Applying GPS Tracking to understand Para-transit: What can we learn from it?

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Introduction and Motivation

- What is para-transit?
  - Refers to demand-driven, unscheduled public transport provided by small operators.
  - It is sometimes called ‘informal’, but operators are not always informal businesses, and they are not necessarily unregulated.
- Very little data describing para-transit is available
- What can we learn from analyzing para-transit using GPS tracking?
  - Movement patterns
  - Time of service
  - Derive statistical indicators describing the whole system
  - **Investigate the trip purpose**

Workflow

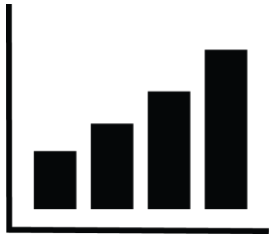
GPS-Data Collection

Database construction

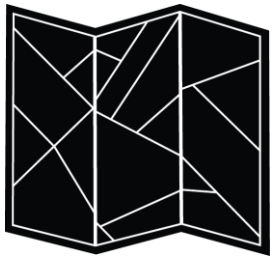
Data Processing

- Data cleaning
- Trip segmentation

Data Analysis



Statistical Analysis



Spatial Analysis

GPS-Data Collection

- Six locations in Dar es Salaam, Tanzania
  - Over 4 weeks, Dec. 2015
  - Each driver 2 - 4 days
- Two different type of GPS loggers
- Distributed to 39 mototaxi
  - Boda-boda (2 wheeler)
  - Bajaj (3 wheeler)

Source: African Community Access Partnership

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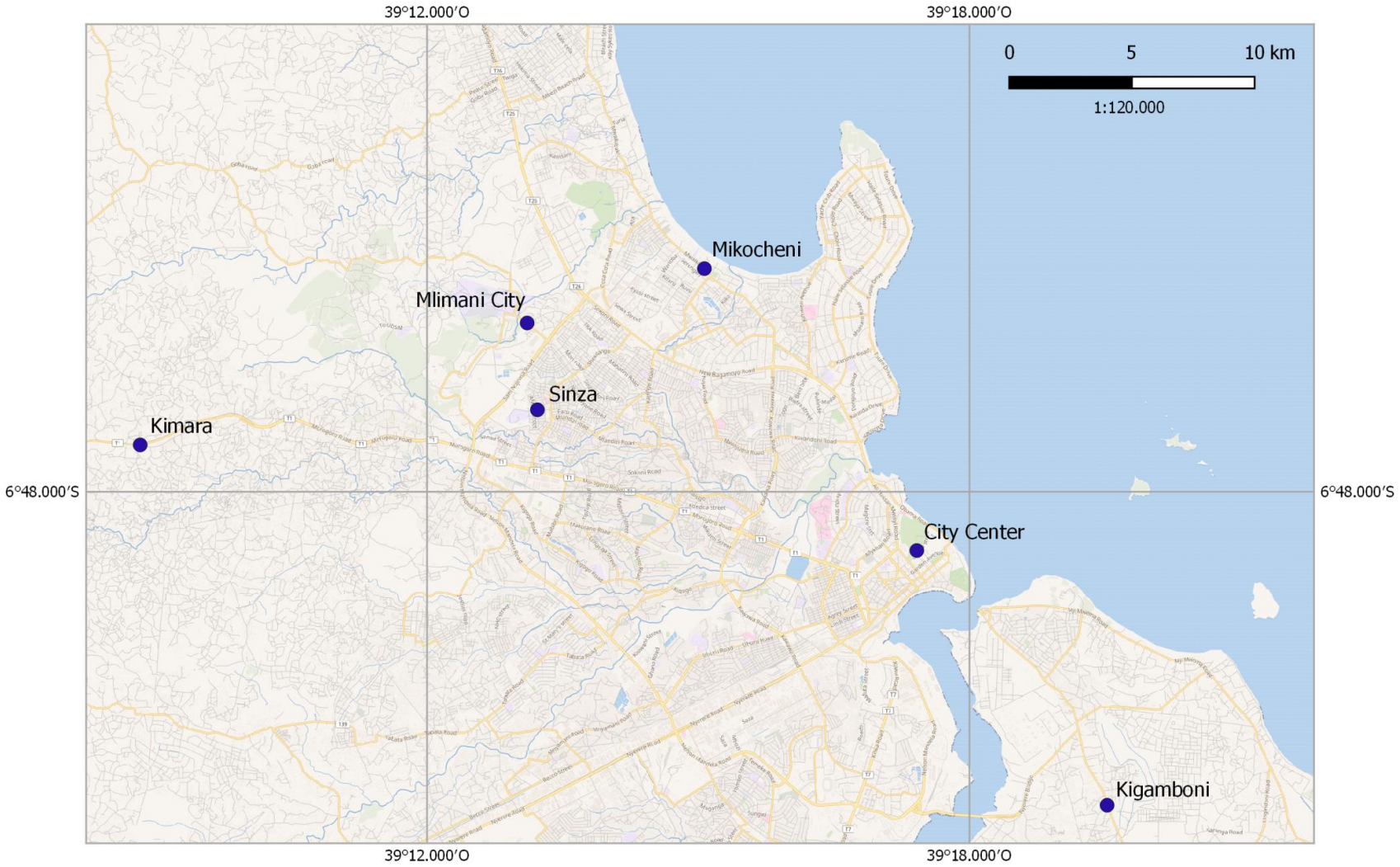
Dar es Salaam: Six Stations Selected for Data Collection



