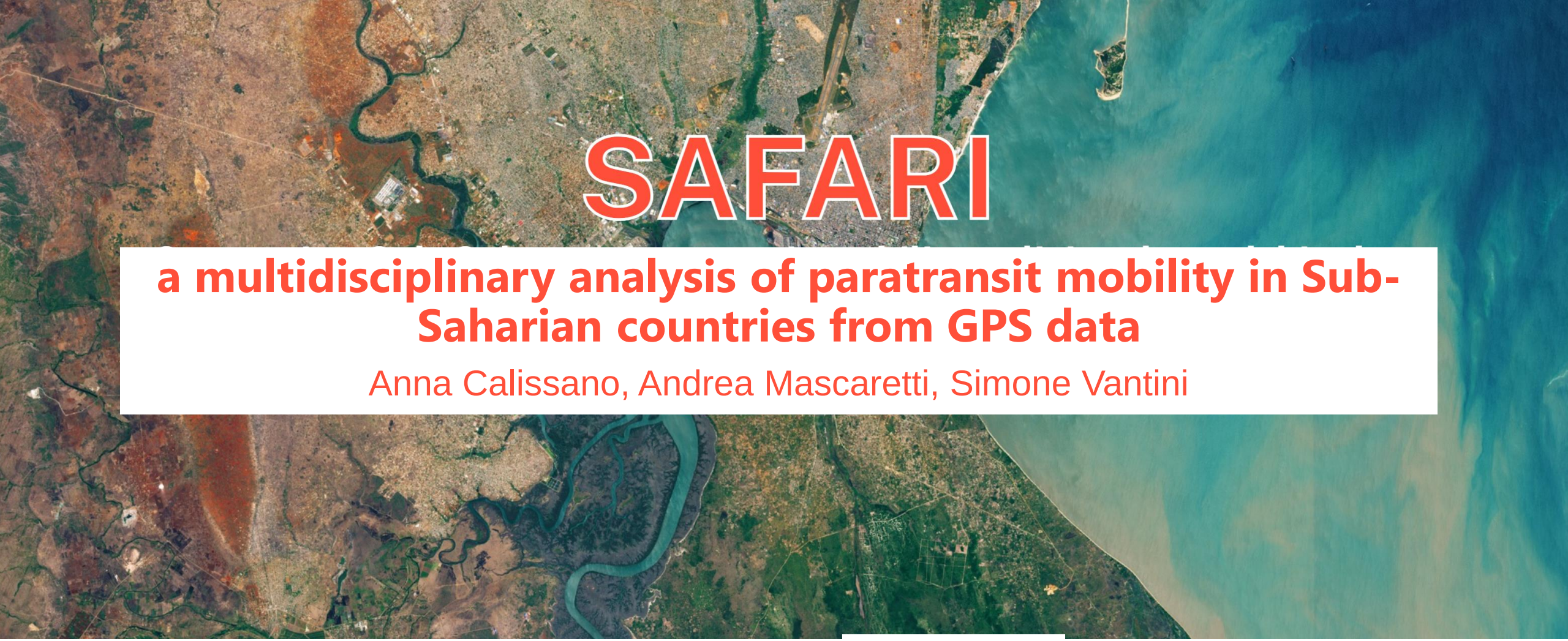

SAFARI

a multidisciplinary analysis of paratransit mobility in Sub-Saharian countries from GPS data

Anna Calissano, Andrea Mascaretti, Simone Vantini

Politecnico di Milano

ENBIS 2021

Safari njema

Polisocial Award 2018

POLITECNICO MILANO 1863

POLISOCIAL

The Safari Njema Project

Project Aim:

Study paratransit mobility in sub-saharian context to decrease transport poverty.

POLITECNICO MILANO 1863

POLISOCIAL

Interdisciplinary research team:

Department of Mathematics
Department of Urban Studies
Department of Management
Department of Design
Department of Computer Science

vodacom, cuebiq, AMT, UN HABITAT, WAZA, Universidade Eduardo Mondlane, MIT, T-SUM Transitions to Sustainable Urban Mobility, Agenzia Italiana per la Cooperazione allo Sviluppo, digitalmatatus, UCL

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POLITECNICO MILANO 1863

POLISOCIAL

Prof. Simone Vantini

Anna Calissano

PhD Student – now postdoctoral fellow at INRIA Sophia Antipolis

Andrea Mascaretti

Research Fellow – now phd student at Università degli Studi di Padova

Master Thesis Student

Celeste Principi **Irene Azzini**

Artem Ugarov ***Elena Zazzetti***

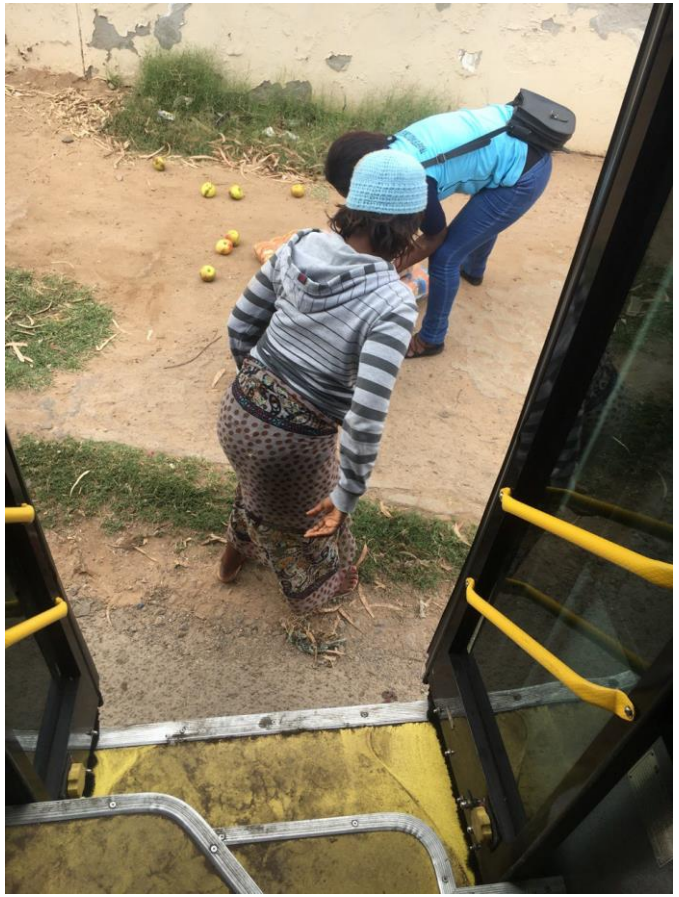
Davide Ranieri ***Marika di Marcantonio***

