EXPLORING "URBAN INTENSITY/VITALITY" WITH OPEN DATA, AND 15-MINUTE ACTION SPACES

SEMESTER PROJECT

Students

Simon DAYER

Supervisors

Marc-Edouard SCHULTHEISS
Vincent KAUFMANN

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1 Introduction

Due to the health crisis of covid 19, the last two years have been very enriching in terms of knowledge of urban planning and urban sociology. Indeed, due to the lockdown, the citizens were forced to reduce their displacements, especially in terms of distance. This change in human habits has also highlighted a lack of access to services in certain neighborhoods. Carlos Moreno initially proposed the idea of a "15-minute city" in 2016 [5]. This concept challenged the notion that cities should have only one center and proposed a concept of multi-centered cities. It also proposes a model of spatial and functional organization for future cities. In recent years, this model has gained a lot of momentum in the field of planning and urbanization. Indeed, it follows very well the sustainable progress of cities. Pozoukidou and al describes new neighborhoods as a transformation from a spatial area of buildings in the city into a cluster of activity and social data [6]. Therefore, if everything could be accessible in our neighborhood, it could also mean that cars would no longer be necessary.

Deepening this idea, another interesting aspect is developed by Carlos Moreno and al. in the paper [5]. They explain that cities have mainly developed around cars. Therefore, the urban network has taken a linear form, even forming grids in some cities. This development according to him has heavy consequences on their current state. Indeed, it impacts both the biodiversity and the lifestyle of residents. A good example is the continuously increasing traffic congestion that affects citizens not only by increasing their commuting time but also by decreasing their mental health and indirectly expressing an economic loss to the society. Nevertheless, some cities such as Barcelona are already close to what is considered to be a 15-minutes city. Indeed, this has been studied by Ferrer-Ortiz and al in their paper "Barcelona under the 15-Minute City Lens: Mapping the Accessibility and Proximity Potential Based on Pedestrian Travel Times" [2]. Their result shows that in Barcelona, most residents already live close to services and could therefore have a fifteen-minute lifestyle. Nevertheless, they also found areas on the periphery that did not have as much access to services.

Studying cities also means understanding how people move and what their needs are. Liang and al. in the paper "The more walkable, the more livable? – can urban attractiveness improve urban vitality?"[3] explores the effect of transforming neighborhood squares into more attractive nodes. Indeed, their results present that by replacing parking cars with bike racks, and adding artworks and recreational urban furniture, the presence of cars decreased and also increased the urban vitality. This augmentation has been evaluated by measuring the number of elements linked to the location that was posted on social media platforms (Twitter, Facebook, and Instagram). In another noticeable paper, Lu and al. study the effect of street-level greenery in Hong Kong. They observe a certain link between parks, trees, and popular places [4]. Lastly, in the paper [8] , Zikirya and al. explore a method based on the services available for urban takeaway to assess urban vitality. It is, however, important to note that not all cities have well-developed Takeaway networks, but it still represents a good proxy for the availability of services as other restaurants.
Those papers can be regrouped to define the concept of "Urban vitality". Indeed, it can be defined as the mapping of high human presence in certain places. The vitality for those places is defined through their accessibility by studying the number car/bike parking or the public transport availability [3] , their security [4], their popularity [3] , and the services availability rate [8].

Our study will follow the two aspects presented above and apply them to one of the main Swiss cities: Geneva. The goal of this paper will be to provide the reader with a good understanding of how the city of Geneva is organized in terms of 15-minute cities, how citizens are moving, what characterizes the "Urban vitality".

As privacy in data recollection is becoming more and more restrictive, this paper concentrate first on a method using Open data from two main sources GTFS, and Open Street Map to establish the supply and establish features to define a notion of Urban vitality. Following those research, we will then be able to have a better understanding of how the city of Geneva could evolve in the future.

2 Research question

To understand the city, we want to first define how to model Geneva's urban vitality with an open dataset as Open Street Map data [1] and then use those indicators to define if the city is ready to accept a 15-min-lifestyle, or otherwise to explain what could be done to progress in this direction. Once this question would be answered, a private dataset will be studied to determine how a sample of the population behaves in terms of mobility. Finally, based on those results, a complete analysis of Geneva would be performed by using both the supply calculated with Open datasets and the demand from the population from a private dataset.

3 Methodology

Back in the 1970s, the concept of Urban vitality was already nurtured by Jane Jacobs which she describes as the "variety of pedestrian flows over time in a place".[7] Moreover, Scepanovic and al in the paper "Jane Jacobs in the Sky: Predicting Urban Vitality with Open Satellite Data" [9] presents Jane Jacob's four conditions to follow to promote life in a place. The block sizes must be small, the land uses diverse, and the place must mix a lot of economic activities and have a good concentration of people. This definition is taken as a base to understand urban vitality. Nevertheless, it can be enhanced by previous year's publications and other proxies can be added in other to merge this definition with the one presented in the introduction. This is why this paper revisits the four conditions of Jane Jacobs' into four more general axes:

- Accessibility
- Security
- Popularity
- Services availability

We can add that the four conditions written by Jane Jacobs' are very similar to the concept of 15-min-cities brought by Carlos Moreno in 2016. Both concepts want to build small neighborhoods with multi-access to activities and different land-use. In the case study presented in this paper, the territory of the canton of Geneva is statistically divided into sectors and sub-sectors as presented in figure 1. So the first step of the analysis is to determine which of those two delimitations is more relevant to representing 15-min cities. By taking as approximation that a human walk at a speed around 4.5 [km/hr] [2] and bike at around 12 [km/hr]. A radius of 3'000 [m] and 1'125 [m] can be calculated for respectively a bike ride and walk of 15 [min]. Then, it can be compared with two measurements extracted from geo-datasets: The density for both the perimeter and the area of each delimitation, which can be accessed in figure 1.

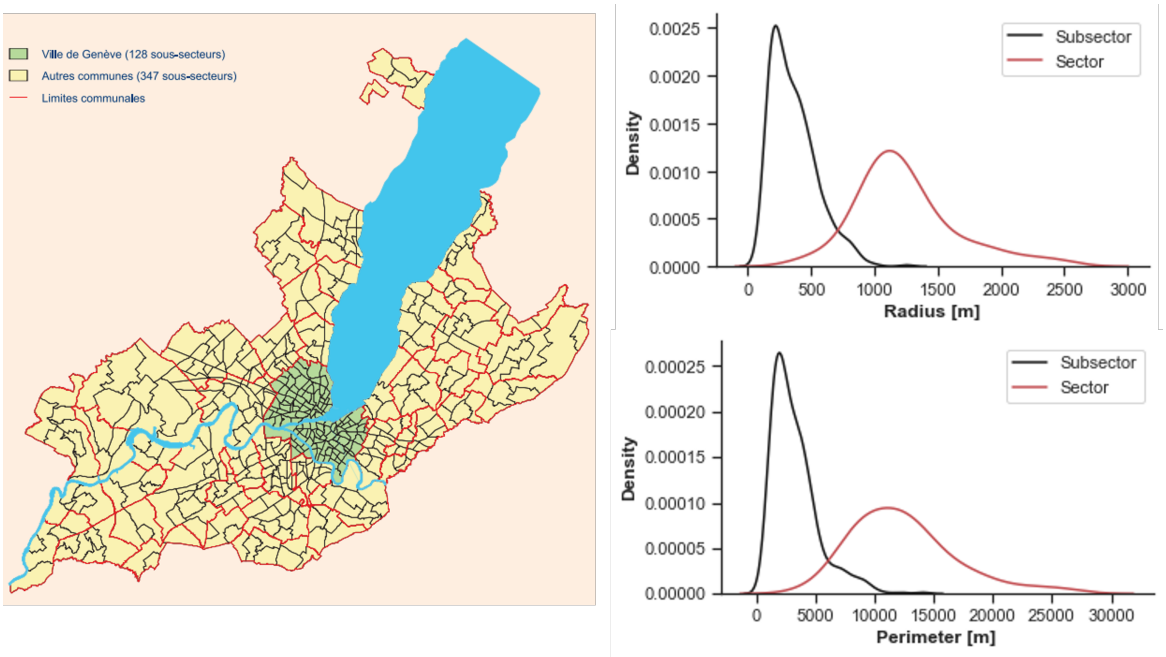


Figure 1: Geneva segmentation

Note that the radius is calculated with the sector's area made as if they were circles. This can be incorrect in the case of elongated sectors or subsectors. Nevertheless, as you can see in the figure above, the more we are in the city less the shapes are elongated. Both density plot of the figure above tends to show that the choice

