

# Multi-Scale Analysis of Accessibility to Shops, Services, and Green Spaces in the Rabat-Salé Conurbation in Morocco

Xavier Lehmann<sup>1</sup>, Ikrame Laadssi<sup>1,2</sup>

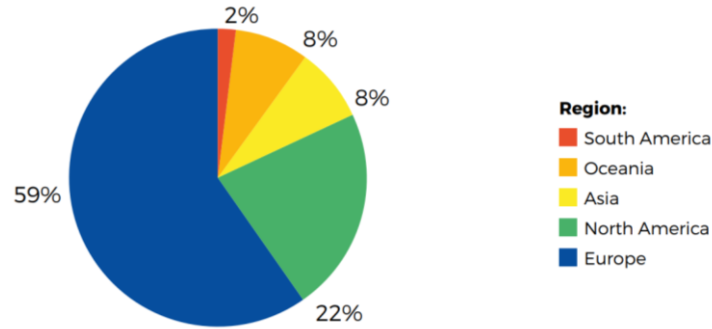
- 1 - LVMT, Gustave Eiffel University, ENPC, Champs-sur-Marne, France
- 2 - National Institute of Planning and Urbanism (INAU), Rabat, Morocco

14th – 15th November 2024

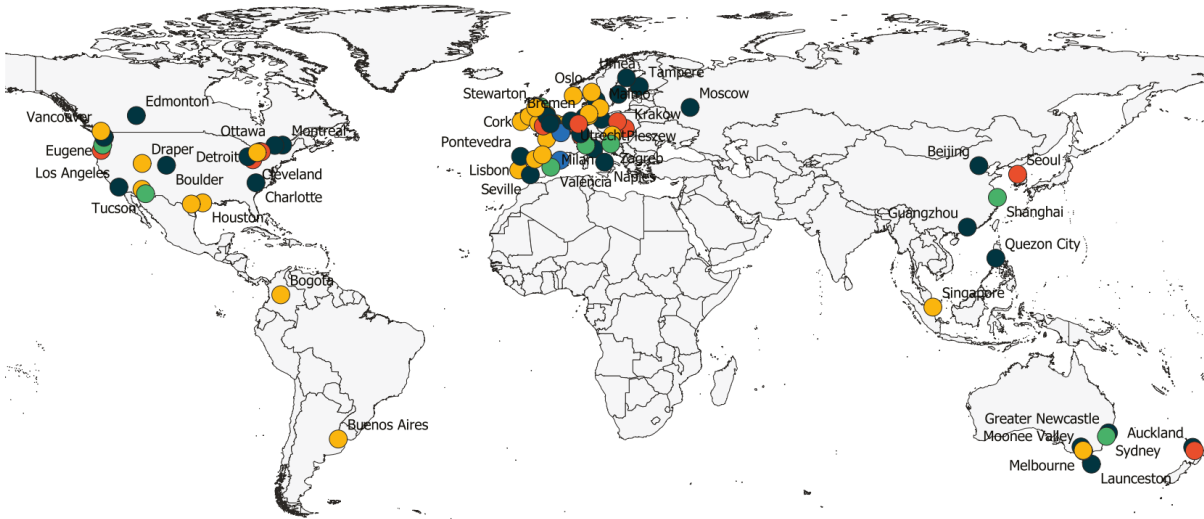


# The challenges of multi-scale accessibility analysis in the North African urban context

## Mapping of 15-minute City Practices



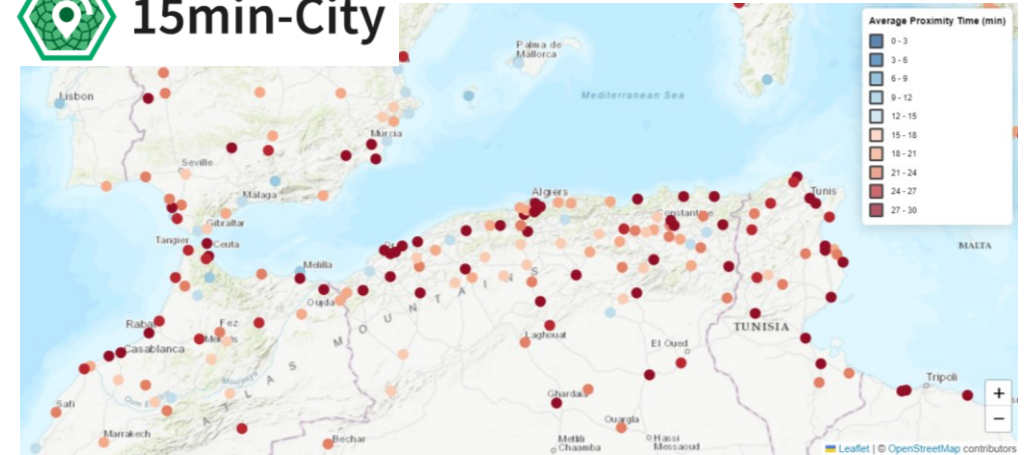
## Cities with “15-minutes City” practices identified by continent



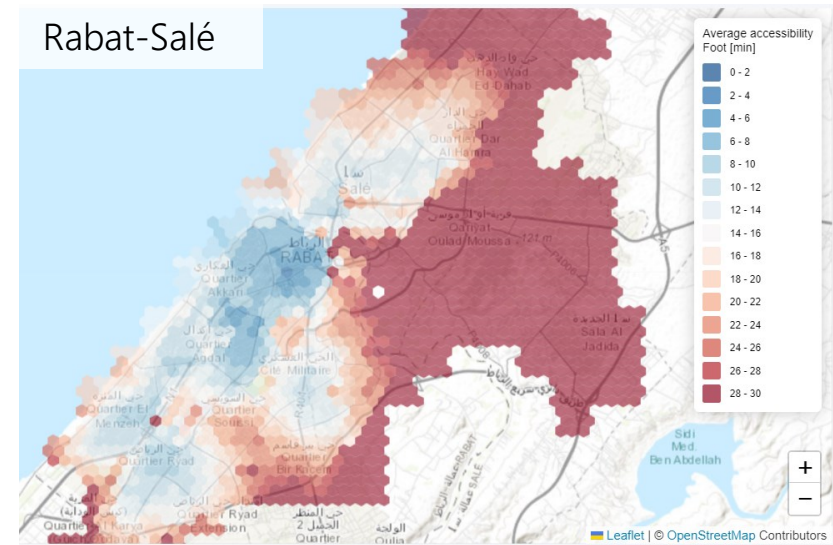
Reference : Büttner, B., Seisenberger, S., Baquero Larriva, M., Gante, A., Ramírez, A., & Haxhija, S., 2022, Urban Mobility Next 9 ±15-Minute City : Human-centred planning in action Mobility for more liveable urban spaces EIT Urban Mobility Munich November 2022. <https://doi.org/10.13140/RG.2.2.10482.79041>



## 15min-City



## Rabat-Salé

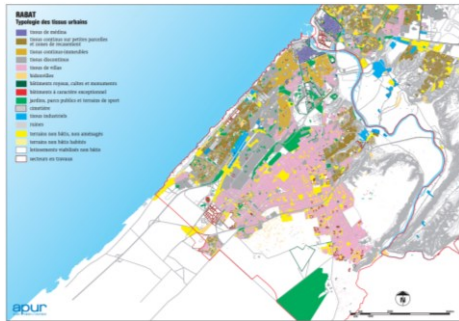


Reference : Bruno, M., Monteiro Melo, H.P., Campanelli, B. et al. A universal framework for inclusive 15-minute cities. Nat Cities 1, 633–641 (2024). <https://doi.org/10.1038/s44284-024-00119-4>  
 15-Minute City Platform : <https://whatif.sonycsi.it/15mincity/index.php>

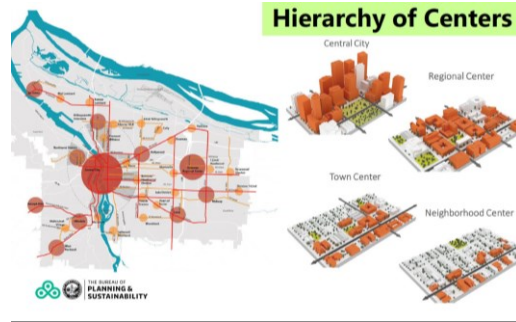
# The Fractalopolis software

<https://sourcesup.renater.fr/www/fractalopolis/> : Open source software of spatial simulation (Java version)

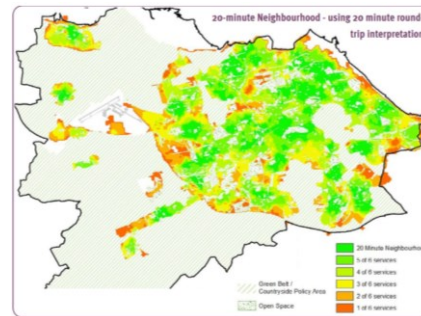
by P. Frankhauser, O. Bonin, G. Vuidel, C. Yamu - Version 1.2.5



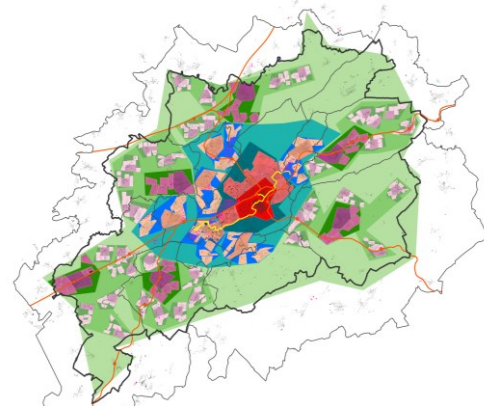
Land use, urban forms  
and green areas



Spatial planning



Accessibility analyses



FRACTALOPOLIS

## Goals of the Fractalopolis concept

- ❑ Respects the **hierarchy of needs**
  - by a **hierarchical organization of "urban" amenities**
  - ensuring **good accessibility to amenities** according to the hierarchical levels, **reduces car use and trip lengths**
- ❑ Preserves **biodiversity** and avoids heat islands by
  - a **linked hierarchical system of green areas** avoiding their fragmentation and that of urbanized areas
  - a **good accessibility** to the different types leisure areas
  - the **green corridors across scales for cooling** urbanized areas
  - allowing to install **suburban agriculture**
- ❑ Prioritize the **public transportation**

