



# **LOGISTICS SPATIAL PATTERNS IN PARIS: THE RISE OF THE PARIS BASIN AS A LOGISTICS MEGAREGION**

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# LOGISTICS SPATIAL PATTERNS IN PARIS: THE RISE OF THE PARIS BASIN AS A LOGISTICS MEGAREGION

## Abstract

The purpose of this paper is to look at the spatial distribution of freight and logistics facilities in both the Paris region and the Paris megaregion (the Paris basin) between 2000 and 2012.

We have documented a major rise in the number of warehousing and logistics facilities since the beginning of the 2000s in both areas. In terms of its spatial characteristics, this growth illustrates both centrifugal processes, from the urban core to the suburban and ex urban areas of the region, and centripetal processes, from the margins of the Paris basin to the edges of the Paris region. The logistics system is a global distribution process from international supply chains to urban supply chains. In this process, freight hubs serve as switches connecting these two scales of the logistics system. This role explains part of the locational patterns of logistics and warehousing facilities in Paris, both at the metropolitan scale of the Ile-de-France region and at the megaregional scale of the Paris basin. We conclude by providing areas of further research that could help establish and better specify the megaregional nature of the Paris basin as far as freight and logistics facilities are concerned.

## INTRODUCTION

Metropolitan areas have become the favored zones for the location and organization of logistics activities as the industry is attracted by the provision of transportation infrastructure and the density of potential clients and workforce that are close at hand. While the cost of land and congestion may discourage some stakeholders who are particularly sensitive to these factors, others, who are motivated by economies of agglomeration and the need to be very close to urban economic activities, tend to concentrate in urban areas. Metropolitan areas are characterized by their function, which is to be an interface between an international network of cities and activities and a local area of consumers and businesses. The metropolis is a node in transport systems at different scales, but also of logistics systems at different scales: the logistics value chains move from shared global flows to that of split and divided local flows (the last mile). The metropolis is the meeting place of these scales. Metropolitan areas are also urban areas where growth in population and economic activities is concentrated, allowing for the evolution of the urban fabric.

Metropolises are characterized by their large and growing population and the fact that economic and leadership activities are concentrated in them. These factors mean that they also have a considerable capacity for growth, so, in spatial terms, they expand physically. The dense, uninterrupted, parts of a large city are easily identifiable. However, the urbanized areas of its outer suburbs, which are scattered over distances of several tens of kilometers from the center, are difficult to distinguish from rural areas. Sprawl starts from the central city to peripheral areas. The urban area, which includes the central

conurbation and its suburban rings, which themselves contain secondary centers of various sizes, has the appearance of a “macro-form,” to use the term coined by Allain<sup>1</sup>. Urban sprawl is a matter of considerable concern to public authorities, based on the idea that the compactness of cities guarantees their sustainability. In the United States, “Smart Growth” describes the improvement in the sustainability of cities, in particular by increasing urban space density. Urban sprawl is a complex process which is not only due to sprawling of the population, but also of economic activities. These economic activities include logistical activities which, frequently unbeknownst to the public authorities, are also subject to processes of sprawl in metropolitan areas and contribute to the expansion of the urban fabric, in some cases far beyond the area covered by residential expansion, pushing the boundaries of the metropolis further outwards.

This paper is organized in four sections. The first describes the method we used for conducting our analyses. The second Section looks at the literature on the issue of logistics sprawl. In Section 3, we analyze logistics sprawl in Ile-de-France between 2000 and 2012 using two complementary methods. Then in Section 4 we put these findings into their context by considering the scale of the Paris basin.

## PROJECT OBJECTIVE

We examine the scale of logistics sprawl by analyzing changes in the location of logistics activities, in particular warehouses, in the Paris metro area. The goal of this paper is to analyze the spatial footprint of the logistics system on the Parisian metropolitan space and how it may contribute to define a larger urban region, or megaregion. To do this we undertake a diachronic analysis of the location of warehouses both in the greater Paris region, called Ile-de-France, and the city’s megaregion, the Paris basin, between 2000 and 2012.

## COMPOSITION OF THE PROJECT

Studies of logistics spatial dynamics have provided an opportunity to question urban policies and in some cases they have even revealed a failure to give due importance to the issue of freight transportation in the planning of economic activities and transportation in large metro areas. In a study of the Piedmont Atlantic Megaregion in the southeastern United States, Dablanc and Ross<sup>2</sup> have shown that logistics activities are spreading outwards at the local scale of the metropolis of Atlanta, and at the same time identified a process of concentration of logistics activities in Atlanta at the macroregional level. In the case of the Paris region, Andriankaja<sup>3</sup> has shown that some logistics activities are subjected to centrifugal forces and pushed into the outskirts. Both scales (metropolitan and megaregional) influence the spatial organization of the city.

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<sup>1</sup> Allain, R. Morphologie urbaine, géographie, aménagement et architecture de la ville. Armand Colin, Collection U, Paris, 2004

<sup>2</sup> Dablanc, L. and C. Ross. Atlanta: A Mega Logistics Center in the Piedmont Atlantic Megaregion (PAM). Journal of Transport Geography, Vol. 24, 2012, pp. 432-442

<sup>3</sup> Andriankaja, D. Le desserrement logistique, quelle responsabilité dans l’augmentation des émissions de CO<sub>2</sub> des activités de messagerie? (Logistics sprawl, what responsibility in CO<sub>2</sub> emissions’ increase for the parcel transport industry?) PhD dissertation, University of Paris-Est, Paris, 2014. Non published.

