

# New York City on the move

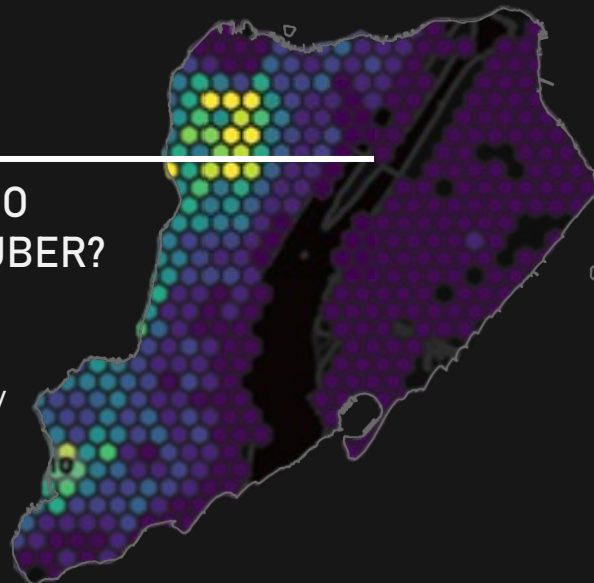
Data visualisation is a powerful means of presenting movement data, and thus the maps of this project aim to provide a holistic understanding of New York City's (NYC) population mobility patterns in the form of an atlas and with the general public as the intended audience. NYC is home to approximately 9 million people and thus it's fascinating to explore their mobility (NYC Planning 2020).

The series of maps that were produced are summarised in the NYC outline on the right, with labels about the information they convey.

1

## WHERE AND WHEN DO NEW YORKERS USE UBER?

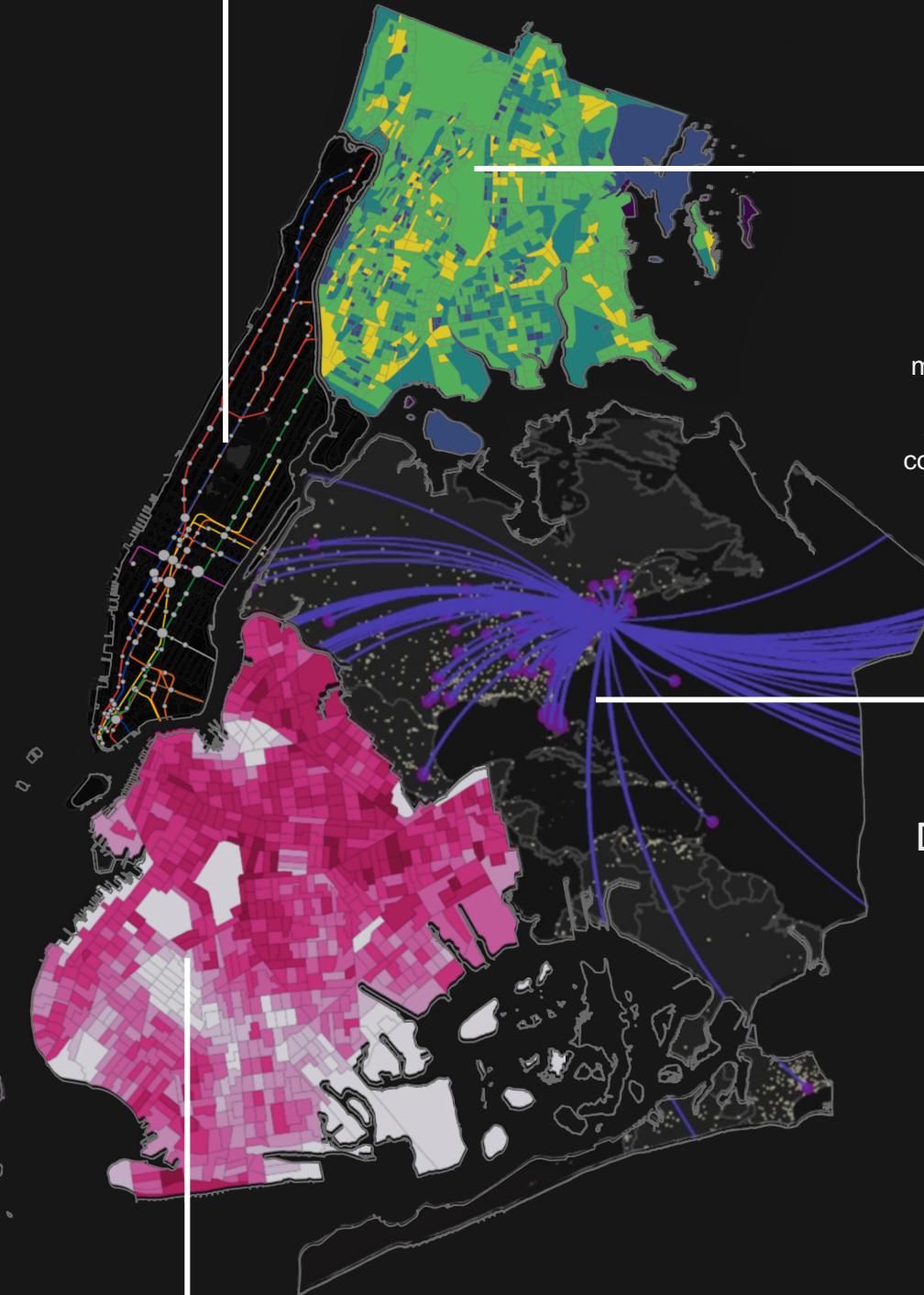
Uber pick-up location data from 2014 was used to understand popular pick-up points in the city and where Uber operates the most.



4

## THE NEW YORK CITY SUBWAY FOR A WEEK

NYC subway station entries and exits were mapped for a week to understand the pulse of people in and out of different areas of the city.



5

## HOW DO NEW YORKERS COMMUTE TO WORK?

Percentage of census tract population commuting by car and public transport were compared to understand the spatial differences in their usage. Travel time was also considered to examine its influence on public transport use.