of subsector as the delimitation of interest would be more relevant. Indeed, a walk of 15 [min] will cover the totality of the subsectors considered as circles.
Once the delimitation of interest has been decided. Another interest of this study is the data itself. Though privacy is becoming an important aspect of our society, it also reduces the accuracy of citizen behavior analysis. Therefore, the organization and the developments of our cities have been more axed on private data such as surveys. The limitation of this type of data is that its collection is time-consuming and expensive. So, it's difficult to produce large private datasets. A secondary goal of this study is also to enhance the differences between private and public data projects. Following this line of thought, the first part of this project will determine the offer of 15-min lifestyle in Geneva based on two sets of open data:

1. **Open Street Map Data (OSM)**: Sets of valuable geospatial components such as the geolocation of different types of icons, routes, or building footprints. Those components can be extracted from the OpenStreetMap Overpass API. This project uses the python library "OSMnx" [1] to access the API. Note that this set is generated by the citizen. Hence, the accuracy of the location point may be wrong. Nevertheless, a method to check the feasibility of Osm points is presented below.

2. **General Transit Feed Specification (GTFS)**: Sets of transit data published by public transit agencies as an accumulated database in GTFS format "[2]. It provides valuable geographical information, such as locations of stops and the number of transfers. Due to the origin of the data, a stricter control than for Osm datasets is assumed to have been performed before publication.

As both open datas presented above have access to Geneva bus stop locations. The Osm bus stops accuracy $[acc_{bus\_stop}]$ is computed following this equation:

$$acc_{bus\_stop} = \frac{stop_{o\&g}}{stop_g} = 0.85 \tag{1}$$

with $stop_{o\&g}$ the number of gtfs stops detected by taking a a buffer of 50 [m] around the Osm stops.

An accuracy of 85 [%] shows the good reliability of the Osm Data. Therefore the following subsection will analyze in detail both datasets to enhance the axis of the project.

3.1 Accessibility

First, Urban vitality will naively depend on how well the area is served by public transportation. The first relevant information is comprehended by the number of stops by sub-sectors. Indeed, this could be used as a proxy for the history of sub-sectors demands. As we could assume that in high-demand subsectors, the authority will place more stops. Nevertheless, this must be nuanced as the size of the subsector is also a relevant factor. Big sub-sectors will also tend to have more stops. Finally, the GTFS database can also calculate the frequencies for each of those stops, and then μ^i_{freq}, the mean frequency is computed over all the stops of a specific sub-sector. Note that as the three inputs have different metrics they all will be normalized for all the subsectors. So, an indice of accessibility can be computed as follow:

$$a = \mu^{rel}_{freq,i} \cdot \frac{{n_{stops}}^{rel}_i}{\sqrt{area^{rel}_i}} \; [-] \quad \forall \; i \; in \; subsectors \tag{2}$$

Then the exploration of the second set of Open Data is deepened to explore the three other axes. Indeed, Osm API can import the location of several tags from a simple fountain to a complex network of roads. So, the tags of interest for this project have been clustered in six groups based on the OpenStreetMap Wiki [3]:

1. Sustenance: composed of different amenity locations such as bars, cafes, pubs, fast food, and restaurant

2. Education: composed of all tags related to knowledge acquisition as schools, universities, libraries, and kindergarten.

3. Healthcare: composed of all tags related to health as clinic, dentist, doctors, hospital, and pharmacy.

4. Entertainment, Arts Culture (e.g. arts center, casino, cinema, nightclub, studio, and theatre)

[1] https://github.com/gboeing/osmnx
[2] https://opentransportdata.swiss/en/group
[3] https://wiki.openstreetmap.org/wiki/Key:amenity

5. Tourism (e.g. viewpoint, museum, attraction, and gallery)
6. Leisure (e.g. swimming pool, park, playground, sports center, fitness center, dog park and recreation ground')

Note that some tags have been left over (driving schools, public bookcases, and baby hatch) as it doesn't add any relevant information. The next sub-sections will study how those groups of interest enhance the popularity, the security, and the service availability for each sub-sectors of Geneva.

3.2 Popularity

Cities provide their citizen's amenities that have different utilities. In this axis, sustenance, entertainment, art culture, and tourism amenities are combined and studied together to model a factor "p", a proxy to the popularity of the sector of interest. This factor is calculated similarly to the accessibility factor by summing all the locations of the sorted tags counts over all sub-sectors after normalizing the input.

$$p_i = \frac{\#amenities_i^{rel}}{\sqrt{area_i^{rel}}} \ [-] \quad \forall \ i \ in \ subsectors \tag{3}$$

3.3 Services availability

Similarly, the same equation can be applied for the evaluation of the availability of other services like fitness centers. Here leisure, healthcare, and education will be combined and studied to form a proxy for what the city offer in term of services. Once again, note that all inputs are normalized.

$$s_i = \frac{\#amenities_i^{rel}}{\sqrt{area_i^{rel}}} \ [-] \quad \forall \ i \ in \ subsectors \tag{4}$$

3.4 Security

Osm Data also provided access to a different type of network as the walking, biking, and driving for the whole city. This project will use those as a proxy for the evolution of the bike facilities, which indirectly shows how secure is the network for citizens. Indeed, authorities often use the construction of bike paths to also renovate the sidewalk. Therefore, a security factor "secu" is calculate below:

$$secu_i = \frac{l_{walk} \cdot l_{bike}}{l_{all_type^2}} \ [-] \quad \forall \ i \ in \ subsectors \tag{5}$$

3.5 Urban Vitality assessment

Finally, one unique proxy can be exported by summing all factors:

$$UV_i^{rel} = a_i^{rel} + p_i^{rel} + s_i^{rel} + secu_i^{rel} \ [-] \quad \forall \ i \ in \ subsectors \tag{6}$$

3.6 15-minutes Offer

Finally, this paper will study the heterogeneity of the 15 minutes lifestyles around all sub-sectors of the city. To do that, fifty geospatial points are chosen randomly in each sub-sectors. For each point, all amenities for each of the 6 Osm groups previously defined (Sustenance, Education, Healthcare, etc.) are counted within a radius of 1125 meters. Furthermore, as the area of the sub-sector doesn't appear in the calculation, the number of accessible items is simply summed for each random point and then normalized by the highest number of items collected:

$$Item = \frac{\#item}{max\#item} \quad \forall \ item \ in \ [Sustenance, Health, Entertainment, Tourism, Leisure] \tag{7}$$

We will then sum those ratios over each osm group and define a ratio of the provided offer for each sub-sectors.

$$O_i = \sum Item_i \ [-] \quad \forall \ i \ in \ subsectors \quad \forall \ item \ in \ [Sustenance, Health, Entertainment, Tourism, Leisure] \tag{8}$$

3.7 15-minutes Demand

The second part of this paper treats a private dataset, "Domotopie" collected through a survey is analyzed. A sample of the questions is accessible in appendix 5. This dataset provides for each subject the five places where the subject spends most of their time. Both travel times and modes of travel for each displacement are also provided. The goal of this analysis is to determine on a subset of the population how well the 15-minutes concept is represented in Geneva. First, survey data are very noisy. Even if the question is created to be as precise as possible, some people could misunderstand the question and add false information to the dataset. Indeed, some of the travel times spotted in the datasets are over 5 hours. We suppose that some subjects thought that the total travel time for the whole year was asking, which is not right. So, all travel time over 5 hours won't be taken into account for this analysis and will be removed.

