



Exploring Human Mobility Patterns Based on Floating Car Data and Mobile Phone Records

Yaofei CHANG, Chun LIU, De WANG

Tongji University, China

cyf0923@tongji.edu.cn

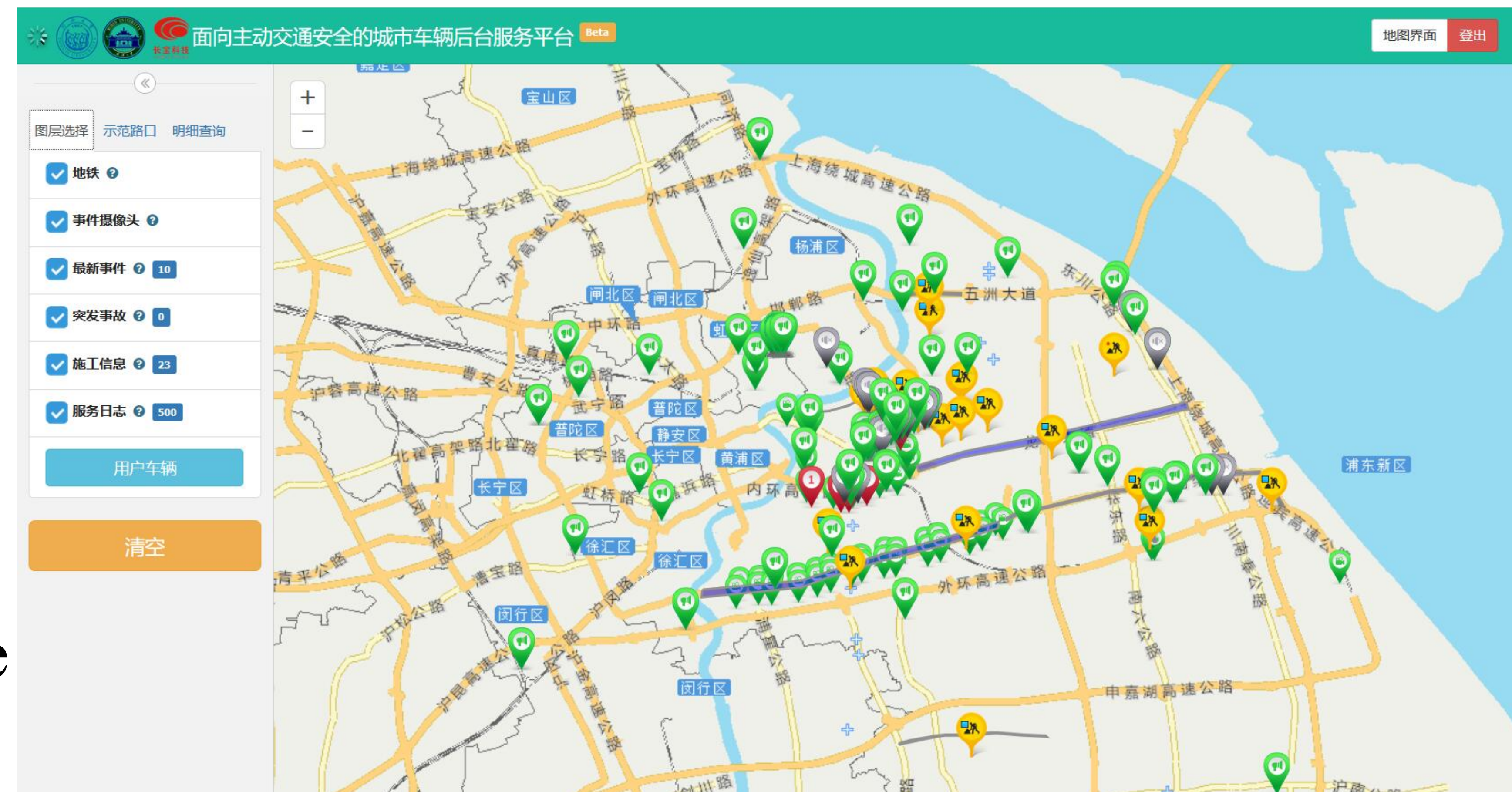
1. Background
2. Purposes
3. Data & Research Area
4. Methods
5. Discussions
6. Conclusions
7. Acknowledgement