3

## HOW WALKABLE IS NEW YORK CITY?

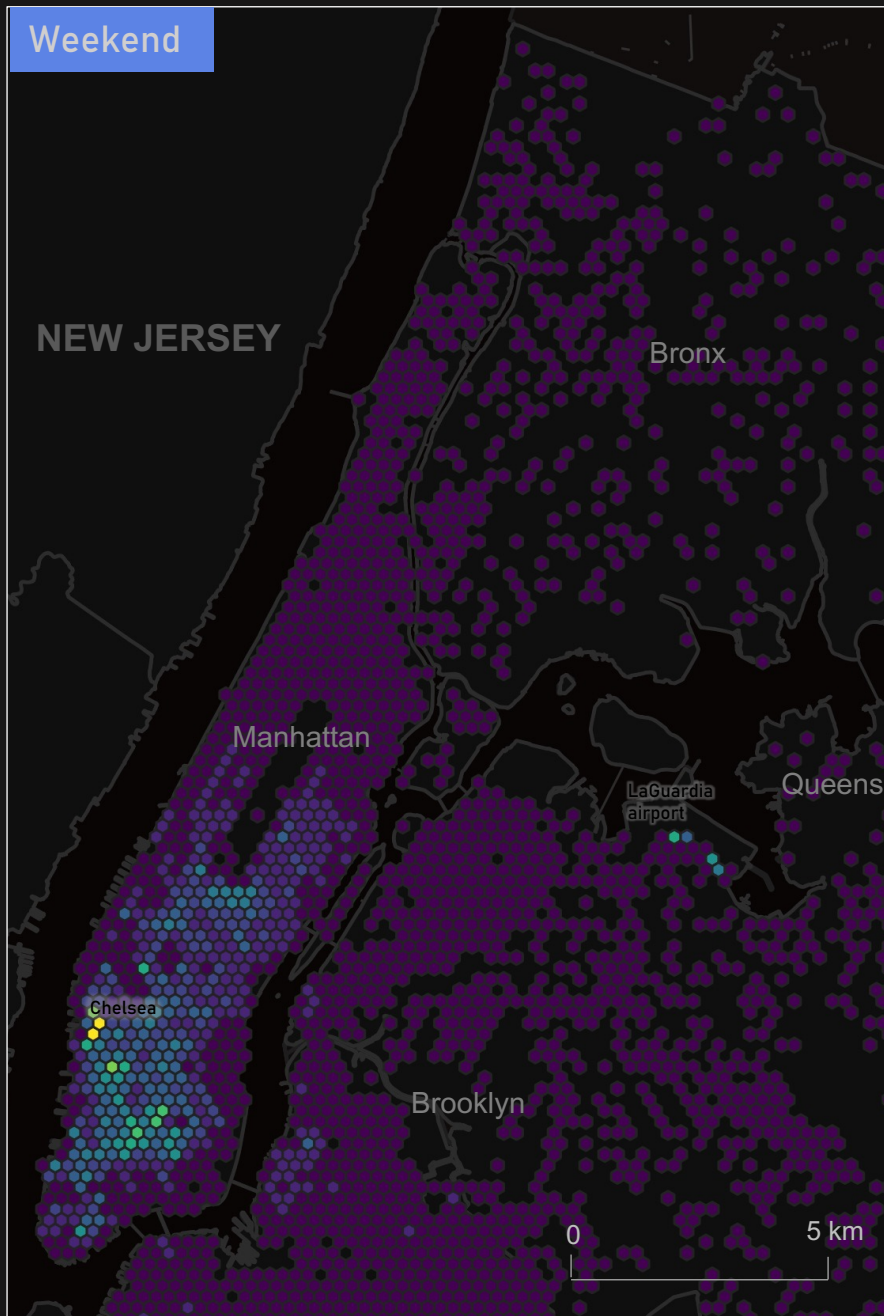
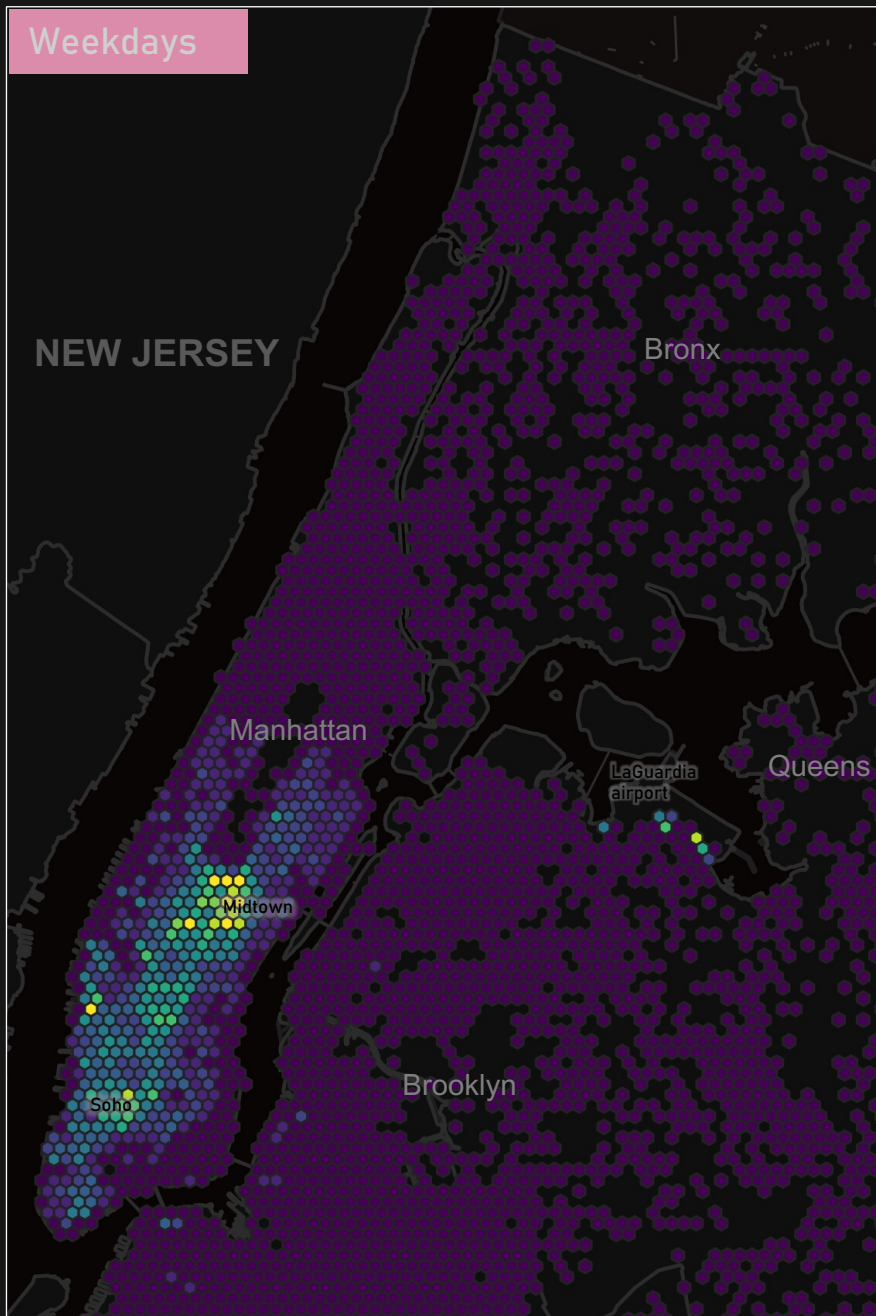
Walkability index scores were mapped to understand the extent to which existing infrastructure supports walking, and how NYC compares in terms of this national index.