From the 1980s, the economy has become largely dependent on increasingly globalized freight distribution networks ruled by “just-in-time” practices<sup>4</sup>. This has led to a reduction in the large inventories of intermediate and end products. Consequently, urban shippers and receivers demand frequent deliveries of small shipments<sup>5</sup>. Low transportation costs make it possible to create what Rodrigue<sup>6</sup> referred to as “greater locational flexibility” for both freight and logistics. This does not mean there has been a reduction in the number of warehouses, on the contrary supply chains require more hubs, and the way these are organized spatially has become vitally important for the efficiency of a freight distribution network. The efficient distribution of products depends on the location and optimum sizing of freight terminals rather than transportation costs, which have become “trivial”<sup>7</sup>. Today’s warehouses are not just storage facilities; they provide a location for freight handling, sorting, consolidation and break-bulk, labeling and packaging activities etc. Logistics hubs function as switches between long distance haulage and urban distribution<sup>8</sup>. Warehouses have become places where value is added to goods: “*the warehouse is becoming the factory of yesterday, logistics is changing to become more like manufacturing, particularly in the case of products with a technological component.*”<sup>9</sup>

Studying the location of logistics activities with reference to the issue of disconnection or sprawl has favored the transition from a local to a regional approach. Urban sprawl is often analyzed as a morphological adaptation of cities to automobile use and the lengthening of transport distances. Logistics sprawl can be seen as the morphological response of the city to a freight transport system mainly performed by trucks. In Ile-de-France, 90% of tons of goods are carried by road. In other words, the organization of road transport will influence the location of logistics activities. By analyzing the evolution of the location of these logistics activities, we will be able to observe implicitly the impact of goods transport by road on the morphology and function of the city and the metropolitan area.

## RESEARCH APPROACH

In this analysis, we conduct a number of interviews with managers working in logistics facilities in the parcel delivery sector and in warehousing. It emerged from our interviews that in the last ten years the locational strategies of logistics operators have changed greatly, in particular as a result of the financial and economic crisis that began in 2007-2008. Although it is difficult to consider such recent changes objectively, it struck us as interesting to try to understand the spatial impacts of these changes in the logistics system. Several methods of spatial analysis have already been used in order to measure sprawl. That used by Andriankaja to analyze the dispersion of parcel delivery agencies between 1975 and 2010

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<sup>4</sup> Hesse, M. and J-P. Rodrigue. The transport geography of logistics and freight distribution. *Journal of Transport Geography*. Vol. 12, 2004, pp. 171–184.

<sup>5</sup> Dablanc, L and D. Rakotonarivo. The impacts of logistic sprawl: How does the location of parcel transport terminals affect the energy efficiency of goods’ movements in Paris and what can we do about it? *Procedia, Social and Behavioral Sciences*. Vol. 2, No. 3, 2010, pp. 6087-6096.

<sup>6</sup> Rodrigue, J-P. Freight, gateways and mega-urban regions: The logistical integration of the BostWash corridor, *Tijdschrift voor economische en sociale geografie*, Vol. 95, No. 2, 2004, pp.147-161.

<sup>7</sup> Glaeser E. and J. Kohlhase. Cities, Regions and the Decline of Transport Costs. *Regional Science*. Vol. 83, No. 1, 2004, pp. 197-228.

<sup>8</sup> Mohavedi, B., K. Lavassani, and V. Kumar. Transition to B2B e-Marketplace enabled supply chain: readiness assessment and success factors. *The International Journal of Technology, Knowledge and Society*. Vol. 5, No. 3, 2009, pp. 75-88.

<sup>9</sup> L’entrepôt devient l’usine d’hier. *Strategie Logistique*, No.57, June 2003. Interview with Jean-Marc Blanc.

seems to be of particular interest. The technique of centrographic analysis provides a way of computing the degree of dispersion of the scatter of points corresponding to the number of warehousing buildings. By computing the standard deviation of the difference between an initial point and the studied points weighted by their number it is possible to obtain a center of gravity and a dispersion ellipsis which describes the average area over which the studied points are spread. We applied this method to our statistical distribution of warehouses.

## DATA

This paper is concerned with the Paris region, or Ile-de-France, which has almost 1,300 municipalities and 12 million inhabitants, as well as the Paris basin, with a population of 21 million inhabitants. The Paris basin, if we use the definition given by Gilli<sup>10</sup> as we shall in this paper, includes the Ile-de-France region and surrounding regions (see Figures 5 and 6). Ile-de-France is France's largest consumer catchment area, so its logistics must be organized efficiently. It is also the most important logistics hub of the country, with a role that goes far beyond the mere organization of freight supply and shipment for local needs: the entire French economy relies at least partially on Paris logistics activities<sup>11</sup>. The Paris region contains 18 million m<sup>2</sup> of warehouse space, which is approximately 20% of the total surface area in France. If we consider the entire Paris basin, this proportion rises to 44%. Between 2000 and 2012 the number of warehousing facilities in the Paris region rose by 33%. How has the Paris conurbation digested this increase?

For the purposes of this study we used the SIRENE database of the French National Institute of Statistics and Economic Studies. This database provides information about the firms located in each municipality, according to their category in the European NACE classification. We extracted all the firms whose activity corresponds to those performed in warehouses: i.e. all those firms in category 52.1 "warehousing", and 52.2 "support activities for transportation," which include freight handling, parcel delivery services and all chartering activities which use warehouses. The number of places of business has been aggregated for each municipality for the years 2000 and 2012. These are listed on the basis of their principal activity. We used this database to conduct a number of statistical analyses. On the one hand, we know the total number of places of business for all the NACE categories together, and on the other hand we know the number of firms in each NACE category so we can compute the proportion of a municipality's places of business that are warehouses. This shows that some municipalities are specialized in warehousing. We looked at these data for 2000 and 2012. As the NACE definitions changed between these two dates (in 2008), we had to conduct a detailed examination of each category in order to be able to compare the data at the two dates. We decided to process the aggregate data for each municipality in order to obtain an overall trend for the entire region and point out the presence of logistics clusters. This method has some limits. Data is not available for areas smaller than municipalities, and it is not available for each category of warehouse (e.g. refrigerated, cross-dock, etc.).