1. Background

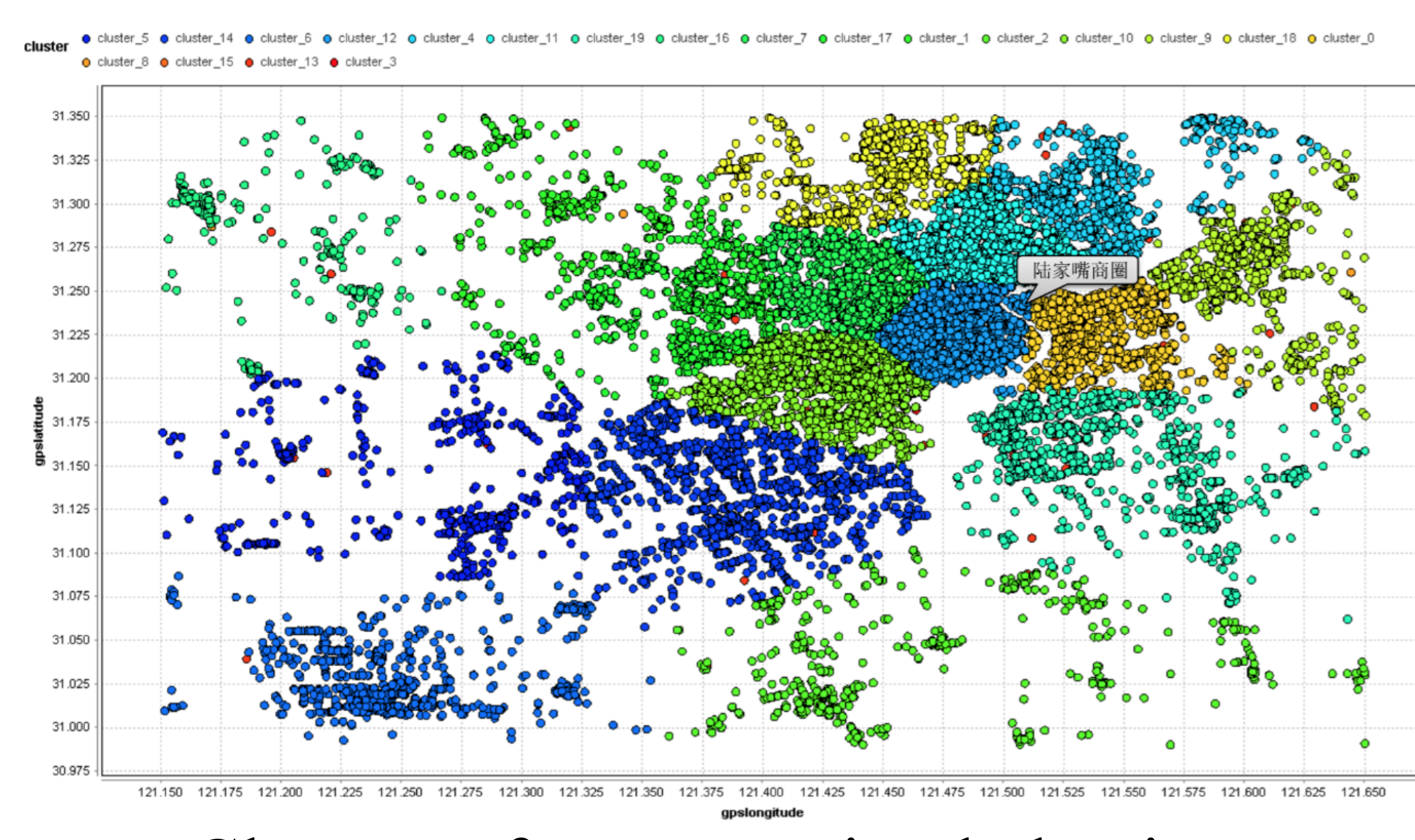


Existing Work

An Active Traffic Safety Service System in Pudong, Shanghai



