

An analysis of the evolution of
warehouses location from 2012 to
2019 in major U.S. metropolitan
areas.
New insights of warehousing spatial
patterns.

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- Social sciences, urban studies, geography and urban planning
- Macro spatial analyses to micro level studies
- Warehouses, innovations, new trends in consumption and impacts on city logistics

<https://www.lvmt.fr/en/chaïres/logistics-city/>

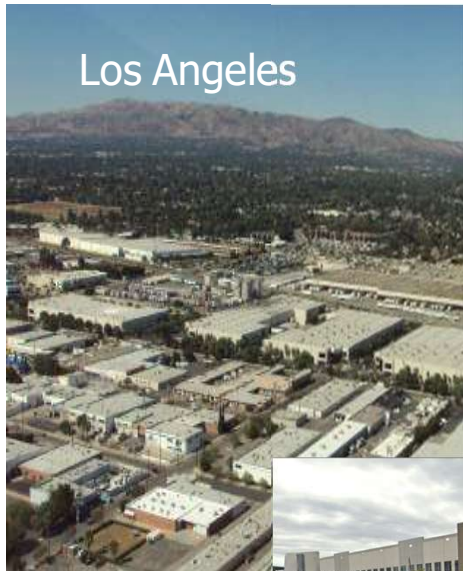
Results available online, eg:

- E-book on warehouse geography in the United States
- Observatory of ecommerce mobilities
- Survey reports on gig workers for instant delivery platforms in Paris 2016, 2018, 2020, 2021
- Logistics real estate and relationships with urban form, macro analyses



Context. New logistics landscapes in large US cities

- The changes in the location of logistics facilities reflect the broader transformation of warehousing and logistics as an economic sector.
 - * On the one hand, the creation of so-called “XXL” distribution centers or mega-fulfillment centers (over 50,000 square meters), which follow the historical trend of logistics zones moving away from urban centers
 - * On the other hand, the search for space in dense areas to meet demand arising from e-commerce.



Los Angeles



New York
(Manhattan)



Seattle



New York (Staten Island)



Brooklyn

State of the art

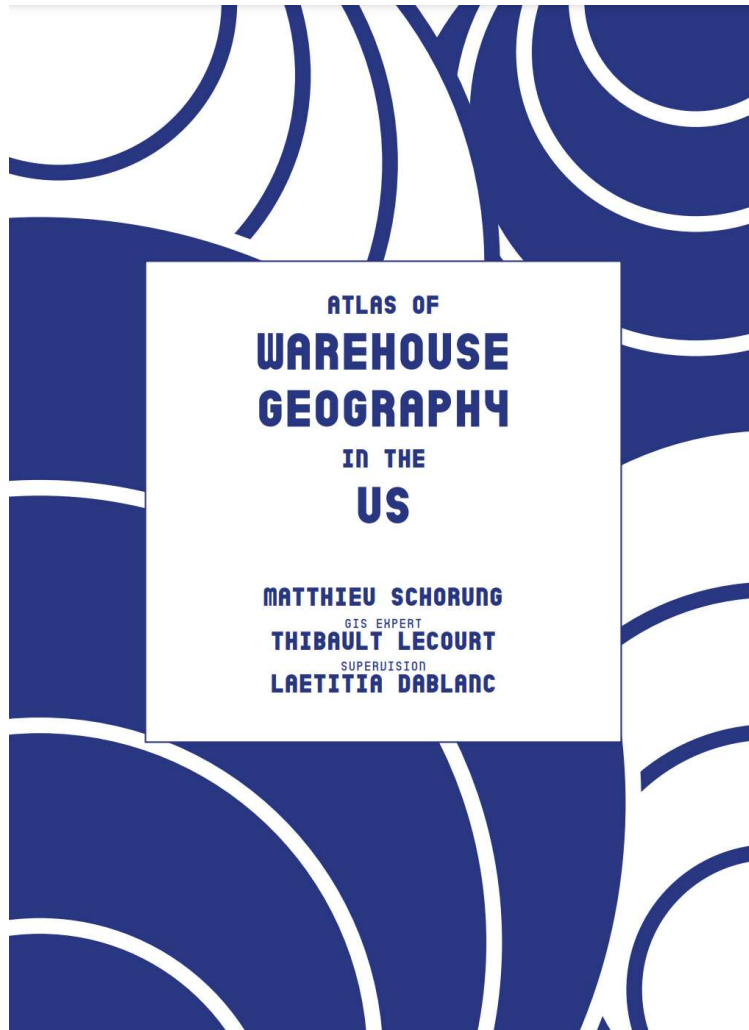
Several recent studies have analyzed the **location of warehouses** in metropolitan areas and how this has changed over time. These studies have demonstrated a **shift in the location of warehouses and logistics facilities to peri-urban areas** (Bowen, 2008; Allen and Browne, 2010; Cidell, 2010; Heitz and Dablanc, 2015; Giuliano et al., 2016; Heitz, Dablanc, and Tavasszy, 2017).

The location dynamics of logistics warehouses are based on **several criteria and a complex supply chain cost structure** (transportation, accessibility, distribution activities, structure of the regional economy, warehouse equipment, land and real estate, organization of logistics flows and the last mile, etc.) (Dablanc and Rakotonarivo, 2010).

This progression has been described as “**logistics sprawl**”, a phenomenon that can be defined as “the tendency for warehouses to move from urban to suburban and exurban areas” (Dablanc and Ross, 2012, p. 434), which has been identified by research in all the case studies considered (Cidell, 2010; Dablanc and Ross, 2012; Dablanc et al., 2014; Heitz and Dablanc, 2015).

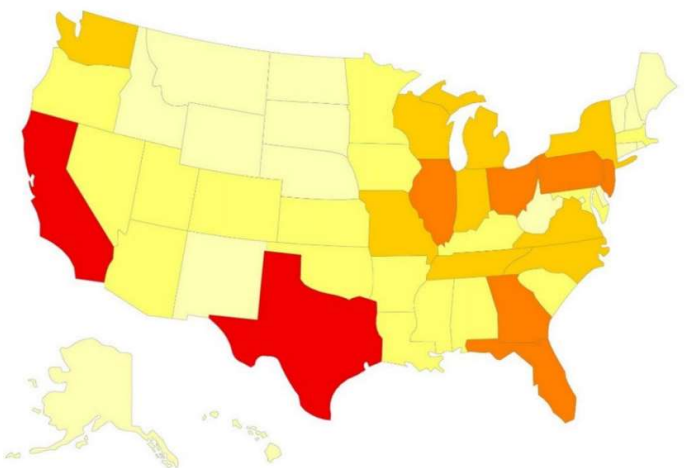
In the **case of North America, there have been several analyses of case studies** in Atlanta, Los Angeles and Seattle, Toronto (Dablanc and Ross, 2012; Dablanc et al., 2014; Woudsma et al., 2016), and recently a comparative study on Chicago and Phoenix (Dubic, Kuo, Giron-Valderrama, Goodchild, 2020).