2

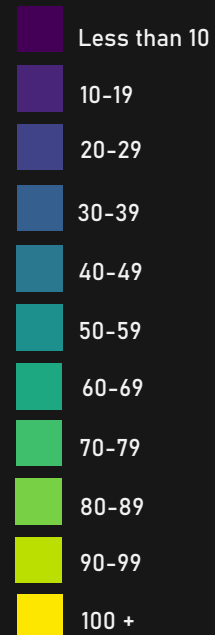
## WHERE DID NEW YORKERS FLY TO DURING THE COVID-19 PANDEMIC

Flights departing from NYC airports during the COVID-19 pandemic compared to pre-pandemic were mapped.

# WHERE AND WHEN DO NEW YORKERS USE UBER?



## AVERAGE UBER PICK-UPS PER DAY



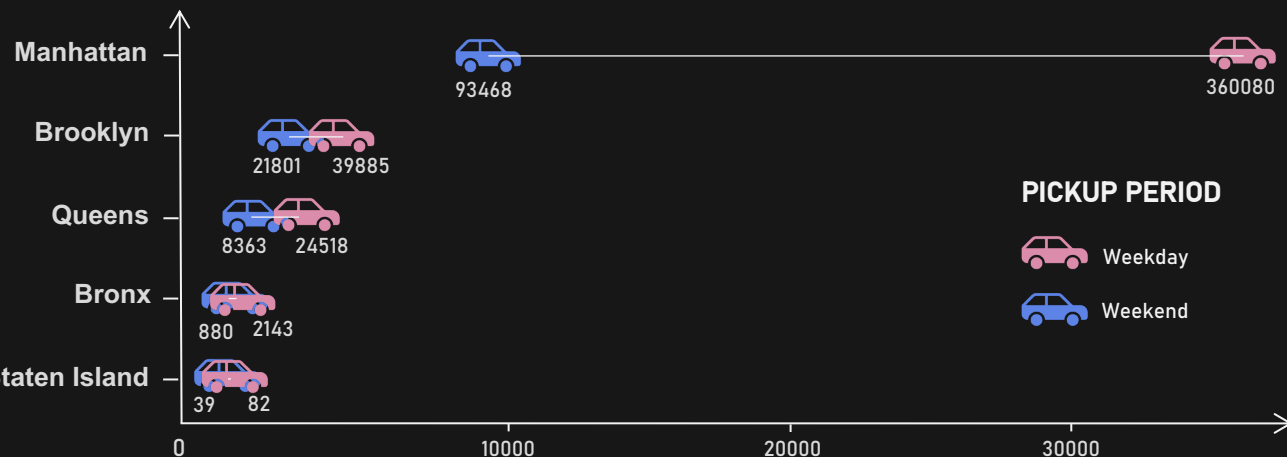
When do New Yorkers use Uber? The maps produced highlight the average number of Uber pick-ups during a weekday and during a weekend, utilising data from April 2014. There were more pick-ups per day during a weekday than a weekend which can suggest that New Yorkers were using Uber for commuting purposes.

During weekdays, there was a high concentration of pick-ups per day in Midtown Manhattan, a pattern which was absent during weekends. Midtown Manhattan is the largest business district (CBD) in New York City which explains why Uber pick-ups were more common during a working day of the week rather than a weekend day.

Is it possible that New Yorkers commute by Uber? It seems so! In 2016 Uber announced the launch of a commuter benefits programme which might have led to an intensification of the observed trend in later years (Uber 2017).