Real-time traffic computation in Shenzhen based on floating car data

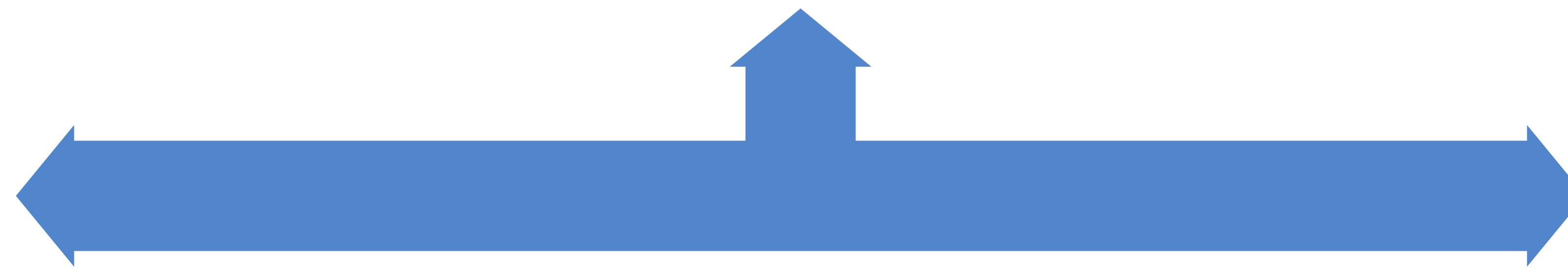


Clusters of consumption