Data Processing I: Cleaning and Filtering the GPS-Data

- Processing using Python

- Storing data in database using PGAdmin
  - Add missing information (e.g. driver-, station- and logger name)
  - Add time zone and geometry
  - Calculate needed values (e.g. distance)
  - Drop values that are not needed
  - Delete errors (e.g. overwriting of some loggers)

- Storing Open Street Map (OSM) on land use in database

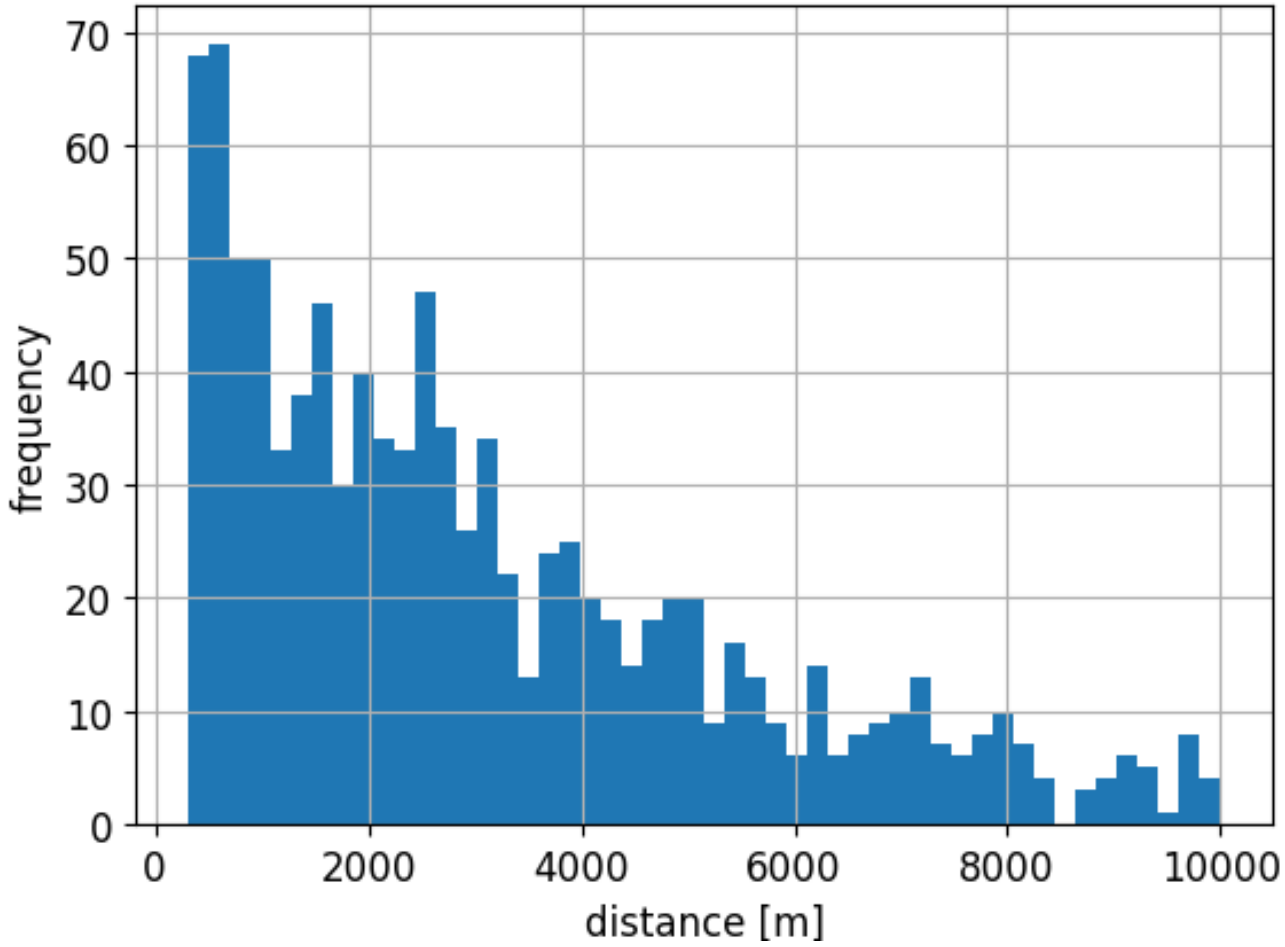
Data Processing II: Trip Segmentation

- Method for trip segmentation based on Zhang (2011)
- Threshold for distance and speed is introduced to identify the segments:
  - Distance: if the distance change is less than 5 meters in 5 continuous seconds
  - Speed: if the speed value is less than 0.5 m/s in 5 continuous seconds.
- Rules to classify the way points into segments :
  - The time between each way point should be less than 120 seconds. If it is more, a new segment begins.
  - One segment should not be less than 120 seconds. If so it will be deleted.

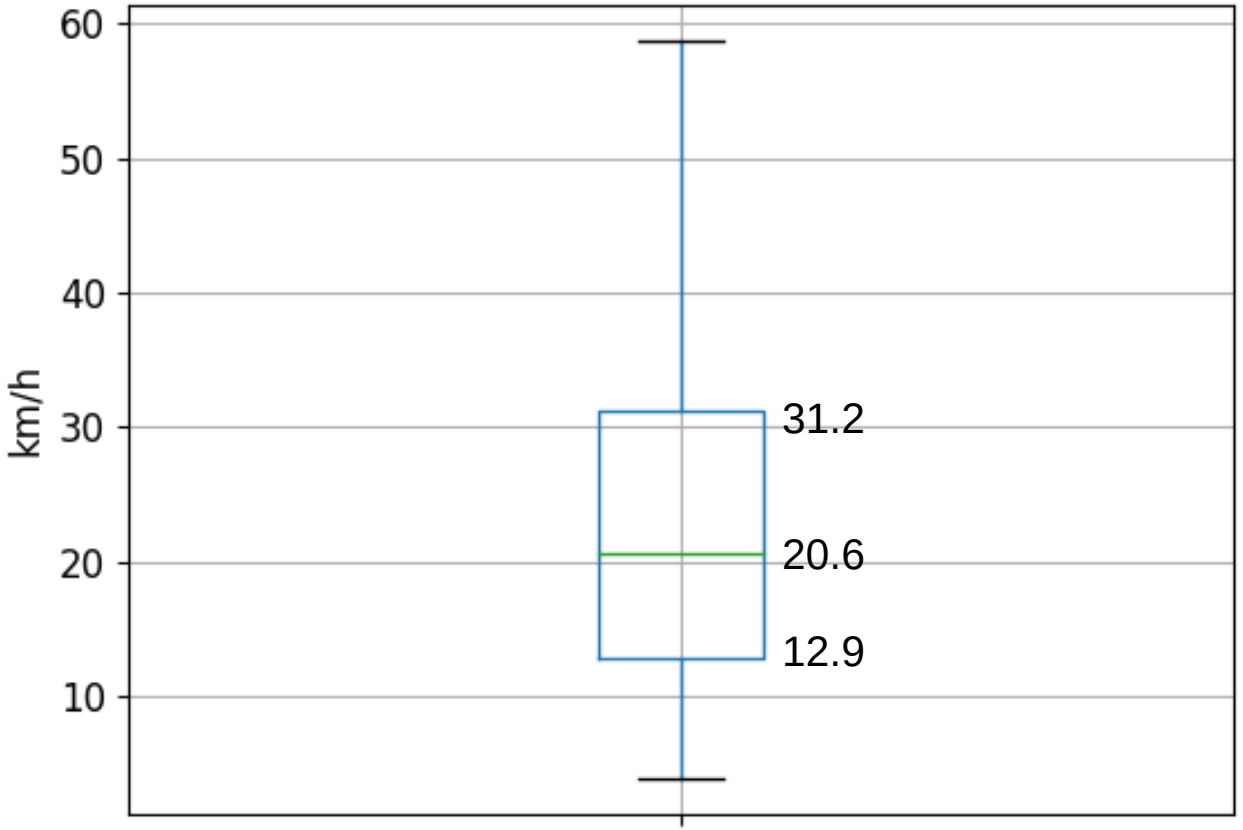
Summary: Output after Data Processing

Drivers logged	39
Valid logs	29
Number of waypoints, Bluemax	773845
Number of segments, Bluemax	1463
Number of waypoints, Columbus	264057
Number of segments, Columbus	507