# The Fractalopolis software

<https://sourcesup.renater.fr/www/fractalopolis/> : Open source software of spatial simulation (Java version)

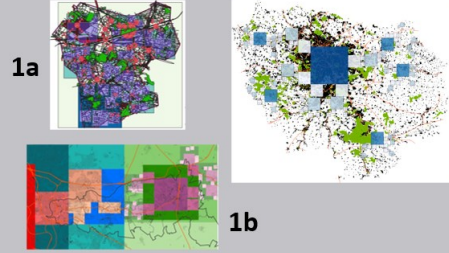
by P. Frankhauser, O. Bonin, G. Vuidel, C. Yamu - Version 1.2.5

## French context

Metropolitan scale : **Ile-de-France Region** / Local scale :

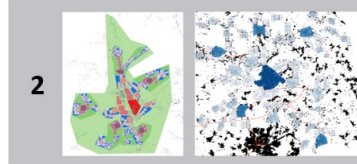
1a - **Est-Ensemble**, O. Bonin et al., 2020

2b – **Marne-La-Vallée**, X. Lehmann, 2023



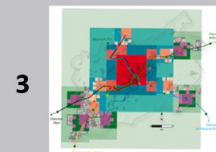
Metropolitan scale : **Pôle métropolitain Nord Franche-Comté** /

Local scale : **Belfort**  
X. Lehmann, 2024

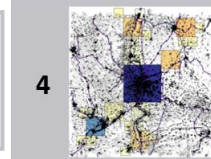


Metropolitan scale : **Grand Besançon Métropole** /

Local scale : **Besançon**.  
J.-P. Antoni et al., 2014



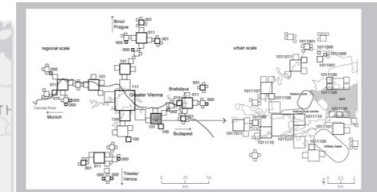
Metropolitan scale : **Lyon conurbation**  
P. Frankhauser, 2012



## International applications

Metropolitan scale : **Vienna-Bratislava metropolitan area** /

Local scale : **Bruck an der Leitha**  
C. Yamu, P. Frankhauser, 2015



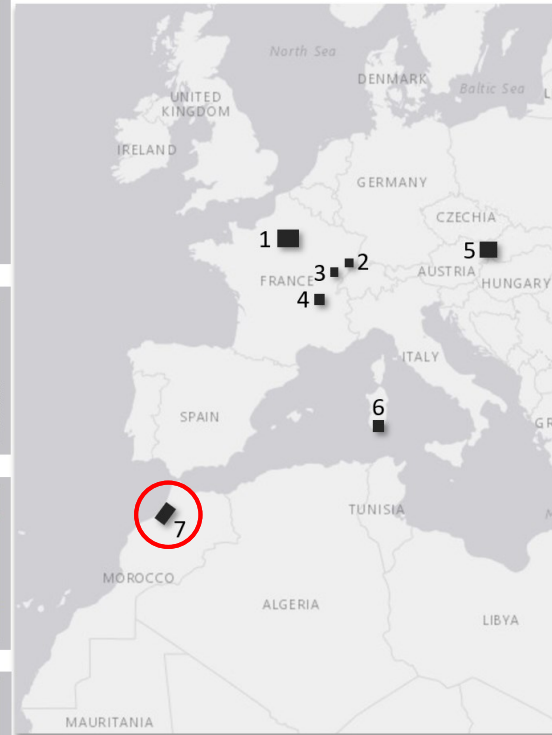
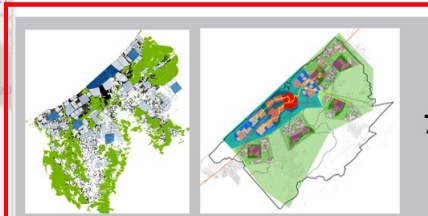
Metropolitan scale : **Sardinia** /

Local scale : **Cagliari**  
C. Garau, P. Frankhauser, 2024



Metropolitan scale : **Rabat-Salé-Skhirat-Témara conurbation**

Local scale : **Rabat-Salé**  
X. Lehmann, I. Laadssi, 2024



# The Fractalopolis methodology



## 1. Analysis of urban planning documents

- Understand the various development issues in the area of application, at different scales
- Understand the organisation of the urban and commercial structure



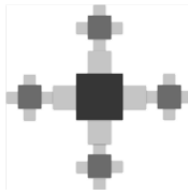
## 2. Understanding the needs and practices of the population

- Mobility practices and use of amenities, access distances by type of amenity
- Select the shops and services to be used for accessibility measures



## 3. Building the database

- Land use data (buildings, green spaces)
- Population distribution and geolocation of amenities

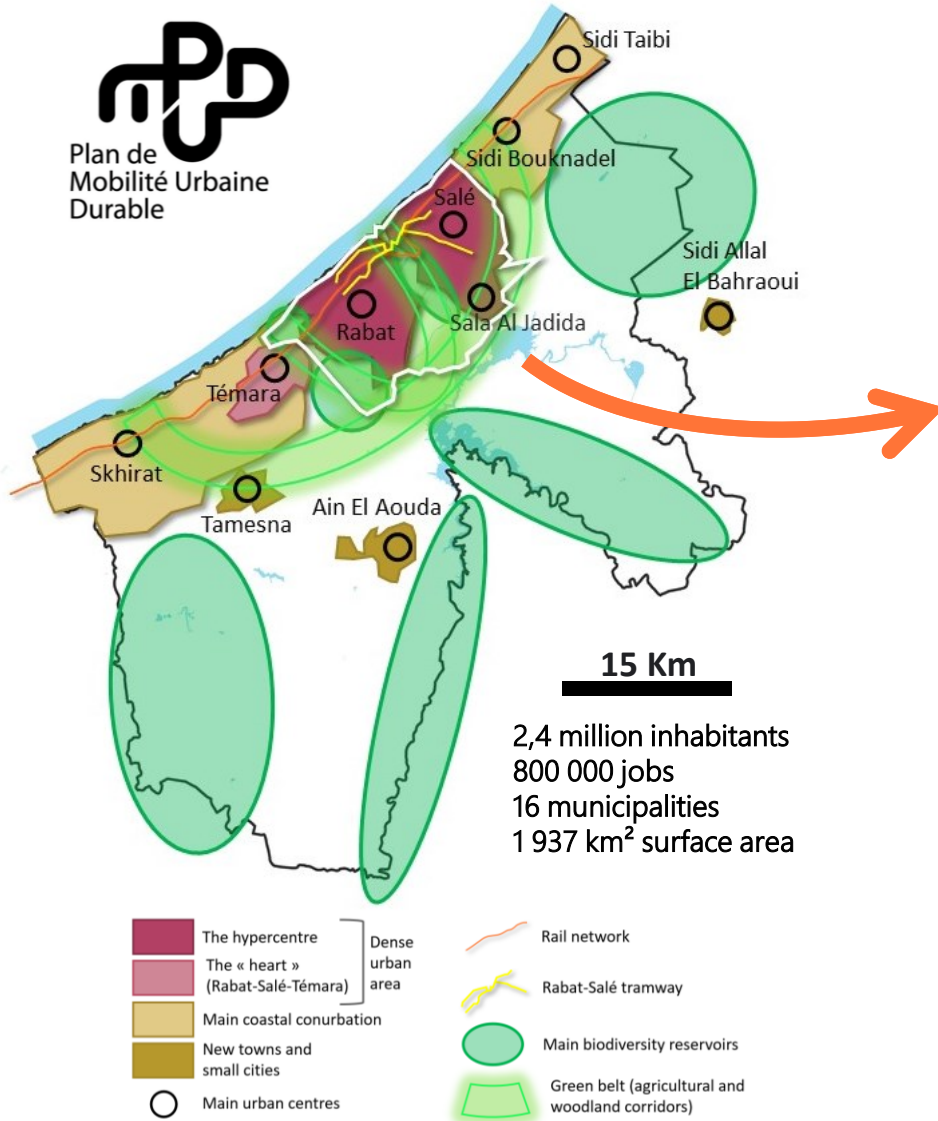


## 4. Fractalopolis project

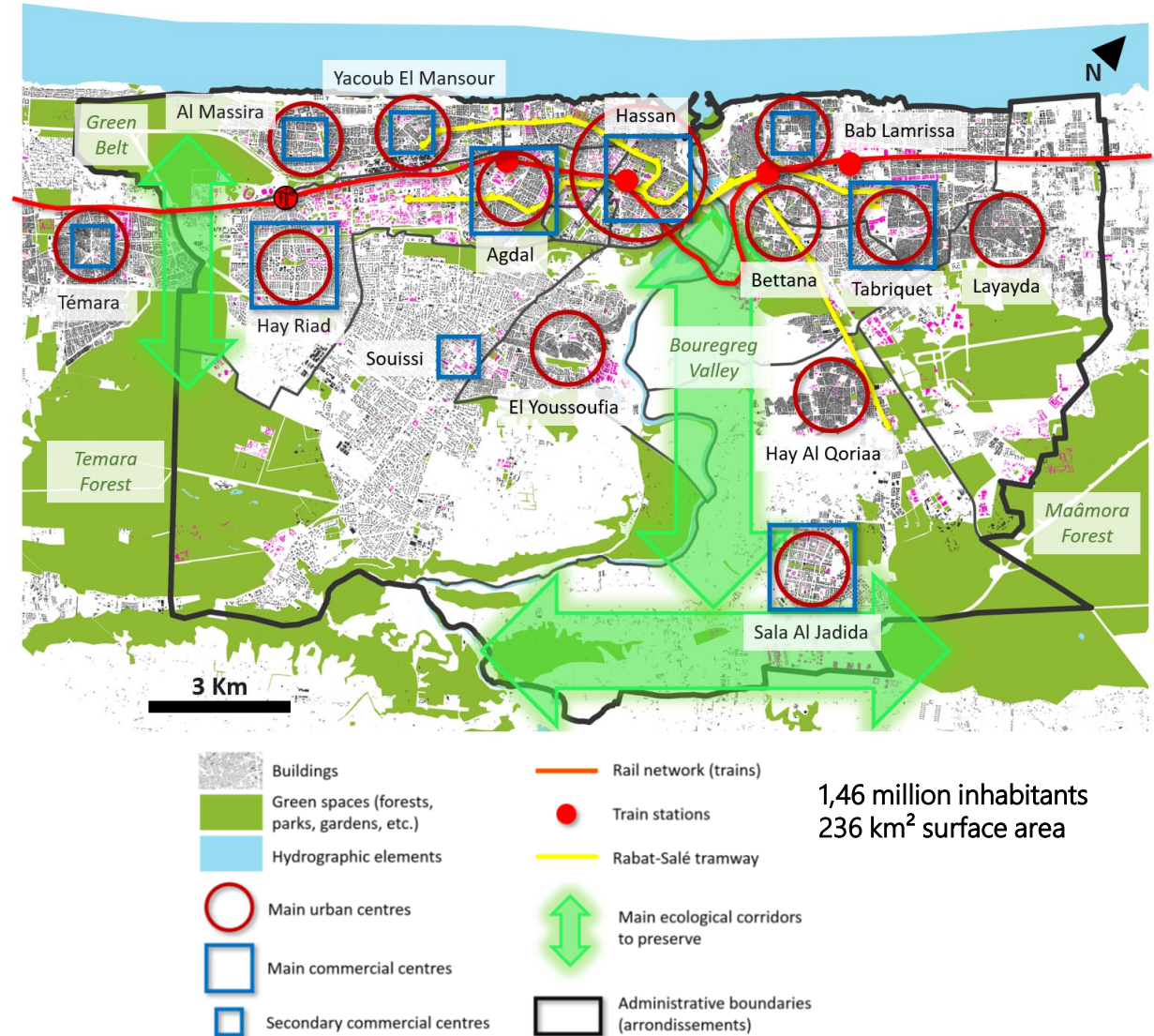
- Development of a multi-scale zoning system
- Satisfaction for zones