Data cleaning	# trips
Before	10'989
After	9'585

Table 1: Number of trips before and after the data pre-processing

Once the data are clean, the average travel time for each mode is first studied on the whole dataset, before narrowing the analysis to the trips that have a travel time under 20 minutes. This analysis will enhance which mode is used in a lifestyle of proximity to this subset of the population. A similar analysis is also performed for each trip. By identifying how long people usually travel to arrive at each place, an analysis of proximity can be done. Indeed, it will be interesting to understand for what purpose a person travels longer. Then, we will once again narrow the dataset to travel times under 20 minutes and observe how purposes are distributed in a 15-minutes lifestyle.

Finally, each subject is classified either as fully in a 15-minute lifestyle, which means that all the most visited places have a travel time below 20 minutes or as not living a life of proximity. As the house locations of the subject are only provided through the id of the sub-sector, we randomly choose a location in the sub-sector and use this location as a proxy for the subject's home. This transformation makes it possible to map all the houses and it will also provide us with a good understanding of where are the people following a 15-minutes lifestyle in the city. Moreover, for each subject with a lifestyle of proximity, we visualize all the modes used for reaching its five most important places. If the feature "all_modes" is not defined, the mode of transport used to go into the most favorite place is chosen. For those where this feature was also not accessible, we had to study each case one by one to manually add the most plausible mode (e.g. if all the other modes had been done with public transportation, the NaN value was replaced by public transportation, otherwise if each place had a different mode of travel, the missing values were replaced by a combination of those.)

Data cleaning	# IDs
Before	2'283
After	2'228

Table 2: Number of subjects after data pre-processing and reconstruction

Those results will be when compared with what has been found with the Open Data set to comprehend how proximity lifestyles are distributed across Geneva.

4 Results

The next part of this paper will travel through all equations described in the methodology and analyze the result more in-depth

4.1 Accessibility

First, it's relevant to note that the number of stops by sub-sector are depend on the authority's choice over a long period. Therefore, the result should be more spread and more organized than other factors. This assumption can be verify in figure 2 below.

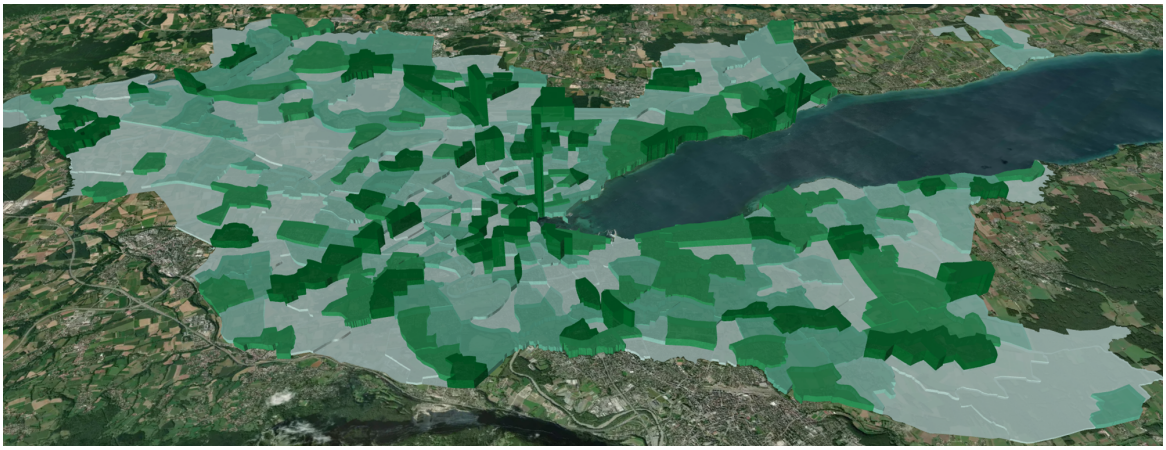


Figure 2: Factor of accessibility by sub-sector

Indeed, the factor of accessibility isn't homogeneous in every sub-sector. The center of the city presents higher accessibility
In figure 3, f_a also increase around the airport and decrease in the aggricultural area.

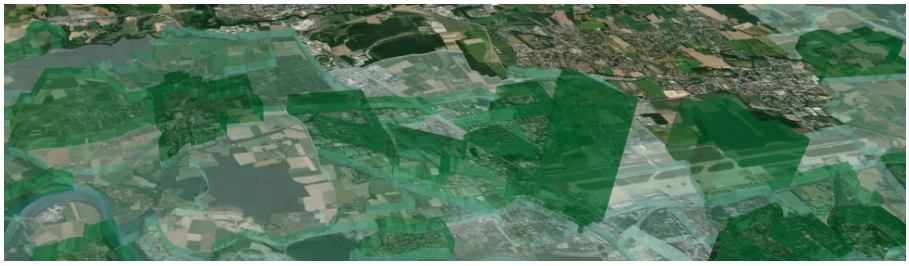


Figure 3: Zoom on the airport

In the countryside, a change of accessibility can also be observed into a same village. In figure 4, a higher accessibility is proposed into the center than at the bottom left residential area. Indeed, as those villages have generally few bus stops it is understandable that the center have a better access.

Figure 4: Zoom on a village

4.2 Popularity

Other relevant information to evaluate Urban Vitality is translated through the factor of popularity on every sub-sector. As in contrary to accessibility, "f_p" depends less on the decision of the authority, this proxy should follows the precedent factor with however less activity in resident area further from the city center.