Statistical Analysis: Distance



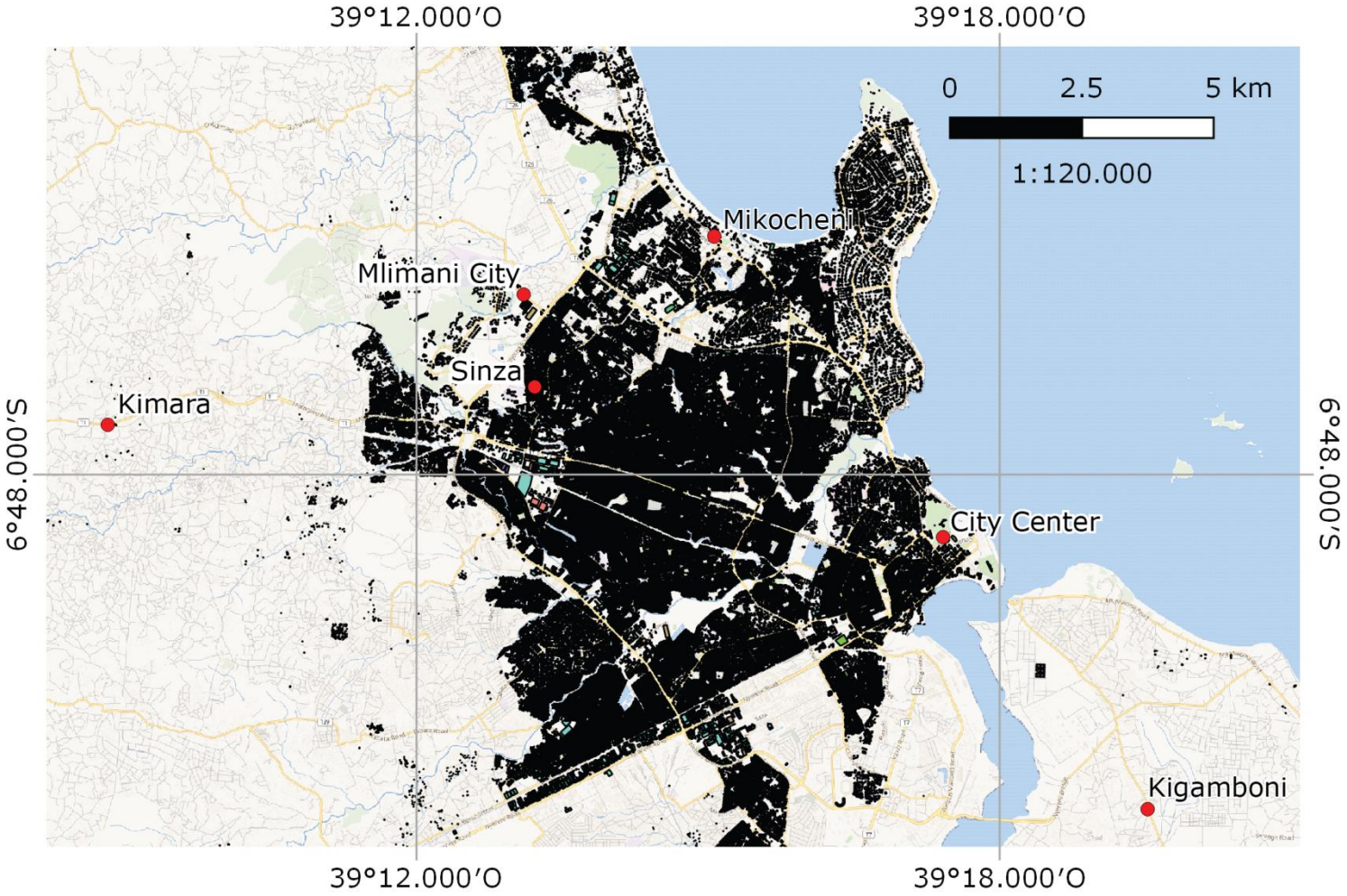
Statistical Analysis: Speed



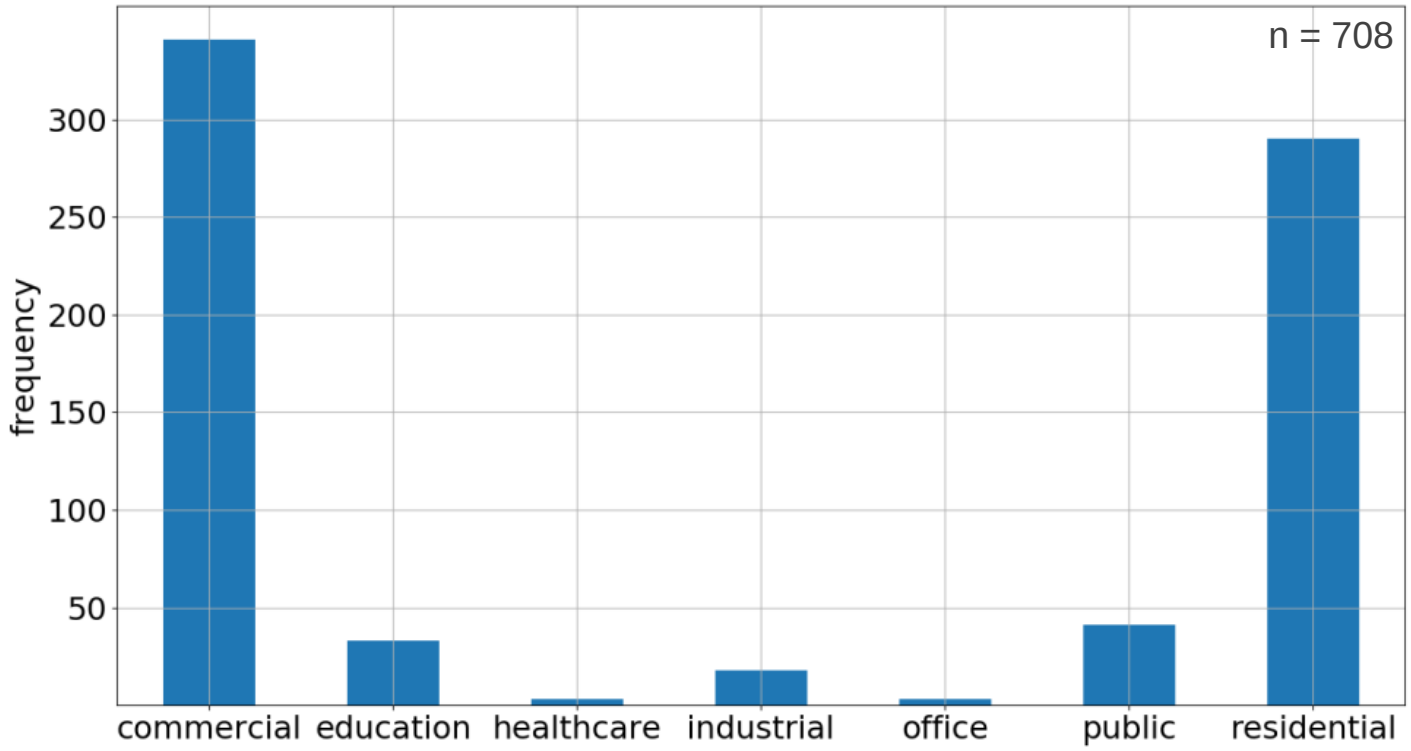
Spatial Analysis: Procedures

- Identification of trip purpose
- Overlay with OSM-Data
  - Extraction of start and stop points of GPS-Data
  - Buffer around points and spatial join with OSM-Data
- Problem: Tagging of OSM-Data
- Summarizing tags together e.g.:
  - residential → *residential, dormitory, apartments*
  - education → *university, school, college*