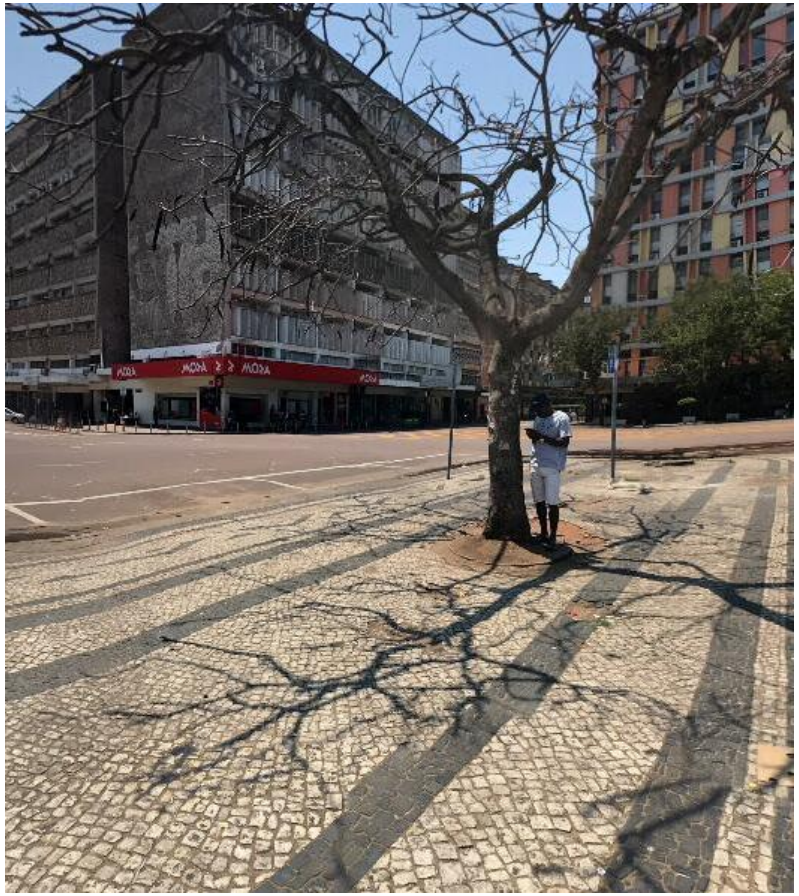
The Safari Njema Project Aim

Problem - safety

Problem - infrastructure

A Road

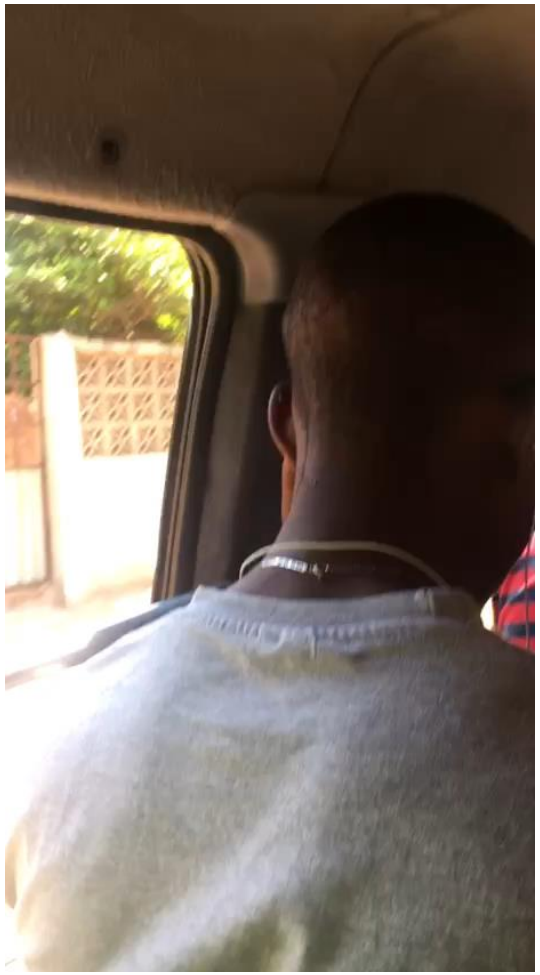




A Bus Stop

Problem - traffic

Problem – personal space and harrasment



The Project Aim

«paratransit» mobility

PROBLEM
banned the whole system from the urban area

SOLUTION
Try to study, understand, regulate and optimize informal mobility, transforming it into an active solution.

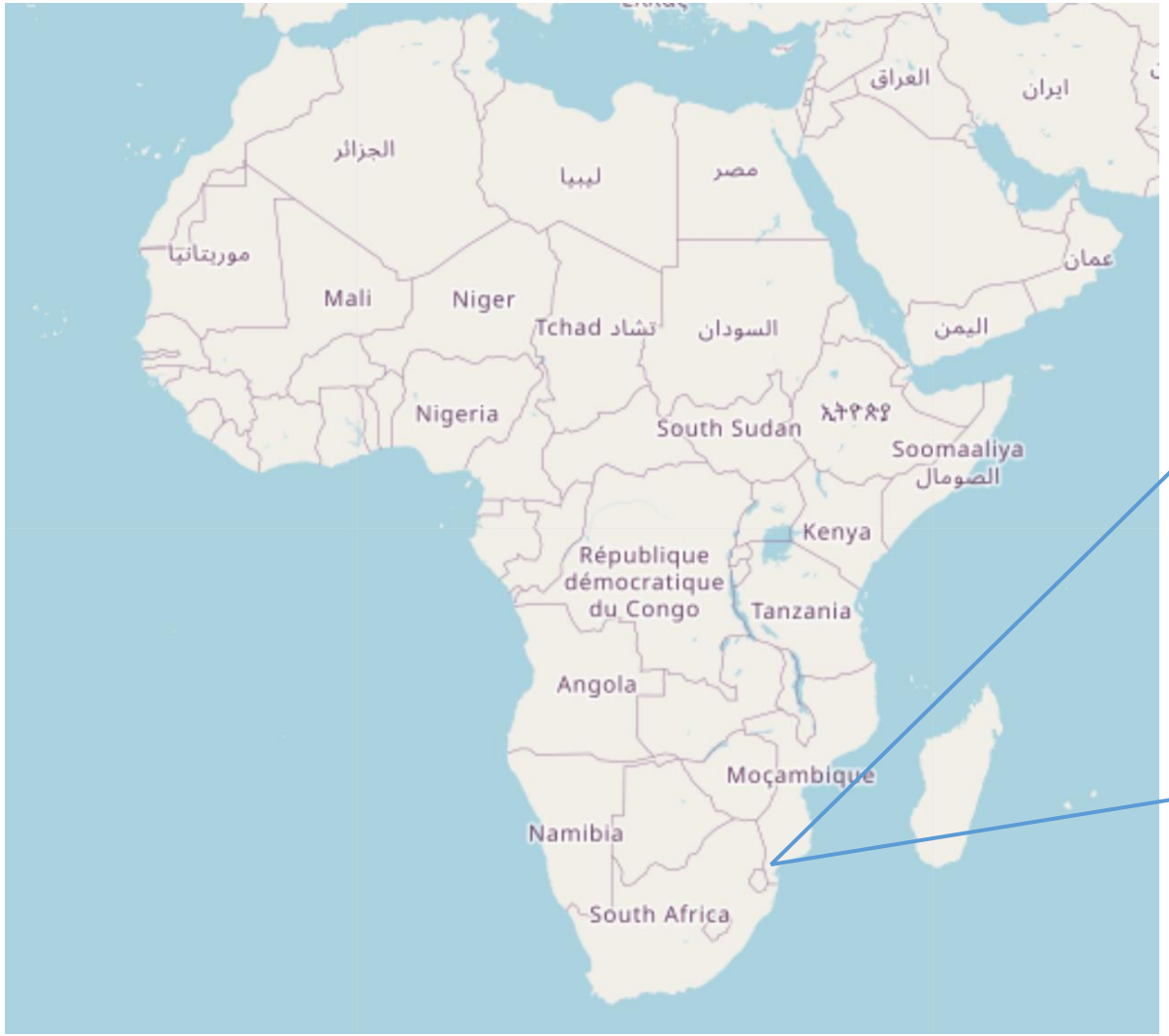
The Project Aim

«paratransit» mobility

SOLUTION

Try to study, understand, regulate and optimize informal mobility, transforming it into an active solution.

