To quantify and locate the first population group, the present study used the number of accommodation units available in lodging establishments. It used the National Register of Addresses for Statistical Purposes - CNEFE (IBGE, 2011) to select the lodging establishments, classified as hotels, lodges and campgrounds. Since there is no specific data for the study region, the data from the Accommodation Services Survey of the State of Rio de Janeiro (IBGE, 2001) were used. The survey presents an average value of 57 accommodation units in the metropolitan areas. This value was applied to the cities of Santos and São Vicente. For other municipalities, the value found for the recreation regions of the coast of Rio de Janeiro were used, due to their similarity with the study region. The value was 18 accommodation units. Since there are no values to characterize the average amount of housing units for campgrounds, they were not included.

For the second group of the floating population, the number of second homes found by the 2010 Population Census was used. This population is not considered in any kind of administrative registration and it is counted at the site of the primary residence, so it is hard to estimate its volume. The greatest difficulty is to assess the size of the family that occupies the second homes. Studies conducted in Canada showed that 97% of second homes are occupied by extended families, that is, families that do not normally share the same home, except during vacation and holidays (DISTRICT MUNICIPALITY OF MUSKOKA, 2005).

In this study, the second homes and the accommodation units were considered equivalent. This way, they could be summed and a spatial analysis could be conducted. Thus, to obtain the total volume of the floating population, first, the number of second homes was added to the number of accommodation units. Then, this value was multiplied by three, in an attempt to have an approximate value, though speculative. This value approximately corresponds to the average of occupied households in the region and of available beds per accommodation unit in lodging establishments.

The spatial analysis of the data was performed using a GIS application that offers spatial statistics tools. ArcMap (ESRI) was chosen. The method selected was the Moran Index, which allows the identification of areas where there is an

aggregation of homogeneous values, whether high or low. The option "fixed distance" was used for the conceptualization of the spatial relationship, and the value was set at 5 km, which is the lowest value found for spatial clusters identification.

Results

The results of the data processing enable quantitative and qualitative evaluations about the concentration of floating population on São Paulo coast. It also provides new forms of explanation for the spatial distribution pattern found.

The estimated volume of the floating population for the study area was 1,164,201 people. If this population decided to live in the region permanently, we would have 3,160,208 inhabitants at the coast. The volume of the floating population is around 58% of the resident population. These are relevant figures in terms of infrastructure projects such as water supply or solid waste management, even as rough estimates. However, the objective of this work was to show that areas with great concentrations of floating population must also be considered in urban planning, both in terms of the design of services and of the creation of zoning and land use policies.

Analyzing the global figures, we can note that the relationship between the number of total households and second homes remained almost constant, varying from 35.95 to 35.07 in the 2000-2010 period. For the municipalities of the North Coast and Metropolitan Region of Santos, this ratio declined in 2010, except for Bertioga, where it increased. For the municipalities of the South Coast, the relationship between the amount of second homes and the total amount of households remained virtually unchanged, except for Cananéia, where it increased. The values are shown in Table 1.

The number of second homes changed considerably in the same period, (see Figure 2). It is noticed that the older areas of occupation, like the Metropolitan Region of Santos, show a marked decrease in the number of second homes in their larger cities - Santos, São Vicente and Cubatão. This is explained by the fact that those locations are no longer the main areas of attraction for second homes, for people want to escape from busy urban areas and go to more peaceful places, closer to nature. The municipality of Bertioga stands out in this

region, showing a large increase in the amount of second homes. This is probably attributable to its abundant environmental resources. On the North Coast, there are also wide areas of environmental protection and this is probably one of the reasons for the increasing amount of second homes in the region.

With respect to lodging establishments, we do not have data to perform a comparison in the 2000 – 2010 period, but we believe that there was an expansion because of the growth of Brazilian tourism in recent years (IBGE, 2010). Figure 2 shows the estimated average number of accommodation units in lodging establishments for the municipalities of the study area in 2010.

