

Geography
Internal Assessment

How does environmental quality, determined by the severity of pollution and the availability of green spaces, differ between a tourist-catering area of Paris versus a residential area?

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May 2021

Word count: TBD

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1 Introduction

1.1 Fieldwork question

How does environmental quality, determined by the severity of pollution and the availability of green spaces, differ between a touristic area of Paris and a residential area?

The fieldwork for our paper was conducted in Paris, one of the largest and most well known cities in the world. The city itself is arranged in a manner such that 20 districts, known locally as *arrondissements*, are placed in a spiral in the city. It is globally known for its high number of tourists per year, equating to around 35 million tourists in the year 2019 alone.¹ Many of them come to visit the world-renowned Eiffel Tower, located in the VIIth *arrondissement*.² To add, Paris is home to 2.2 million people, who mostly live in the outer residential areas, from the XIth to the XXth *arrondissements*.

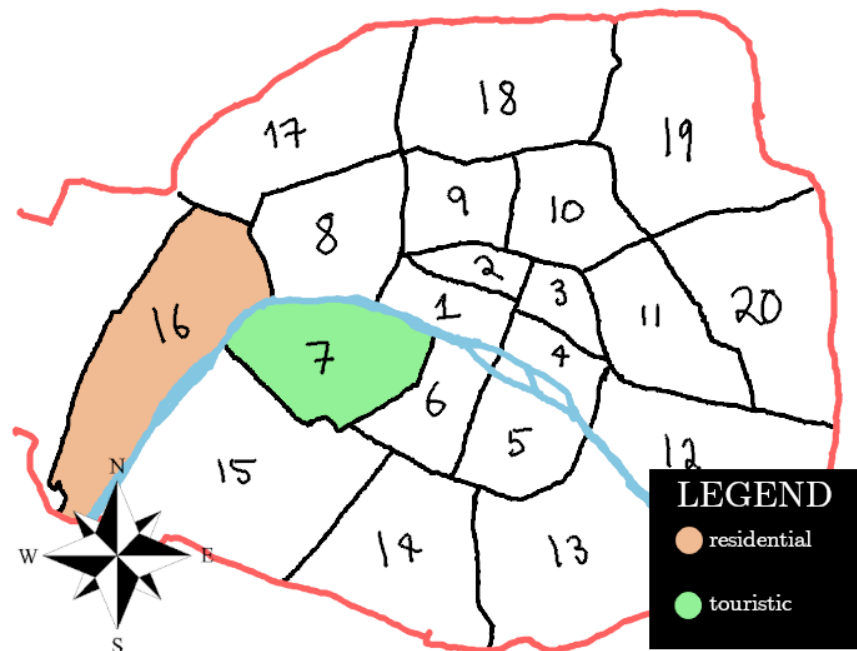


Figure 1: A map of Paris *arrondissements*, drawn by hand.

1.2 Hypotheses

1. According to the Global Development Goals of the UN, 90% of urban areas in the world had polluted air in 2016.³ Paris was among these countries that didn't satisfy WHO's air quality minimum⁴ of 2018, with on average a 50% higher than normal pollution density. In addition,

¹Statista Research Department. *Hotel arrivals in Paris 2011-2019*. Apr. 2020. URL: <https://www.statista.com/statistics/468164/number-tourist-arrivals-hotels-paris>.

²CondorFerries. *Latest France Tourism Statistics & Industry Trends (2020-2021)*. URL: <https://www.condorferries.co.uk/france-tourism-statistics>.

³"The Sustainable Development Goals Report 2020". In: *The Sustainable Development Goals Report (2020)*, p. 47. DOI: [10.18356/214e6642-en](https://doi.org/10.18356/214e6642-en).

⁴*Ambient (outdoor) air pollution*. May 2018. URL: [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health).

the areas of tourism in Paris are, as seen in Figure 2, higher in pollution than residential areas. However, a counterargument to this could be that despite a higher concentration of people, tourist areas in Paris do not suffer as much from high traffic conditions from things such as typical morning rush hours, and tourists preferably using public transport or bikes.

2. As there are more people moving about in residential areas, for example in cars for the morning commute or at noon for lunch, it can logically be theorized that noise pollution, which is obviously a function of the amount of people, would be higher in these places. Today it is estimated that an average noise level of $60dB$ can be found in residential areas, according to the very comprehensive Bruitparif government-sponsored report.⁵ This value largely surpasses the WHO's safe level of $53dB$.⁶
3. The Parisian mayor, Anne Hidalgo included the betterment of the environment in her campaign. The mayor has promised to make so-called "green spaces" no further than 200 meters to any person,⁷ and as such, it should be hypothesized that green spaces, which include parks, agglomerations of trees, shall be distributed evenly with no difference between residential and touristic areas. The mayor emphasized on "urban forests" — places where residents and tourists alike could enjoy the company of trees while walking along the city streets.