# 1. Analysis of urban planning documents

## Great Rabat Region



## Rabat-Salé conurbation



# 1. Analysis of urban planning documents

- References



## PMUD - Great Rabat Region

- Sustainable Urban Mobility Plan (PMUD) 2040
  - SOAP de Rabat-Sale-Skhirat, 2011
- SDAU 2040 Rabat-Salé-Témara, 2015 (unfinished)
  - Rabat-Salé Urban Agency documents

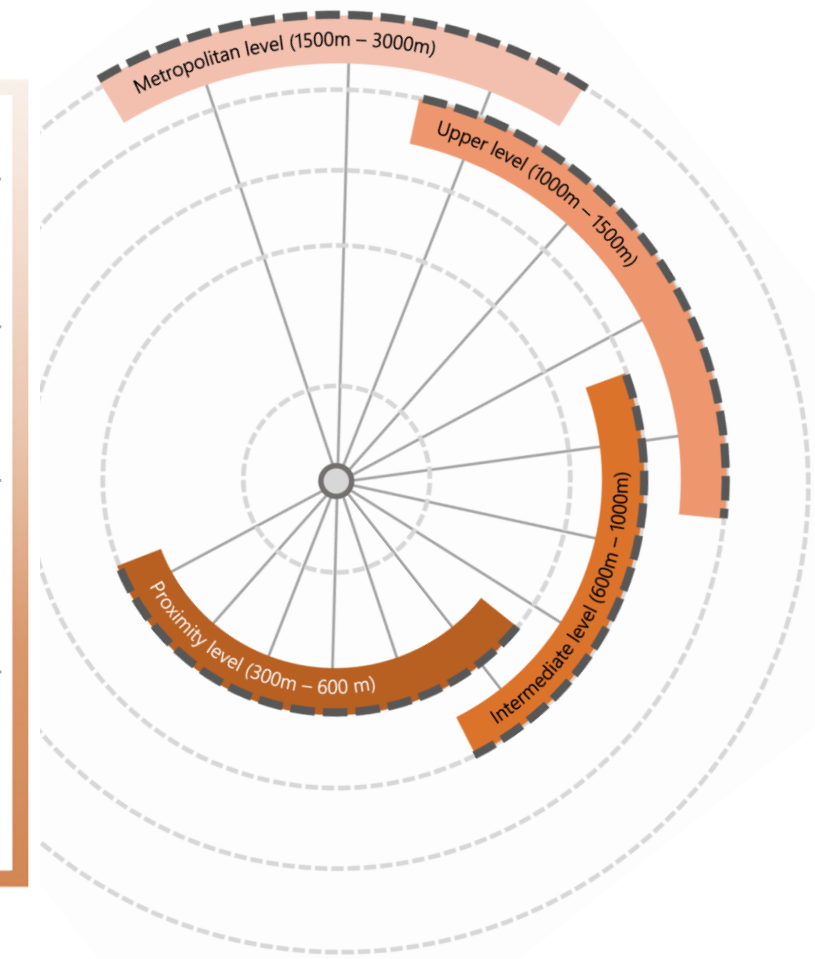
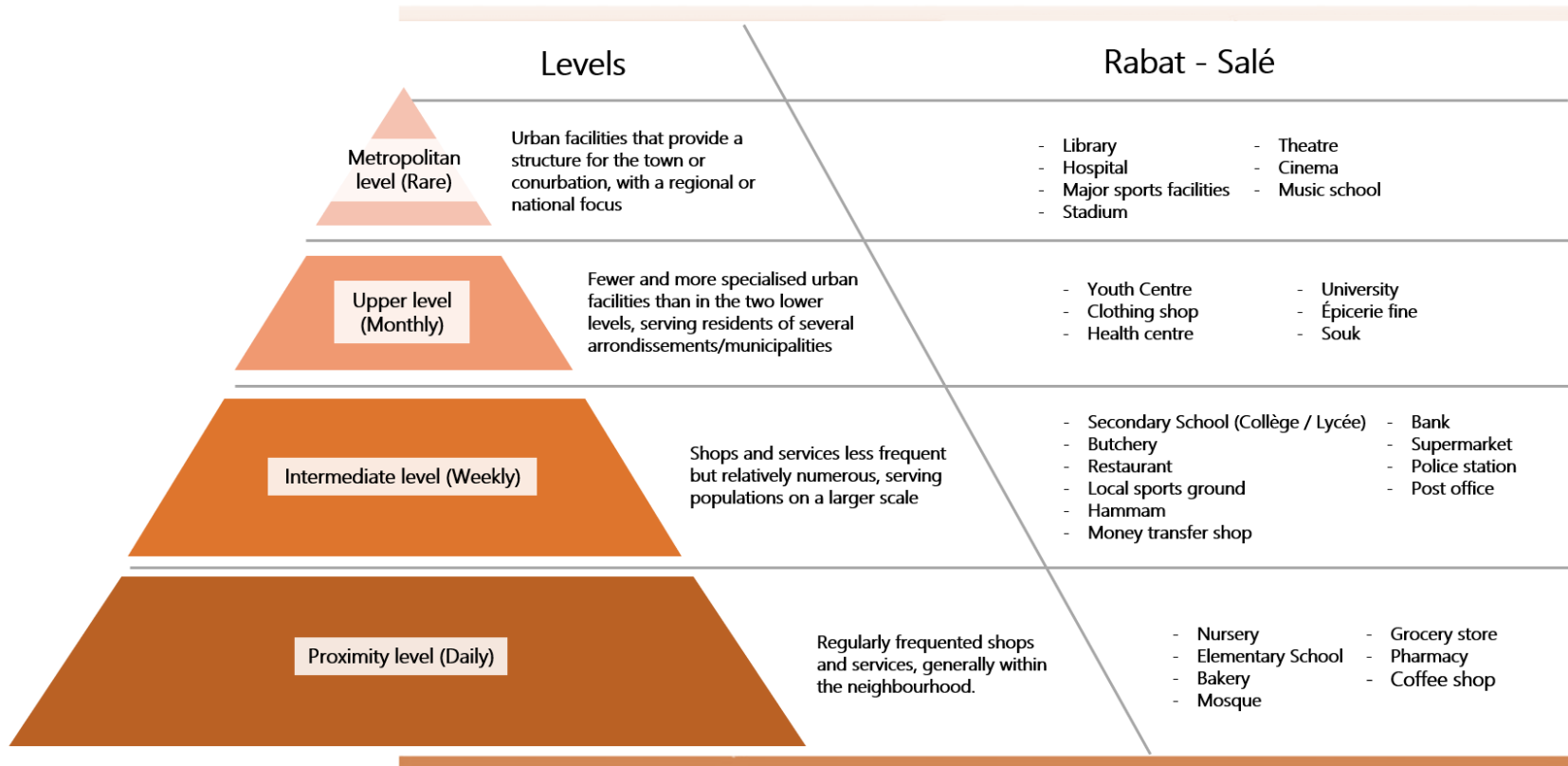
## Rabat - Salé



- APUR study to draw up unified development plans for Rabat and Salé, 2009
- Architecture and urban planning student projects (INAU / ENA de Rabat)
- Rabat-Salé Urban Agency Geoportal

## 2. Needs and practices of the population

- Types of shops and services, frequency of use, Accessibility distance threshold
- land use planning standards an important role in classifying shops and services