## ANALYSIS AND RESULTS

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<sup>10</sup> Gilli, F. Le Bassin parisien, une région métropolitaine. *Cybergeo*. Vol. 305, 2005

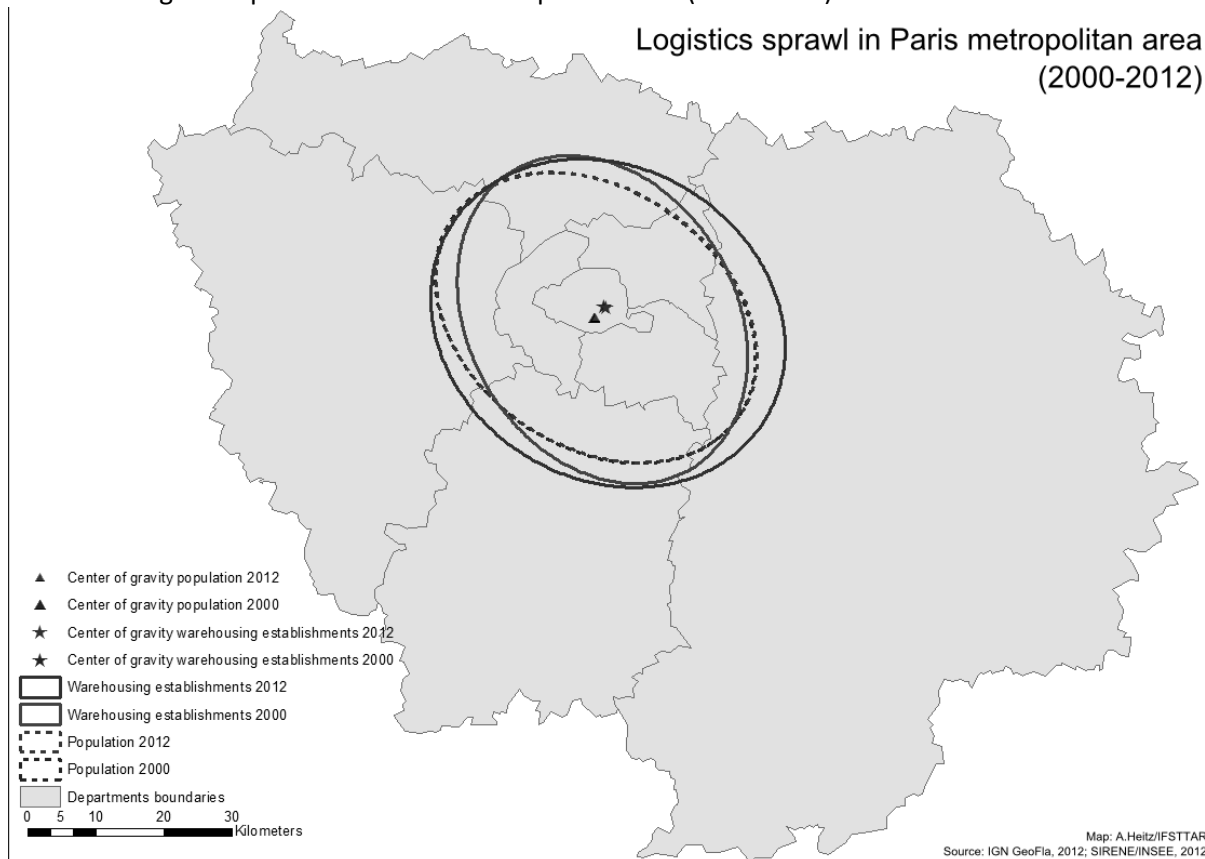
<sup>11</sup> Dablanc, L. and A. Frémont. The Paris region: operating and planning freight at multiple scales in a European city. In Hall, P. and M. Hesse (Ed.). *Cities, Regions and Flows*, Routledge, 2012

## 1. DILATATION OF THE METROPOLITAN AREA FROM LOGISTICS SPRAWL

In recent years the location of logistical activities, in particular with regard to the issue of logistics sprawl, has emerged as a topic in the literature, both in Europe and the United States. Strictly speaking the term "sprawl" means that the relocation of activities in the suburbs is accompanied by a decrease in their concentration in the central areas. We choose to use the term "sprawl" in a larger sense, since we believe this is the word which best expresses the effect of the dynamics of the urban fabric. Logistics sprawl refers directly to the physical expansion of the metropolitan area.

To analyze logistics sprawl and changes in the location of warehouses in the Paris region, we have used two indicators: the dispersion ellipsis and the mean distance of warehousing establishments (places of business) from their center of gravity. On the maps, the difference in the surface area between the dispersion ellipsis of warehouses in the year 2000 (in light) and 2012 (in dark) means that sprawl has occurred. Moreover, between 2000 and 2012 the mean distance to the center of gravity has increased by 0.5 km.

FIGURE 1: Logistics sprawl in the Paris metropolitan area (2000-2012)



By comparing the evolution of the location of warehousing establishments with the evolution of the location of the population, we realize that sprawl is relatively stronger for logistics activities, with a larger average distance to the centroid. Warehousing establishments are the most spread-out activities within the metropolitan area. This confirms the findings of Andriankaja's study over a longer period (1975-2010), namely that logistics activities are those spreading out the furthest in the Paris metropolitan area, pushing the urban boundaries the most. The relocation of logistics activities does not