E-book on Warehouse Geography in the United States



- Major mapping work including the latest CBP database available (2019)
- Analysis at the national scale
- **45 US metropolitan areas (MSA / CSA)**
- **8 US megaregions**
- Diachronic interpretation (from 2012 to 2019)
- Calculation of indicators (barycenters, ellipses, warehouse density)
- Different method of map representation (grid, heatmaps)

Map 1.
Share of logistics
establishments by state in 2019.

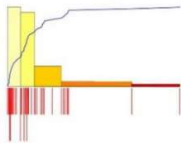


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[Jenks] Proportion_Entrepots_2019_ %

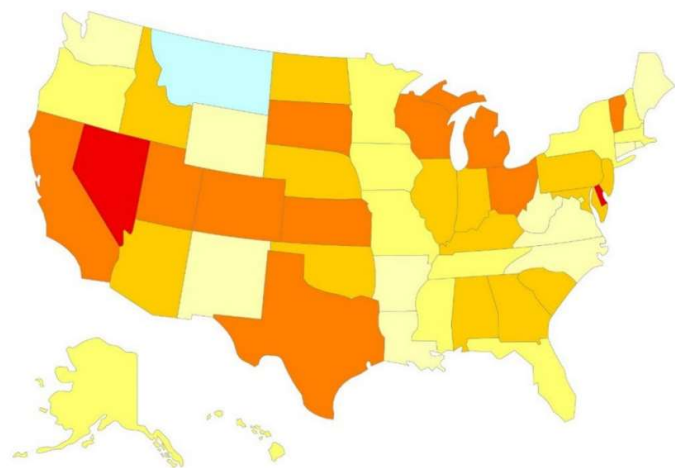


Les surfaces des rectangles de l'histogramme
sont proportionnelles au nombre d'unités spatiales
dans chaque classe définie sur la variable :
"Proportion_Entrepots_2019_ %"
maximum= 17 pour la classe n° 1



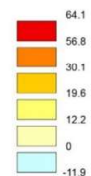
SOURCE
COUNTY BUSINESS PATTERNS, 2019
REALISATION: MATTHIEU SCHORUNG

Map 2.
Changes in the number of
logistics facilities by state
between 2012 and 2019.

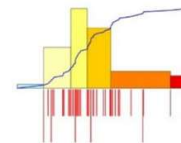


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[Q6] Evolution_Entrepots_2012_2019_ %



Les surfaces des rectangles de l'histogramme
sont proportionnelles au nombre d'unités spatiales
dans chaque classe définie sur la variable :
"Evolution_Entrepots_2012_2019_ %"
maximum= 14 pour la classe n° 4

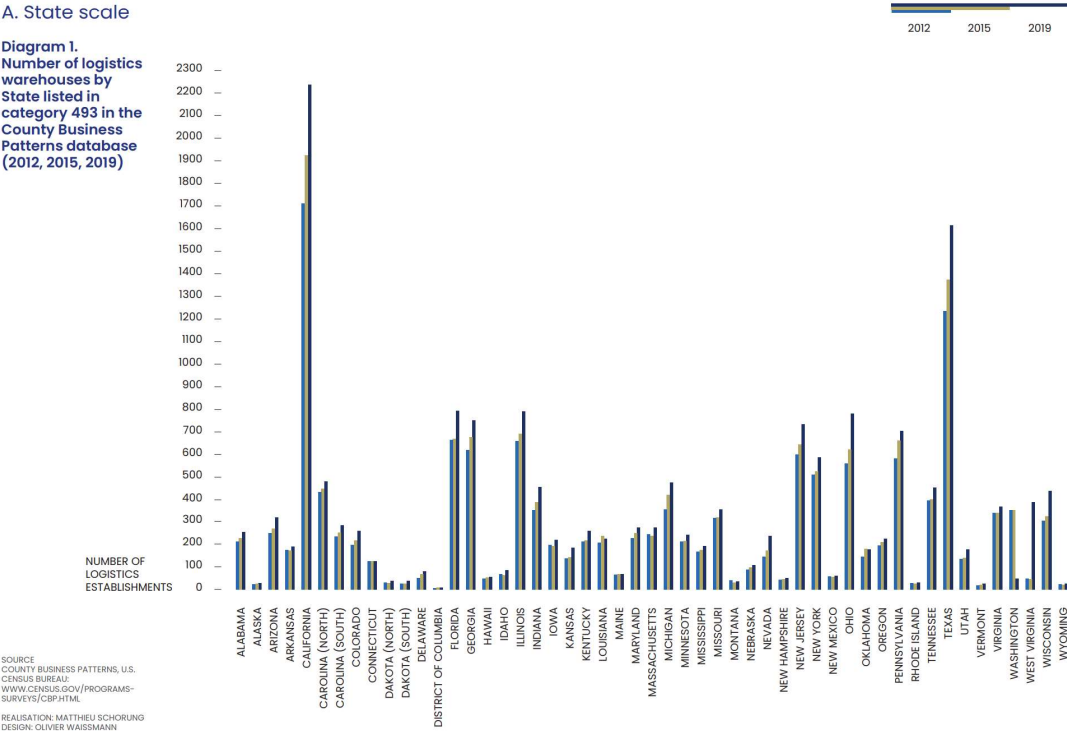


SOURCE
COUNTY BUSINESS PATTERNS, 2019
REALISATION: MATTHIEU SCHORUNG

An evolving geography

A. State scale

Diagram 1.
Number of logistics
warehouses by
State listed in
category 493 in the
County Business
Patterns database
(2012, 2015, 2019)