Maputo (Mozambique) as a Case Study



Data Mapping

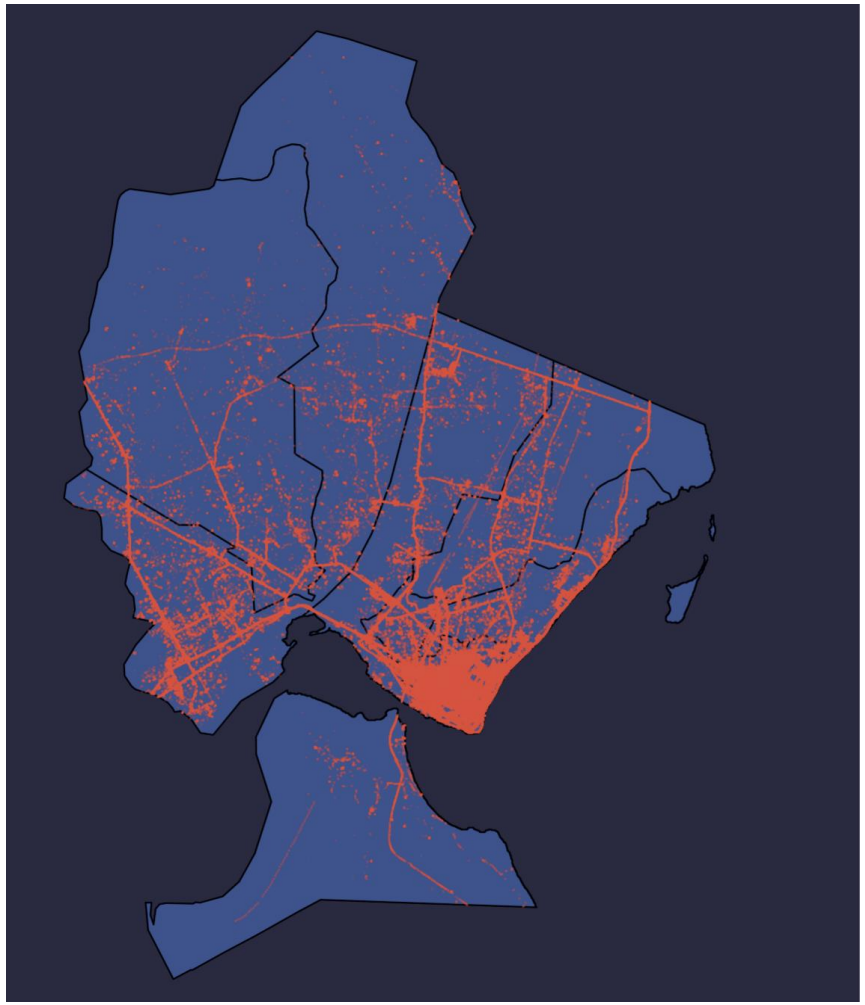
Undestranding «paratransit» mobility

- **Demand**
  How do people move around the city? Where do they wait the most?
  - Thought GPS data shared by mobile phone users

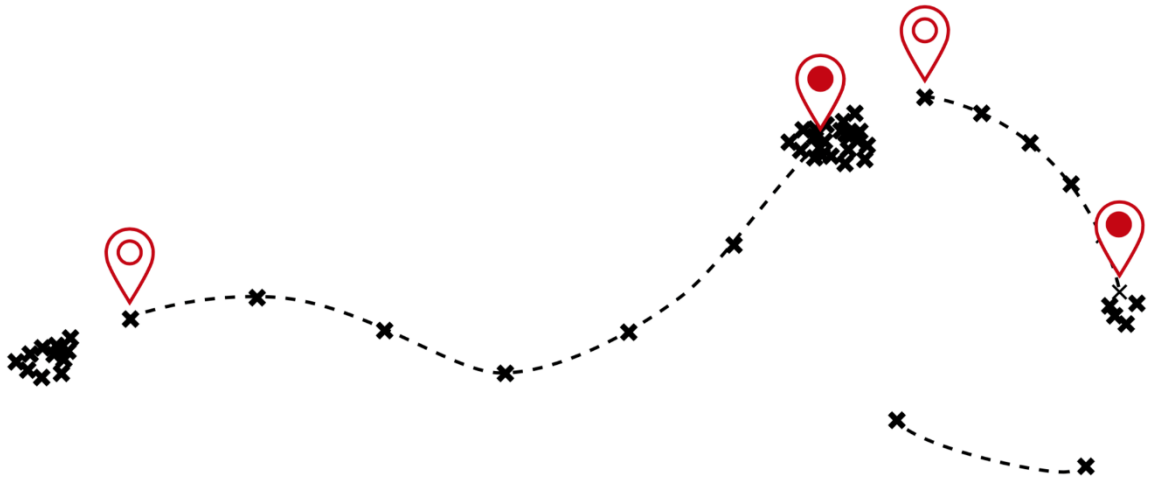
- **Offer**
  Which are the active route? Where is the lack of offer located?
  - Through a Maphaton

- **Infrastructure**
  Which is the condition of the infrastructure? Which road are concrete, soil, sand?

Demand: Cuebiq Data



cuebiq

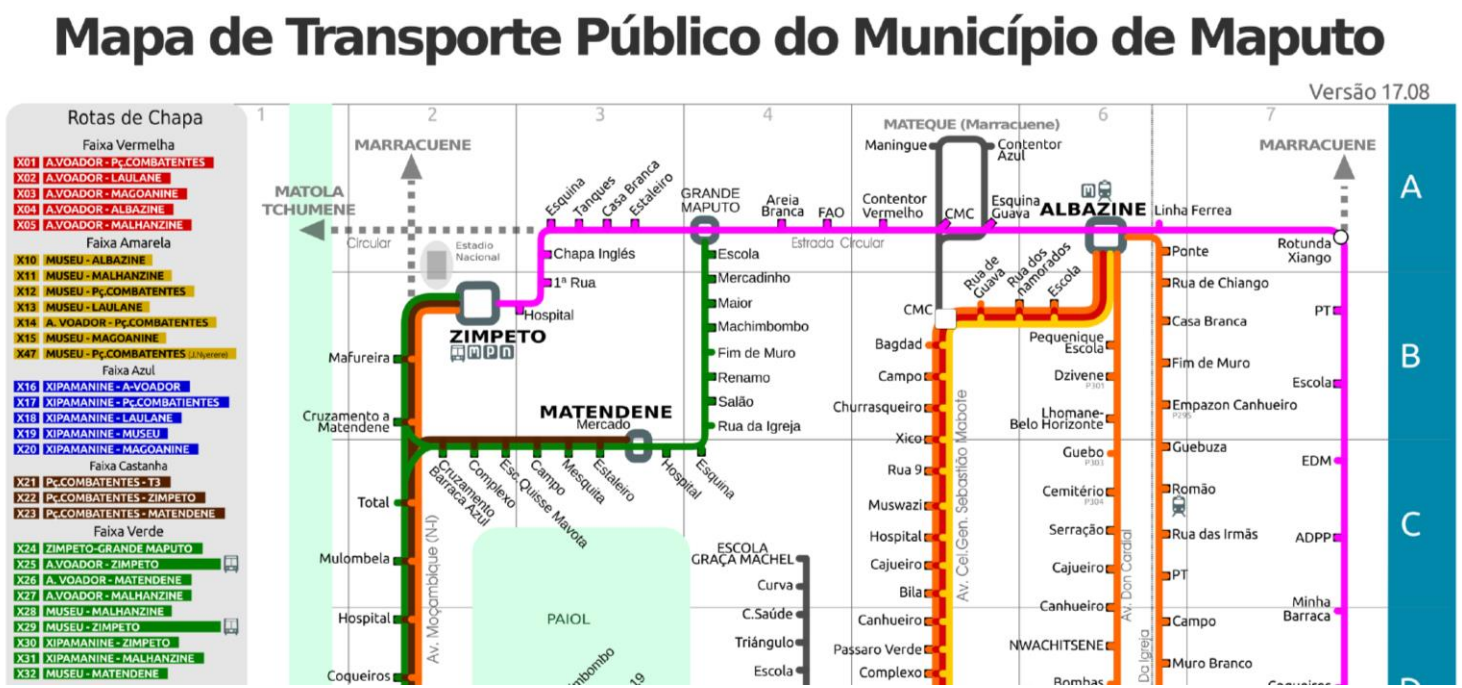


Collection window: **January 31st 2019 - ongoing**
Collection area: **Greater Maputo (Mozambique)**
Monitored unique users: **20k**
Average daily number of data points per user: **~150**

Offer: Maphaton

Maphaton is a collective project aimed at mapping the actual system offer.