### Reference :

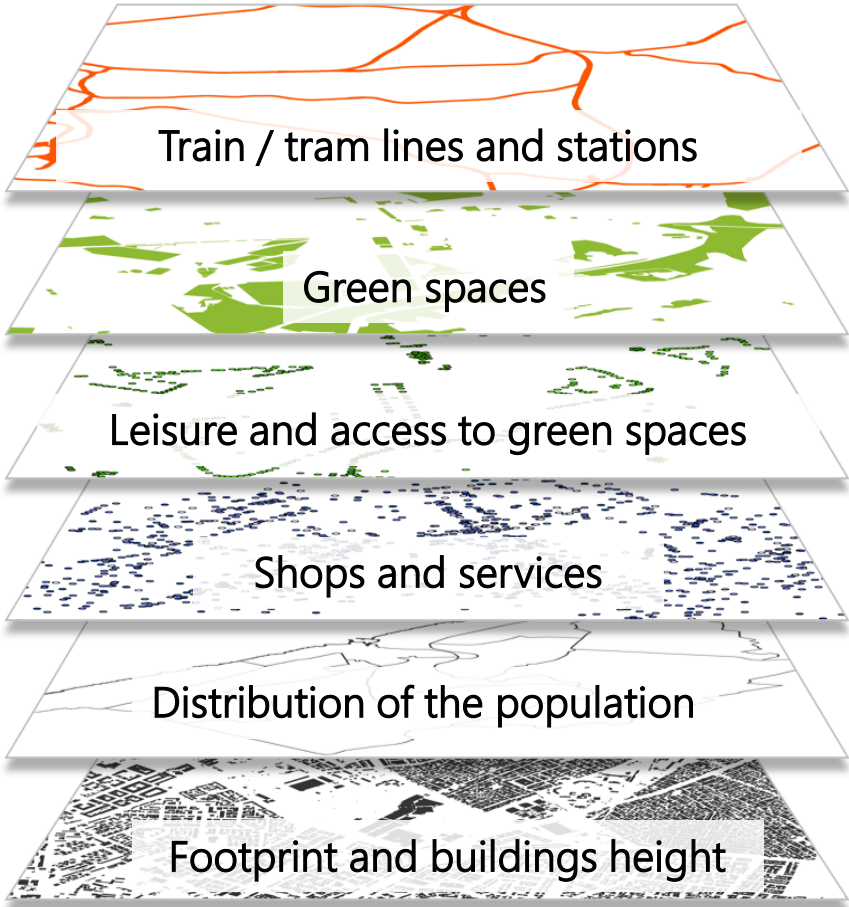
- AREA, 2016, Référentiel de programmation des équipements publics et privés d'intérêt général. Ministère de l'Urbanisme et de l'aménagement du Territoire, Direction de l'Urbanisme, Royaume du Maroc.
- Bonin O. et al., 2020, Projet SOFT : Sobriété énergétique par les formes urbaines et le transport. [Rapport de recherche] THÉMA, UMR 6049; Institut pour la Transition Energétique, Efficacity; LVMT.

Reference : Madec, P. et al., 2008, Le bio-îlot et la ville de la pantoufle. in Ecologik N° 5



# 3. Building the database

## 🌐 World open databases



### Rabat - Salé

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OpenStreetMap 2024	🌐
OpenStreetMap 2024	🌐
OpenStreetMap 2024 / Strava Global Heatmap 2024	🌐
Google maps 2024 / Geoportal of the Rabat Salé Urban Agency	
Kontur Population density dataset 2023	🌐
Google-Microsoft Open Buildings / GHS-BUILT-HR2023A	🌐

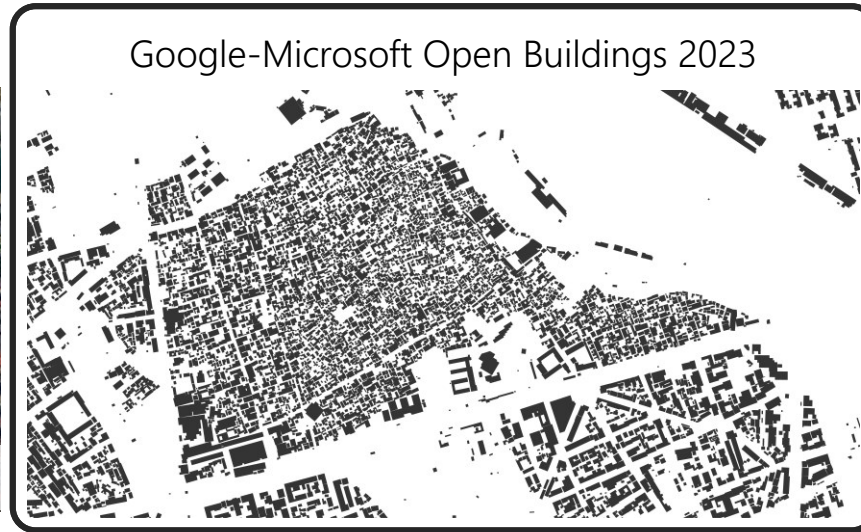
# 3. Building the database

## Buildings footprint

Google Earth 2024



Google-Microsoft Open Buildings 2023

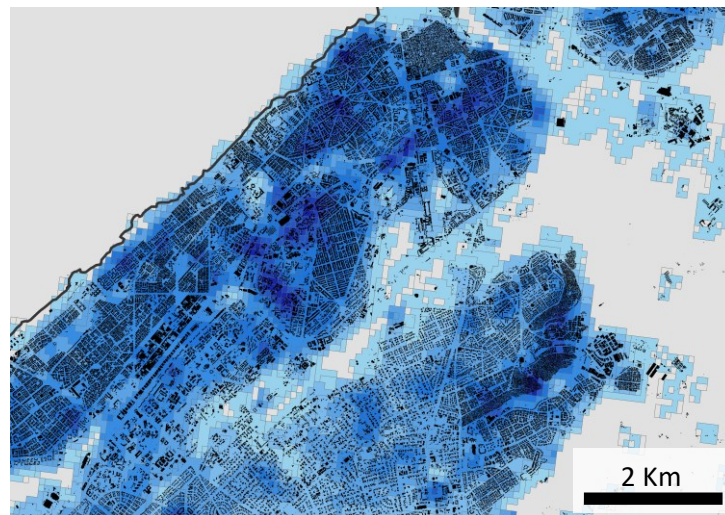


OpenStreetMap 2024



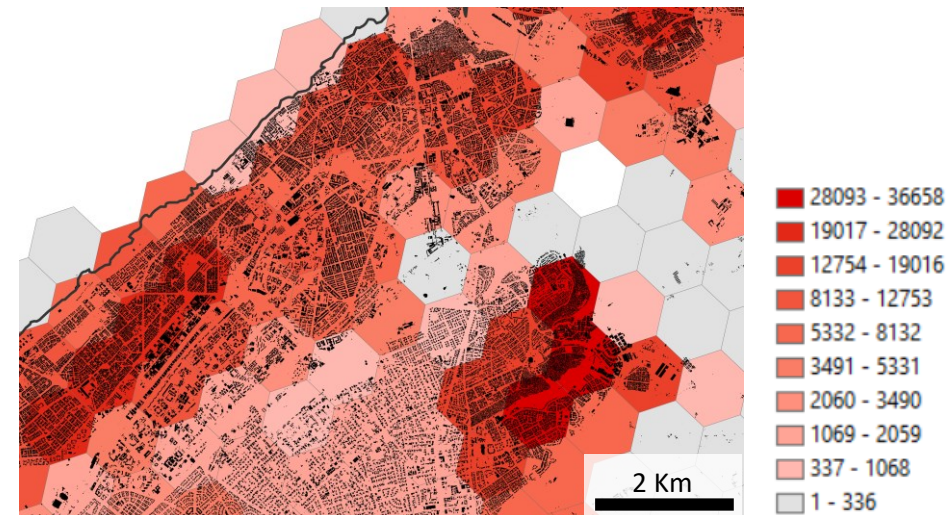
## Buildings height

GHS-BUILT-H\_GLOBE\_R2023A –  
Average of the Net Building Height (ANBH)

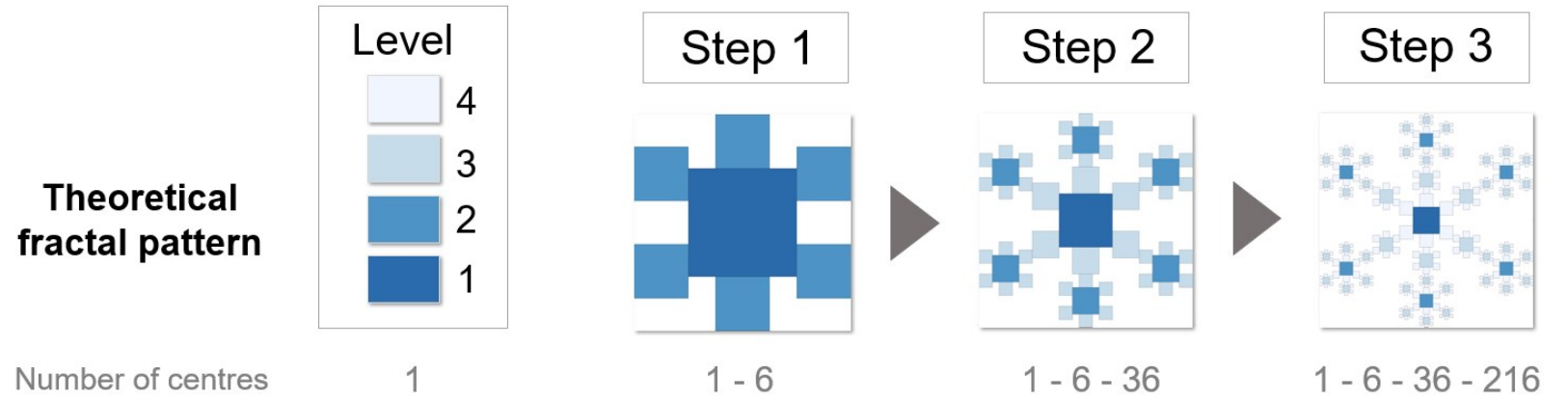
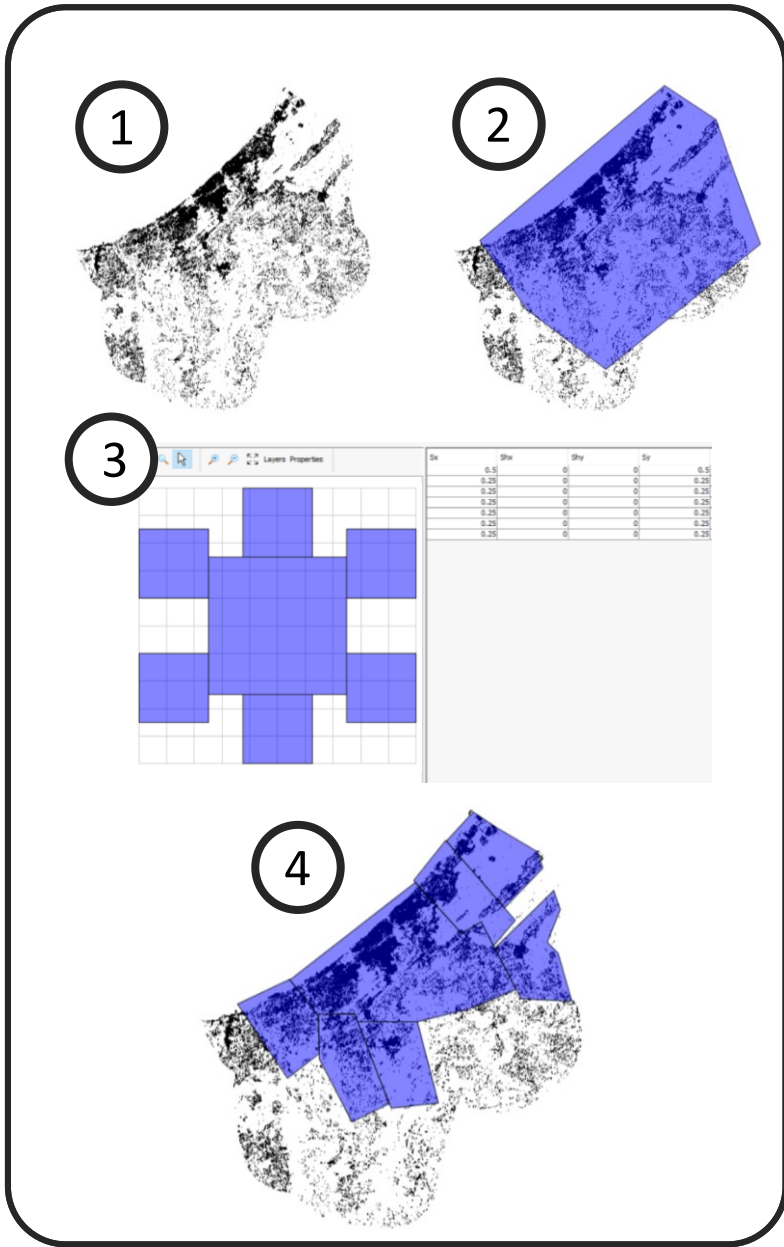