behaviors based on credit card data

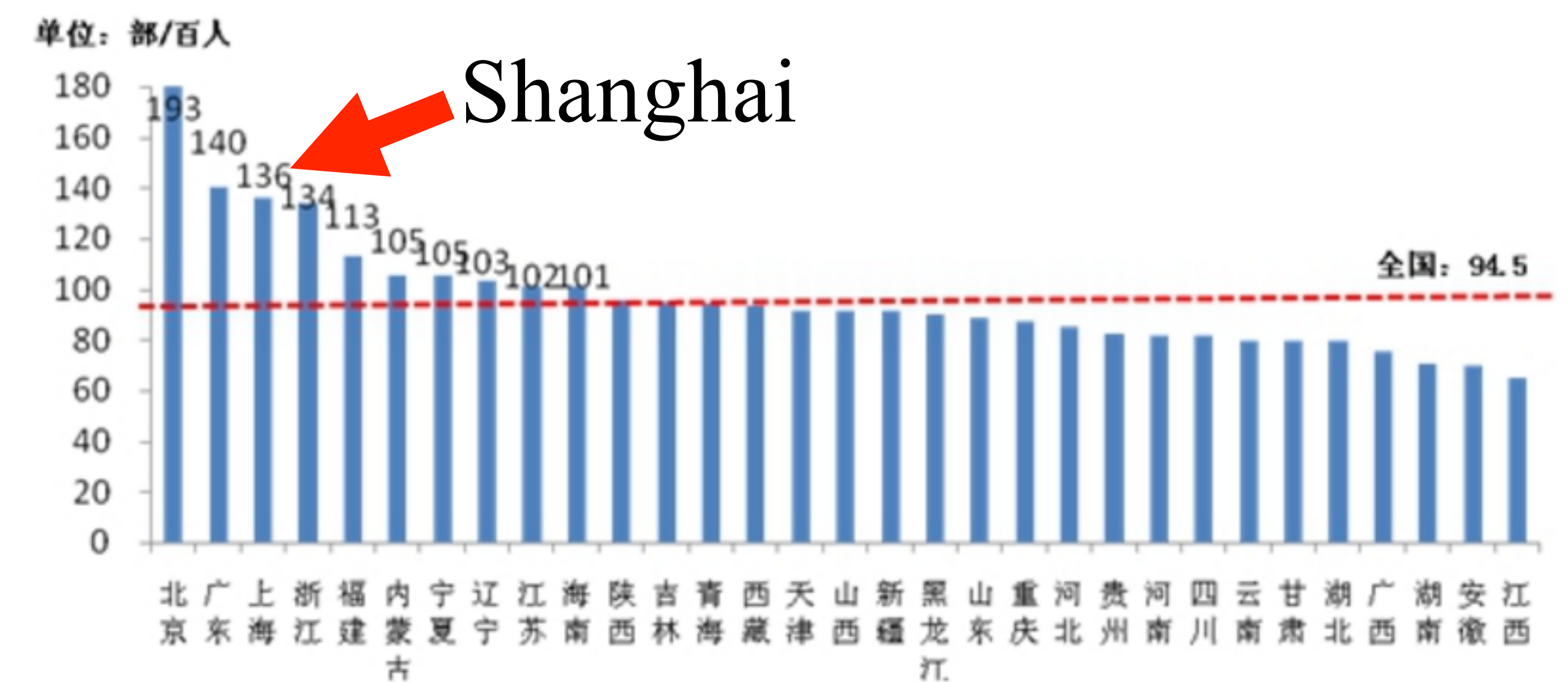
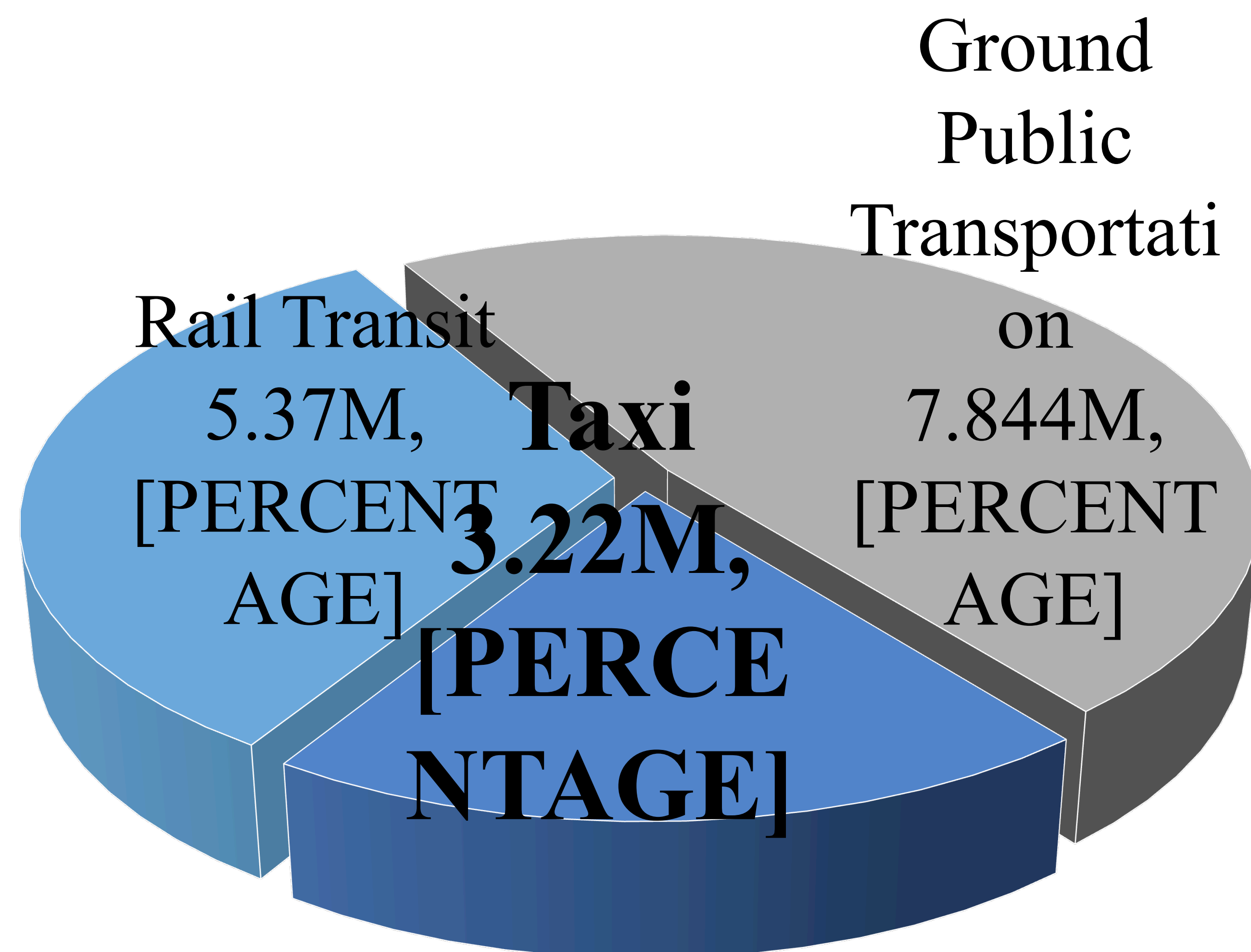
1. Background