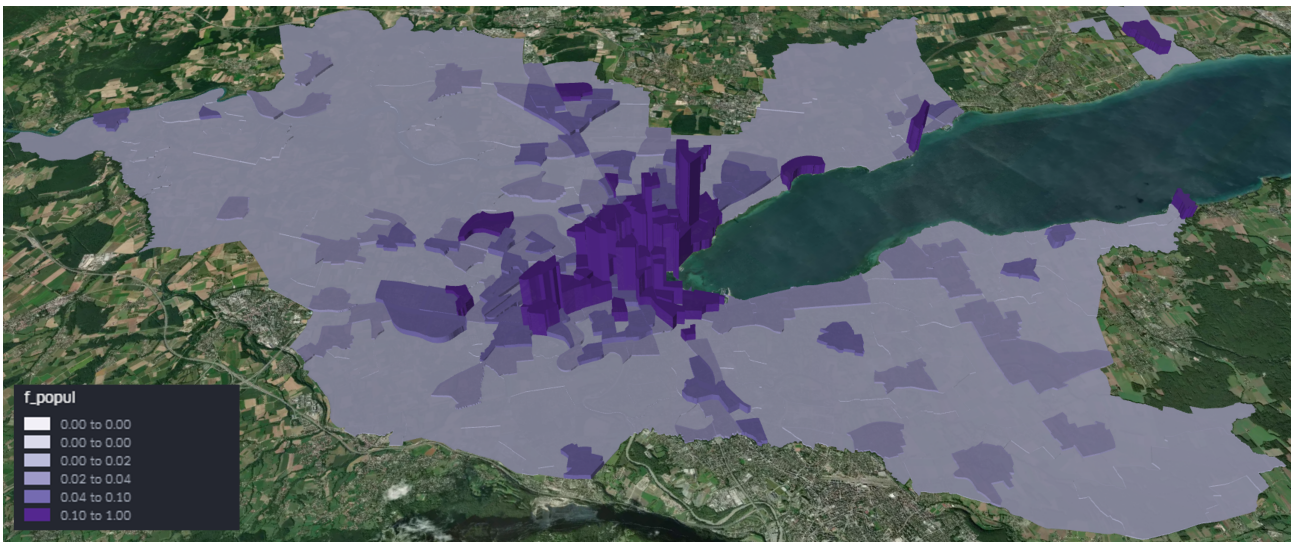


Figure 5: Factor of popularity by sub-sector

In figure 5, the precedent assumption is verify. Indeed, the distribution of this factor is closer to a Gaussian distribution with nevertheless some exotic values in some subsectors. Some of those exotic values correspond to some highly-populated areas, as in "Les Palettes" seen in figure 6.

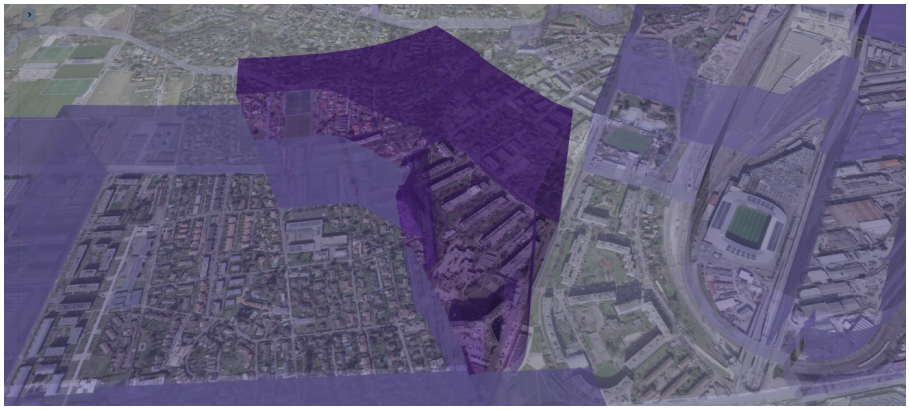


Figure 6: Les Palettes

As a result of this analysis, a possible link between the population rate of the sub-sector and its popularity cannot be excluded. Nevertheless, further study of this element should be undertaken and then we could try to add it in equation 3.

4.3 Services availability

This axis groups different vital item as health centers or school, therefore the result should distribute more homogeneously in the cities. This assumption is verify in figure 7.

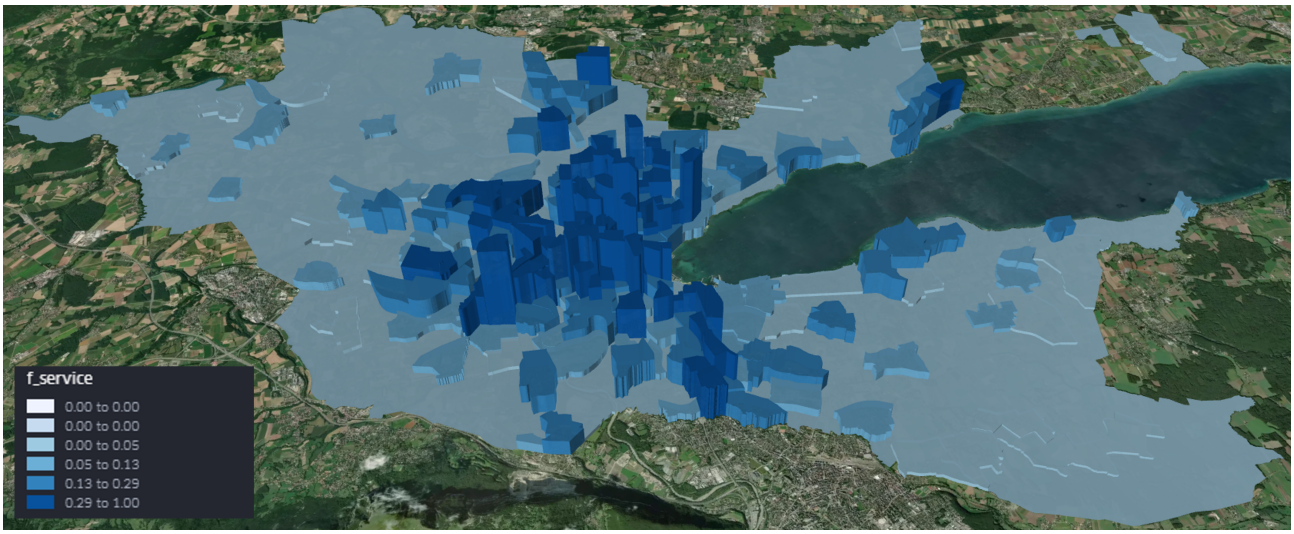


Figure 7: Service availability by sub-sector

Indeed, the distribution still follows a Gaussian distribution around the city's center. Nevertheless, the standard deviation is wider in this factor. This can be explained by the necessity of those items for each citizen.

4.4 Security

For this last axis, the distribution should be very different than the others. Indeed, security doesn't increase proportionally to the density of people show in the appendix 5, which on contrary is the case in the equation of the popularity or service availability factor. In figure 9, we observe an inversion in the distribution around the city center. Nevertheless, subsectors far from the center tend to have more security, which follows what is commonly accepted.