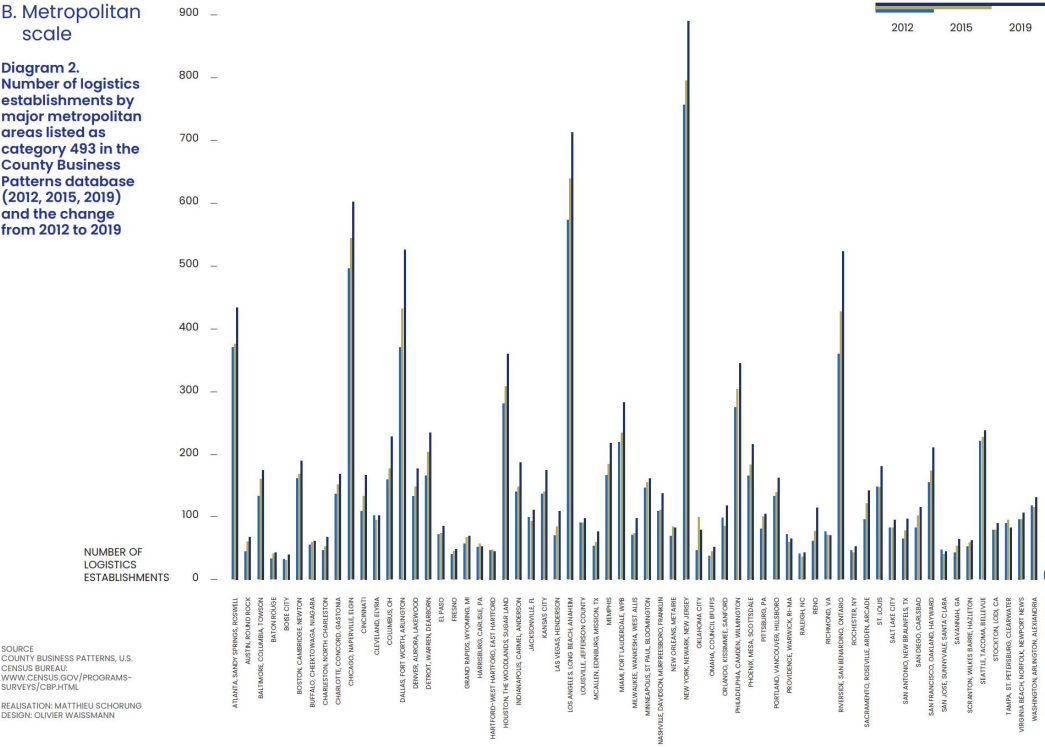
SOURCE:
COUNTY BUSINESS PATTERNS, U.S.
CENSUS BUREAU;
WWW.CENSUS.GOV/PROGRAMS-
SURVEYS/CBP/HTML
REALISATION: MATTHIEU SCHORUNG
DESIGN: OLIVIER WAISSMANN

- States with the most warehouses (2019) : California, Texas, New York+New Jersey
- Metropolitan areas with the most warehouses (2019) : New York, Los Angeles+Riverside, Chicago, Dallas, Atlanta

An uneven spatial distribution of logistics warehouses in the US

B. Metropolitan scale

Diagram 2.
Number of logistics
establishments by
major metropolitan
areas listed as
category 493 in the
County Business
Patterns database
(2012, 2015, 2019)
and the change
from 2012 to 2019



SOURCE:
COUNTY BUSINESS PATTERNS, U.S.
CENSUS BUREAU;
WWW.CENSUS.GOV/PROGRAMS-
SURVEYS/CBP/HTML
REALISATION: MATTHIEU SCHORUNG
DESIGN: OLIVIER WAISSMANN

- In 2019, only nine states had more than 500 logistics facilities listed under the County Business Pattern survey code 493: New York (589), Pennsylvania (706), New Jersey (736), Georgia (752), Ohio (781), Illinois (791), Florida (795), Texas (1616) and California (2238).
- Only 8 metropolitan areas had more than 300 logistics establishments in 2019. In addition, the trend is for the main logistics hubs to grow in size, in a process that could be likened to a metropolization of logistics

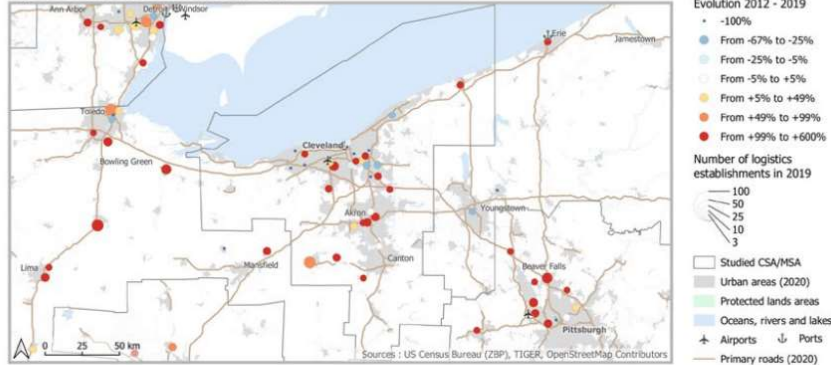
Tab. 1. Number of logistics establishments per major metropolitan areas listed as category 493 in the County Business Pattern database (2012, 2015, 2018, 2019) and the change between 2012 and 2019.

MSA	2012	2015	2018	2019	Evolution 2012-2018 (%)
Atlanta, Sandy Springs, Roswell	371	376	419	434	16.9
Chicago, Naperville, Elgin	496	544	580	602	21.3
Dallas, Fort Worth, Arlington	371	432	505	526	41.7
Houston, The Woodlands, Sugar Land	281	308	362	360	28.1
Los Angeles, Long Beach, Anaheim	573	639	707	713	24.4
New York, Newark, New Jersey	757	795	861	890	17.5
Philadelphia, Camden, Wilmington	275	304	339	345	25.4
Riverside, San Bernardino, Ontario	360	428	496	523	45.2

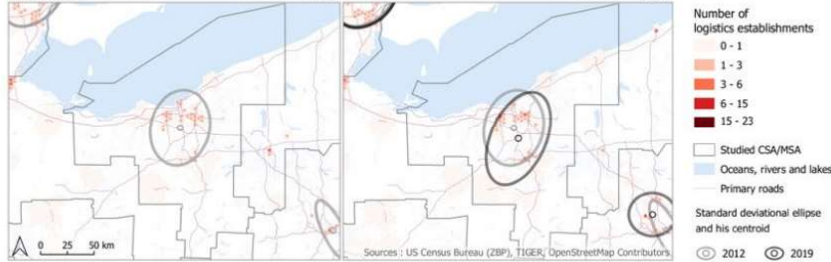
(Source : U.S. Census Bureau, 2012, 2015, 2018, 2019)

[CSA] Cleveland-Akron-Canton, OH

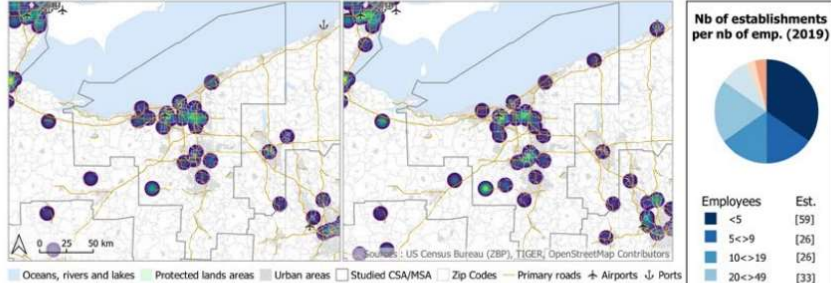
Zip Codes centroids between 2012 and 2019