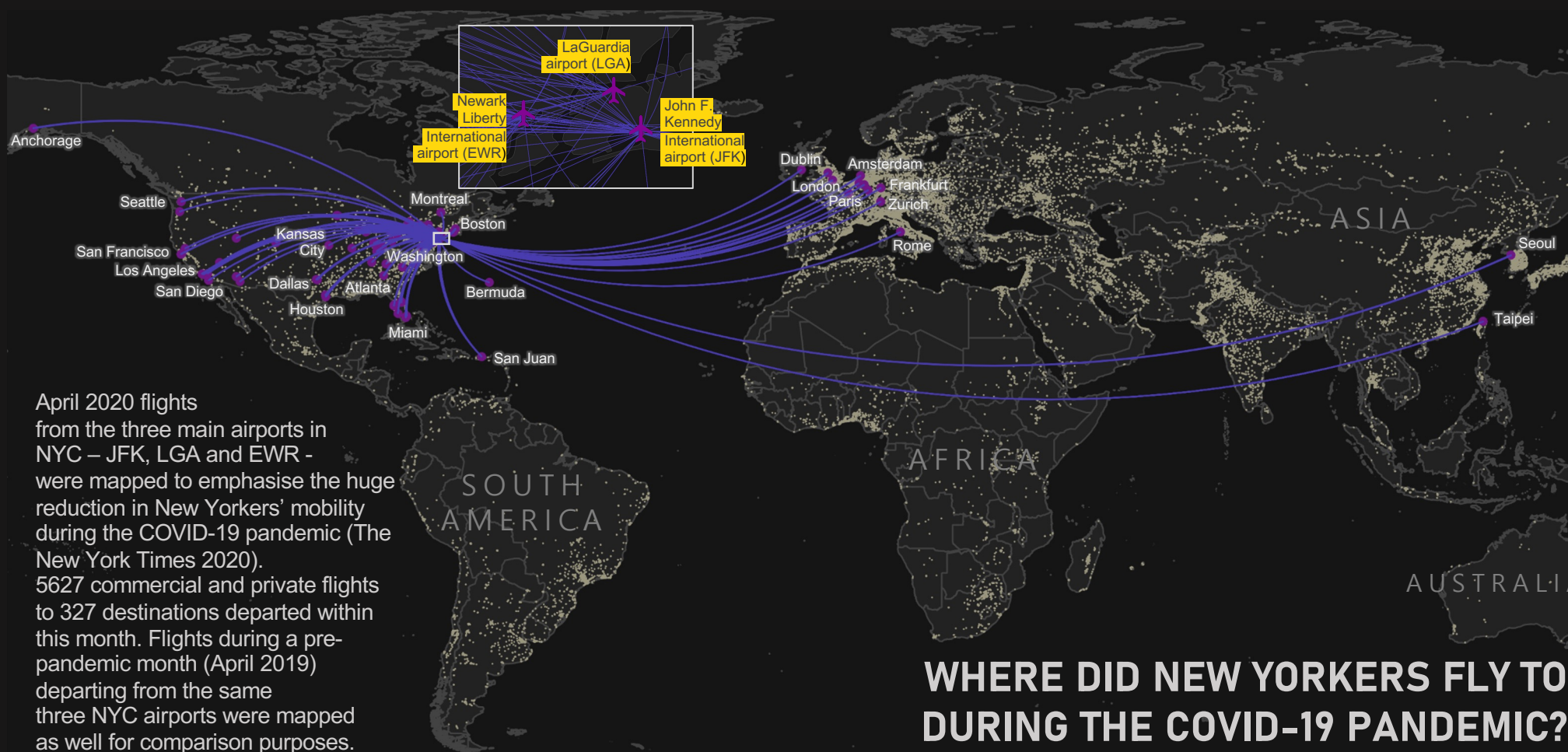
During the weekends, average pick-ups per day reached up to 180 in Chelsea and Soho which are both areas filled with night-time and daytime activities including restaurants, bars, shops and famous sights.

## TOTAL PICK-UPS BY COUNTY



Hexagonal grids helped preserve the granularity of the Uber pick-up data and thus were chosen as an appropriate method of data visualisation. Any hexagon with zero pick-ups was set to transparent. Colour and legend choices were made to highlight the differences between the weekday and weekend average pick-ups, facilitate direct comparisons and be colour-blind friendly.

Uber mostly operates in Manhattan which is highlighted in the figure by the number of pickups reaching approximately 550000 in total during April 2014. The other counties are listed in descending order, showing the low number of pickups in comparison to Manhattan. Weekend trips as a percentage of total trips are highest in Brooklyn (35.3%), followed by Staten Island (32.3%), Bronx (29.1%), Queens (25.7%) and Manhattan (20.6%).



April 2020 flights from the three main airports in NYC – JFK, LGA and EWR - were mapped to emphasise the huge reduction in New Yorkers' mobility during the COVID-19 pandemic (The New York Times 2020). 5627 commercial and private flights to 327 destinations departed within this month. Flights during a pre-pandemic month (April 2019) departing from the same three NYC airports were mapped as well for comparison purposes.

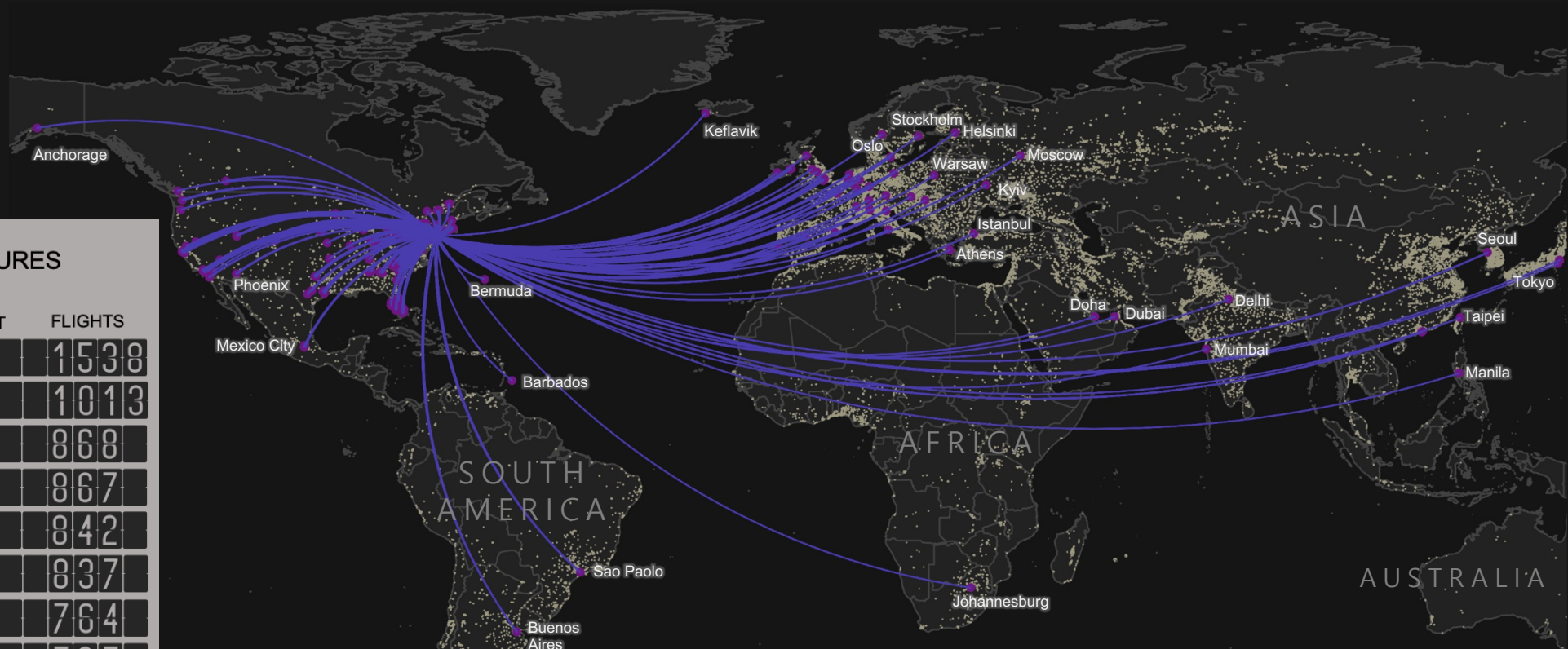
**DEPARTURES**

RANK	AIRPORT	FLIGHTS
1	ATL	315
2	BOS	256
3	ORD	249
4	LAX	237
5	SDF	177
6	LHR	172
7	CLT	154
8	SFO	140
9	DFW	135
10	MIA	121