Table 1 - Total private households and second homes, 2000 and 2010

|	A =TOTAL HOUSEHOLDS		B = SECOND HOMES		RATIO = B/A * 100	
	2000	2010	2000	2010	2000	2010
TOTAL	906,313	1,081,673	325,856	379,295	35.95	35.07
NORTH COAST	140,535	181,857	65,651	78,674	46.72	43.26
Caraguatatuba	51,972	64,590	24,795	27,902	47.71	43.20
Ilhabela	9,714	14,540	3,146	4,130	32.39	28.40
São Sebastião	32,792	43,022	13,713	16,606	41.82	38.60
Ubatuba	46,057	59,705	23,997	30,036	52.10	50.31
METROPOLITAN REGION of SANTOS	743,712	869,177	252,514	288,958	33.95	33.25
Bertioga	26,054	44,725	15,691	27,878	60.22	62.33
Cubatão	33,663	38,873	313	219	0.93	0.56
Guarujá	126,452	137,430	44,981	46,346	35.57	33.72
Itanhaém	50,877	67,078	26,752	34,857	52.58	51.96
Mongaguá	33,103	41,783	21,183	25,327	63.99	60.62
Peruíbe	32,007	40,054	15,049	17,736	47.02	44.28
Praia Grande	160,133	199,944	93,275	104,912	58.25	52.47
Santos	170,252	176,899	20,816	20,073	12.23	11.35
São Vicente	111,171	122,391	14,454	11,610	13.00	9.49
SOUTH COAST	22,066	30,639	7691	11663	34.85	38.07
Cananéia	4,474	5,551	971	1,363	21.70	24.55
Iguape	11,585	14,426	2,826	3,466	24.39	24.03
Ilha Comprida	6,007	10,662	3,894	6,834	64.82	64.10

Source: Population Census 2000 and 2010 – IBGE. Design: authors.

By comparing the numbers in Table 1 and 2, we can see that the number of accommodation units in lodging establishments is considerably smaller, even as

an estimate based on average values, than the amount of second homes in the region. This finding is consistent with the literature on the subject (LEMMEN, 2011).

The Global Moran's I measures the spatial autocorrelation based on values of a given variable and on the spatial location. The results for the region of study showed that data are spatially clustered. We performed the same analysis separately for each municipality, and the values show that in Ilha Comprida and Cubatão the floating population is dispersed, in Cananéia it is poorly clustered, while in the others it is clustered. The results can be seen in Table 3.

Figure 2 - Growth of second homes (percent), 2000-2010
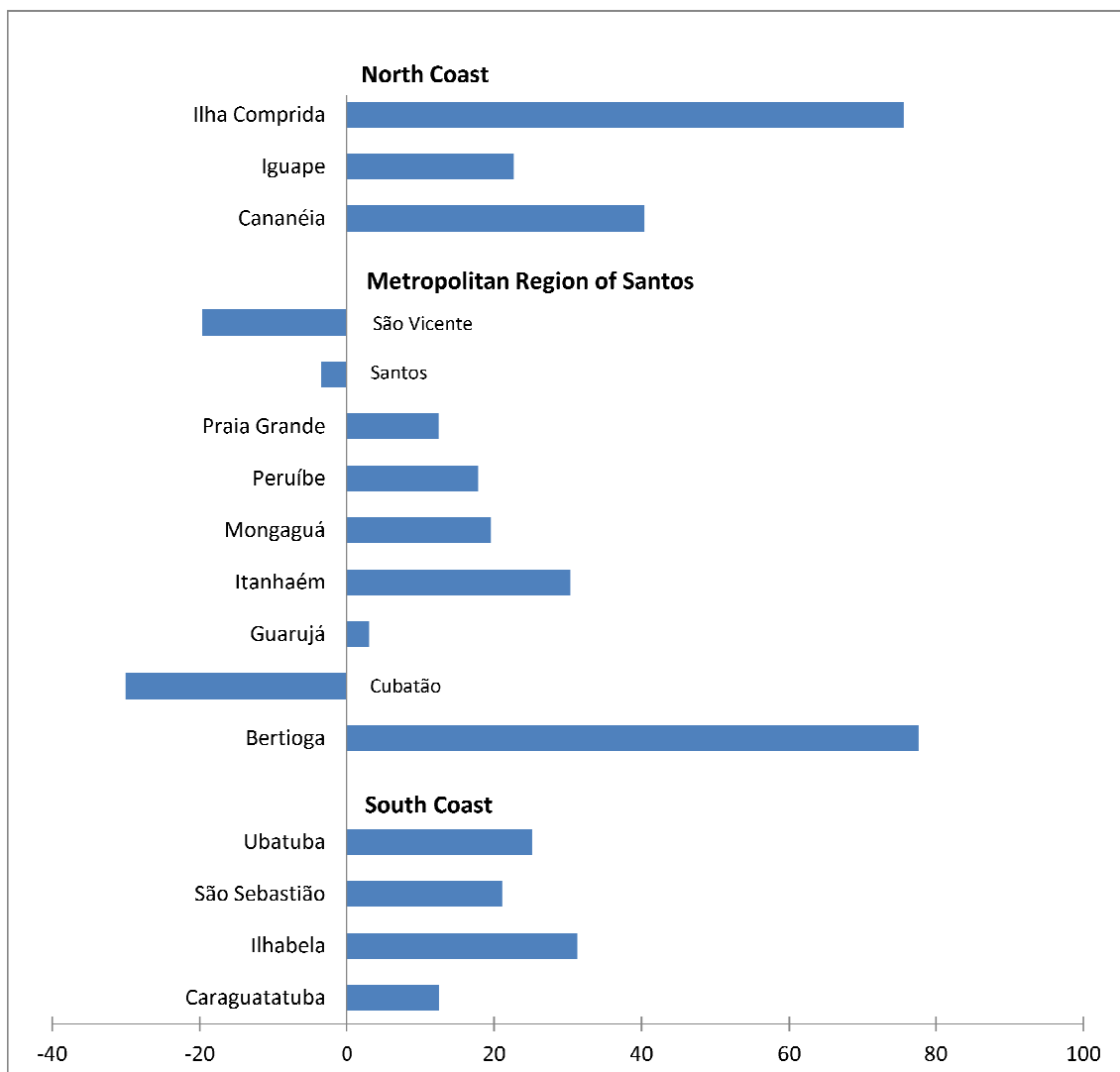
Source: Population Census 2010 – IBGE. Design: authors.