Grid 5x5km 2012 2019



Heatmaps (radius 10km) 2012 2019

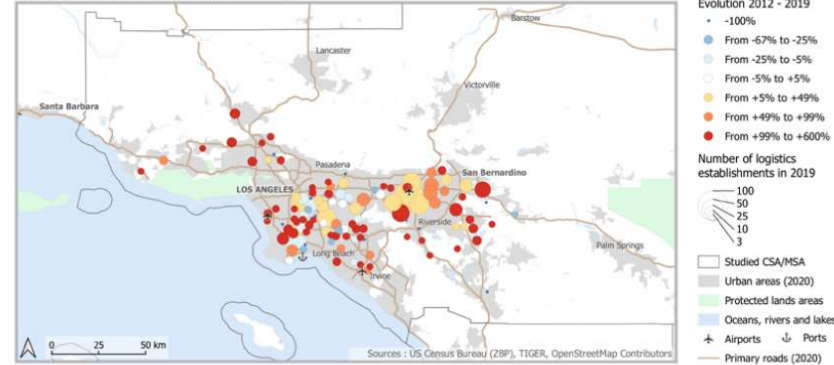


Statistics	Pop.	Emp. 493	Est. 493	Average nb of emp. per est.	Nb of est. per 10 000 inhabs	Standard deviational ellipse area	Movement of the centroid's ellipse
2012	3170314	4175	154	27.11	0.49	2998.49 km²	-
2019	3149448	6034	188	32.1	0.6	3634.4 km²	-
Gross change	-20866	+1859	+34	+4.99	+0.11	+635.91 km²	10.68 km
% change	-0.66%	+44.53%	+22.08%	+18.39%	+22.89%	+21.21%	-

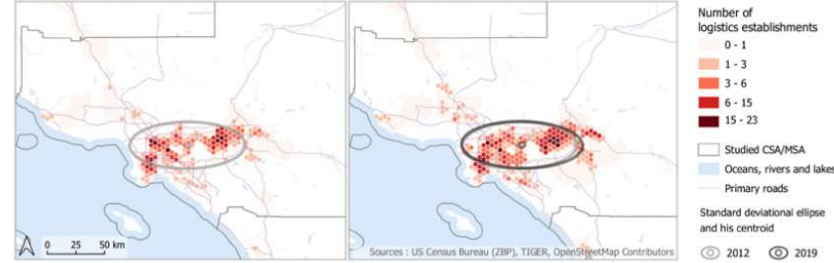
Statistics sources : US Census Bureau (CBP/MSA)

[CSA] Los Angeles-Long Beach, CA

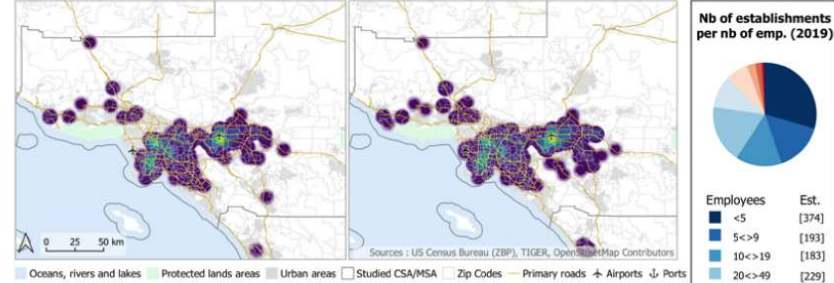
Zip Codes centroids between 2012 and 2019



Grid 5x5km 2012 2019



Heatmaps (radius 10km) 2012 2019



Statistics	Pop.	Emp. 493	Est. 493	Average nb of emp. per est.	Nb of est. per 10 000 inhabs	Standard deviational ellipse area	Movement of the centroid's ellipse
2012	18181675	45623	957	47.67	0.53	3161.46 km²	-
2019	18711436	82543	1267	65.15	0.68	3369.87 km²	-
Gross change	+529761	+36920	+310	+17.48	+0.15	+208.41 km²	2.2 km
% change	+2.91%	+80.92%	+32.39%	+36.66%	+28.64%	+6.59%	-

Statistics sources : US Census Bureau (CBP/MSA)

Two examples of map boards in the e-book

- It is crucial to understand the factors that drive the location of logistics facilities in metropolitan areas
- Phenomenon of logistics sprawl or the gradual return of small logistics facilities to the central zones of MSAs.
- The term “logistics sprawl” refers to growth in the number of warehouses on the outskirts of large cities, particularly in peri-urban areas where densities are low, land is available and cheap, and plots are large (Giuliano et al., 2013; Dablanc et al., 2014).
- The lack of regulation in metropolitan margins has encouraged the construction of warehouses in peri-urban areas, fueling a process of logistics sprawl (Dablanc et al., 2014) in which warehouses become concentrated in sparsely populated peri-urban areas (Bowen, 2008; Cidell, 2010).
- The intensity of logistics sprawl varies with the type of warehouse (greater for distribution centers, lower for courier terminals) and according to the type of strategy pursued by logistics actors.

An analysis of warehousing development patterns in four metropolitan areas :

- 1) Dallas-Fort Worth-Arlington MSA
- 2) Houston-The Woodlands-Sugar Lands MSA
(Texas Triangle megaregion)
- 3) New York-Newark-New Jersey MSA
- 4) Philadelphia-Camden-Wilmington MSA
(south of the Northeast megaregion)

Methodology

The aim of this research is to analyze warehousing development patterns in **four U.S. metropolitan areas**, based on the **County Business Pattern database** (U.S. Census Bureau) for 2012 and 2019 data at Zip Codes granularity.

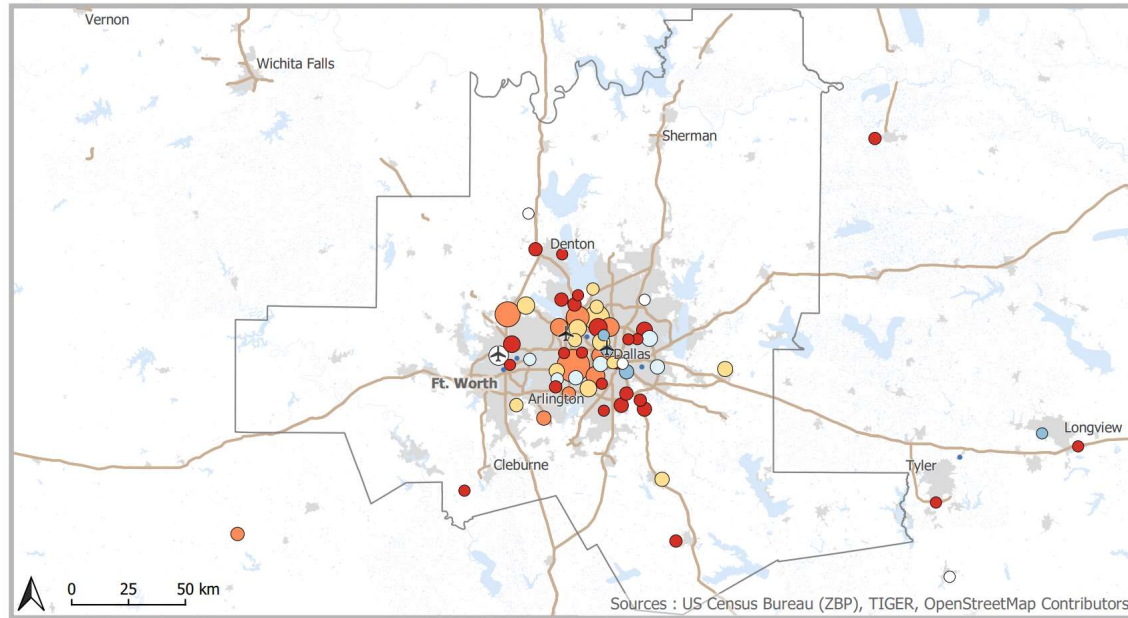
The **same data period (2012-2019)** was defined for the four metropolitan areas to ensure consistency in the analysis. Warehousing is defined in this study as establishments classified in subsector **493** (“Warehousing and Storage”) of the North American Industry Classification System (**NAICS**). This classification covers establishments engaged in operating merchandise warehousing and storage facilities.