The table for April 2020's top destinations consists of a much lower number of flights than April 2019. Nine out of ten destinations were within the US, with LHR in the United Kingdom remaining within the top 10. Despite the mobility reductions, New Yorkers still flew to several European destinations.

## WHERE DID NEW YORKERS FLY TO DURING THE COVID-19 PANDEMIC?

April 2019 had a total of 32060 flights with 670 different destinations. **The pandemic led to a reduction of approximately 82% of flights departing from NYC**, thus limiting the movement of New Yorkers and tourists around the globe. A comparison of the two maps reveals a more clear reduction in the range of international destinations that domestic ones.



The table on the right shows the combined departures from the three NYC airports to other airports around the globe for April 2019. The most popular destination was Chicago O'Hare International airport with 1538 flights. Eight of the top ten destinations involved domestic flights to other US States – Illinois, California, North Carolina, Florida and Texas. Two international destinations were London Heathrow Airport (LHR) in the United Kingdom, and Toronto International Airport (YYZ) in Canada.

**DEPARTURES**

RANK	AIRPORT	FLIGHTS
1	ORD	1538
2	SFO	1013
3	CLT	868
4	HWO	867
5	DFW	842
6	HHR	837
7	LHR	764
8	RDU	707
9	OPF	848
10	YYZ	831

## VS BEFORE THE PANDEMIC?

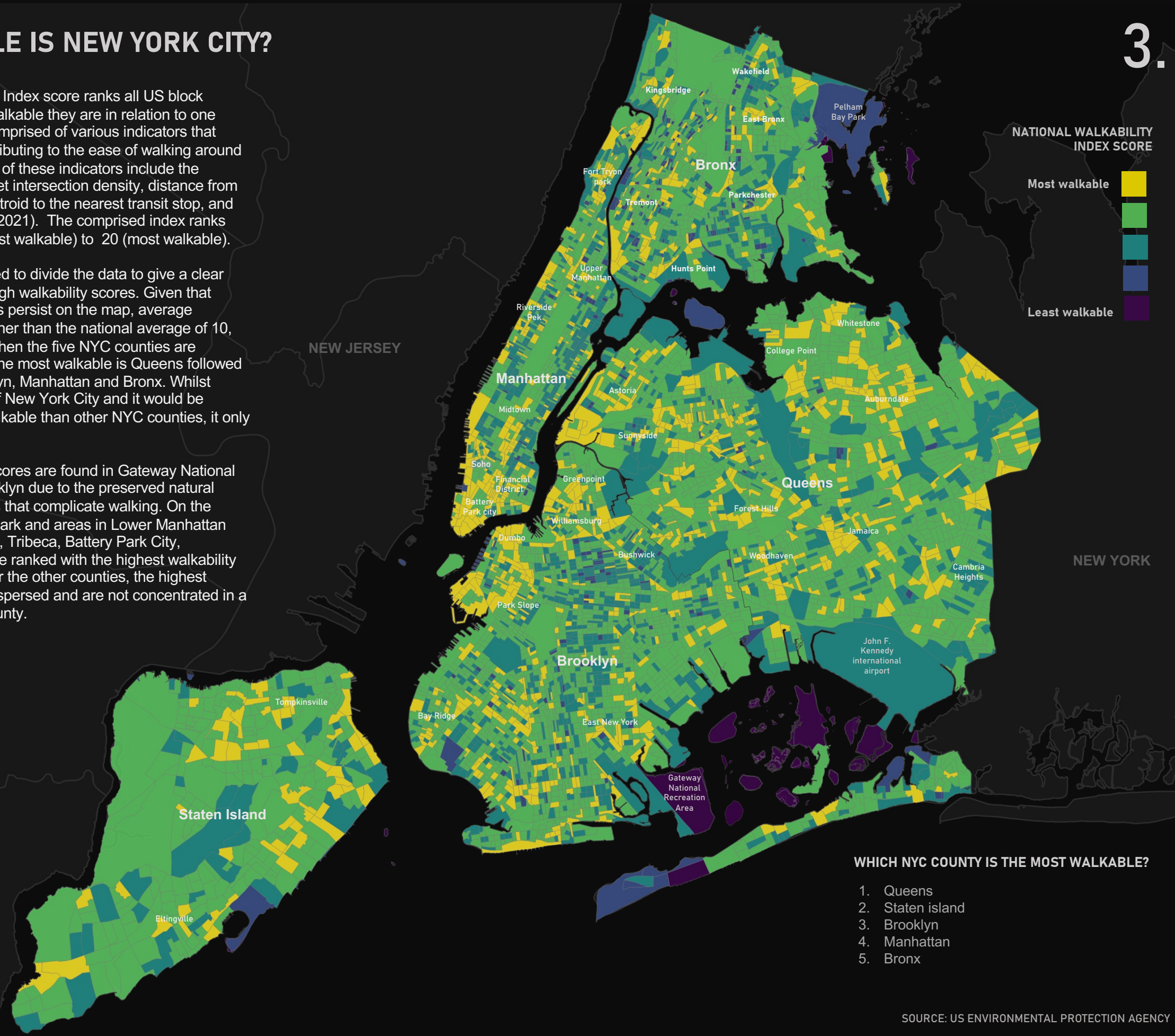
SOURCE: OPENSKY AND OPENFLIGHTS

# HOW WALKABLE IS NEW YORK CITY?

The National Walkability Index score ranks all US block groups based on how walkable they are in relation to one another. The index is comprised of various indicators that were thought to be contributing to the ease of walking around a neighbourhood. Some of these indicators include the pedestrian-oriented street intersection density, distance from population weighted centroid to the nearest transit stop, and land use diversity (EPA 2021). The comprised index ranks block groups from 1 (least walkable) to 20 (most walkable).