## Distribution of the population

Kontur Population density dataset 2023



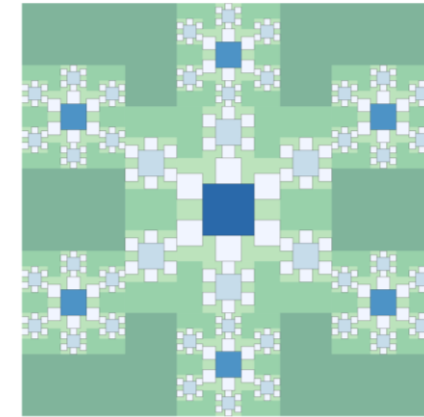
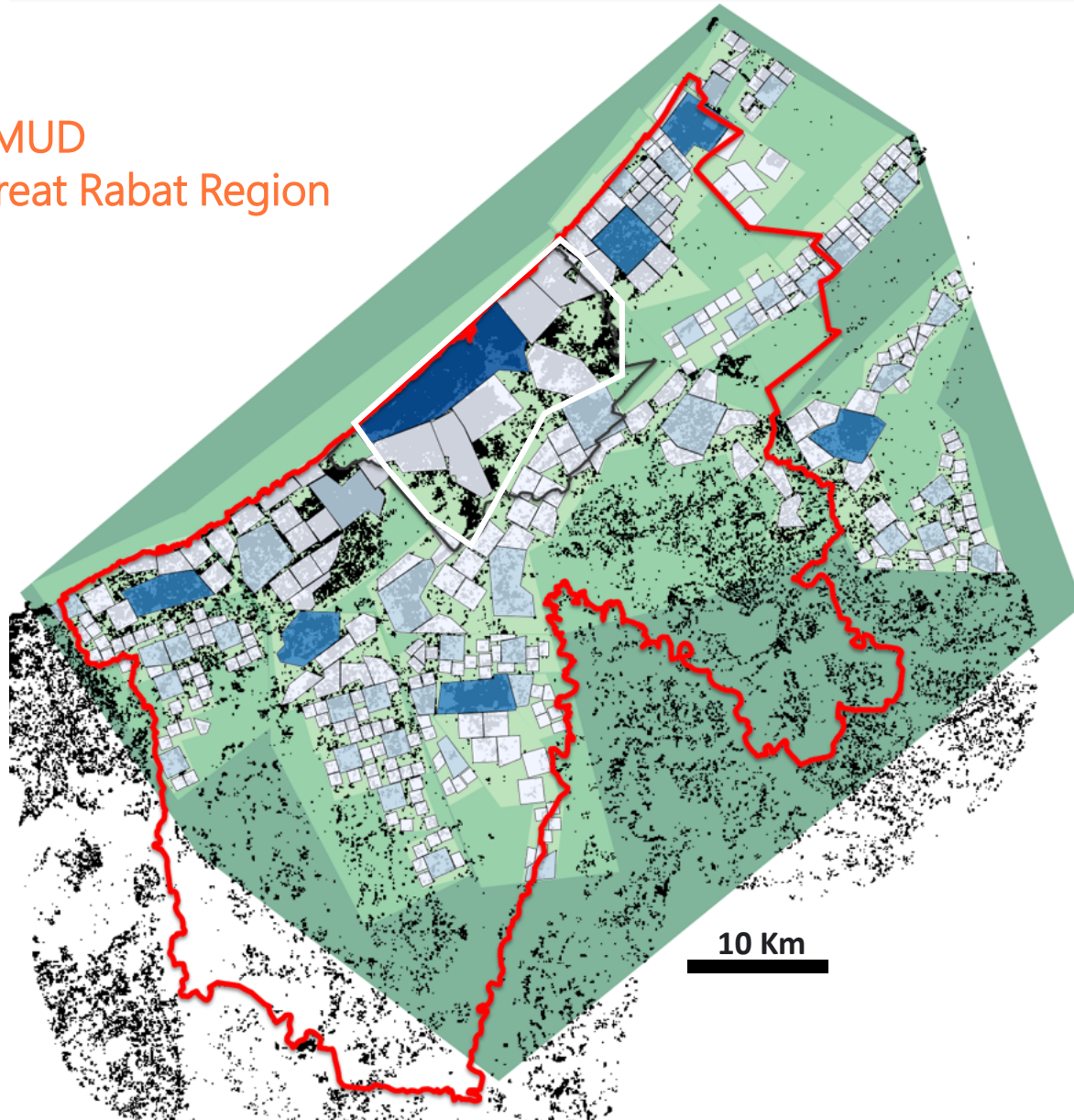
# 4. Delimiting study area, number and position of subcenters



1 - Buildings and population data / 2 - Defining the study area / 3 - Iterative Functional System (IFS): the choice of the number and size of centres generated at each step / 4 - Positioning and deformation of centres in relation to buildings

# 4. First step of analysis: : Urban areas and natural spaces

PMUD  
Great Rabat Region

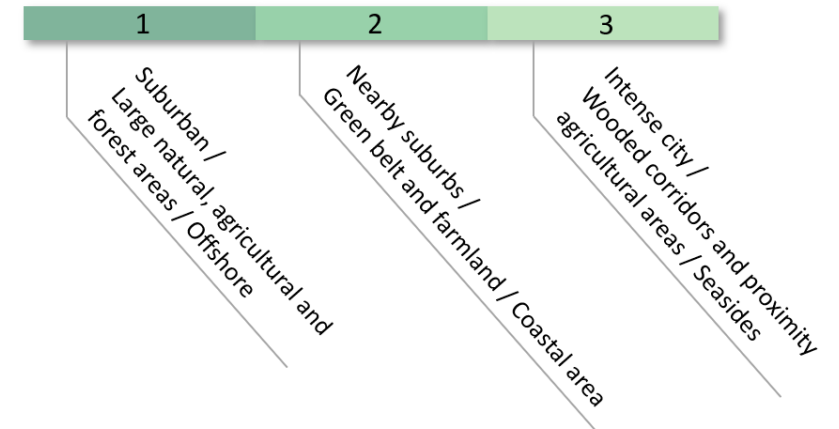


Theoretical pattern

Hierarchy of urban centres  
(degree of independence)

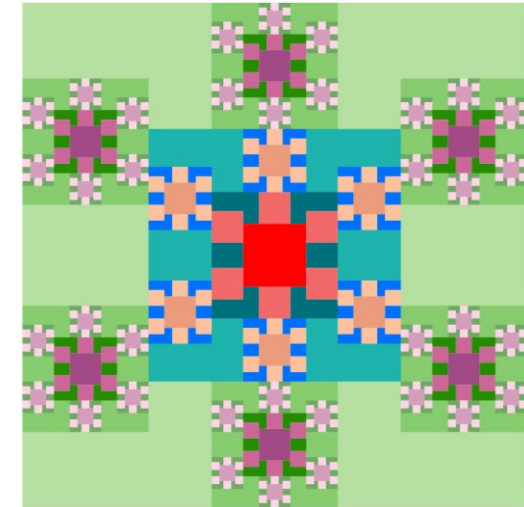
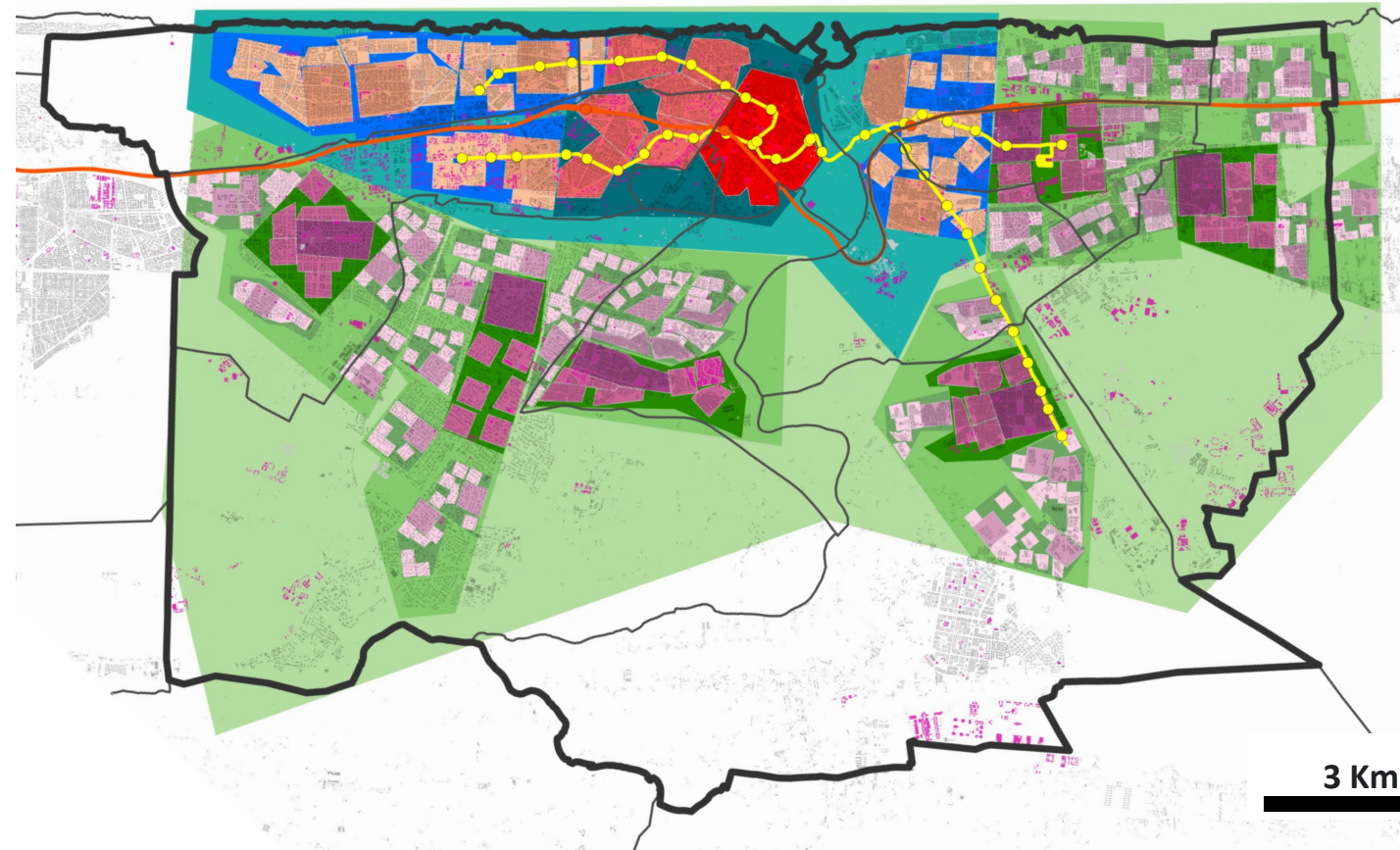
Step 0	1
Step 1	2
Step 2	3
Step 2	4