This research used **R**, a language for statistical computing, to compile, aggregate the data and the **QGIS** software was used to map the warehouse establishments and to provide the spatial analysis, especially the barycenters.

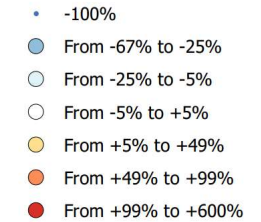
DALLAS-FORT WORTH-ARLINGTON MSA

- Evolution (2012 and 2019) in the Dallas-Fort Worth CSA: 41.7 % increase → 376 warehouses (2012), 533 (2019)
- A significant increase : the northeast part of the metropolitan area, the southeast, and the southwest near Arlington.
- A dual pattern of warehousing development: the reinforcement of logistics establishments in the first peri-urban ring around Dallas and at the same time the rapid development of a second ring on the edges of the Dallas metropolitan area.
- The standard deviational ellipse area from the barycenter in 2012 was 1942.65 km² → an increase of 19.6% (2012-2019)

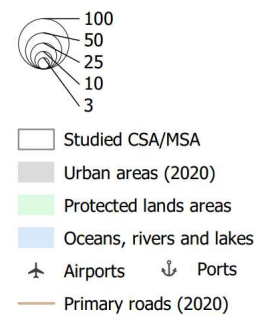
Zip Codes centroids between 2012 and 2019



Evolution 2012 - 2019



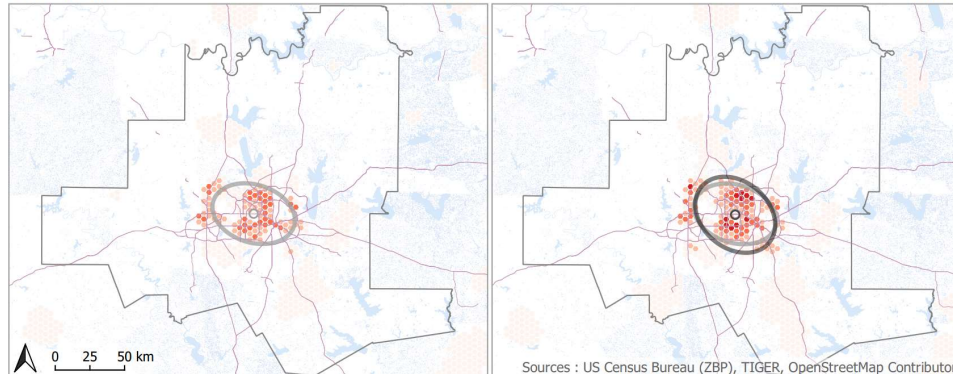
Number of logistics establishments in 2019



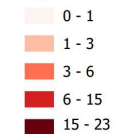
Grid 5x5km

2012

2019



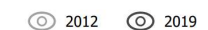
Number of logistics establishments



Studied CSA/MSA

- Oceans, rivers and lakes
- Primary roads

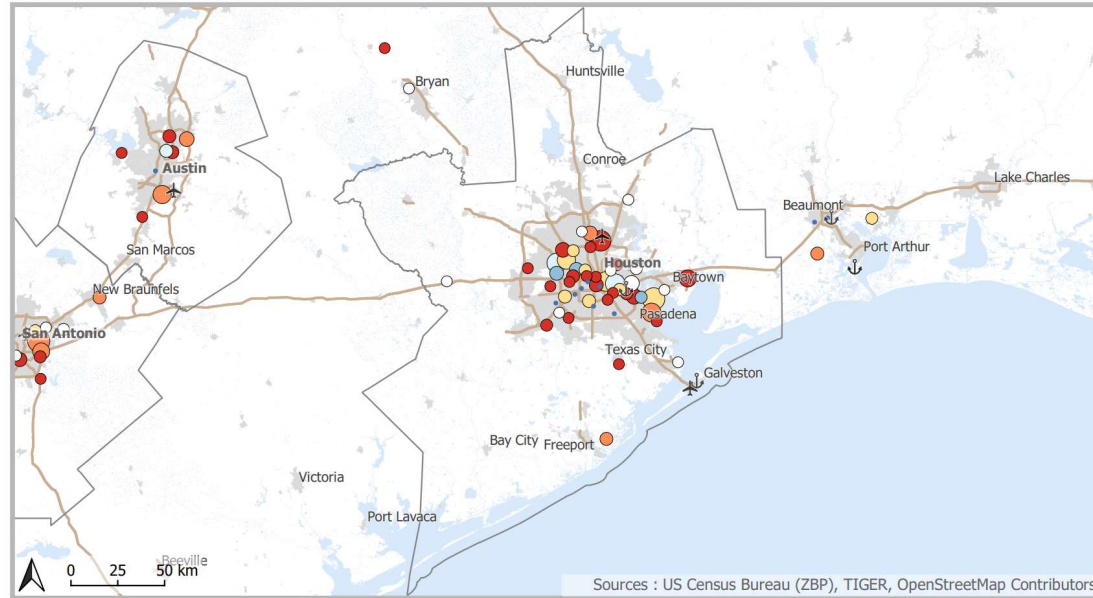
Standard deviational ellipse and his centroid



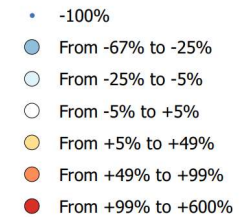
HOUSTON-THE WOODLANDS-SUGAR LANDS MSA

- A fast-growing logistics hub : increase of 29,1% (2012-2019) : 281 warehouses (2012) ; 363 (2019)
- Typical of large Sunbelt cities: strong demographic and economic growth & very significant levels of urban sprawl.
- Three main logistics clusters: a cluster around the Port of Houston to the southeast; a cluster around the international airport to the north; and a west/northwest axis from downtown (Interstate 10, Washington Avenue, Interstate 610, Hempstead Road)
- The standard deviational ellipse area from the barycenter was 2328.13 km² (2019) → increase of 13.7% (2012-2019)