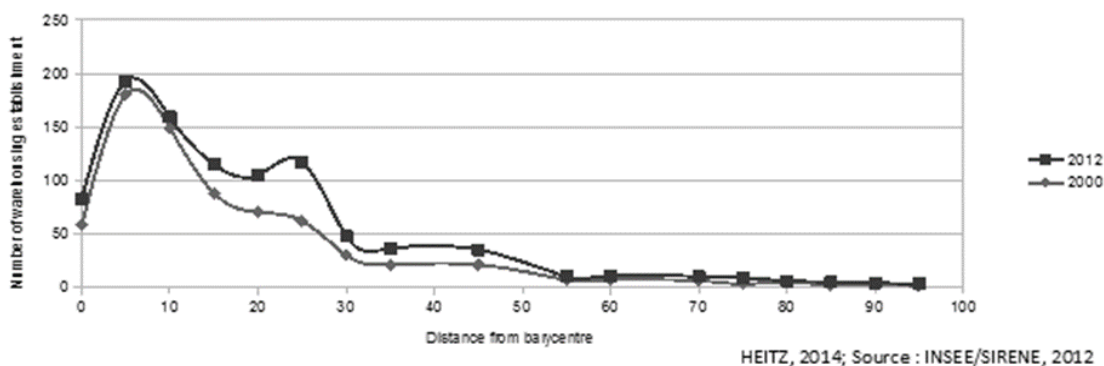
mean the existence of a vacuum, the logistical sprawl process is primarily the result of significant growth in the number of warehouses in the suburbs more than a relocation of warehouses from the center to the suburbs. Logistics activities are growing in the suburbs where they are attracted by a number of enabling factors. Mérenne-Schoumaker<sup>12</sup> identifies five indicators that guide the choice of location of the logistics activities and warehousing establishments: proximity to markets and consumption area, accessibility and availability of infrastructure (roads), the availability of land (area and price are taken into account), the availability of a local labor market, and the role of attractive public policies (in favor of developing logistics policies, such as financial assistance, regulation...). These factors partly explain the relocation of logistics activities in peripheral areas. Studies of logistics suburbanization by Raimbault<sup>13</sup> show that logistics activities relocate in places where they have more space, easy access to the road network and therefore to consumption areas.

## 2. THE EMERGENCE OF A SPECIFIC TYPE OF MULTI-CLUSTER METROPOLIS AROUND PARIS

### 2.1. Diffusion of warehousing establishments in the suburbs of the metropolitan area

Logistics sprawl takes the form of a disintegration of the concentrations of activities in the metropolitan area. This spread is accompanied by the creation of new logistics clusters in the periphery. The following graph shows the number of warehousing establishments depending on the distance to their center of gravity (or barycenter).

FIGURE 2: Number of establishments from the center of gravity in 2000 and 2012



There is a decrease in the number of establishments as the distance from the center of gravity increases. This reflects the structure of the Paris metropolitan area, and the fact that economic activities are overly concentrated in the center of the region. One would have expected to have more warehousing establishments in the suburbs, yet the central fringes of the metropolitan area experienced strong concentration of these activities. Since we have no information on the size of these establishments, we may think that this represents the development of small size establishments, suited to an urban environment. One of the most spectacular evolutions is in the area between 20 and 30 km away from

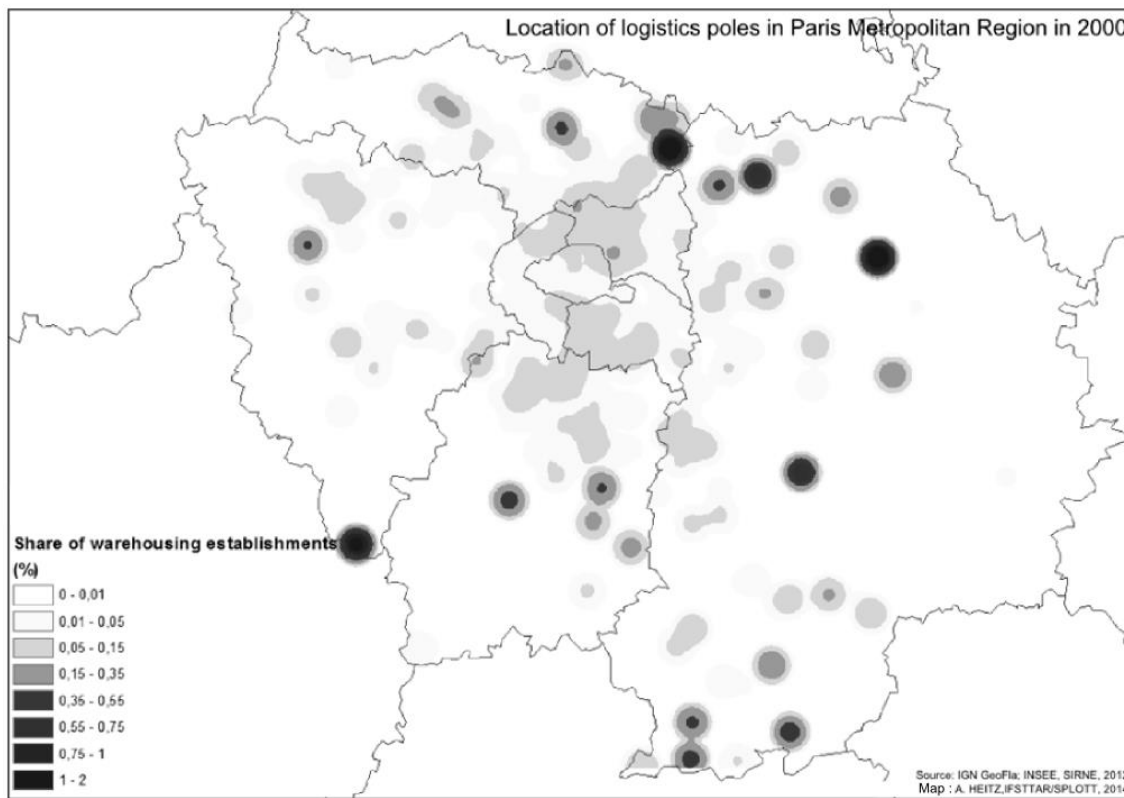
<sup>12</sup> Merenne-Schoumaker B., La localisation des grandes zones de logistique, Bulletin de la Société géographique de Liège, 49, pp. 31-40, 2008.

<sup>13</sup> Raimbault, N. and F. Bahoken. Quelles places pour les activités logistiques dans la métropole parisienne? *Territoire en Mouvement*, Vol. 23-24, 2014.

the center of gravity. This zone corresponds to the fringes of the first ring of the suburb in Paris. This peak suggests that logistics sprawl is partly caused by the increasing number of warehouses between 2000 and 2012 in this area, which reflects the emergence of clusters in the suburbs.