- Stops
- Timetable
- Lines
- Interchages
- …



Infrastructure: Satellite and OSM Data

To understand the quality of the infrastructure, we explored two data sources:

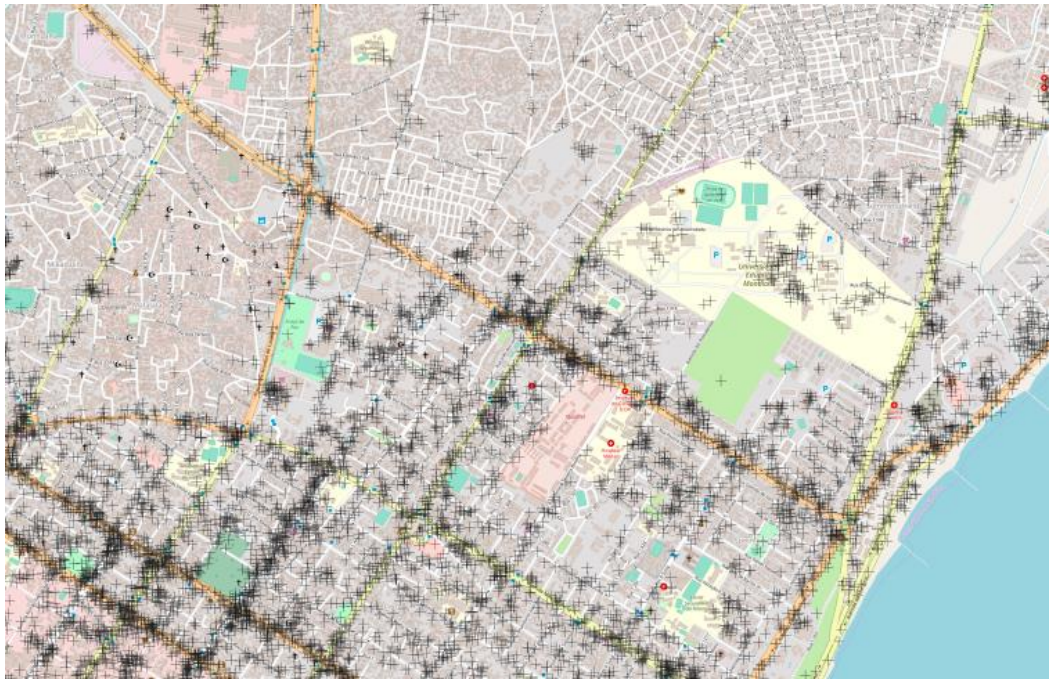
- **Open Street Map Data**
  to understand which infrastructure are present in the area.

- **Google place API Data**
  to identify important venues, such as hospitals, markets, shopping malls.

Data Analysis

The analysis conducted using these data are:

- **OD Matrices**
- **User-Line Analysis**
- **Isocrone Analysis**
- **Transport Mode detection**
- **Stop Analysis**
- **Infrastructure Analysis**



https://www.openstreetmap.org/search?query=maputo#map=11/-25.9664/32.5672

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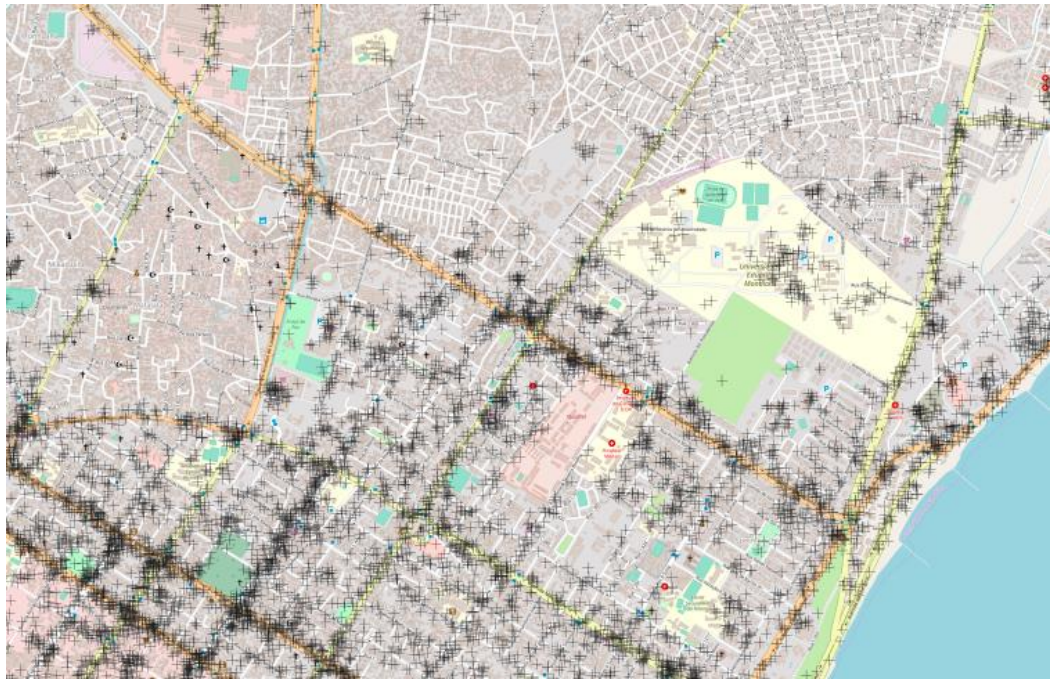
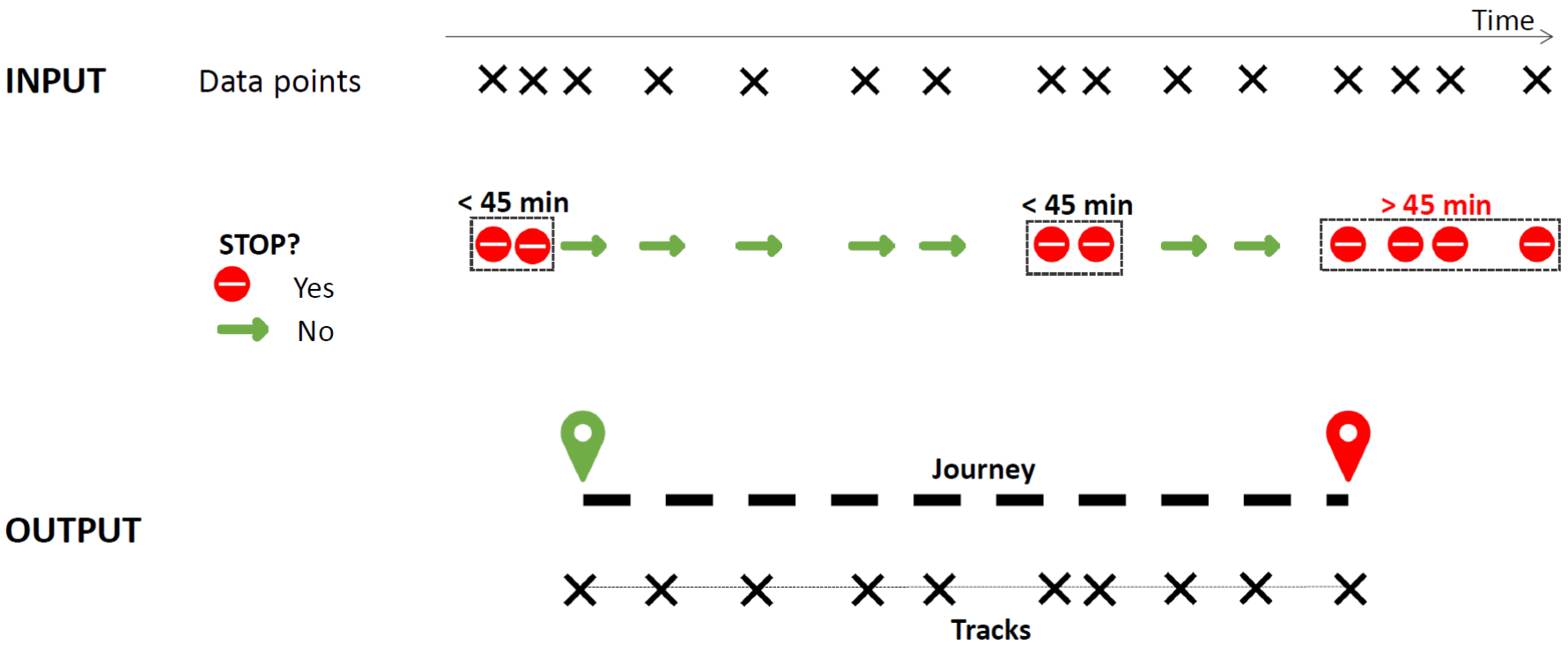
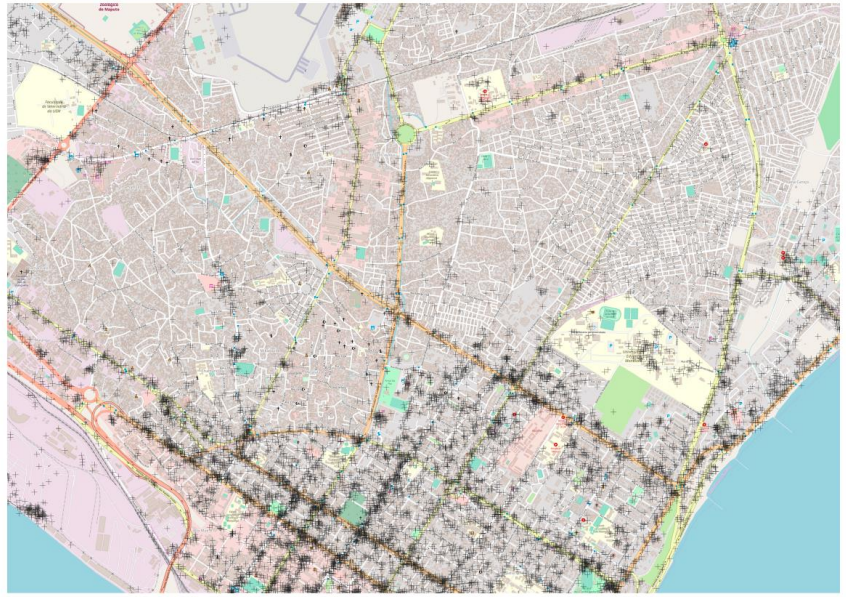