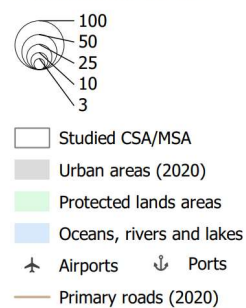
Zip Codes centroids between 2012 and 2019



Evolution 2012 - 2019



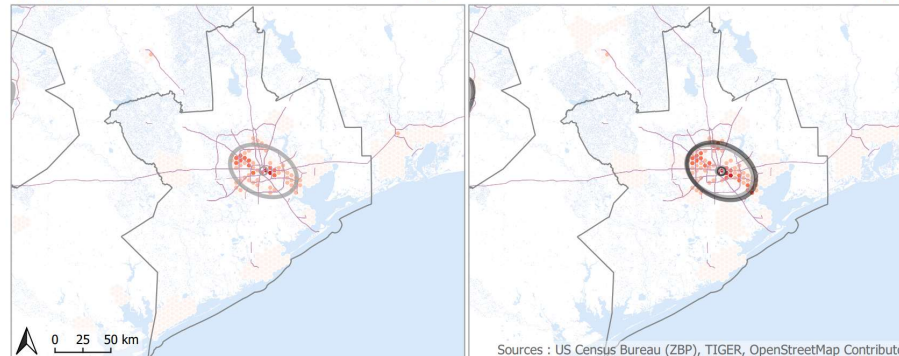
Number of logistics establishments in 2019



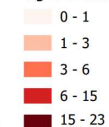
Grid 5x5km

2012

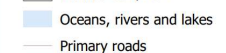
2019



Number of logistics establishments



Studied CSA/MSA



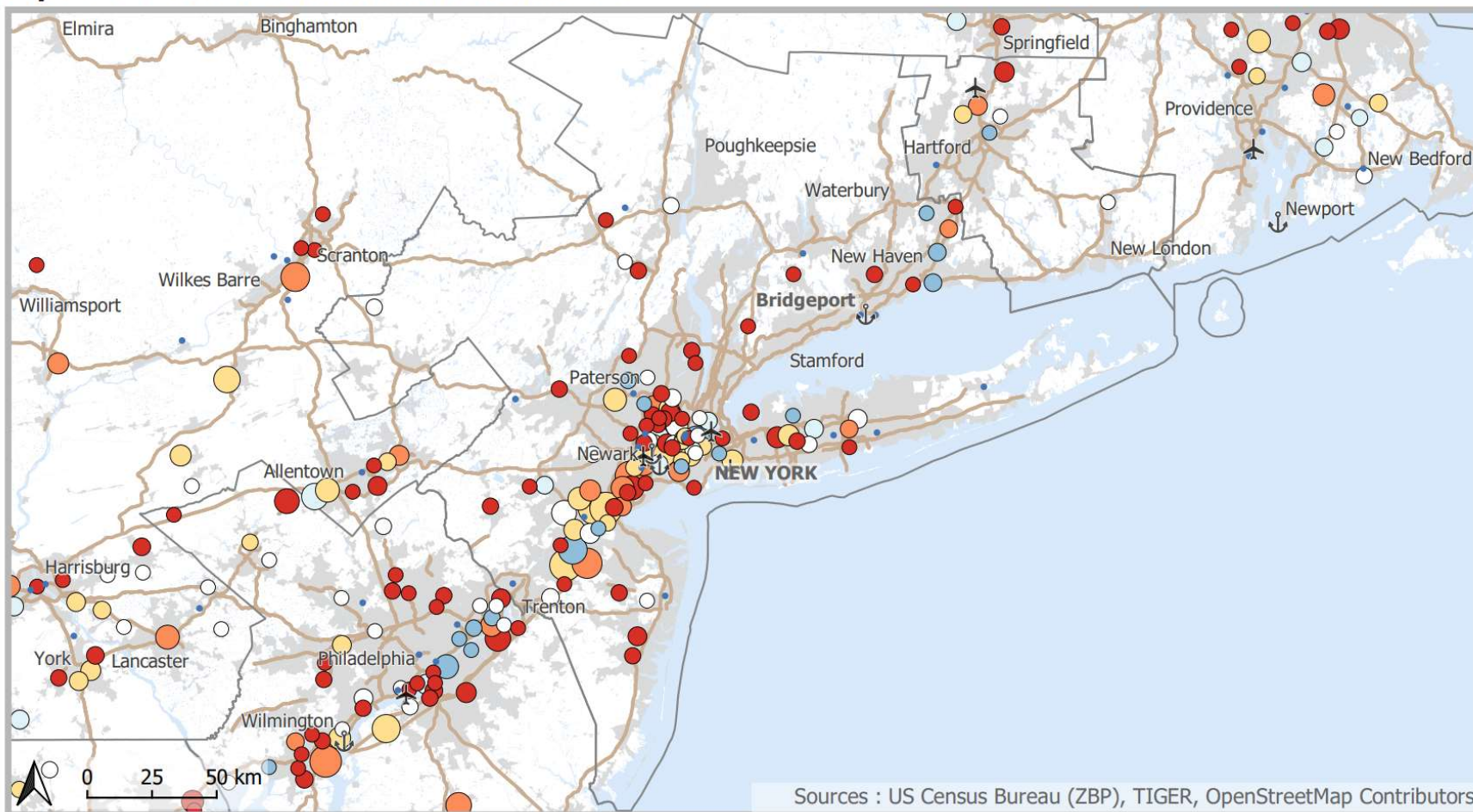
Standard deviational ellipse and his centroid



NEW YORK-NEWARK-NEW JERSEY CSA

- Major warehousing hub in the US : 844 warehouses (2012), 993 (2019) → 17.6% increase over the seven years. New York's major logistics hub continues to grow, confirming the metropolitan area's role as an international and domestic gateway.
- High concentration of logistics establishments that makes the map harder to read than in the other case studies.
- A distinctive form, essentially confined to the megacity's urban corridor.
- Why ? Major transportation infrastructures (Port of New York-New Jersey, Interstates, Newark and La Guardia airports) & the limited number of available parcels of land in a highly urbanized region
- The standard deviational ellipse area (from the barycenter) was 4906.91 km² in 2019 → a **decrease** of 7.25% between 2012 and 2019

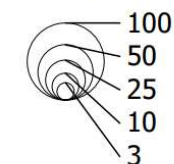
Zip Codes centroids between 2012 and 2019



Evolution 2012 - 2019

- 100%
- From -67% to -25%
- From -25% to -5%
- From -5% to +5%
- From +5% to +49%
- From +49% to +99%
- From +99% to +600%

Number of logistics establishments in 2019



- Studied CSA/MSA
- Urban areas (2020)
- Protected lands areas
- Oceans, rivers and lakes
- Airports
- Ports
- Primary roads (2020)