Urban thresholds and hierarchy of natural, agricultural and forest areas

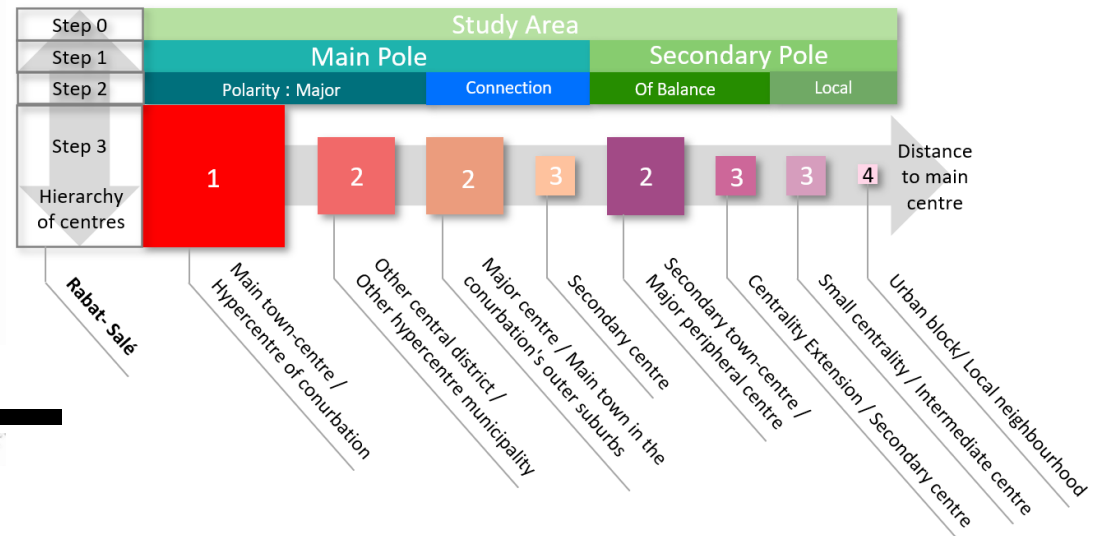


# 4. Second step: The local scale - Fractalopolis Space System

Rabat-Salé conurbation



Theoretical pattern



# Building the database

Shops and services



Google maps



Geoportal

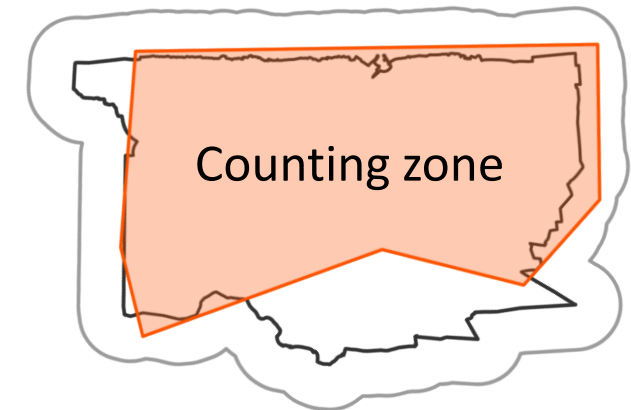
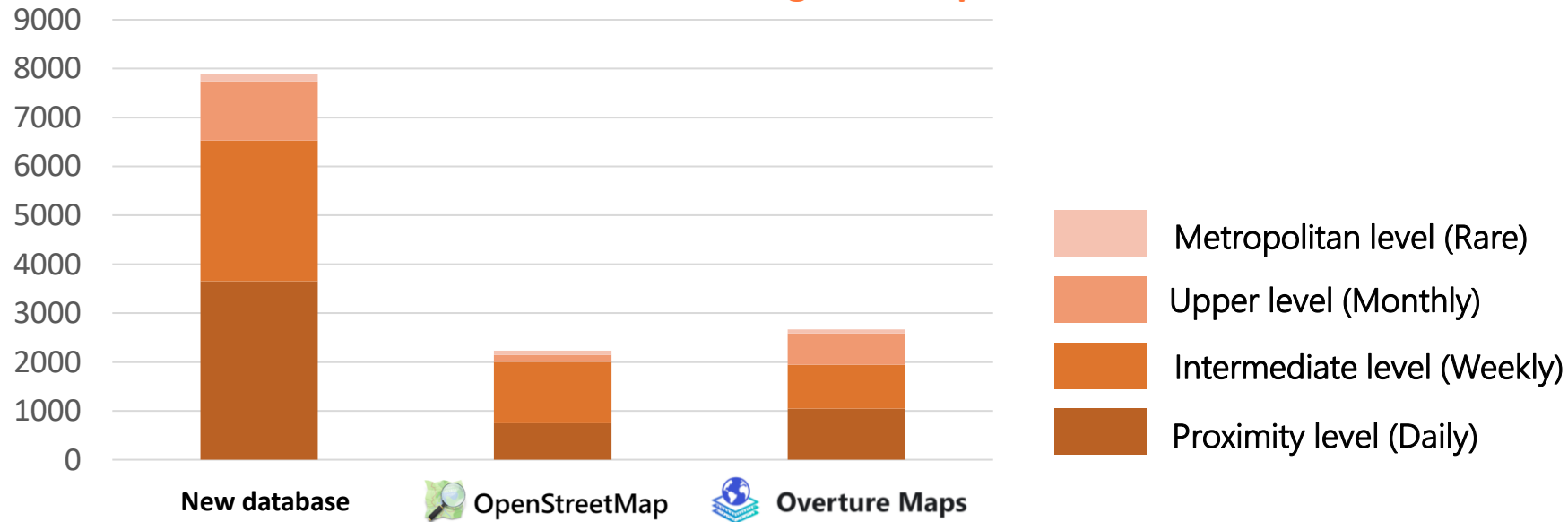


Observation



Strava

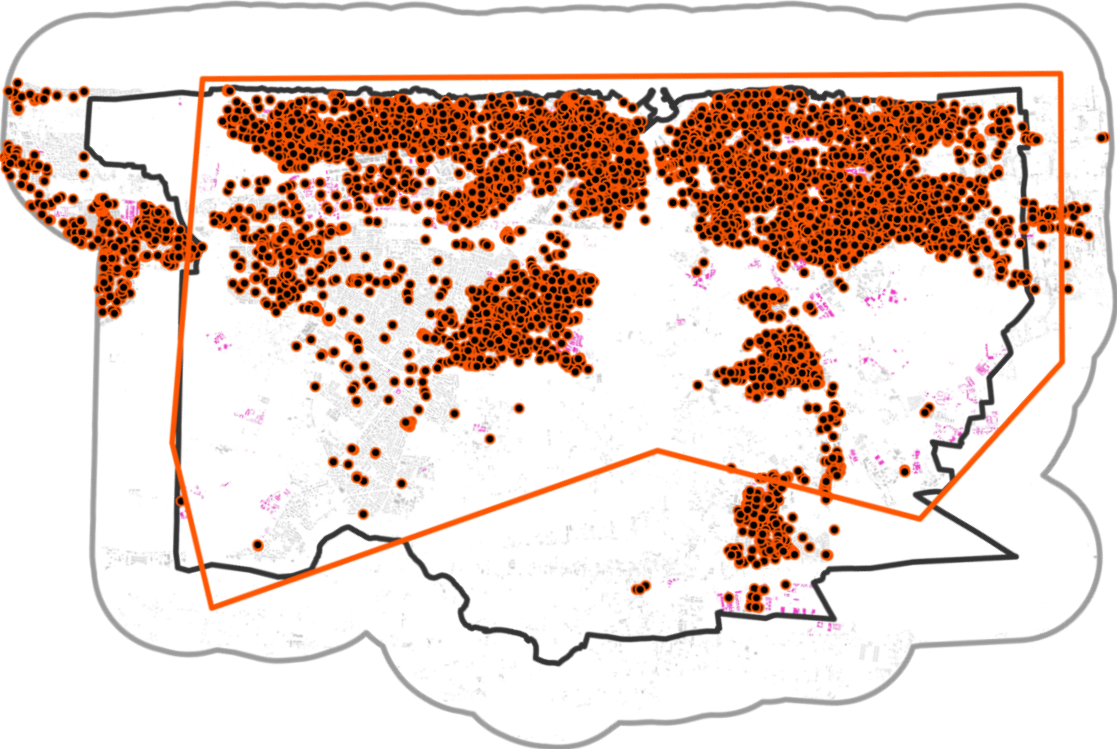
## Number of POIs according to the open database, in 2024