Our analysis based on dispersion ellipses and change in the mean distance from the center of gravity has shown that there is a general trend towards logistics sprawl, but it does not allow us to make a detailed analysis of this sprawl by distinguishing a concentration of facilities in a number of clusters. The technique of Kernel Density Estimation (KDE) allows us to identify “hot spots” (see below) and reveals both the process of sprawl and the development of clusters. KDE is a smoothing technique which highlights clusters with a high density of municipalities specialized in logistics facilities, and attenuates the “boundary” effect that is caused by the administrative division into municipalities. Kernel Density Estimation was first applied in the field of social sciences and spatial issues in the 1980s, and it has recently been applied in the field of urban studies<sup>14</sup>. We have used discretization based on equal numbers (quantiles). This has the advantage that it can be applied to statistical series that are heterogeneous and skewed, such as our series for 2000 and 2012.

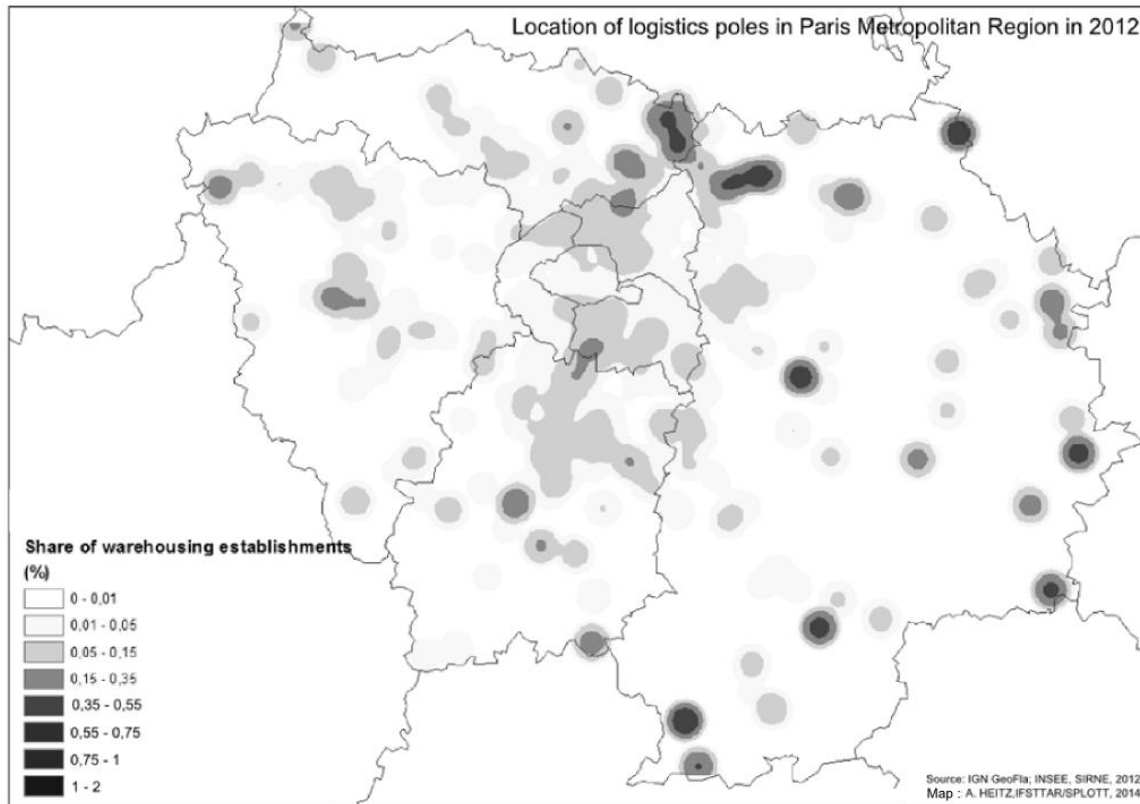
FIGURE 3: Location of logistics clusters in the Paris metropolitan region in 2000



<sup>14</sup> Borruso, G. Network Density and the Delimitation of Urban Areas. *Transactions in GIS*. Vol. 7, No. 2, pp. 177–191, 2003.



FIGURE 4: Location of logistics clusters in the Paris metropolitan region in 2012



On the basis of the proportion of all the warehouses in a municipality, we are able to identify those municipalities (or parts of municipalities) where logistics is the dominant activity and identify logistics clusters that are specialized in logistics. The spatial analysis of logistics activities allows us to glimpse a sprawling, shifting metropolis with multiple clusters. In general, the Paris region consists of a constellation of medium-sized specialized logistics clusters. The development of medium-sized concentrated clusters in the west and the increase in the proportion of warehousing facilities point to the existence of low density sprawl, that is less concentrated in clusters. In the east, we can observe the movement of successive fronts of medium-sized clusters which push metropolitan boundaries ever further outwards.

In 2000 and 2012 we can observe two moving clusters to the north and to the south of Paris, in the inner suburban ring where warehousing activities seem to be particularly prone to locate. These concentrations covered fairly large areas in 2000, which corresponded to the former industrial areas (as Pantin or La Courneuve, in the north). They connect with smaller clusters in the outer suburban ring. In 2012, these areas have become more marked as a result of a grouping together of warehousing activities and the emergence of a major cluster around St Denis, Aubervilliers and Le Bourget. The growth of logistics activities is based on a diffuse polarization in the inner suburbs, reinforcing logistics sprawl and lengthening distances from the historical Paris center. Another element related to these logistics activities in the densest parts of the metropolitan area is that they are mostly located in interstitial spaces and can claim only punctual and limited insertion. Their urban location requires

extensive negotiations with public authorities because they are mostly considered as public nuisance by the population.