Reading the City



Recording Human Mobilities



Ownership of mobile phones in China per hundred people

Daily passenger volumes in Shanghai

Statistics: Shanghai Municipal Transportation Commission (<http://www.jt.sh.cn/>)

Ministry of Industry and Information Technology of the RPC (<http://www.miit.gov.cn/>)

2. Purposes

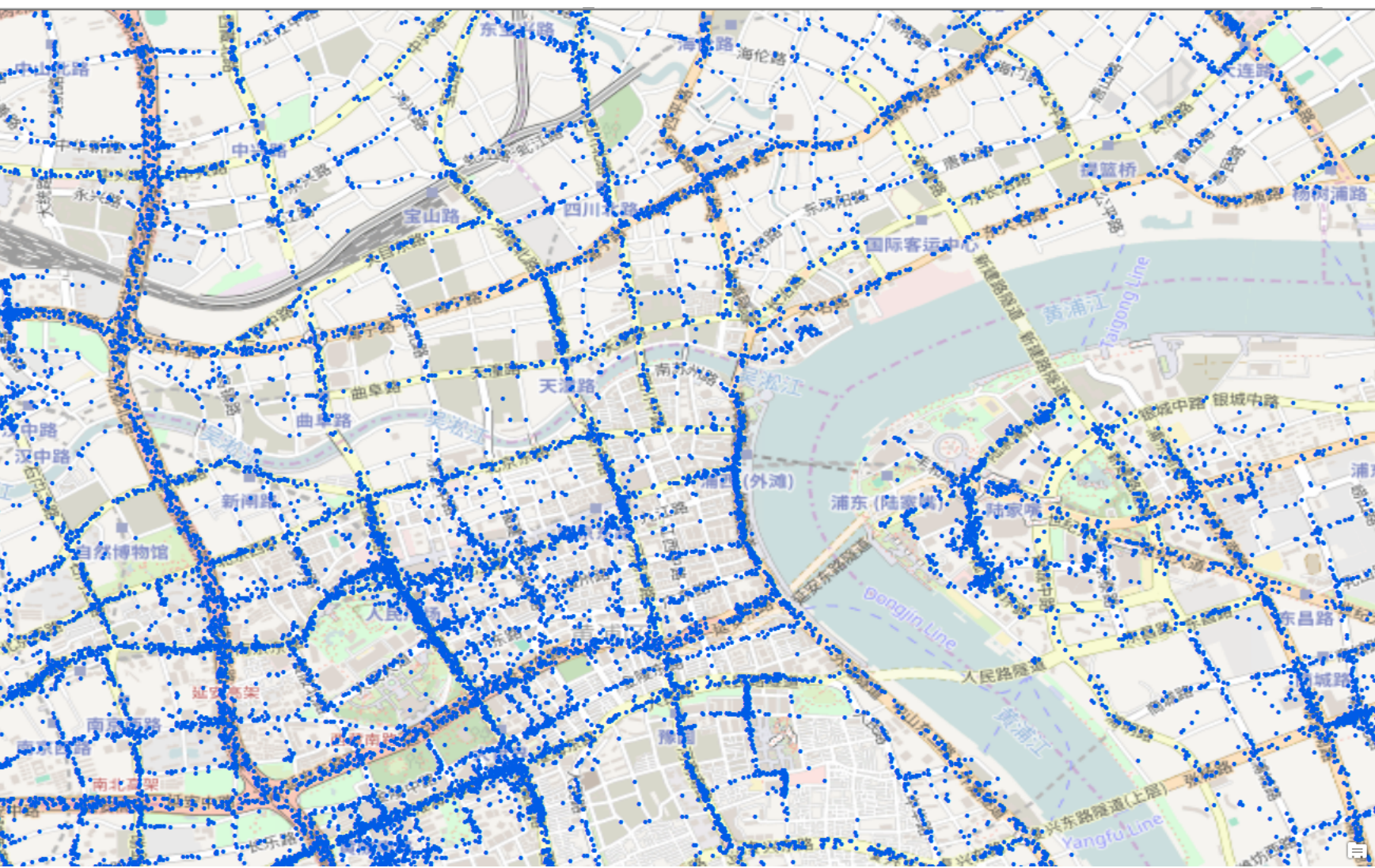


- (1) To discover spatial and temporal characteristics of human mobility patterns based on floating car data and mobile phone records.
- (2) To infer urban structures underneath human mobility patterns.