https://www.openstreetmap.org/search?query=maputo#map=11/-25.9664/32.5672

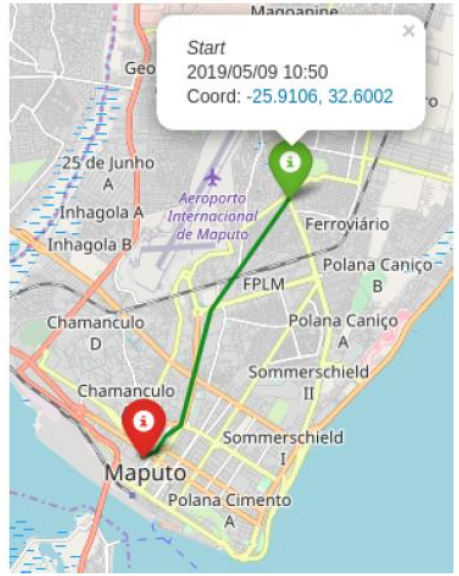
Data Preprocessing



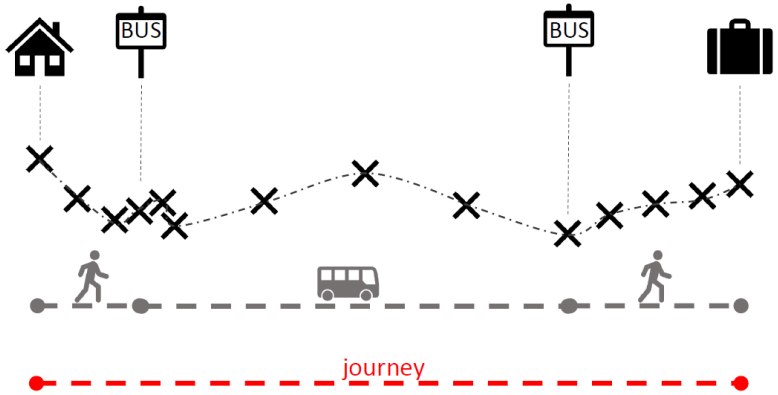
Data Preprocessing: from points to journeys



Initial Dataset
5m GPS location
20k unique users



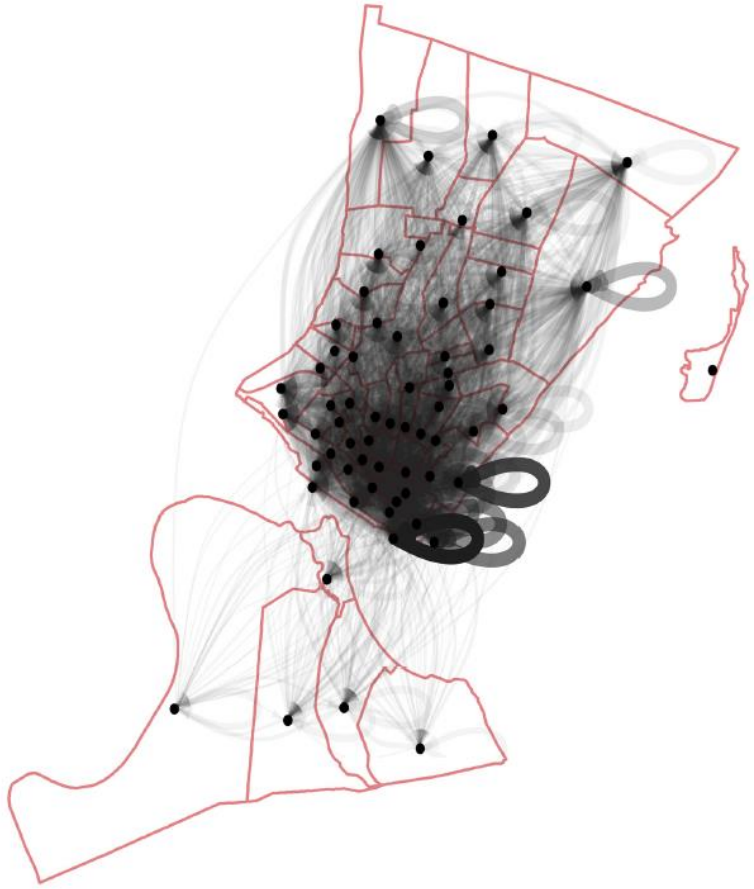
Set of Journeys
7k unique users



Origin Destination Matrix

The aim of the origin destination matrices is to understand the mobility between different area at different time of the day . The area can be build based on the census samlping area, to allow rescale the analysis easily.

	Mavalane A	Louis Cabral	F. P. L. M.	Polana Canico A	...
Mavalane A					
Louis Cabral	+1				
F. P. L. M.				+1	
Polana Canico A					
⋮					



User-Line Analysis

The User-Line helps to understand the potential demand on a specific line and to identify the lines connection.