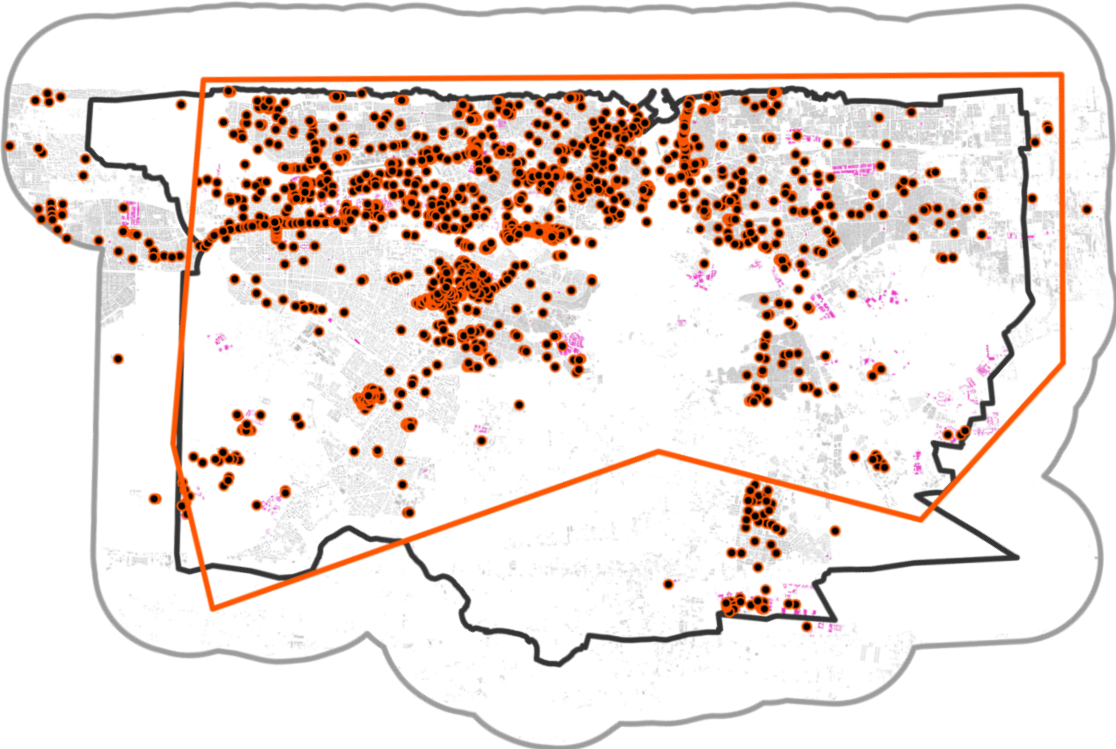
# Building the database

Distribution of POIs by database, in 2024

New database

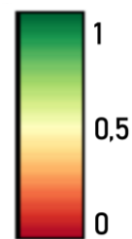
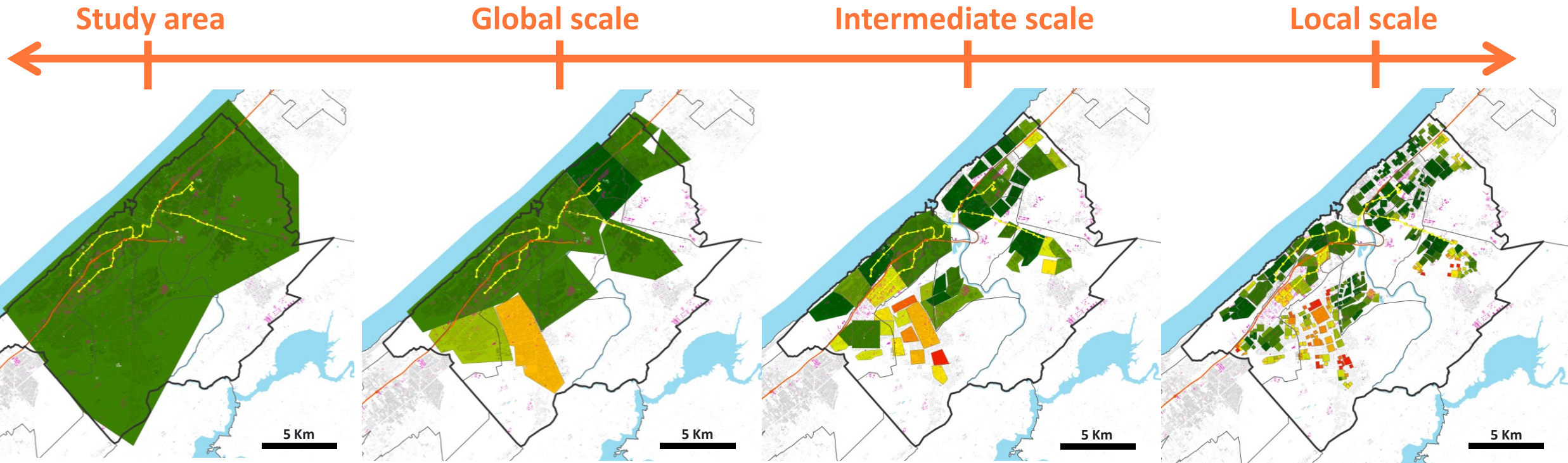


 OpenStreetMap



## 5. Results of accessibility measurements

- Accessibility scores for shops and services, by level of spatial scale

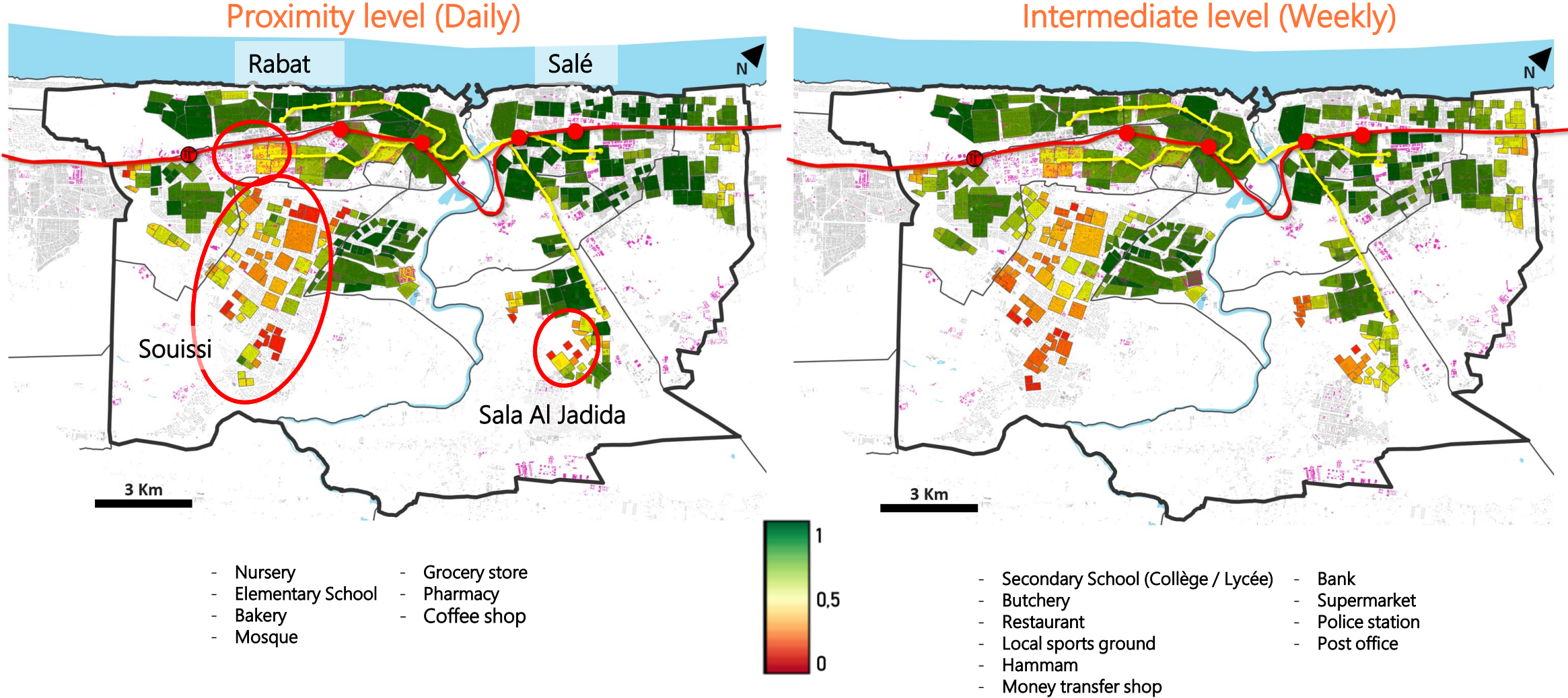


The score tends towards 1 when the level of accessibility is good and towards 0 when it is poor.