## 2.2. Logistics sprawl through suburban clustering

Warehouse clusters also appear at the fringe of the first ring of suburbs. These clusters are located around specific multimodal transport infrastructure such as ports and airports. The cluster formed by Roissy CDG airport also seems to have grown and covers a wider area in 2012 than in 2000 when freight activities were just grouped around the airport. In 2012 the inner suburban cluster stretches outwards towards the outer suburbs. Clusters are both more concentrated in terms of the number of facilities and more widely spread out. This dual mode of growth is partly responsible for the general sprawl that affects warehouses that we pointed out in the first part of this study. The three main clusters in the inner suburban ring (Gennevilliers to the north, Roissy to the north-east, and Orly-Rungis to the south) are also major national and regional freight gateways. These clusters have excellent transportation infrastructure: port terminals, container terminals, airports and good highway connections. While this set of infrastructure does not supply all the freight for the Paris metropolitan area, it attracts other warehouses and logistics infrastructure which are unrelated to international freight transportation. In his analysis of the “BostWash” corridor (the huge metropolis that stretches from Boston to Washington), Rodrigue has also observed the scale of the growth of logistics activities in peripheral zones rather than central zones, and in particular their tendency to develop near transport infrastructure, forming clusters in the suburbs around interchanges or specific sections of road. Andriankaja has also pointed out the presence of a dual dynamic at work in the organization of the logistics fabric of Paris region. This involves on the one hand “powerful logistics nodes”<sup>15</sup> that are located at the interfaces with motorways, ports, airports or railways; and on the other hand a large number of logistics facilities that are scattered throughout the region without necessarily forming clusters. Strale<sup>16</sup> has noted the increasing importance of mega structures such as mega ports, air transportation hubs and break-bulk and transshipment ports. The Paris metropolis has a similar hierarchy as the largest clusters (which are the most concentrated and cover the largest areas) consist of airports, ports or major structures such as the international wholesale food market in the south.

In parts of the metropolitan area where the urban fabric is looser, sprawling mainly follows the road network and the warehousing establishments are free to settle either individually or in aggregate around them. In the Paris region, a large number of warehouses are dispersed, or even isolated. Raimbault and Bahoken have demonstrated this phenomenon in the case of warehouses for the mass retail sector. In the last few years the development of organized logistics parks appealed strongly to public authorities as it provides a way of limiting logistics sprawl. It involves grouping an area’s logistics activities together in logistics sites known as “freight villages.” The spaces around major transportation and modal terminals seem to naturally suit logistics villages. This may help to explain the increase in the concentration of warehouses in the Paris conurbation. Freight villages’ success can be explained by the services that are provided (such as surveillance or catering), or even more simply by the availability of land and adequate facilities, as well as favorable municipal policies with regard to logistics developments.

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<sup>15</sup> Savy, M. and J. Burnham. *Freight transport and the modern economy*. Routledge, 2015.

<sup>16</sup> Strale, M. *Logistics: location of activities and territorial impacts*. PhD Dissertation, University of Brussels, Belgium, 2013. Non published.

The way the distribution of spaces that are specialized in logistics warehousing has changed allows us to glimpse a specific type of multi-cluster metropolis in the case of Paris. On the one hand it is made up of low density clusters located in the inner suburban ring, and on the other hand it is spreading outwards by generating new suburban clusters which cause the conurbation to expand. What is occurring is both a process by which the center of the metropolis is expanding as a result of the contiguity of specialized logistics clusters and the emergence of new clusters in the outskirts.

### 3. GOING BEYOND THE METROPOLITAN SCALE: LOGISTICS INFLUENCE ON THE PARIS BASIN MEGAREGION

The Paris region is characterized by the outward spread of logistics activities and major suburban clusters. This is one of the spatial dynamics which “traditionally” affect metropolises: centrifugal forces at the local level. But these forces do not fully characterize metropolitan areas. There are centripetal forces at another scale (macro-regional) which illustrate the attractiveness of the Paris region as a metropolis. The strengthening of its influence on the system of cities that make up the Paris basin reflects a form of territorial expansion from the metropolis to the megaregion. Sprawl takes a new form. At the local level we observe the effects of suburbanization around each city locally. But at the scale of the megaregion that we have defined as the Paris basin (see Section 1), this effect is erased by the weight and influence of Paris.

When Gilli considered the metropolitan nature of the area around Paris, he attempted to reveal the existence of a large economic region that surrounds the Paris region, with a view to seeing whether or not it forms an integrated space, with shared economic concerns. He chose a different approach to the metropolis close to the concept of a major urban region, or “megaregion” which was developed a decade ago in North America in the context of developing medium-distance inter-urban ties. Megaregions form large “networks of connected metropolitan centers and their surrounding areas... spatially and functionally linked through environmental, economic and infrastructure interactions”<sup>17</sup>. The result is a set of urban centers which interact strongly with each other and with their respective hinterlands by both material flows (e.g. goods, people) and non-material flows (e.g. information, capital). Megaregions are characterized by their network organization, and challenge the classical model of the clustering of logistics activities<sup>18</sup>.

Logistics sprawl to some extent challenges the traditional picture of metropolitan space. When one thinks of the position of Paris in a global network one naturally considers its megaregional hinterland, i.e. whether some cities like Orleans or Beauvais have a specific position in this network. The spatial organization that is apparent extends beyond the conurbation or even the urban region, which encourages us to engage more in a reticular analysis of the Paris metropolis. However, logistics activities belong to networks which extend beyond the administrative boundaries of the region and encourage us to consider the megaregional scale, that of the Paris basin.

The foregoing analyses demonstrate the movement of a logistical “front” on the edges of the Paris region. This space is essentially dominated by the capital region (Ile-de-France) which accounts for half of the basin’s population. This disproportional distribution of population also applies to jobs. However, if

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<sup>17</sup> Ross, C. and M. Woo. Identifying Megaregions in the United States, Implications for Infrastructure Investment. In Ross, C. (Ed.) *Megaregions, Planning for Global Competitiveness*, Island Press, Washington, 2009, pp. 53-80.