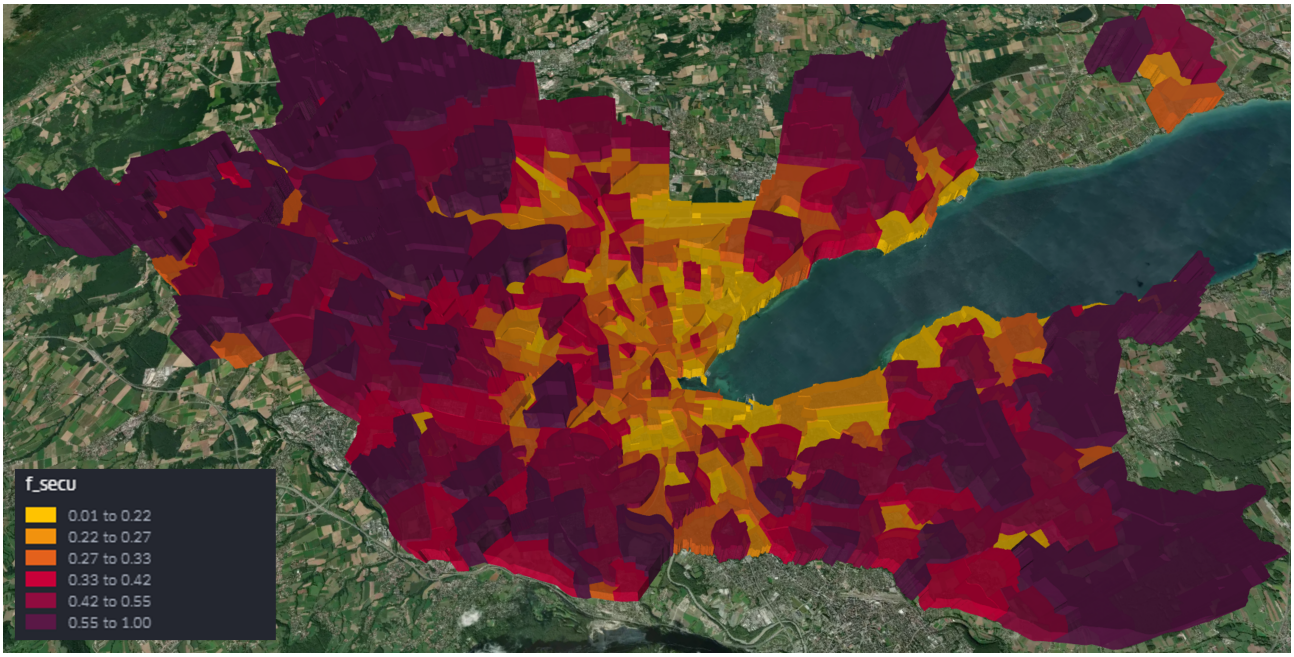


Figure 8: Security factor by sub-sector

4.5 Urban Vitality assessment

As described before, urban vitality can be now assessed with the help of the four proxies from the four axes: accessibility, popularity, services availability, and security. As for now any ponderation of those axes is known, the urban vitality will simply be considered a unitary ratio between the axis.
Note that to be able to compare those factors, relative values need to be taken into consideration. To do this, we simply divide each factor by its maximal value.

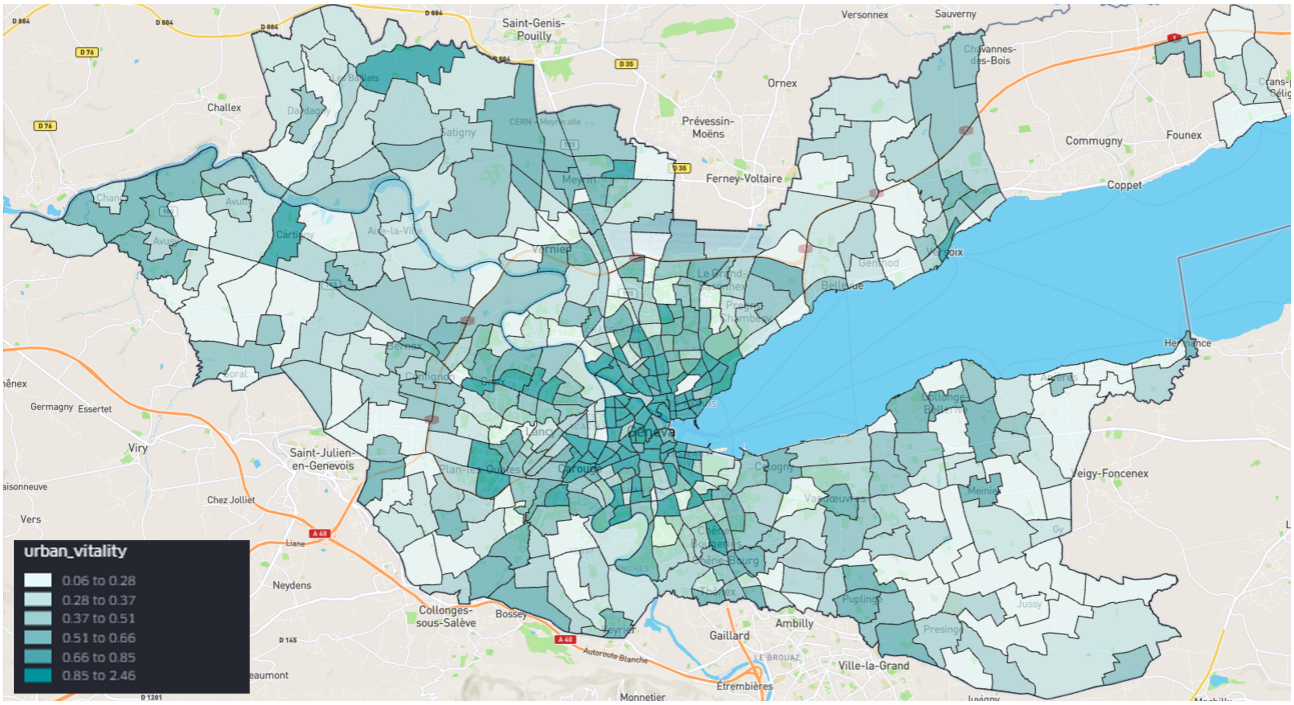


Figure 9: Urban Vitality by sub-sector

The previous analysis tends to show a possible correlation between the distance from the center and urban vitality. Nevertheless, some subsectors on the periphery of the city show some surprisingly high values of Urban Vitaly. Indeed, figure 10 shows a subsector entirely composed by forest with a high Urban Vitality assesment.

Figure 10: Satigny-Grands-Bois

This anomaly is caused by the fact that only the factor of security is represented with a high value. Therefore, by summing the factor in equation 6, it leads to a high Urban Vitality. A basic change that could solve the bad evaluation of Satigny-Grands-Bois is to set the Urban vitality to all subsectors without any population to zero (the distribution of the population throughout the canton of Geneva is accessible in the appendix 5). Nevertheless, the definition of Urban Vitality proposed in this paper doesn't exclude unpopulated areas. So we believe that a better solution would be to create a new survey and asks specifically all the respondents which axis is the most relevant to them in order to modify equation 6.

To deepen the analysis, the distances between each sub-sector and the Geneva train station have been calculated. Figure 11 describes the relationship between the four components of the Urban Vitality and all

subsectors' distances from the center of the city. This figure also verifies the assumption previously spotted about possible Gaussian distributions of the popularity and service availability factors. For the accessibility factor, no relationship can be deduced. This is understandable, as the distribution of stops and their frequency is organized by the canton in collaboration with other companies. Indeed, this factor has less freedom than the others. The security factor shows a bimodal distribution with two peaks for sub-sectors in the periphery. The most relevant parts of figure 11 are the analysis of the two remaining factors. Indeed, we observe that the distribution of the data for the distance from the center match Gaussian distributions centered on zero. Moreover, the standard deviation of the popularity factor is smaller than that of the service availability factor. This is understandable because some of the elements taken into account in the calculation of the latter are vital needs (health, education, etc.)