PHILADELPHIA-CAMDEN-WILMINGTON CSA

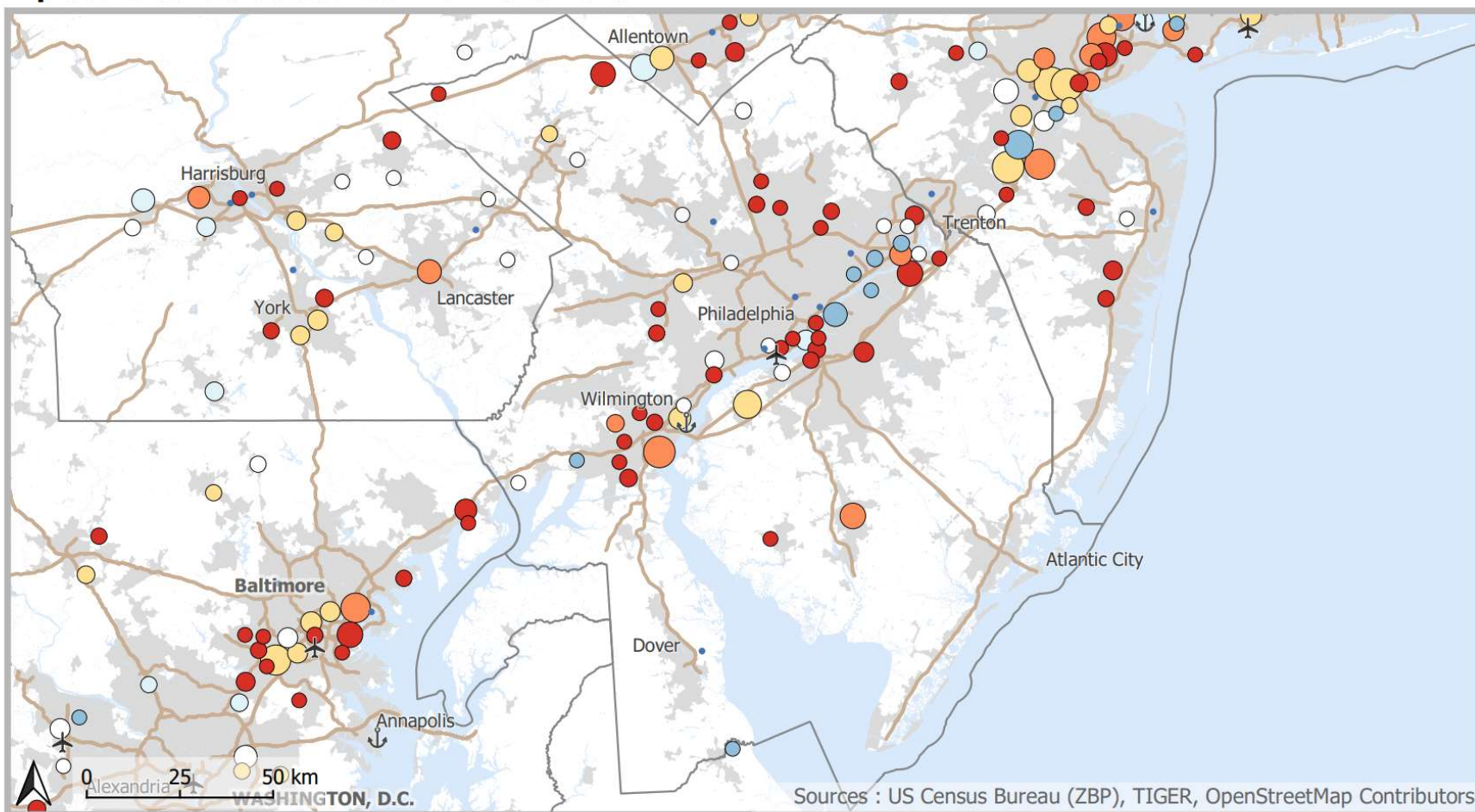
The number of warehouses in the Philadelphia-Camden-Wilmington CSA grew significantly between 2012 and 2019, from 324 logistics facilities in 2012 to 395 in 2019, an increase of 21.9 percent. As a result, the number of warehouses per 10,000 residents increased by 20.4% from 2012 (0.45/10,000 residents) to 2019 (0.55/10,000 residents). The location patterns of the logistics warehouses differ significantly (Fig. XX) from those in the Dallas-Fort Worth CSA. Most warehouses follow the Megalopolis urban corridor along a longitudinal northeast/southeast axis. It is within this urban corridor that major highway and rail transportation infrastructure, as well as major ports and airports, are concentrated.

The case of the Philadelphia-Camden-Wilmington CSA seems to confirm the major trends in the logistics real estate market, in particular a division in this market between warehouses located on the periphery (where owners are looking for large and inexpensive parcels) and warehouses located near the center of the metropolitan area to meet the needs of intra-urban logistics and e-commerce. To measure the changes in the locations of warehouse establishments, the standard deviational ellipse area (from the barycenter) was calculated for both years:

- in 2012 the standard deviational ellipse area from the barycenter was 4763.58 km²;
- in 2019, this area was 5567.76 km².

The standard deviational ellipse area increased by 16.8% between 2012 and 2019.

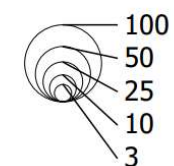
Zip Codes centroids between 2012 and 2019