<sup>18</sup> Cidell, J. Concentration and decentralisation: the new geography of freight distribution in US metropolitan areas. *Journal of Transport Geography*. Vol 18, 2010, pp. 363-371.

we look at the specialization of the logistics clusters in the Paris basin, the distribution is less disproportional. If we consider again the proportion of all the places of business that consist of warehousing facilities we can attempt to reveal zones where there is a great deal of logistics activity. In other words, we can highlight those areas which are specialized in warehousing logistics. If we compute the mean distance between the logistics facilities in the Paris basin and the basin's center of gravity in 2000 and 2012 (see Figure 5), we can already see the extraordinary growth in the number of warehousing facilities near Ile-de-France (within 60 km) between 2000 and 2012. The first thing that strikes one is the increase in the concentration of warehouses in the central part of the Paris basin between 2000 and 2012. Overall, there were fewer warehouses over 100 km away than in 2000. Between 2000 and 2012, the mean distance from the center of gravity fell from 155 km to 110 km (see below): there is clearly an inward movement around the Paris region. We are observing the attraction exerted by Paris and the centripetal metropolitan forces which converge on the Paris region.

FIGURE 5: Location of logistics clusters in the Paris basin in 2000

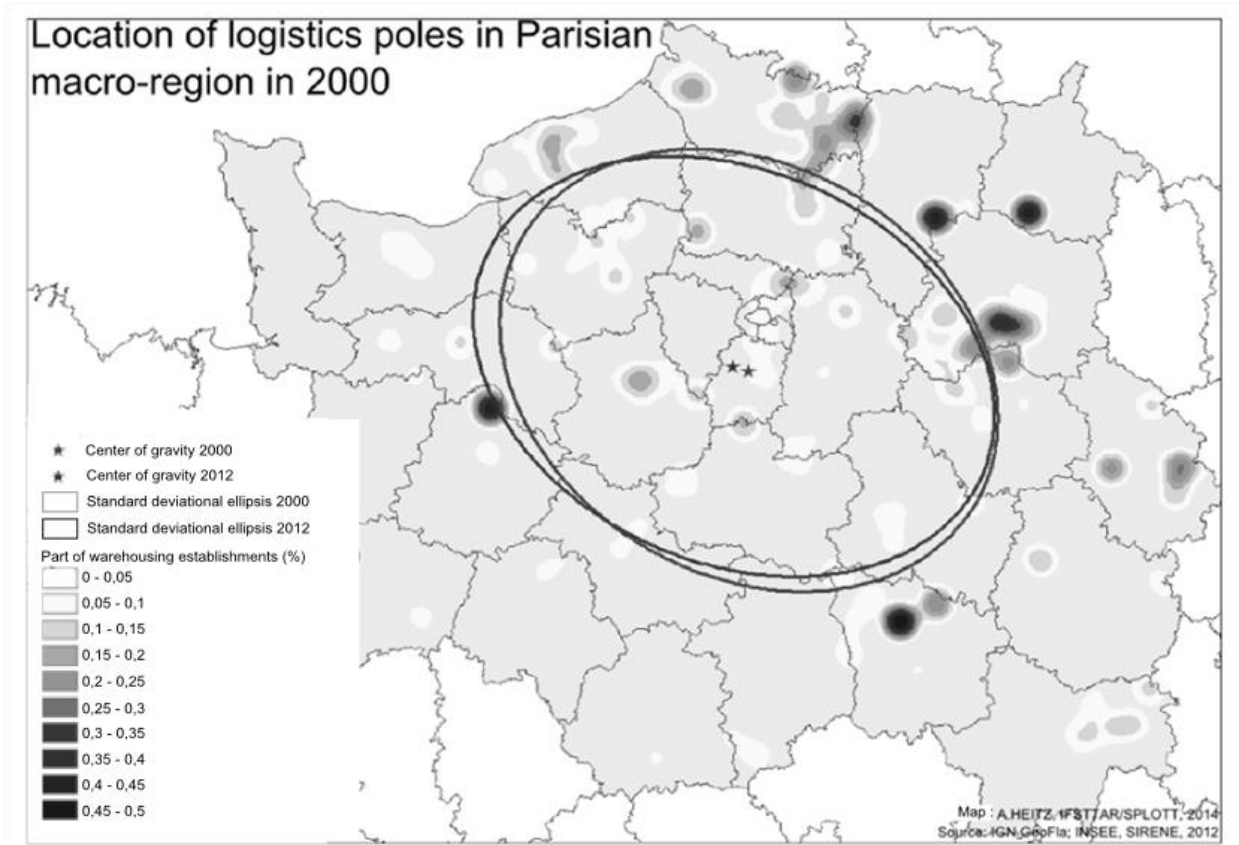
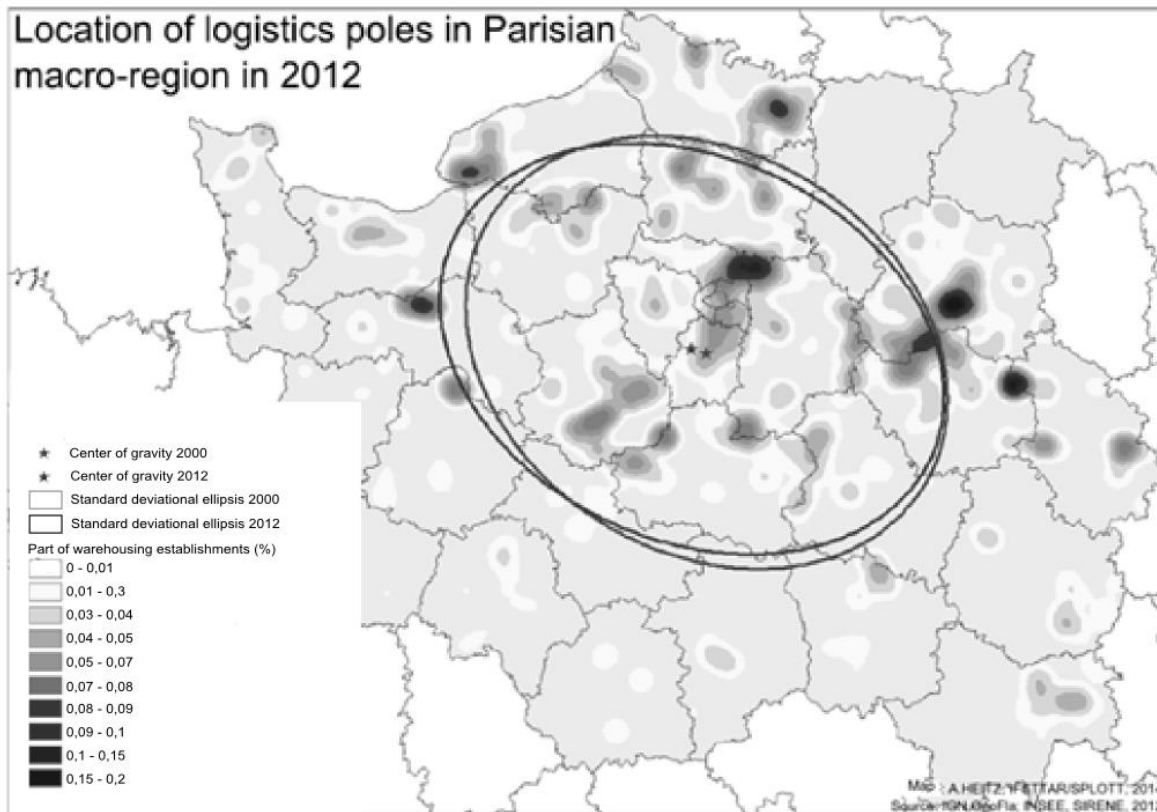