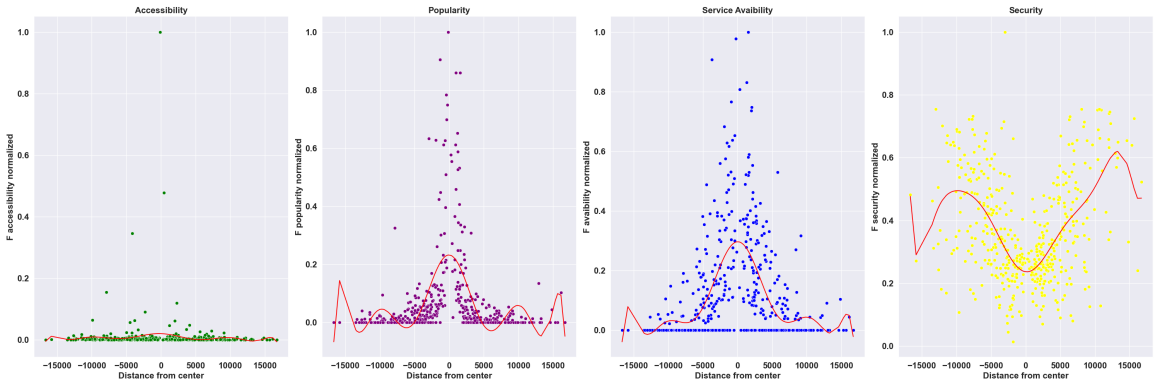


Figure 11: Distance from the train station analysis

4.6 15-minutes supply

In figure 12, the provided supply is described for each sub-sector. This result looks plausible as a higher supply is expected in the center as well as on the shores of the Leman lake. Moreover, some sub-sectors have no or very little supply. This confirms that the sub-areas in the periphery are still unsuitable for the 15-minute city concept.

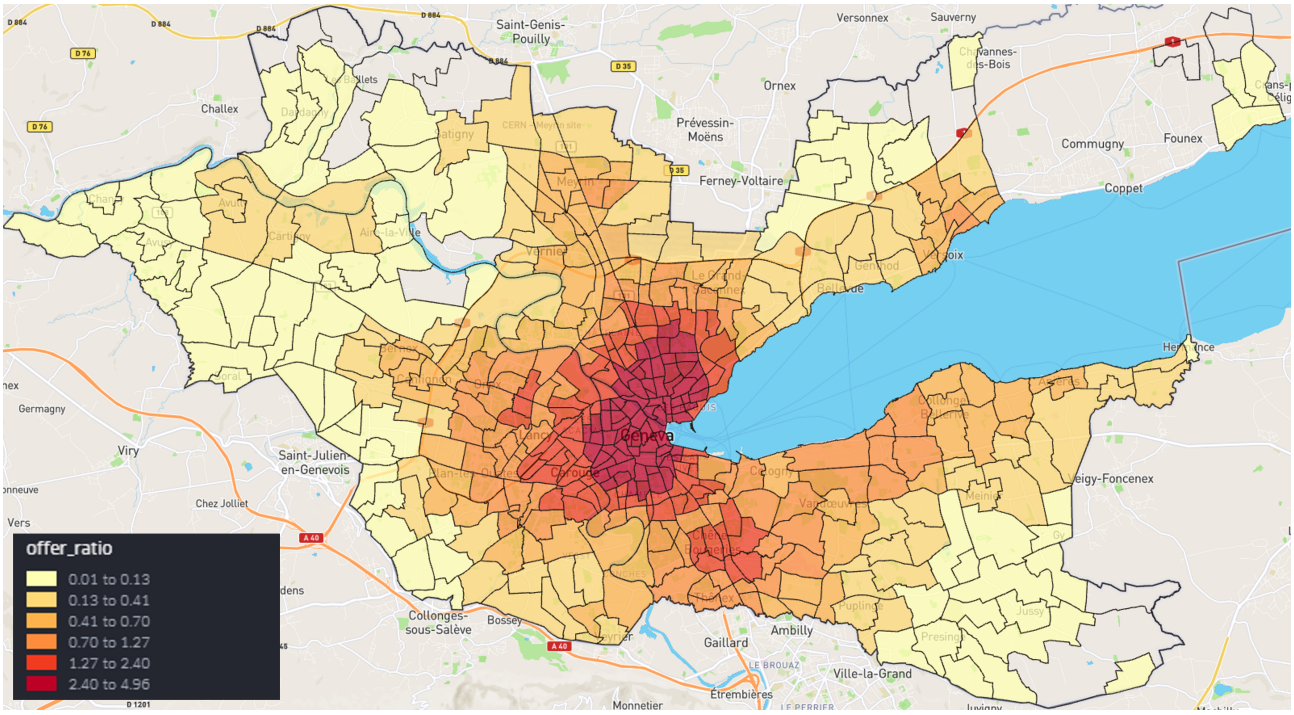
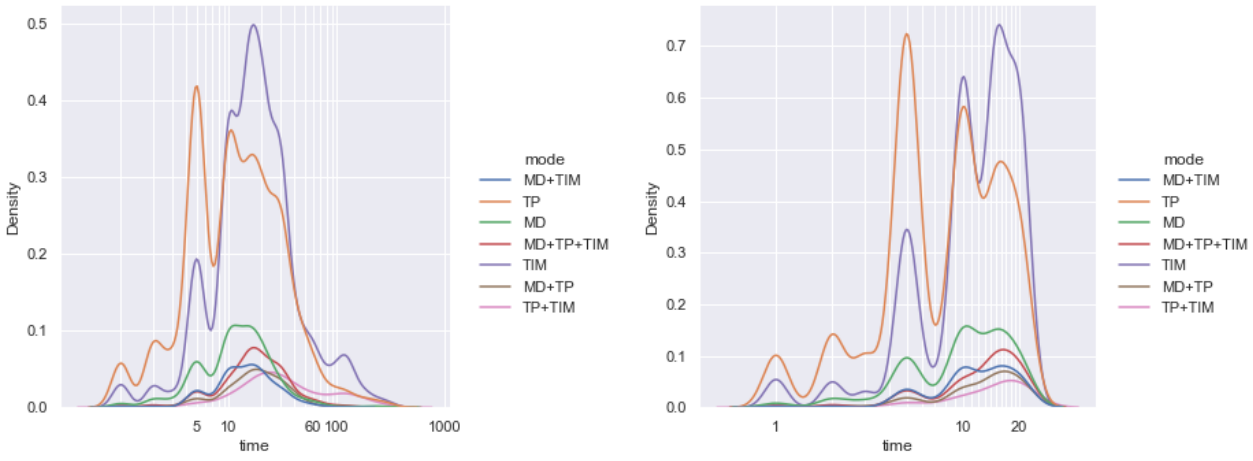


Figure 12: 15-minutes supply by sub-sector

4.7 15-minutes demand

Mode of transport

As a first step, an analysis of the average travel time for each mode is presented based on the private dataset "Domotopie". As mixed travel modes are difficult to interpret, this analysis will concentrate on the soft mode of transport (MD), public transportation (TP), and individual motorized transportation (TIM). Indeed, in figure 13, a higher proportion of trips using either TP or TIM are observed for both plots. In addition, those two lines are crossing around 9 minutes of travel time. Before this intersection, most of the trips used TP as their mode of travel, and then TIM is more represented. Concerning MD, this mode is a lot less represented than TP or TIM. Nevertheless, a peak is also observed between 10 and 20 minutes of travel time. Note that for short distances no mix between the travel mode is observed. So the subjects are choosing one of the main travel modes to move around.