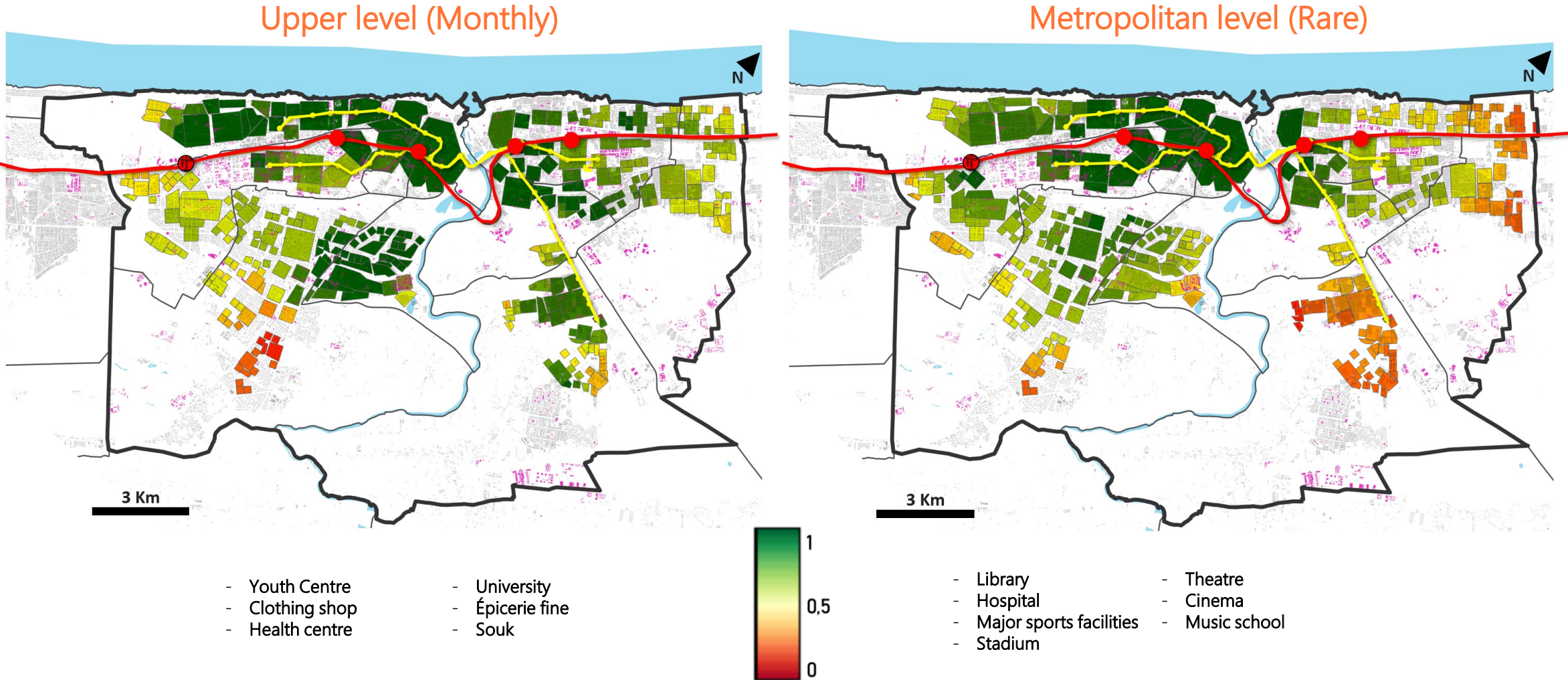
# 5. Results of accessibility measurements

- Accessibility scores for shops and services, by level of frequency



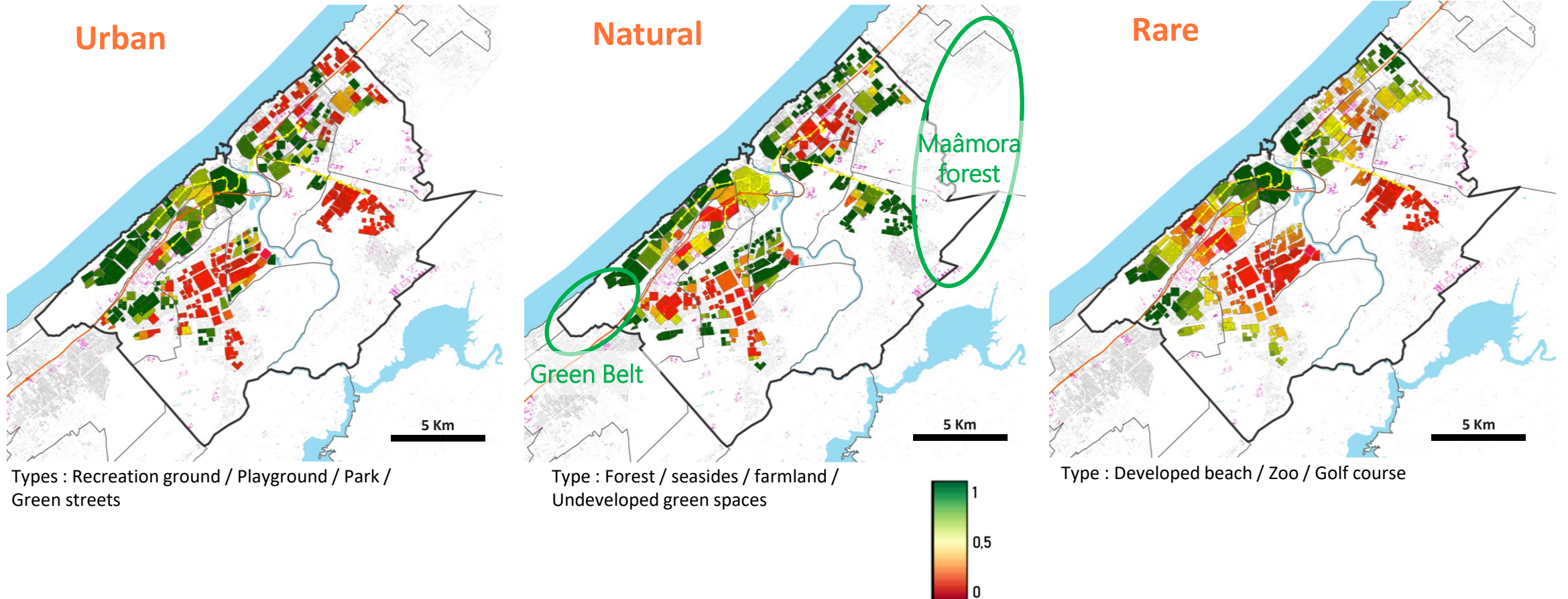
# 5. Results of accessibility measurements

- Accessibility scores for shops and services, by level of frequency



# 5. Results of accessibility measurements

- Accessibility scores for green spaces and leisures, by frequency of use category

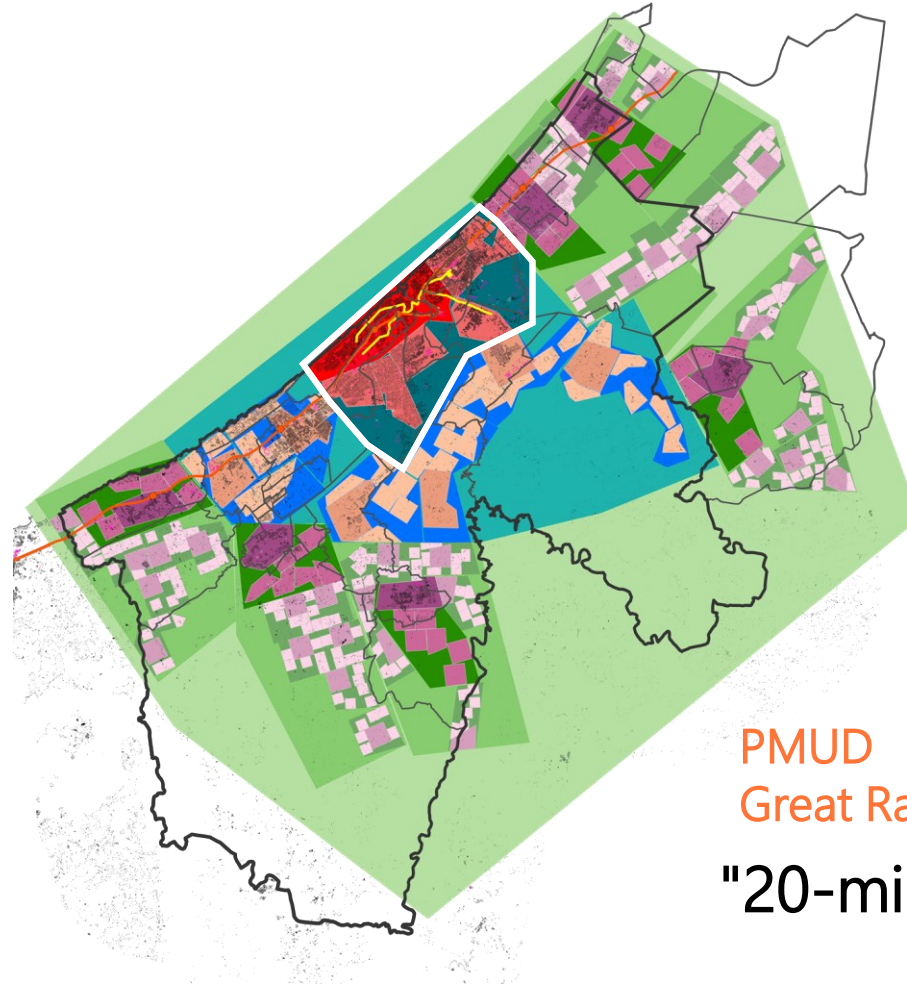


# Conclusion and next step



Rabat-Salé conurbation

"15-min city" study ✓



PMUD  
Great Rabat Region  
"20-min region" ?

Presentation and collaboration with urban planners



# References

- Bonin O., Bonneau P., Clerc M., Cousin J., Frankhauser P., et al., 2020, Projet SOFT : Sobriété énergétique par les formes urbaines et le transport. [Rapport de recherche] ThéMA, UMR 6049; Institut pour la Transition Energétique, Efficacity; LVMT, 214 p. (hal-03111221) <https://hal.science/hal-03111221>
- Bruno, M., Monteiro Melo, H.P., Campanelli, B. *et al.* A universal framework for inclusive 15-minute cities. *Nat Cities* **1**, 633–641 (2024). <https://doi.org/10.1038/s44284-024-00119-4>  
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- Yamu C., Frankhauser P., 2015, Spatial accessibility to amenities, natural areas and urban green spaces: using a multiscale, multifractal simulation model for managing urban sprawl, *Environment and Planning B: Planning and Design*, 42(6), 1054-1078. <https://research.rug.nl/en/publications/spatial-accessibility-to-amenities-natural-areas-and-urban-green->
- Pesaresi, M.; Politis, P., 2023, GHS-BUILT-H R2023A - GHS building height, derived from AW3D30, SRTM30, and Sentinel2 composite (2018).European Commission, Joint Research Centre (JRC) PID: <http://data.europa.eu/89h/85005901-3a49-48dd-9d19-6261354f56fe>

PEOPLE

CITY

TRANSPORT

2024



Thank you!



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Ikrame Laadssi : [ikrame.laadssi@enpc.fr](mailto:ikrame.laadssi@enpc.fr)