Buffer [m]
100

X12 Museu - Praça dos Combatentes

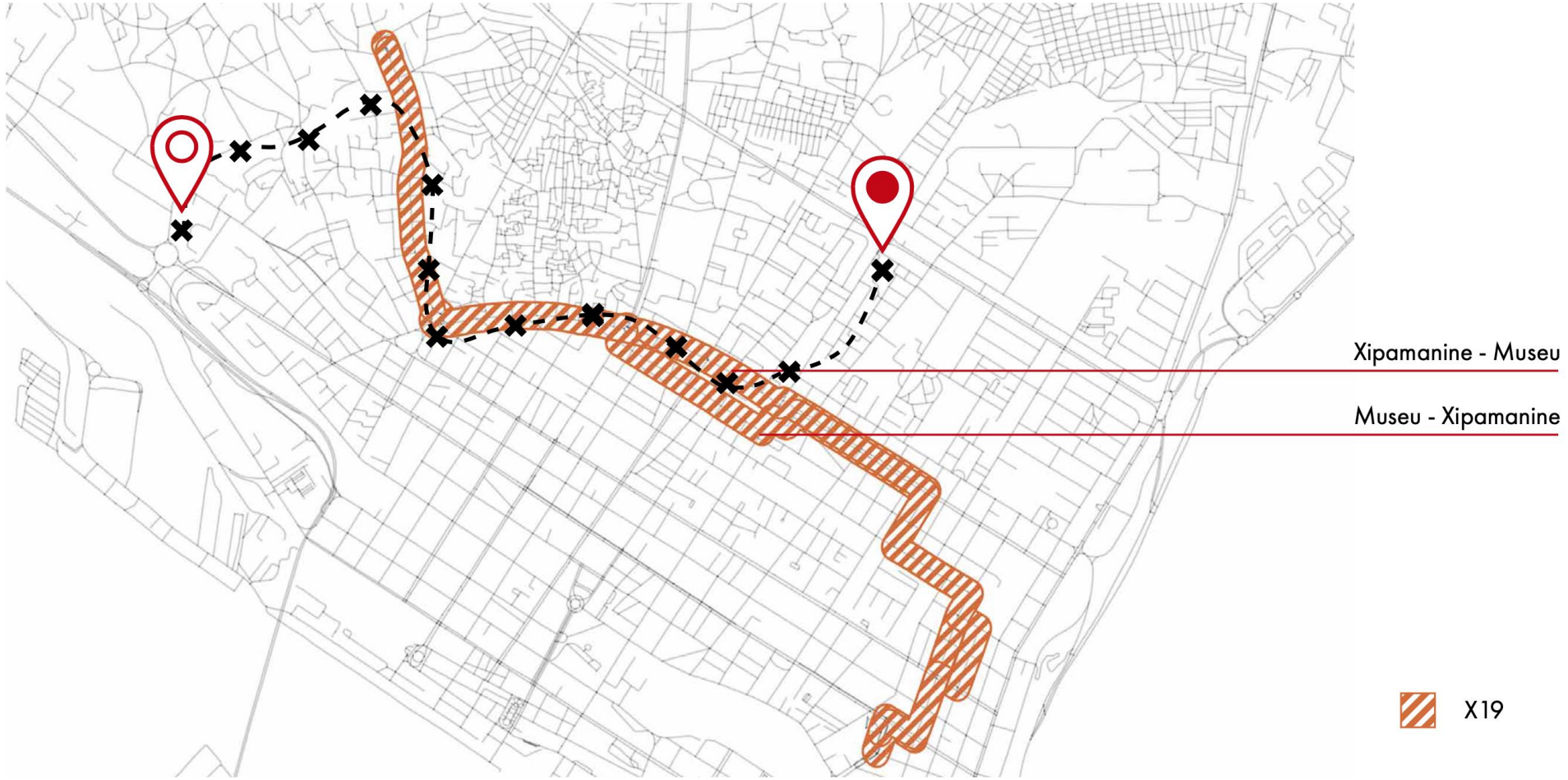
X14 Anjo Voador - Praça dos Combatentes

X19 Xipamanine - Museu

X34 Praça dos Combatentes - Costa do Sol

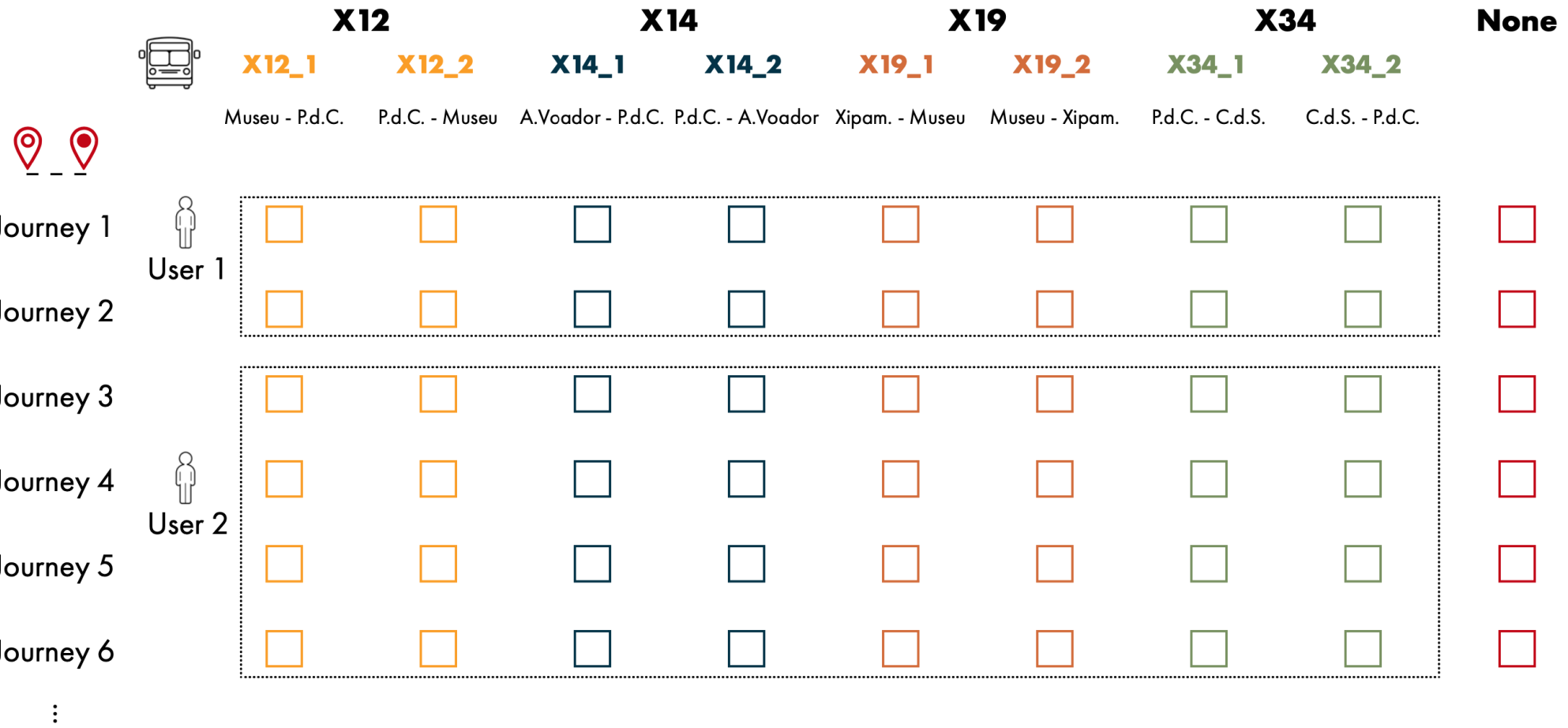
User-Line Analysis

The User-Line helps understanding the potential demand on a specific line and to identify the lines connection.