(a) All

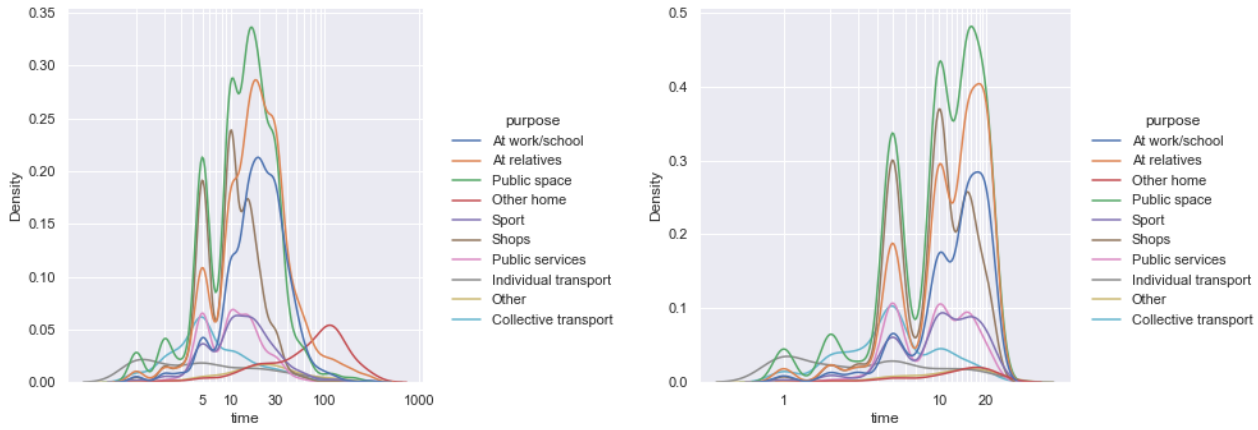
(b) Travel time under 20 minutes

Figure 13: Mode of transport

The same patterns are observed when sorting only the travel time under 20 minutes 13(b). Those results show good use of the public transportation system for small displacement in Geneva. Nevertheless, by implementing measures against individual transport and also encouraging public transportation, the share of trips made by TIM under 8 minutes could be reduced and then distributed to PT or MD.

Purpose

Similarly, the average travel time is analyzed once again and compared with the purpose of each trip. In both plots of figure 14, most trips under 30 minutes are directed to public places, relatives, work or school, or shops. This shows that people travel longer only for nonvital purposes, as to travel to other homes. Note that those homes aren't from relatives. Moreover, all purposes are represented even after removing all longer trips. This express that a lifestyle of proximity could apply to all subject.



(a) All

(b) Travel time under 20 minutes

Figure 14: Purpose

Finally, a spatial analysis of the dataset is also provided. In table 3, the number of subjects classified as living a live style of proximity is shown.

Lifestyle	# subject's house location
All type	2'228
Proximity	279

Table 3: Number of subject living a livestyle of proximity

Indeed, 12.5 [%] of the 2'228 subjects, which have responded to the survey are characterized as living a lifestyle of proximity. Let's remind that it means that all the places that the subjects have classified as places where they spend the most of their time are under 20 minutes of travel times. Then, each subject's houses are approximate and mapped on figure 15.

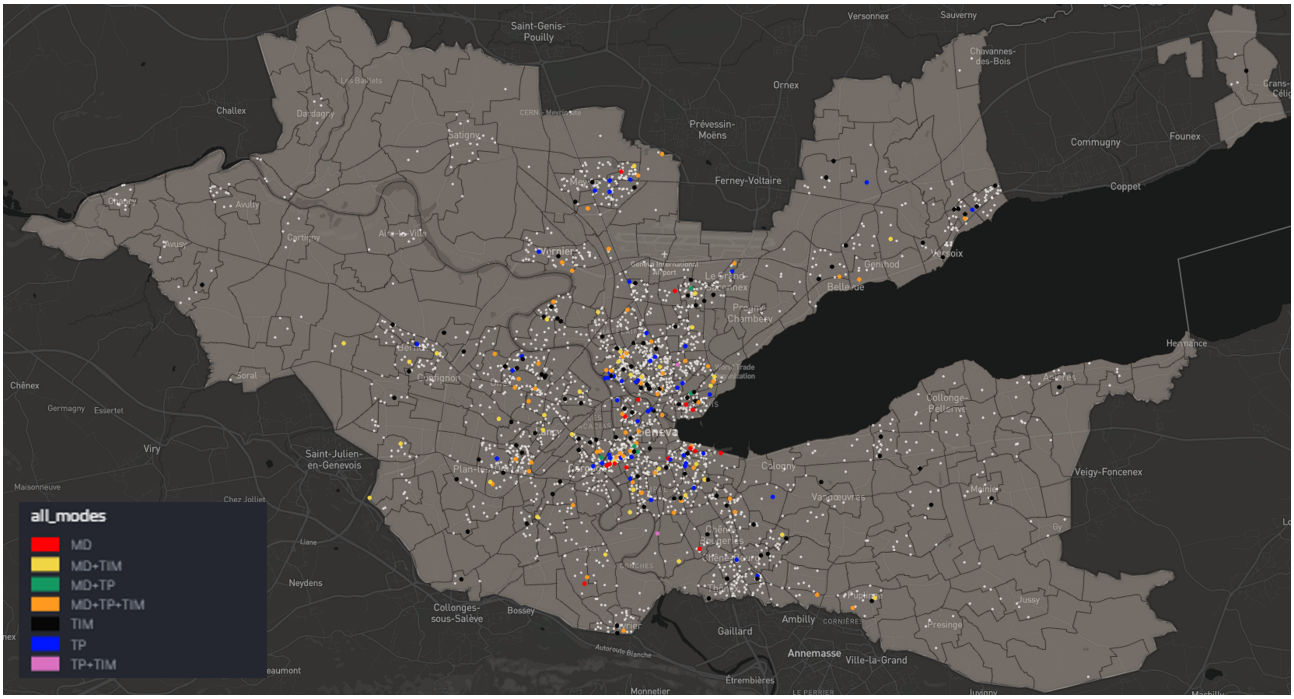


Figure 15: Subject's house locations and all modes of transport

As before, the analysis will concentrate on the unique mode of travel. The result conforms to the theory of transportation. Indeed, people from the center of the city are more tempted to have a 15-minutes lifestyle as more shops, activities, and services are provided. More precisely, subjects only traveling with MD are located in the lower part of the center of the city, which is close to Geneva university hospital. It is also surprising to see that even in the center of the city some subjects only use TIM as their mode of transport. This shows that the future has room for improvement. Lastly, people living in the surrounding area are using cars even when traveling less than 20 minutes. Indeed, the surroundings are composed of small villages with not as much accessibility as the center as shown before in the supply factor maps, so those results could correspond to a subject going to the next village to see friends and having less choice in what mode of transport taken. However, those results must be nuanced as the subject is not equally distributed in the whole canton. Indeed, the total distribution of all subjects is also centered at the center, which could contradict the hypothesis stated above that people experiencing a 15-minute live style were more concentrated in city centers.

5 Conclusion

In summary, we observe that the four axes developed during this project provide a good overview of the Urban vitality supply. Indeed, Geneva has a city center well-developed with high services availability and popularity. Nevertheless, a lack of security is also spotted. As this factor was calculated using the length of the walkable and bikeable network in comparison with all the networks. This could be an indication that Geneva's downtown should improve these roads to make more room for pedestrians and bicycles. The main villages surrounding the city are less accessible but much more secure than the center. This result looks reasonable, as more space is available in the countryside and also because there are fewer residents. If fewer needs for mobility are spotted, the authority will also provide less supply. A map representing the distribution of the population can be found in the appendix 5. By studying the supply, it appears that the surroundings of Geneva aren't ready to adapt to a 15-minutes lifestyle. Indeed, to follow this direction, it would be necessary to make available to these residents more elements proposed by the OSM groups.