Table 2 - Accommodation units in lodging establishments, 2010

MR of SANTOS		TOTAL	
	5022		7953
Bertioga	270	NORTH COAST	2247
Cubatão	342	Caraguatatuba	288
Guarujá	660	Ilhabela	504
Itanhaém	360	São Sebastião	450
Mongaguá	144	Ubatuba	1005
Peruíbe	432	SOUTH COAST	684
Praia Grande	306	Cananéia	216
Santos	1995	Iguape	468
São Vicente	513	Ilha Comprida	0

Source: authors. Design: authors.

The value of Z, measured in units of standard deviation, is a measure that helps decide if there is a spatial pattern of the variable studied. Z values are compared to critical values for each level of significance and thus the final classification is achieved. The spatial autocorrelation scale can be seen in Figure 3.

Table 3 – Global Moran's I

	Moran I	Z value	result
NORTH COAST			
Caraguatatuba	0.03	4.07	clustered
Ilhabela	0.17	6.28	clustered
São Sebastião	0.12	5.83	clustered
Ubatuba	0.14	14.23	clustered
MR of SANTOS			
Bertioga	0.23	12.30	clustered
Cubatão	-0.01	-0.42	random
Guarujá	0.13	52.80	clustered
Itanhaém	0.18	25.77	clustered
Mongaguá	0.03	3.01	clustered
Peruíbe	0.15	14.99	clustered
Praia Grande	0.03	12.09	clustered
Santos	0.03	24.74	clustered
São Vicente	0.04	27.52	clustered
SOUTH COAST			
Cananéia	0.16	2.13	low clustered
Iguape	0.16	4.89	clustered
Ilha Comprida	0.01	1.06	random

Source: authors. Design: authors.

Another analysis that also concerns the spatial autocorrelation is the Local Moran's I, which aims to locate spatial clusters and delineate features with values different from their neighbors. Using this analysis, we can visualize groups with high and low amounts of floating population in each of the municipalities in the area of study. The map in Figure 4 shows the results. The red areas are hot spots or areas with high value clusters of the variable studied and the blue areas are cold spots or areas with low value clusters of the variable studied.