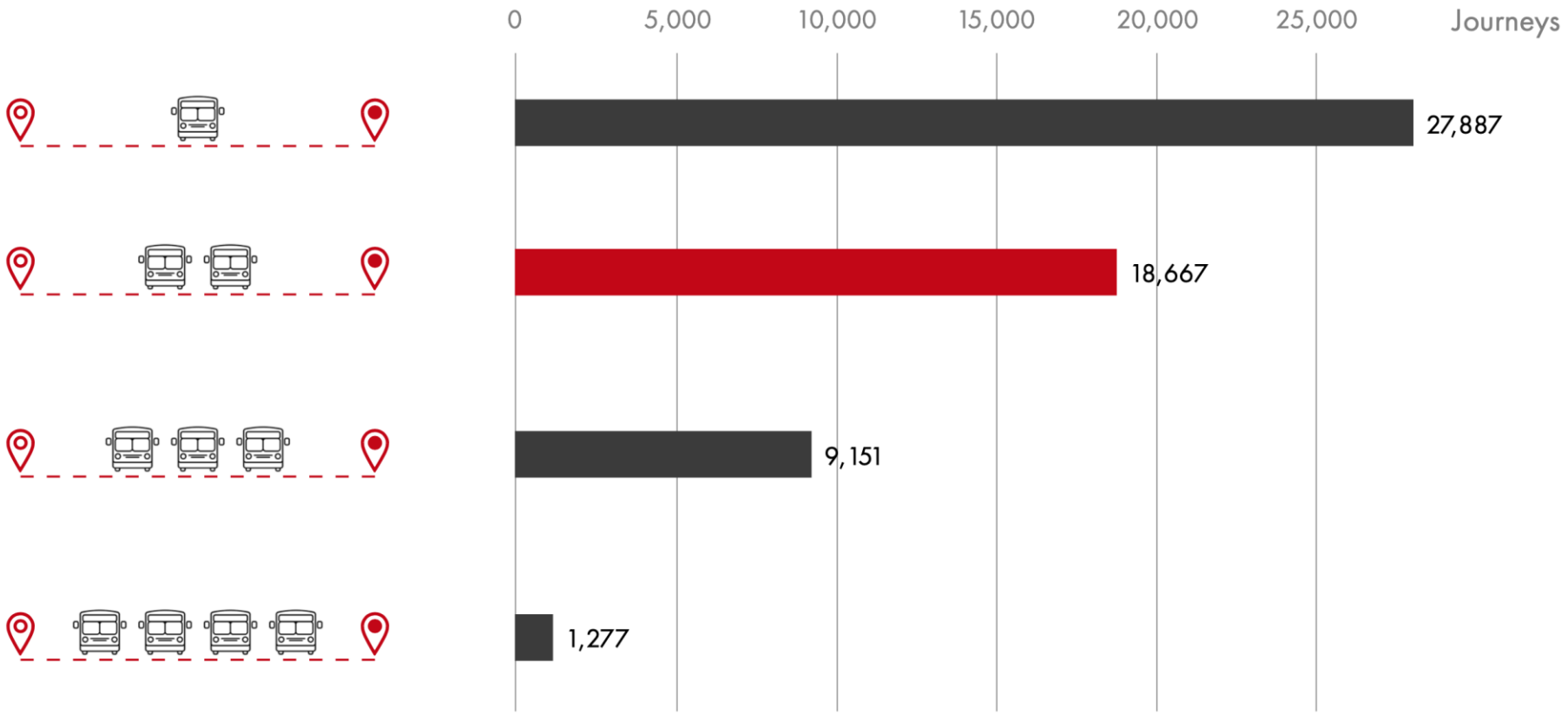
User-Line Analysis

The result is a bipartite graph, with interaction between users and lines.



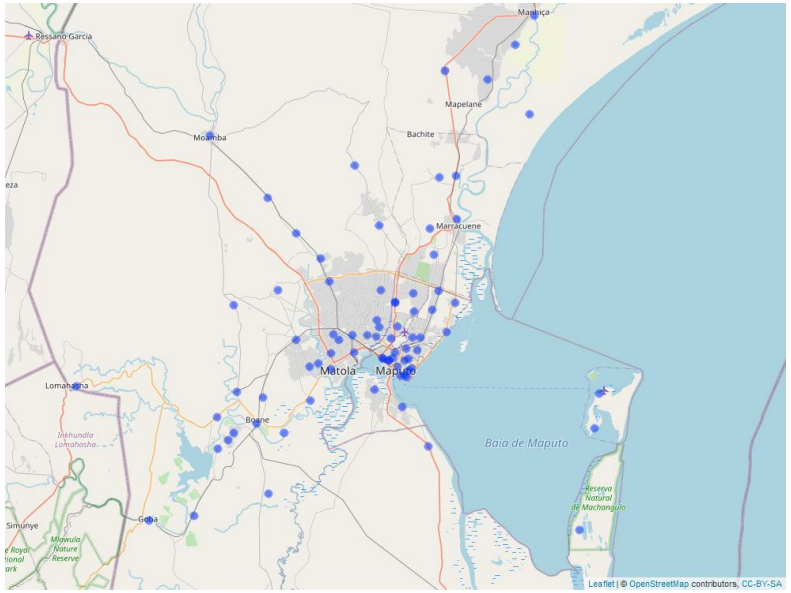
User-Line Analysis

The User-Line analysis could help us understanding the «breaking points» of a journey, i.e. how many changes a user should do to arrive to its final destination.

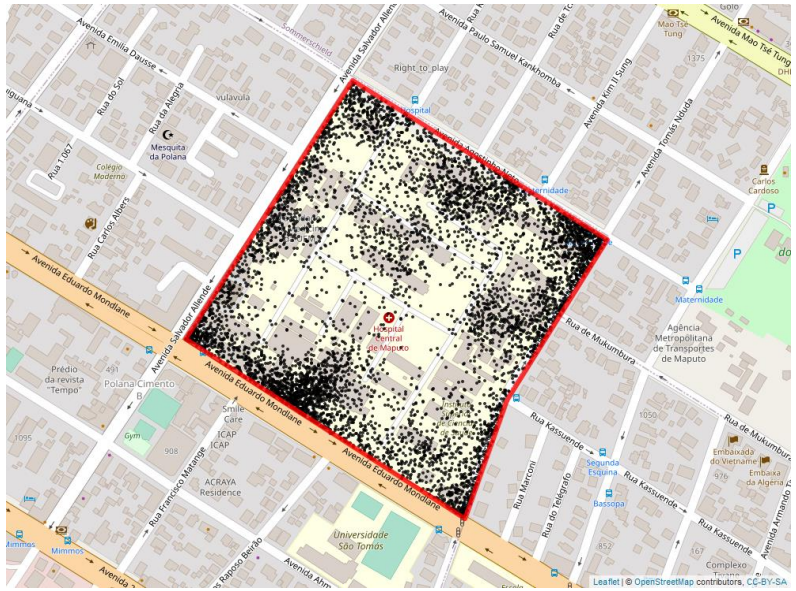


Isocrone Analysis

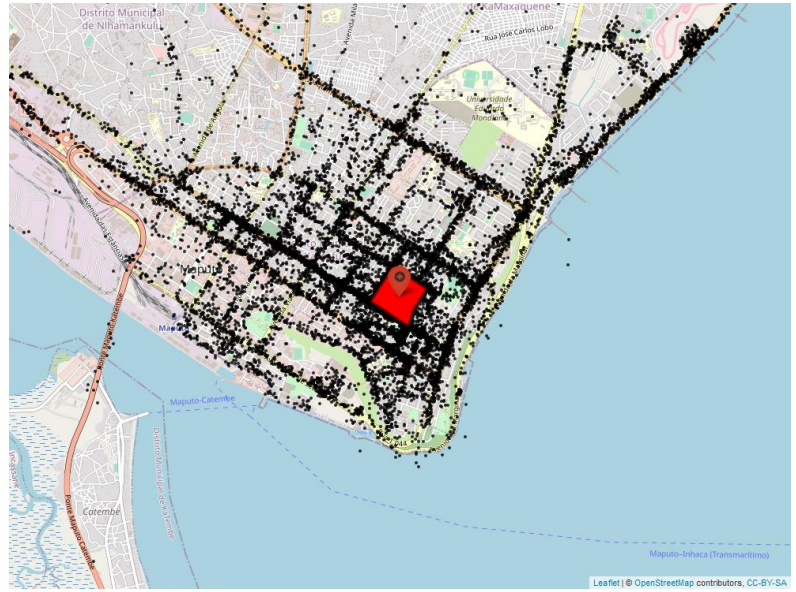
Isocrone Analysis focuses on understanding which is the travelling time between the urban area and important venues such as hospitals.