Based on the private datasets "Domotopie", we were able to understand the demand. Firstly, we observed that most of the trips reached a public space and takes less than 30 minutes. This highlights the importance of having a well-developed space inside the city. Secondly, we also understood that Geneva is not a 15-minutes city. Indeed, only 12.5 [%] of the survey respondents are living a life of proximity. This number is quite low even if the city presents a high supply in the center as you could see on the map 12. Moreover, the fact that some of the subjects live a 15-minutes lifestyle using only individual motorized transportation is very surprising and somewhat a bit revolting. We can add that more relevant information could be extracted from these datasets by collecting more answers. After cleaning the subject's IDs only 2'228 subjects are usable, which represents a very tiny subset of the population. Indeed, the canton of Geneva measured a population of 506'343 on 31 December 2020, therefore only 0.44 [%] of the demand has been studied.

Our methodology shows some weaknesses when calculating the Urban vitality in equation 6 and the supply of OSM in equation 8. Indeed, all the factors have been simply summed. In figure 10, it has been shown that it leads to a bad evaluation of Urban vitality when only one factor is provided (e.g Satigny-Grands-Bois). We believe that with the further investigation a better-weighted sum would be implemented and provide a better evaluation of the supply and the Urban Vitality. In conclusion, open data appears to provide a good overview of the city's mobility, but it must be supplemented with private data to understand the relationship between factors and how the residents' behavior influences them.

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Pour commencer, faisons connaissance :

Q1. Vous êtes :

- un homme..... ☐ 1
- une femme..... ☐ 2
- autre..... ☐ 3

Q2. Quelle est votre année de naissance ?

_____

Q3. Dans quel pays êtes-vous né e ?

_____

Q4. Quel est votre métier ?

_____

Q5. Quel est votre niveau d'étude ?

- scolarité obligatoire non-achevée..... ☐ 1
- scolarité obligatoire..... ☐ 2
- école professionnelle ou diplôme d'apprentissage..... ☐ 3
- maturité / Baccalauréat..... ☐ 4
- bachelor ou Master..... ☐ 5
- doctorat..... ☐ 6

Nous allons maintenant aborder le parcours qui vous a conduit à habiter votre logement actuel.

Q6. Vous estimez avoir beaucoup déménagé pendant votre vie :

Pas du tout d'accord				Tout à fait d'accord
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Q7. Depuis combien de temps habitez-vous la Suisse ?

- depuis moins d'un an..... ☐ 1
- depuis moins de 5 ans..... ☐ 2
- depuis moins de 10 ans..... ☐ 3
- depuis plus de 10 ans..... ☐ 4
- depuis toujours..... ☐ 5

Q8. Depuis combien de temps habitez-vous le canton de Genève ?

- depuis moins d'un an…… ☐ 1
- depuis moins de 5 ans…… ☐ 2
- depuis moins de 10 ans…… ☐ 3
- depuis plus de 10 ans…… ☐ 4
- depuis toujours…… ☐ 5

Q9. Vous quitteriez facilement votre logement actuel :

Pas du tout d'accord				Tout à fait d'accord
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Q10. En vous projetant dans les 5 prochaines années, si vous deviez déménager, quelle pourrait être la raison ?

- raison familiale…… ☐ 1
- raison professionnelle…… ☐ 2
- raison financière…… ☐ 3
- caractéristiques du quartier et du voisinage…… ☐ 4
- caractéristiques du logement (plus grand, plus récent, …)…… ☐ 5
- Moins de trajets quotidiens…… ☐ 6
- autre raison…… ☐ 7
- je n'ai aucune raison de déménager.. …… ☐ 8

Q11. Nous vivions actuellement dans un contexte sanitaire particulier. Pour chaque situation ci-dessous, indiquer à quel point la crise sanitaire de COVID-19 a entrainé des changements dans votre vie :

Une réponse par ligne svp	**Aucun changement**				**De grands bouleversements**
- votre situation professionnelle (changement ou perte d'emploi, conditions de travail différentes)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
- votre situation familiale / personnelle (rupture ou rapprochement amoureux, perte d'un proche…)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
- votre situation résidentielle (déménagement, …)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Q12. Comment avez-vous adapté votre logement depuis le confinement de mars 2020 ?
Plusieurs réponses possibles

- je n'ai rien changé……..……..... ☐ 1
- bouger les meubles……..……. ☐ 2
- faire des travaux de réaménagement……..... ☐ 3
- ré-agencer les espaces……..……. ☐ 4
- faire du vide ……..……. ☐ 5
- faire du rangement/grand ménage……..……. ☐ 6
- faire de la personnalisation et décoration esthétique……..... ☐ 7
- rééquiper le logement en électroménager……..……. ☐ 8
- rééquiper le logement en mobilier……..…….. ☐ 9
- rééquiper le logement en matériel électronique (écrans, appareils de communication, ...)……..…….. ☐ 10
- rééquiper le logement en matériel de loisir……..……..... ☐ 11
- pas concerné……..……..... ☐ 12

Q13. Précisez comment votre vie quotidienne actuelle est perturbée par la COVID au moment où vous remplissez ce questionnaire. ***Plusieurs réponses possibles***

- pas de grand changement, situation "habituelle"……..….. ☐ 1
- vous faites plus de travail à la maison (télé-travail)..... ☐ 2
- vous passez plus de temps chez vous en général (confinement, quarantaine, etc.)……..…. ☐ 3
- vous vous déplacez moins (pour le travail ou le loisir)……..…. ☐ 4

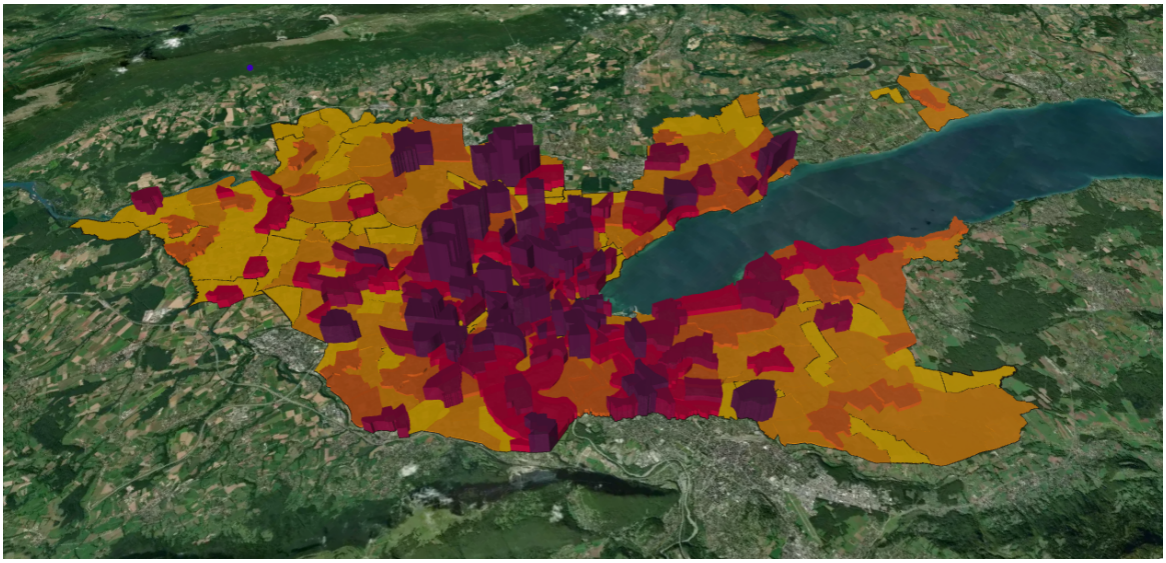

Figure 16: Population disribution by sub-sector