FIGURE 6: Location of logistics clusters in the Paris basin in 2012



We are still interested in the share of warehousing establishments on the total share of economic establishments. The first thing to notice on the maps above (Figures 5 and 6) is the strong general growth in spaces that are specialized in logistics. Firms call more and more on external service providers, which leads to an increase in the number of logistics facilities and cluster sizes. The number of warehousing facilities has increased by 30% in twelve years. As in the case of the analyses of the Atlanta megaregion in the United States<sup>19</sup>, we can explain the high level of specialization of the areas closest to Ile-de-France by the proximity to the Paris region. The urban density in Ile-de-France and the price of land are forcing logistics service providers and specialized real estate developers to provide additional warehousing locations outside (but just outside) Ile-de-France. This trend increases the distance traveled by distribution trucks inside the metropolitan area as the final hub for goods prior to final delivery is further away from the dense areas. The logistics system, whose location depends to a large extent on

<sup>19</sup> Dablanc, L. and C. Ross. Atlanta: A Mega Logistics Center in the Piedmont Atlantic Megaregion (PAM). *Journal of Transport Geography*, Vol. 24, 2012, pp. 432-442.

the cost of the location of warehouses, will spread out around Ile-de-France in the Paris basin. Thus, within the Paris basin the Paris metropolis can exert a force that both attracts and polarizes logistics activities.

In 2000, clusters were already apparent to the east and north of the Paris region, as were two more, relatively distant, clusters in the south east and south west. In 2012, the Paris region, which itself is specialized in warehousing logistics is encircled by logistics clusters. We can see that the edge of Ile-de-France is more affected by this increase in clusters than the south of the Paris basin. Moreover, the clusters located in the east and the south, have become considerably larger. The regions to the north and east seem to have become specialized in this type of logistics between 2000 and 2012 which has been confirmed in the specialized press as well as from the interviews we have conducted. These regions are in a strategic position as they are located on the route between Rotterdam/Antwerp and Eastern Europe. To give an example, between 2000 and 2010, freight traffic in ton-kilometer terms entering Picardie from abroad increased by 17%, compared with 3% in the Centre region during the same period<sup>20</sup>. The logistics system prompts us to reconsider this megaregion as an appropriate scale for analyzing logistics activities, in particular warehousing. In terms of its spatial characteristics, this growth illustrates both centrifugal processes, from the urban core to the suburban and ex urban areas of the region, and centripetal processes, from the margins of the Parisian basin to the edges of the Paris region. The logistics system is a global distribution process from international supply chains to urban supply chains. In this process, freight hubs serve as switches connecting these two scales of the logistics system. This role explains part of the locational patterns of warehousing facilities in Paris, both at scale of the Paris region and at the megaregional scale of the Paris basin.

## CONCLUSIONS

In this paper, we put in light the link between a morphological approach and a functional approach of the metropolitan area. By measuring logistics sprawl at the metropolitan scale we have been able to understand some urban dynamics that occur into the urban fabric. In this article we have documented a major rise in the number of warehousing and logistics facilities since the beginning of the 2000s in the Paris region and the larger Paris basin as well as some levels of logistics sprawl. The process is occurring at two different scales: on the one hand within the urban areas of the main conurbation, and on the other from the Paris region towards other regions. A. Frémont has identified two major dynamics which mark metropolitan areas. One is due to centripetal forces which are the outcome of the agglomeration processes which apply to cities in general. Metropolization accentuates this process, by increasing the proportion of functions which are located in the largest cities and increasing the concentration of the population in urban areas. Conversely, at the scale of the urban area, centrifugal forces push functions to the outskirts in order to keep high added value activities in the center. These two trends contribute to the dispersion and sprawling of activities into the suburbs, making the already unclear boundaries of the metropolis increasingly uncertain. The metropolitan system is therefore marked by an extension of its zone of influence as the result of an internal dynamic which tends to propel its population and activities outwards and which is heightened by the attraction of activities and population at the macroregional level.

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<sup>20</sup> SITRAM. French national data on freight transport and logistics. Available from <http://www.statistiques.developpement-durable.gouv.fr/donnees-ligne/r/flux-marchandises-sitrami.html>. Last accessed July 31, 2014

Our analysis emphasizes the existence of a spatial scale that is little recognized but is key to the understanding of the logistics system: the megaregional scale. We do not wish to state that the Paris basin is a megaregion in the fullest sense of the term, as identified by recent academic studies. However, by identifying a megaregional logistics system, we are led to suggest two further areas of investigation that could be of interest for the study of the spatial patterns that affect freight and logistics. One relates to planning and policies.

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