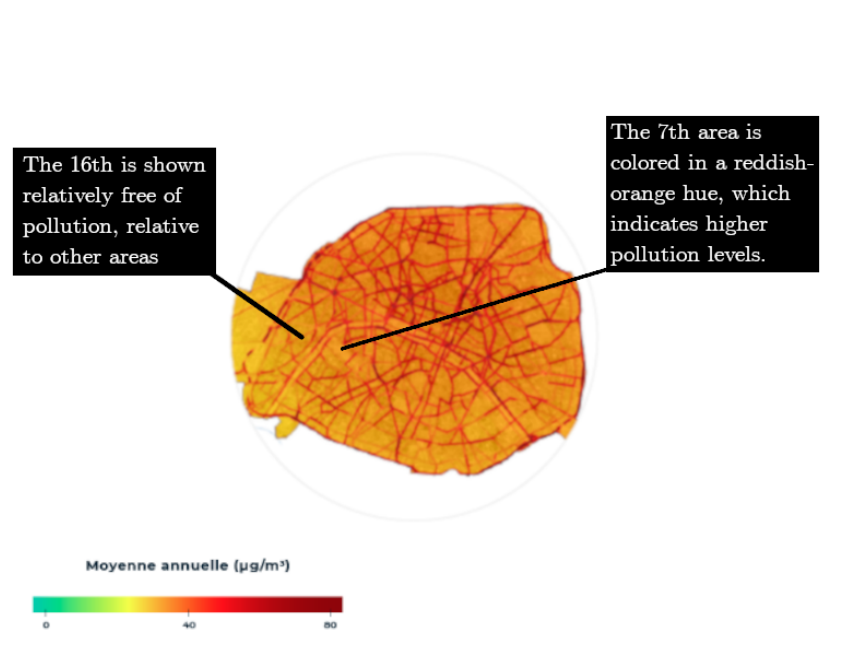


Figure 2: A map of Paris NO2 levels in 2018, as reported by AirParif, on the official Paris website^a

^aÉtat de la qualité de l'air à Paris. URL: <https://www.paris.fr/pages/etat-des-lieux-de-la-qualite-de-l-air-a-paris-7101>.

⁵Mairie de Paris. *PLAN DE PRÉVENTION DU BRUIT DANS L'ENVIRONNEMENT 2015 > 2020*. URL: <https://www.bruitparif.fr/PPBE/75056%20-%20Paris/PPBE%20Paris%202015-2020.pdf>.

⁶"Environmental Noise Guidelines for the European Region". In: (2018), p. 8. URL: https://www.euro.who.int/__data/assets/pdf_file/0009/383922/noise-guidelines-exec-sum-eng.pdf.

⁷Anne Hidalgo. *Comment Paris peut-elle être une ville encore plus végétale ?* URL: <https://annehidalgo2020.com/question/comment-paris-peut-etre-une-ville-encore-plus-vegetale/>.

2 Method

For our investigation, the topic in question is the environmental quality. We shall compare the environmental quality of two areas, one meant as a residential one and one with a heavy tourist presence. To best represent these areas, we have chosen the XVI^e and the VII^e, justifiable as the XVI^e is home to many housing complexes and fosters facilities aimed at catering to the residents whereas the VII^e sees many tourists as it is home to the famed Eiffel Tower and the Seine river, prime tourist attractions of Paris.

2.1 Study site choices

We chose 10 sites in total to conduct a bipolar survey, shown below in Figures 3, 4.



Figure 3: Map of sites chosen for the residential area, the XVIth *arrondissement*. Map base layer courtesy of Google Maps, pictures seen are taken on a mobile phone.

This site was chosen as, like stated before, it is a residential area. There are other residential areas, however this one was specifically chosen for reasons of convenience.