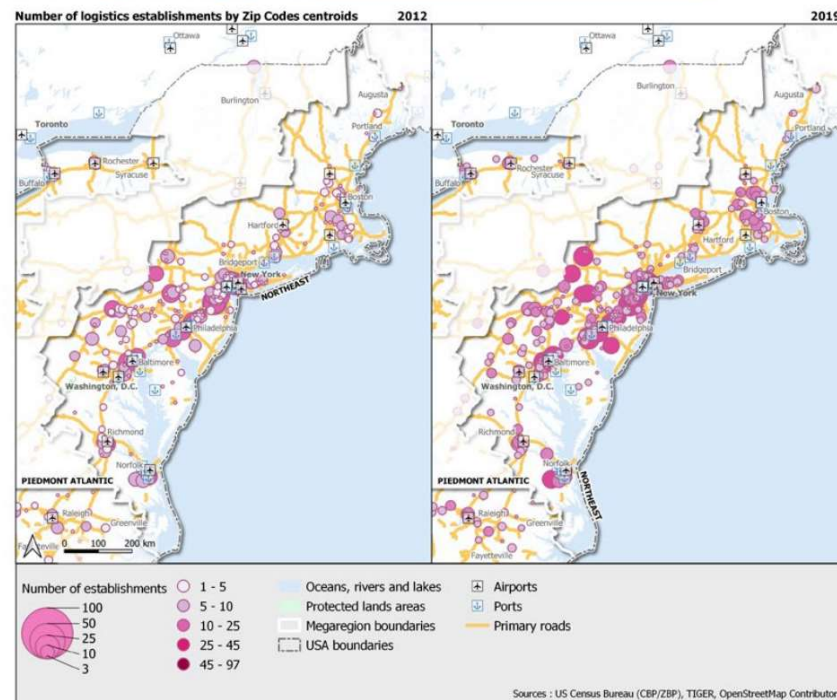
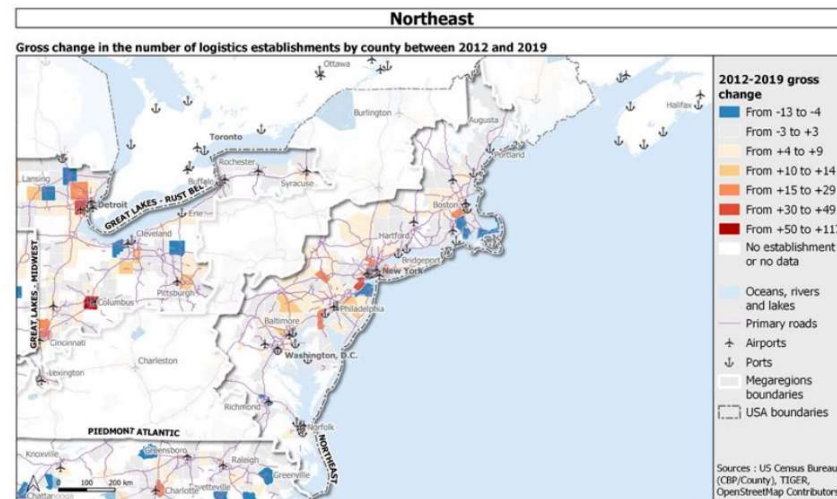
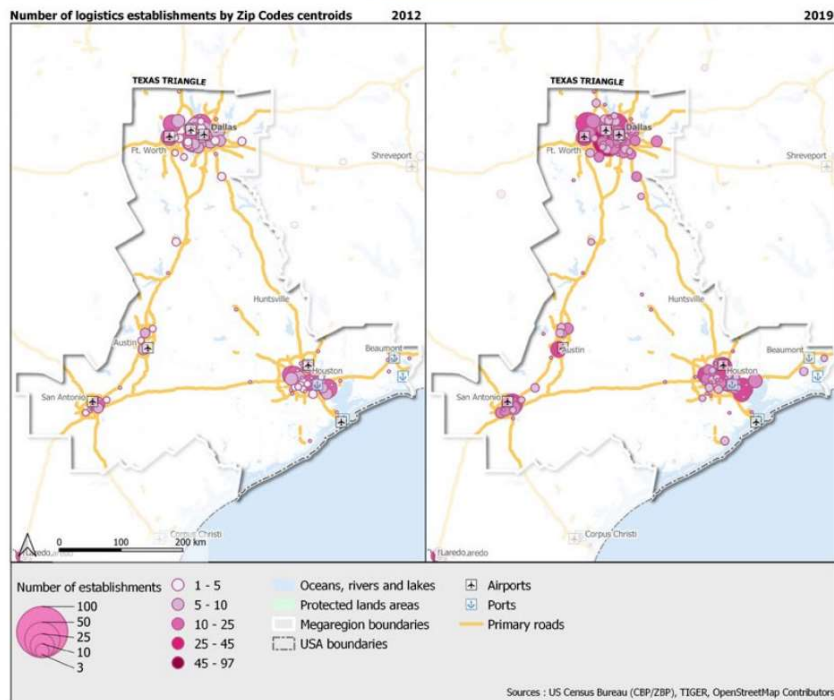
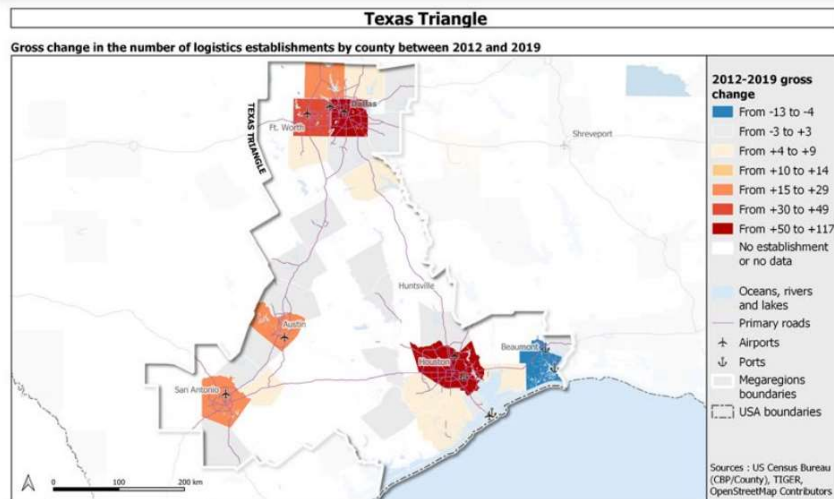
Evolution 2012 - 2019

- -100%
- From -67% to -25%
- From -25% to -5%
- From -5% to +5%
- From +5% to +49%
- From +49% to +99%
- From +99% to +600%

Number of logistics establishments in 2019



- Studied CSA/MSA
- Urban areas (2020)
- Protected lands areas
- Oceans, rivers and lakes
- ✈ Airports
- ⚓ Ports
- Primary roads (2020)



A look at the megaregion scale: logistics clusters

Conclusions and discussions

- 1) The number of warehouse establishments in the four metropolitan areas analyzed in this study grew rapidly between 2012 and 2019.
- 2) There was an increase in warehousing in the Houston and the Dallas areas, which have experienced steady logistics sprawl. The Dallas area is a typical case of a booming warehousing hub (+41.7% between 2012 and 2019) and of a sprawling metropolitan area.
- 3) The Houston-The Woodlands-Sugar Lands CSA appears to be following the same path. This area has also experienced strong growth in numbers of logistics establishments (+29.1% between 2012 and 2019) but has undergone less sprawl than the Dallas area.
- 4) Significant clustering of warehouses in these areas → proximity of major infrastructures (Port of Houston, Houston International Airport) and interstates/highways.

Conclusions and discussions

5) The two other case studies (Philadelphia-Camden-Wilmington CSA and New York-Newark-New Jersey CSA) reveal quite different trajectories.

Especially, the New York-Newark-New Jersey metropolitan area has experienced moderate growth in the number of logistics establishments (+17.6% between 2012 and 2019) but this growth occurred in an already mature and well-developed logistics market (993 warehouses in 2019).

This is the only one of the four case studies to show shrinkage in its standard deviational ellipse area and reduced sprawl in its warehousing sector.

This present research adds new metropolitan areas to those where the phenomenon of logistics sprawl has been analyzed. Logistics sprawl has been confirmed for six metropolitan areas in North America and Europe (Atlanta, Los Angeles, Phoenix, Chicago, Toronto, and Paris) (Dablanc et al., 2014; Heitz and Dablanc, 2015; Woudsma et al., 2016; Dubie et al., 2020) and has not been confirmed for one metropolitan area (Seattle) (Dablanc et al., 2014).

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Thank you for your attention !

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