Equal intervals were used to divide the data to give a clear sense of low, mid and high walkability scores. Given that green and yellow colours persist on the map, average walkability in NYC is higher than the national average of 10, with a score of 13.44. When the five NYC counties are considered separately, the most walkable is Queens followed by Staten Island, Brooklyn, Manhattan and Bronx. Whilst Manhattan is the CBD of New York City and it would be expected to be more walkable than other NYC counties, it only ranks fourth.

The lowest walkability scores are found in Gateway National Recreation Area in Brooklyn due to the preserved natural environment and islands that complicate walking. On the contrary, the Riverside park and areas in Lower Manhattan like the Financial District, Tribeca, Battery Park City, Chinatown and Soho, are ranked with the highest walkability scores in Manhattan. For the other counties, the highest walkability scores are dispersed and are not concentrated in a specific region of the county.



## WHICH NYC COUNTY IS THE MOST WALKABLE?

1. Queens
2. Staten island
3. Brooklyn
4. Manhattan
5. Bronx

# THE NEW YORK CITY SUBWAY FOR A WEEK

The total number of entries to and exits from every New York City subway station were mapped for the week commencing 19 March 2022.

Subway stations in Midtown and Lower Manhattan were the busiest stations, highlighted by the larger in size symbols. When comparing the two maps, it is clear that the volume of exits was larger than the volume of entries in the above locations, thus emphasising the pulse of people in Manhattan from other countries. Another region with a large number of entries and exits was the Flushing-Main Street station near the New World mall in Queens located at the east end of Line 7.

### VOLUME OF WEEKLY FLOWS

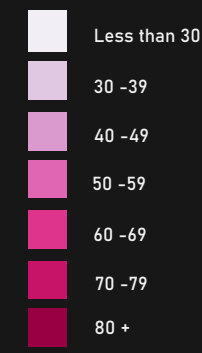
- 100,000
- 200,000
- 300,000
- 400,000
- 450,000



# HOW DO NEW YORKERS COMMUTE TO WORK?

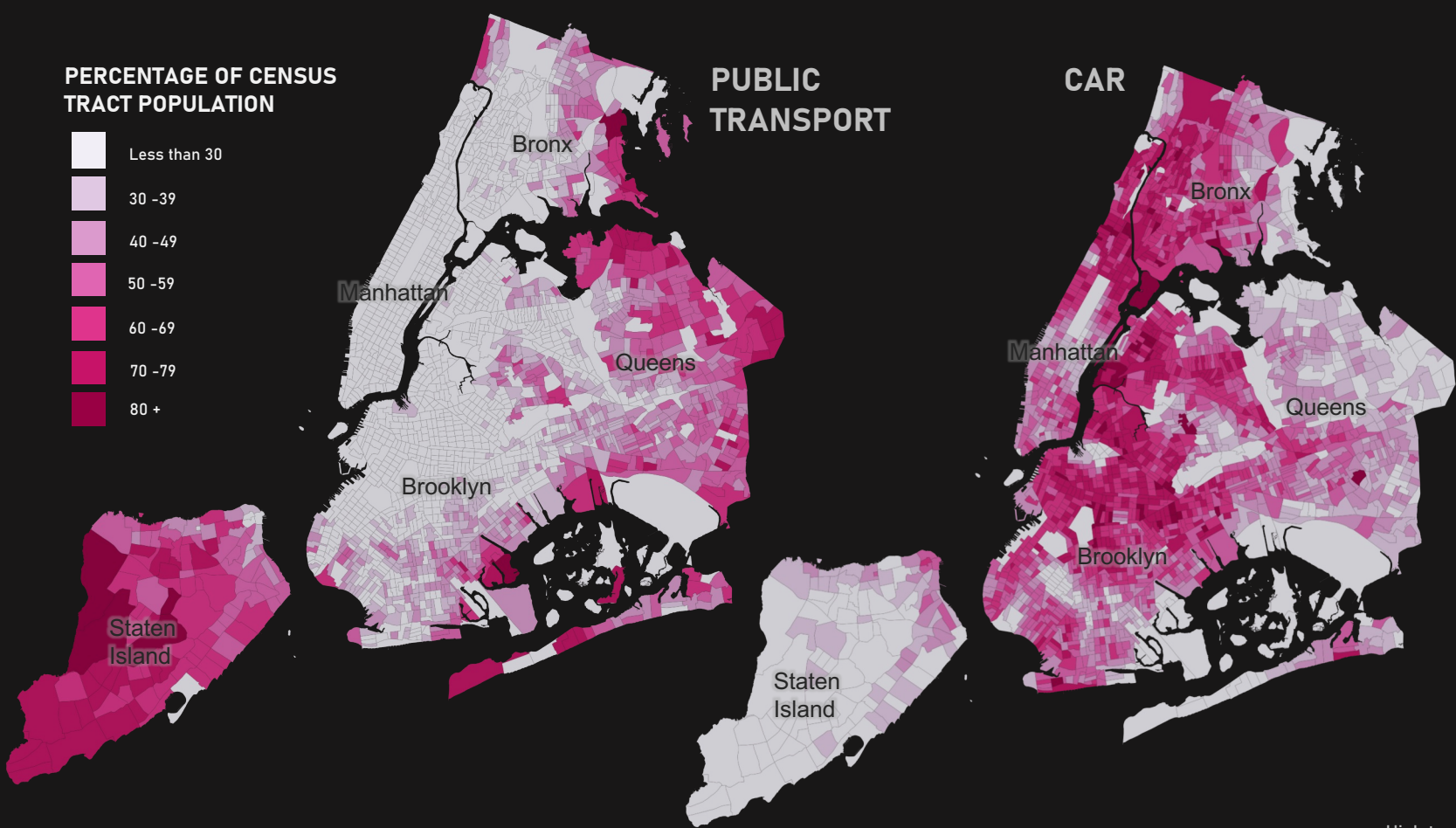
After undertaking analysis to understand when and where New Yorkers move around the city, it was important to understand how they do so. The data comes from the 2019 American Community Survey as of 17<sup>th</sup> September 2020 where respondents from each census tract could choose their commuting modes. Their choice could include more than 1 mode of transport, but only the two most popular - car and public transport - were mapped. There is a clear difference between car and public transport usage by location which might be linked to the distance from the CBD as well as travel time. In most Staten Island and East Queens tracts, more than 70% of respondents reported that they were commuting by car. On the contrary, percentage of census tract population commuting by public transport was highest in North Manhattan, Bronx, Brooklyn and West Queens. It's interesting how the patterns of the two are completely opposite.