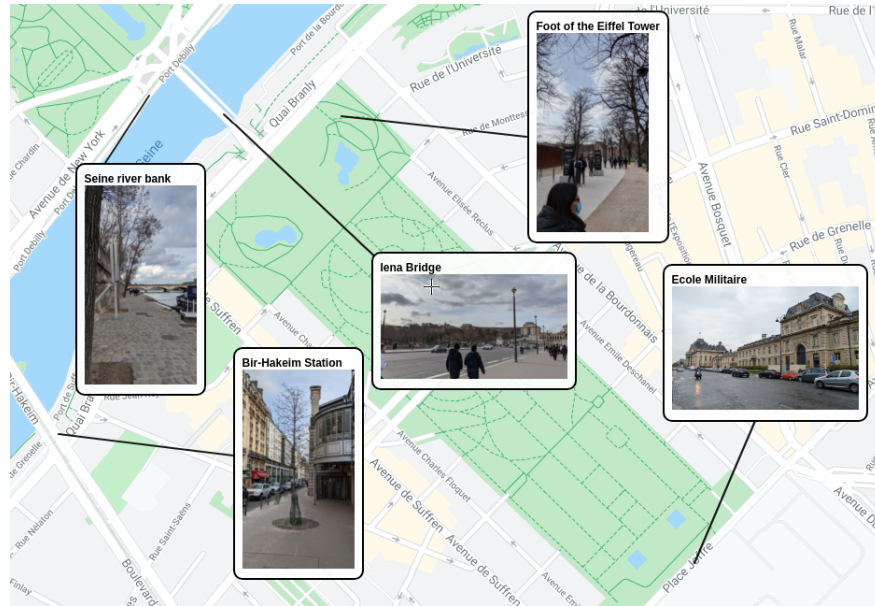


Figure 4: Map of sites chosen for the residential area, the XVIth *arrondissement*. Map base layer courtesy of Google Maps, pictures seen are taken on a mobile phone.

This area in the VIIth was chosen as it is a staple of tourism in France. It is home to the famed Eiffel Tower, the Ecole Militaire building and the Seine river bank.

2.2 Our sampling method

The sites in the two areas were chosen using a method of stratified sampling, as seeing that the VVIth does indeed contain residential sites and the XVIth touristic ones, we can discard the ones that are irrelevant to our study.

2.3 Method

2.3.1 Bipolar semantic survey

The sites will be visited to conduct a so-called "bipolar survey", which consists of rating the site based on multiple criteria. This process was done by selecting a single person from our group to visit one of the sites, and complete a bipolar semantic survey. They would grade several different aspects of the site (such as general cleanliness, noise, amount of cars), and take a set of 3 images of the site.⁸

2.3.2 Statistical evaluations

In order to either support or disprove our third hypothesis, it is important to study how trees are scattered in Paris, which reveals how dispersed green spaces are from one another. A statistical test called the Nearest Neighbor Index (NNI) test can provide a reasonable answer to this: if the index

⁸Images taken for our study can be found at <https://github.com/kinnounko/notes/tree/main/geography/ia/images>

is similar for both sites, it can easily be said then that our hypothesis is supported. This value also reveals information about the distribution of trees: clustered, random or in a regular pattern, as seen in Figure 5 below.

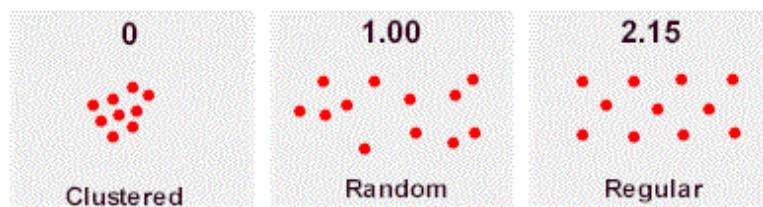


Figure 5: The NNI measures the spacial distribution of data. From a value of 0, representing a clustered pattern, to 1 (random) and to 2.15 (uniform pattern)

As individually counting trees in these areas would be a tedious task, we used the Paris OpenData platform (licensed under the permissive ODbL license⁹), owned by the government. The fact that this kind of database platform exists, shows a certain level of transparency on the government's part.

We used the trees dataset procured from this library, which contains the exact coordinates of trees in the city.¹⁰ There are also other information such as species of the tree and such, however these are cleaned from the dataset for our purposes.

A script, written in Python was programmed for the task of calculating the NNI value, because with a dataset of over 20,000 data points this would not be possible by hand. We go through each point, and find its nearest neighbor. In order to calculate distances between these two points, we use the Haversine Formula, as the two points would be in the form of coordinates. With this information the NNI can be calculated with the simple formula

$$Rn = \frac{2\bar{D}}{\sqrt{\frac{a}{n}}}$$

where Rn is the NNI index value, \bar{D} is the mean observed distance to the nearest neighbor, a is the area of the zone and n is the total number of data points.

3 Analysis

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3.1 Environmental and cultural sustainability

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⁹Open Data Commons Open Database License (ODbL) - Open Data Commons: legal tools for open data. URL: <https://opendatacommons.org/licenses/odbl/>.

¹⁰Les arbres. May 2021. URL: <https://opendata.paris.fr/explore/dataset/les-arbres/information>.

3.2 Economic sustainability

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4 Conclusion

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Notes

This paper is written with the aid of the typesetting software \LaTeX . On a PDF viewer, the sections in the table of contents can be clicked to access that section.

All media and information related to this IA can be found on the URL <https://github.com/kinnounko/notes/tree/main/geography/ia>. This includes images, the \LaTeX source code to this paper, and the Python program used to calculate the NNI value.

References

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A Appendix

A.1 Appendix Test