Figure 3 – Spatial autocorrelation scale
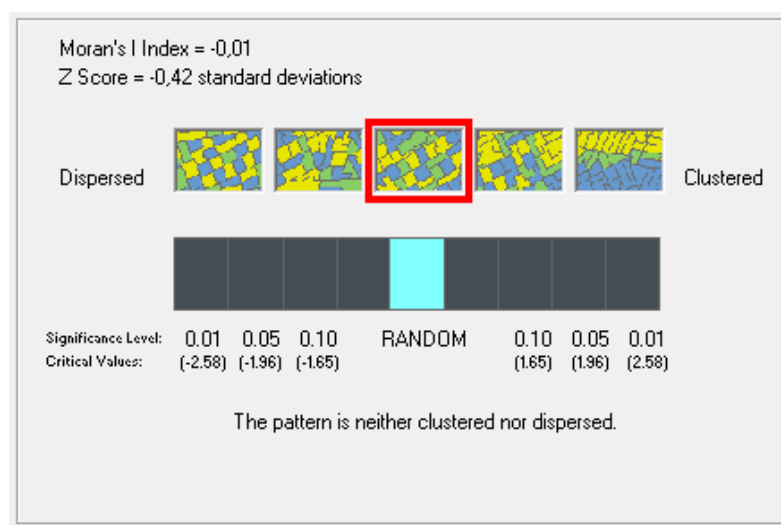

Source: ArcGIS Desktop software.

Analyzing the map in Figure 4, we note that the largest cities of the Metropolitan Region of Santos - Santos, São Vicente and Cubatão - have large areas with a small floating population. This reflects the decrease in the number of second homes in these areas due to the low attraction to leisure activities and tourism. As we move away from these cities, both to the south and to the north, there are more clusters of floating population. This is explained by the fact that as we move away from the core of the metropolitan area, we found smaller and more attractive cities in terms of recreation. The municipalities of the South Coast do not have clusters of floating population because they have some occupancy restrictions due to the existence of protected areas. The municipalities of the North Coast, despite having areas of environmental protection in their territories, present well-defined clusters of floating population. These municipalities also have some areas with a small floating population surrounded

by areas with high values of floating population. These cold spot areas are classified as rural and characterized by poor infrastructure, hard accessibility, and long distance from the coast. Consequently, they hold little attraction to leisure and tourism.

Comparing our results with studies of social and environmental vulnerability (D'ANTONA et al., 2010; MELLO et al., 2010; ALVES et al., 2010), it is clear that several areas with high concentrations of floating population coincide with areas with high and very high social and environmental vulnerability.