## PERCENTAGE OF CENSUS TRACT POPULATION



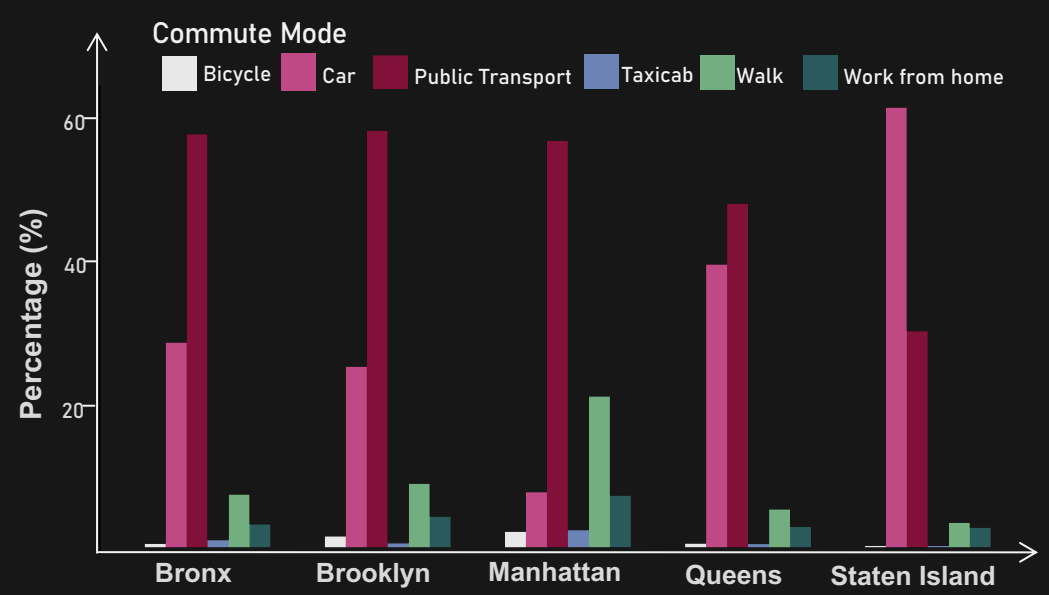
## PUBLIC TRANSPORT

## CAR



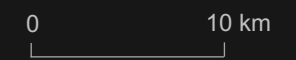
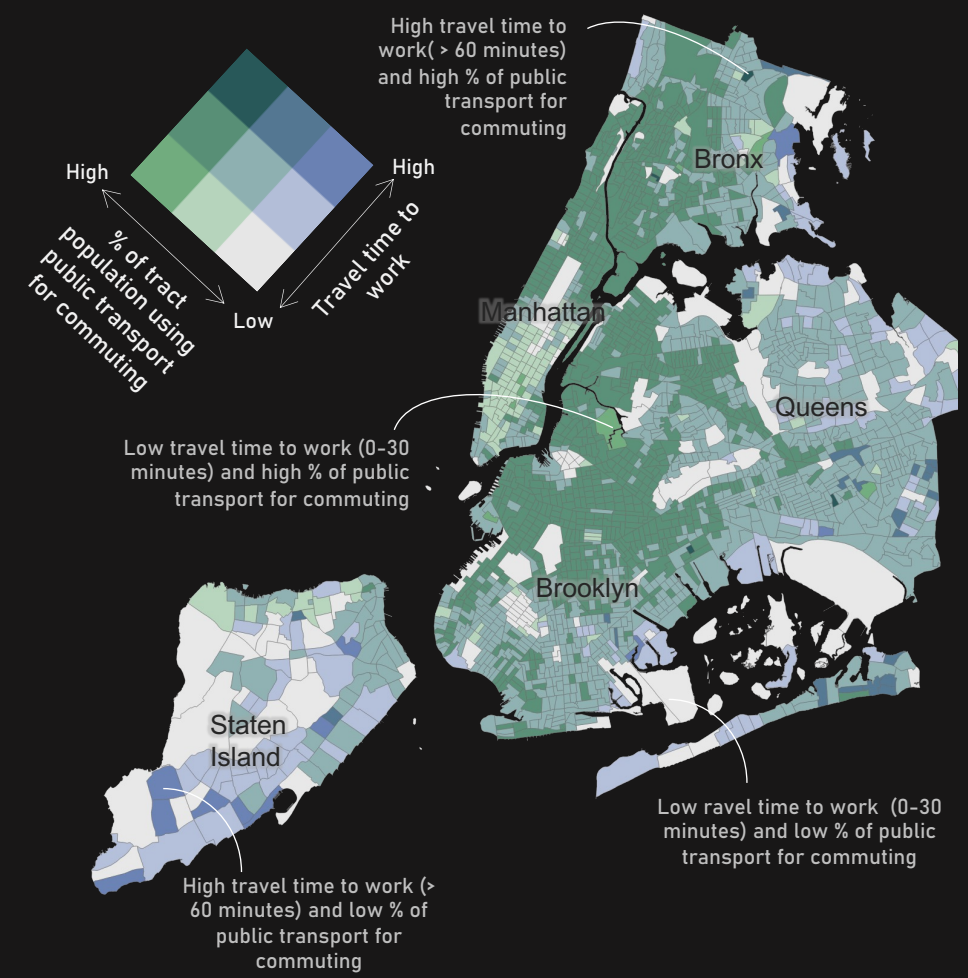
## PERCENTAGE OF COMMUTERS BY MODE IN NYC COUNTIES

Public transport was the dominant commute mode for all counties except Staten Island where car was the dominant one. Commuting by bicycle was most common in Manhattan, followed by Brooklyn. This is probably due to the transport infrastructure, bike-sharing schemes and close proximity to the major employment hub, encouraging active modes of commuting. Walking was more common than cycling to work in all counties, and lastly, work from home was more common in Manhattan tracts.