Venues in Maputo



Central Hospital

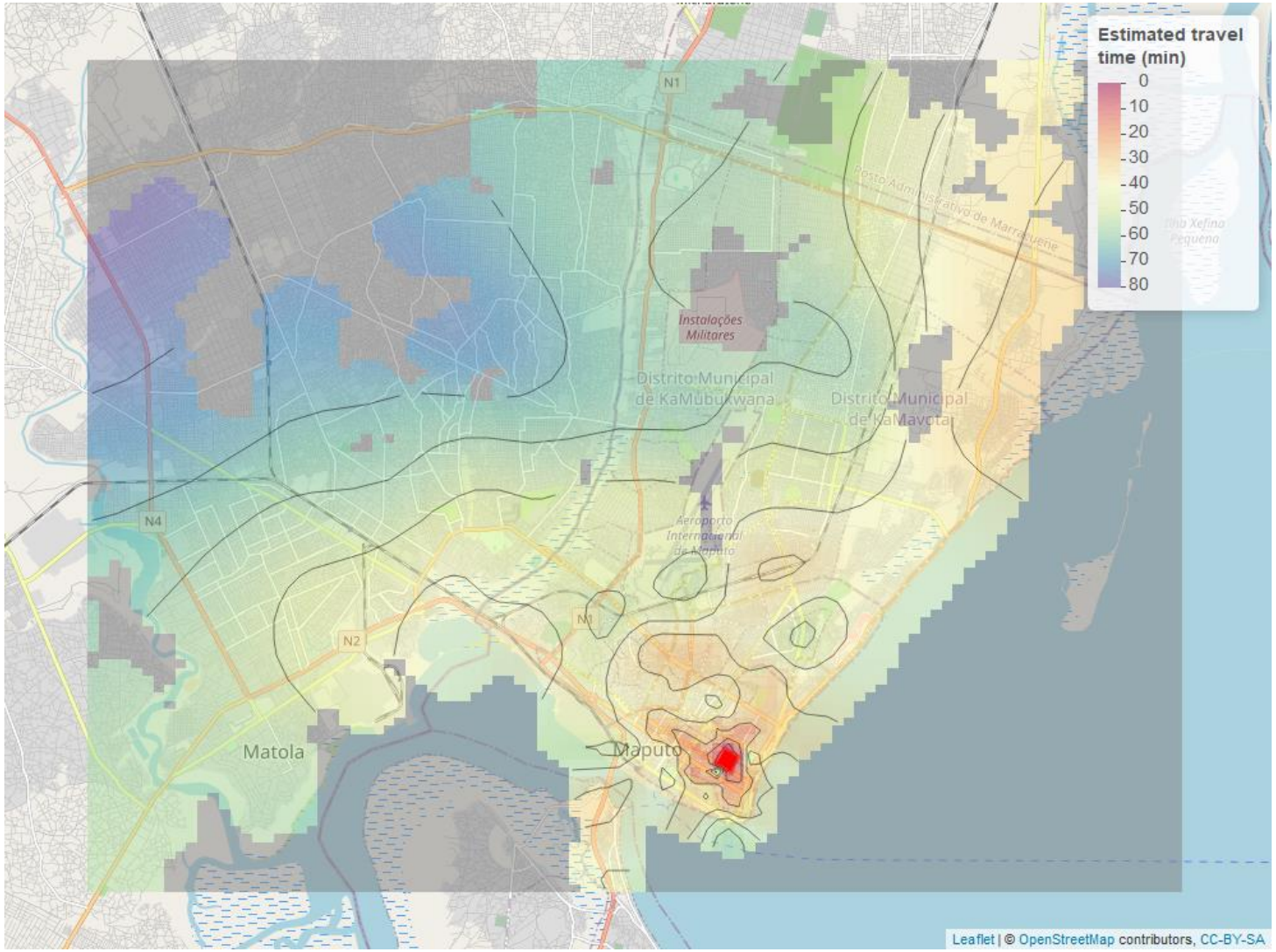


Paths crossing the hospital buffer

Isocrone Analysis

Isochrone map to reach the central hospital.

The maps shows the travelling time to the hospital, by coloring areas in the same color if the travelling time from the area to the hospital is within the same time range.



Data Analysis

The analysis conducted using these data are:

- **OD Matrices**
- **User-Line Analysis**
- **Isocrone Analysis**
- **Transport Mode detection**
  Understanding which mode the trajectory is travelling on (bus, chapas, car, bike).
- **Stop Analysis** – *In collaboration with Agostino Torti*
  Analysis of the stops, understanding the waiting time at the main stops.
- **Infrastructure Analysis**
  Using Satellite images and Open Street Map infrastructure classification to label the streets which are not labelled yet.

Conclusion

Undestranding «paratransit» mobility

We studied with non-official real time data:

- **Demand** OD Matrices, User-Line
- **Offer** User-Line, Stops Analysis, Isochrone
- **Infrastructure** Satellite Analysis, Stops Analysis

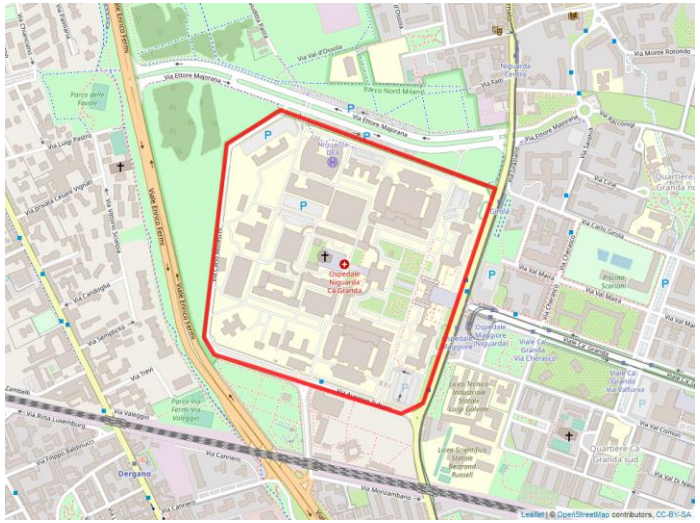
→ The analysis were shared with the local transport administration to support the integreation of the chapas system in the public transport network.

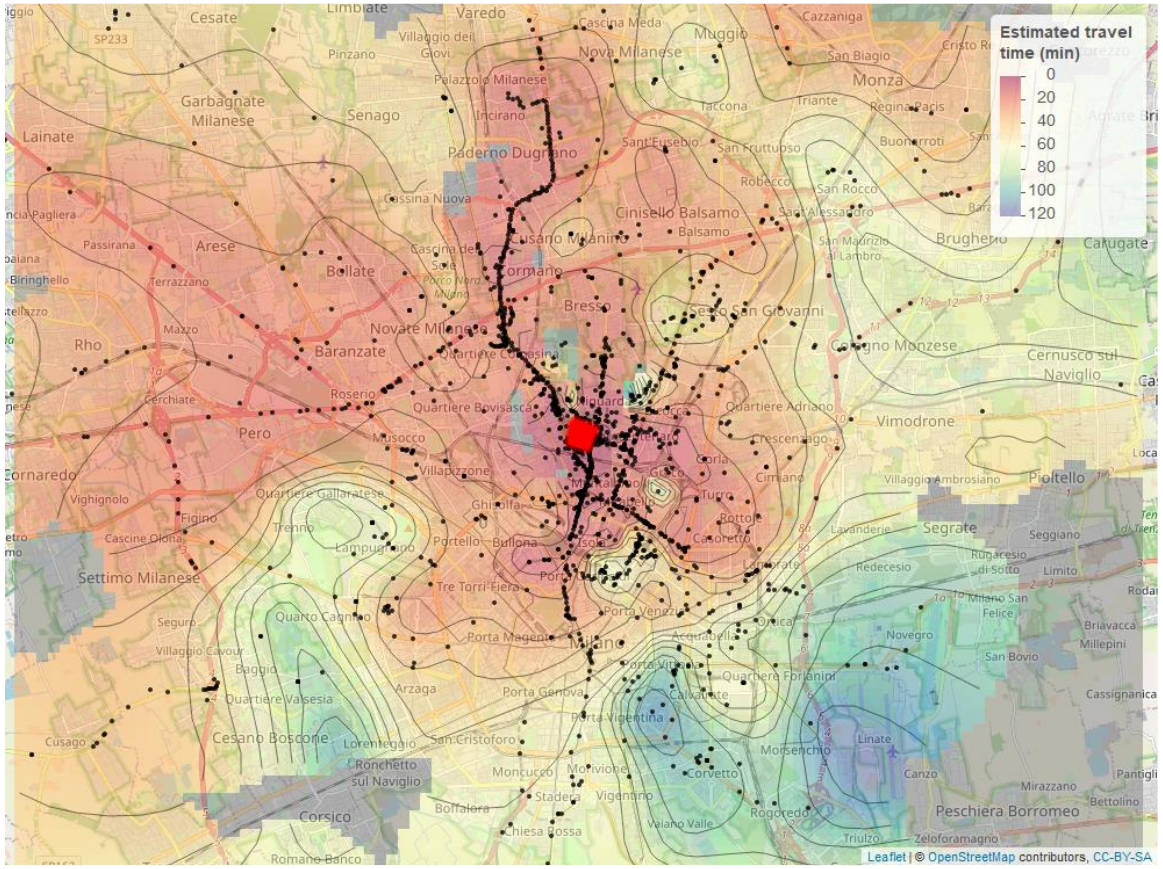
Scalability

The methodology proposed here can be scaled to any other context with data availability.

Example: Isochrone analysis in Milan

Data Source: Cuebiq, Open Street Map
Focus: Niguarda Hospital
Result: Map of the time to reach the the hospital.





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Check our website and the upcoming book!

Thank you!

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