Open Street Map Data

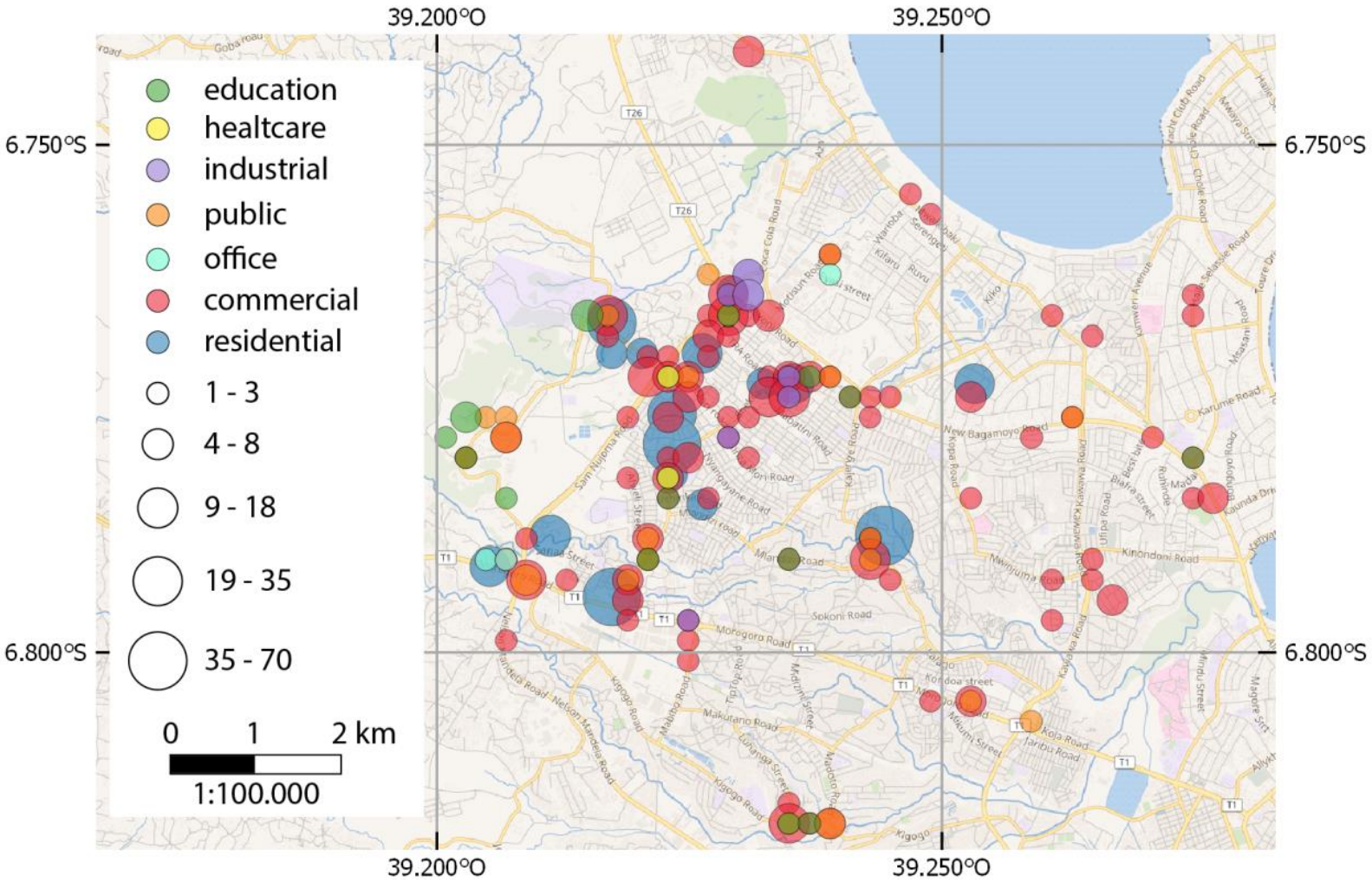


Spatial Analysis: Activities at Endpoints of Trips



Activities derived from spatial join with OSM tags; frequency based on a per-trip analysis for the station “Mlimani City”.

Spatial Analysis: Spatial Distribution at Endpoints



Summary of Results

- Most trips have a short distance.
- Endpoints in commercial areas are frequently distributed over the city.
- Trips with endpoints in residential or educational areas tend to cluster in some areas.
- Most trip activities end at residential/commercial areas which have a presumably high demand in feeder transportation supply.

Limitations and Outlook of the Methodology

- Results strongly depend on the quality and availability of the OSM data.
- Certain areas might be tagged more precisely than others.
- If tagged sufficiently, the method works to give a better understand para-transit.

- GPS loggers worked well with strengths regarding cost and simplicity.
- In future, smartphones could become a more effective way.

Conclusion

- GPS logging can be used to improve the understanding of para-transit.
- Results show that the method is working and can give valuable insights.
- Shows first estimations that are usually known in formalized public transport, but not in informal transport.

- This information can be used for:
  - administrative planning activities, like the creation of new formal public transport routes
  - informal providers which can use this information to provide a more efficient and user-oriented service

Thank you!