## TRAVEL TIME AND PUBLIC TRANSPORT USE

The bivariate map links travel time to work with the % of tract population using public transport for commuting. It is clear that a high % of public transport use for commuting was mostly associated with mid-high travel time (30-60 minutes). High travel time (>60 minutes) was not associated with a large % of public transport use which might suggest that car was used instead.



# SELF-REFLECTION

Through the maps I produced, I aimed to explore different methods of visualisation beyond those I used in the past - hexagonal grids and bivariate maps. The assessment was completed using a mixture of R and QGIS where some initial cleaning and data preparation steps were performed in R and then visualised in QGIS. This was the first time I used QGIS for such a big-scale project and it helped me become more proficient in changing the properties of map layers, clipping layers and editing attribute tables. Specifically, the creation of the proportional symbol maps for subway data, and origin-destination matrices for flight data involved first gaining a deep understanding of how layer properties work. The granularity of most datasets used allowed for disaggregate methods of analysis which helped avoid the Modifiable Aerial Unit Problem (MAUP). However two of the maps present data at an aggregate level either in census tract blocks or census tracts which could be subject to MAUP. Despite that data was easily available, it was difficult to find datasets covering similar time periods. The data analysed ranges from 2014 (Uber data) to 2022 (Subway data), and this might be affecting the nuance of the analysis. Nonetheless, to narrow down the focus of the project all maps are central to New York City. Lastly, if I could improve one of the maps, that would be the NYC subway map which includes data that was the most complicated to both clean and visualise in an effective way.

# REFERENCES

Cheshire, J. and Uberti, O. (2016) *London: the information capital: 100 maps and graphics that will change how you view the city*. London: Penguin Books. - no particular reference was made to this book but inspiration was drawn from it.

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# DATA LINKS

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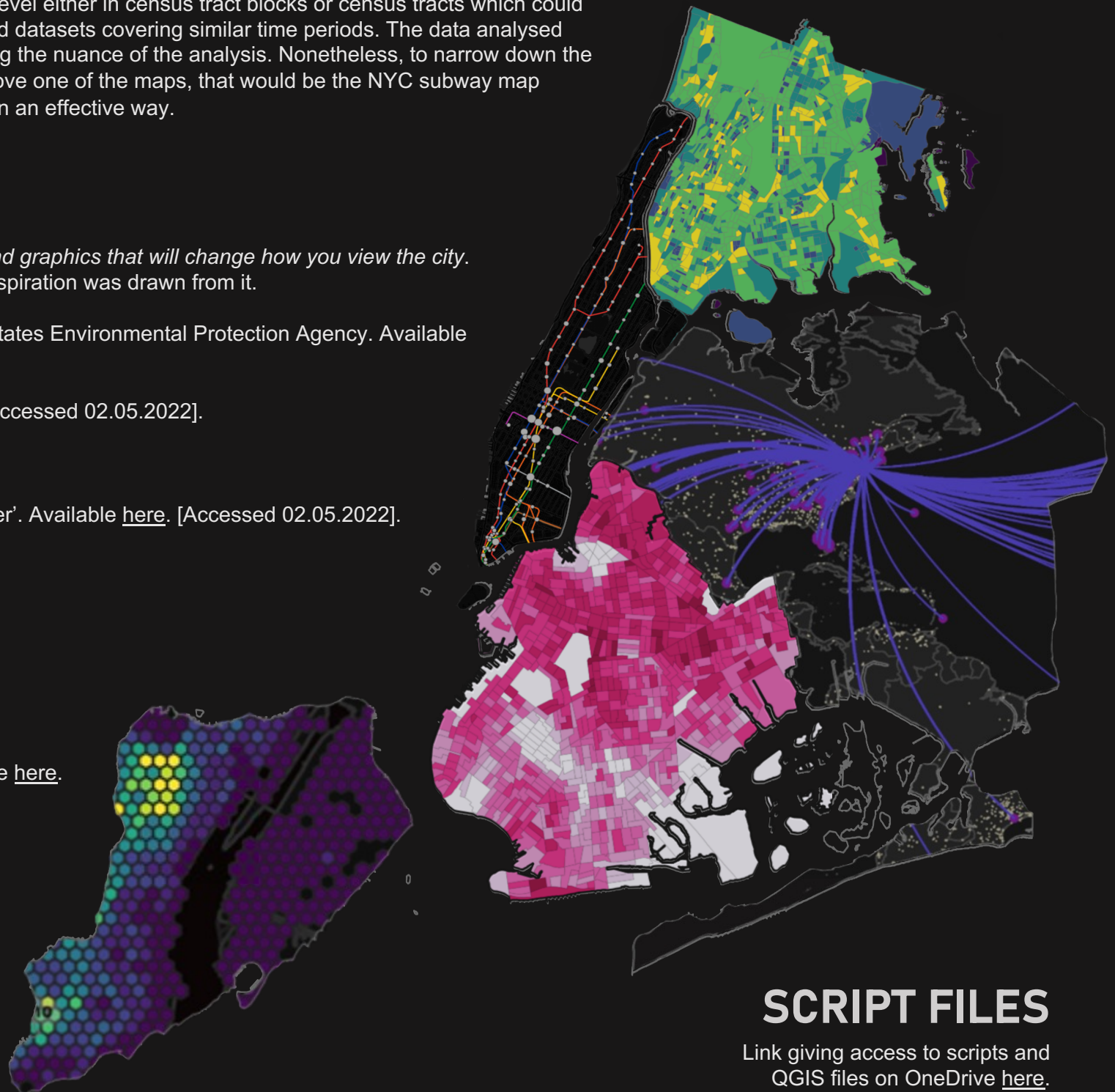
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Metropolitan Transportation Authority (2022). Turnstile data. Available [here](#).

U.S. Environmental Protection Agency, Office of Sustainable Communities (2022) Walkability Index. Available [here](#).

Xavier Olive, Martin Strohmeier, & Jannis Lübbe. (2022) Crowdsourced air traffic data from The OpenSky Network 2020. Available [here](#).



# SCRIPT FILES

Link giving access to scripts and QGIS files on OneDrive [here](#).