Figure 4 – Hot and Cold spots to floating population on São Paulo coast

A – South Coast   B – Metropolitan Region of Santos   C – North Coast
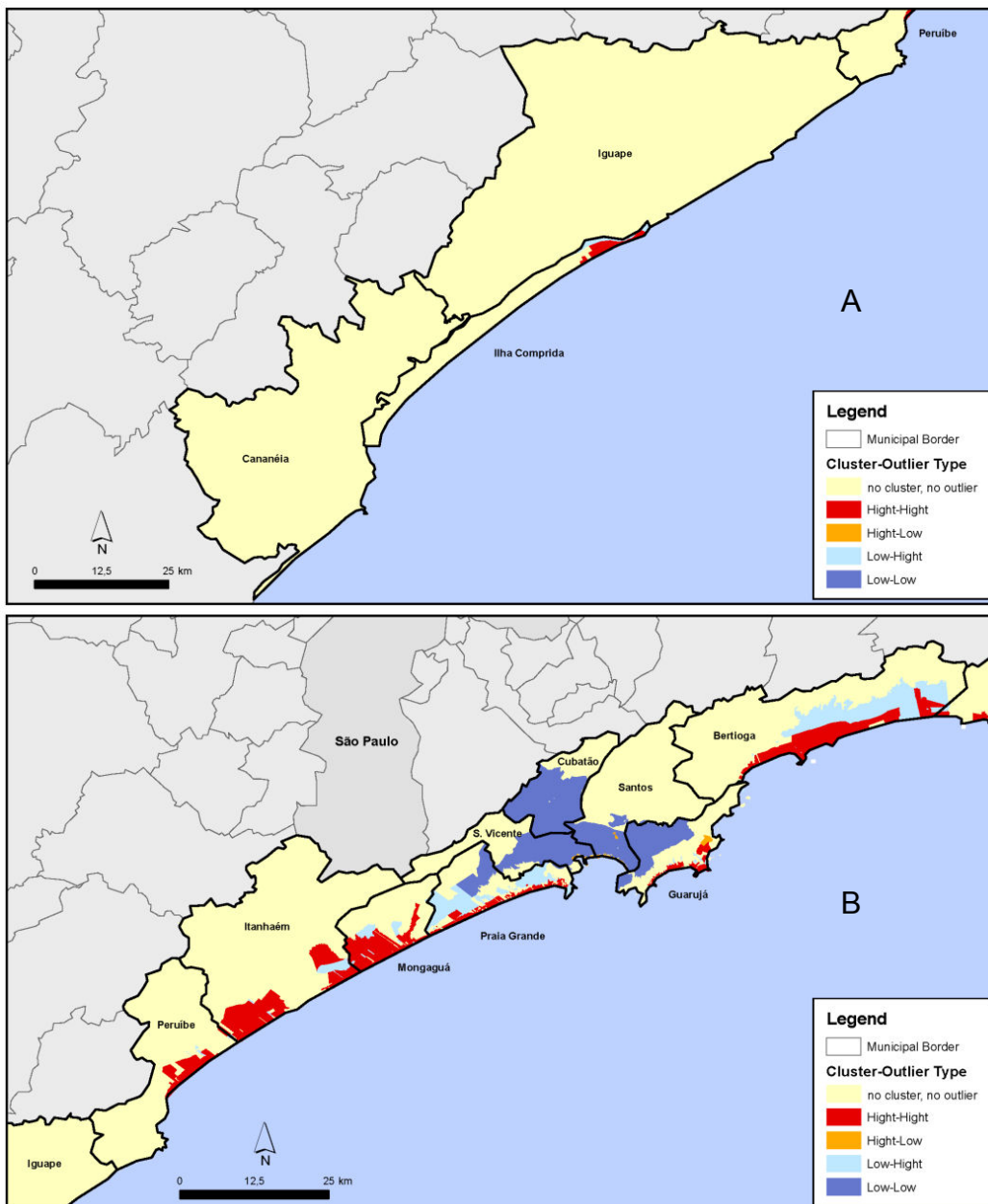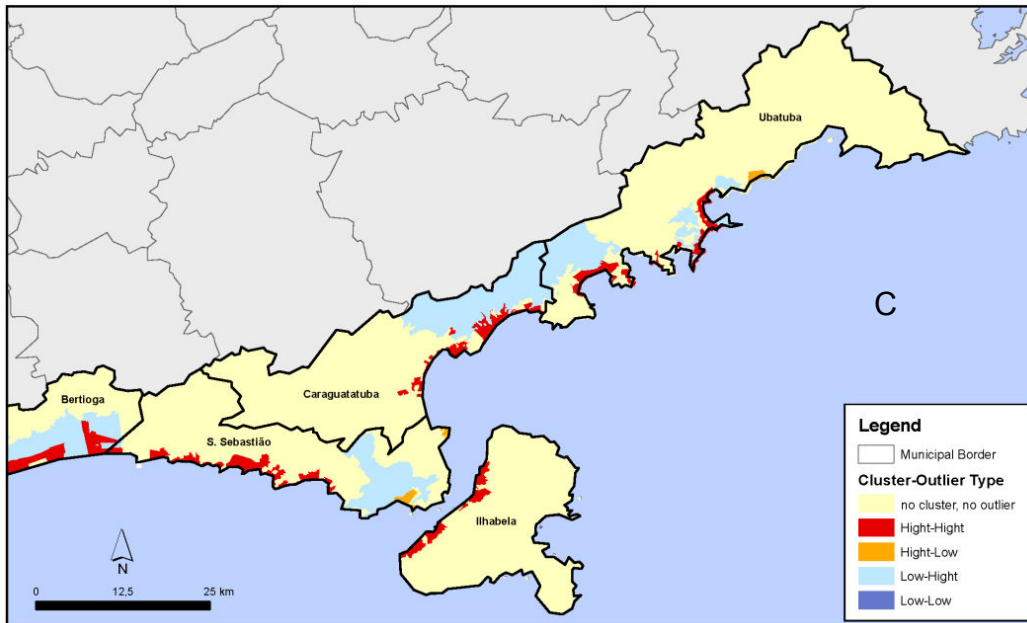
Source: authors. Design: authors.

Method potential and limitations

Greater accesses to places and higher time availability have led to an increase in the volume of second homes for weekends and / or holidays. This phenomenon generates good and bad impacts on the region where it occurs. Therefore, it needs to be better understood and analyzed so it can be effectively included in city planning. Up to now, only the volume of this floating population has been estimated for purposes of infrastructure development, mainly in terms of water supply.

The method adopted in this work presents relevant results about the spatial distribution of floating population for urban planning and local public policies. The method should be coupled with studies in the area of Population and Environment, because that portion of population is often overlooked, despite its significant size.

Finally, there is a notable lack of studies and researches to support assumptions that could lead to a more accurate estimate of this portion of population.

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