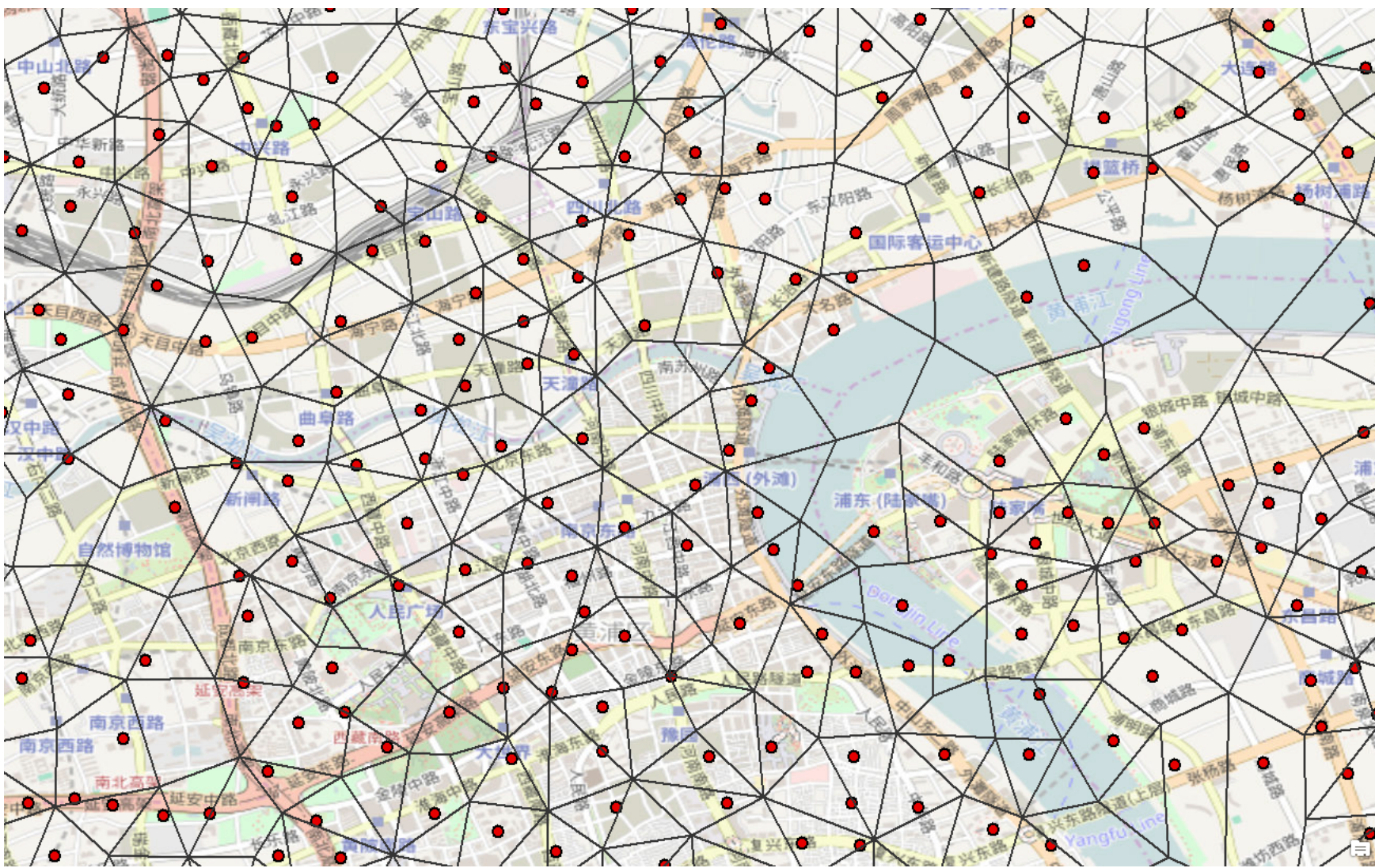
3. Data & Reasearch Area



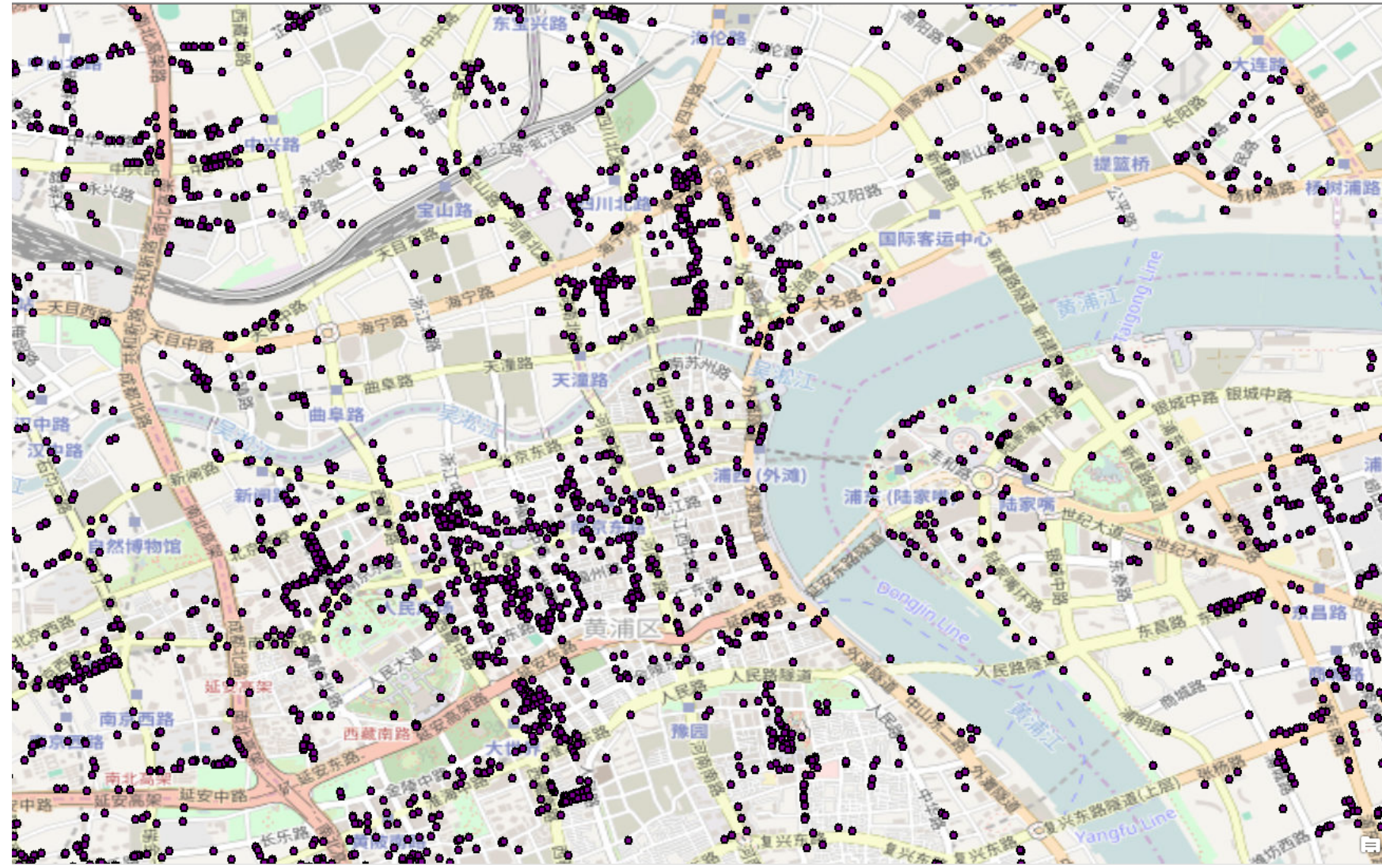
Type	Description	Interval	Contents
Floating Car Data (FCD)	One week 8,000 taxis	10s	Longitude, latitude, time, speed, status
Mobile Phone Records (MPRs)	One day 7,000,000 users	seconds (move) minutes (stay)	Longitude, latitude, time
Points of Interest (POI)	17 categories ≈200 thousands	/	Transportation, entertainment, tourism, shopping, finance, education, etc.



FCD



MPRs

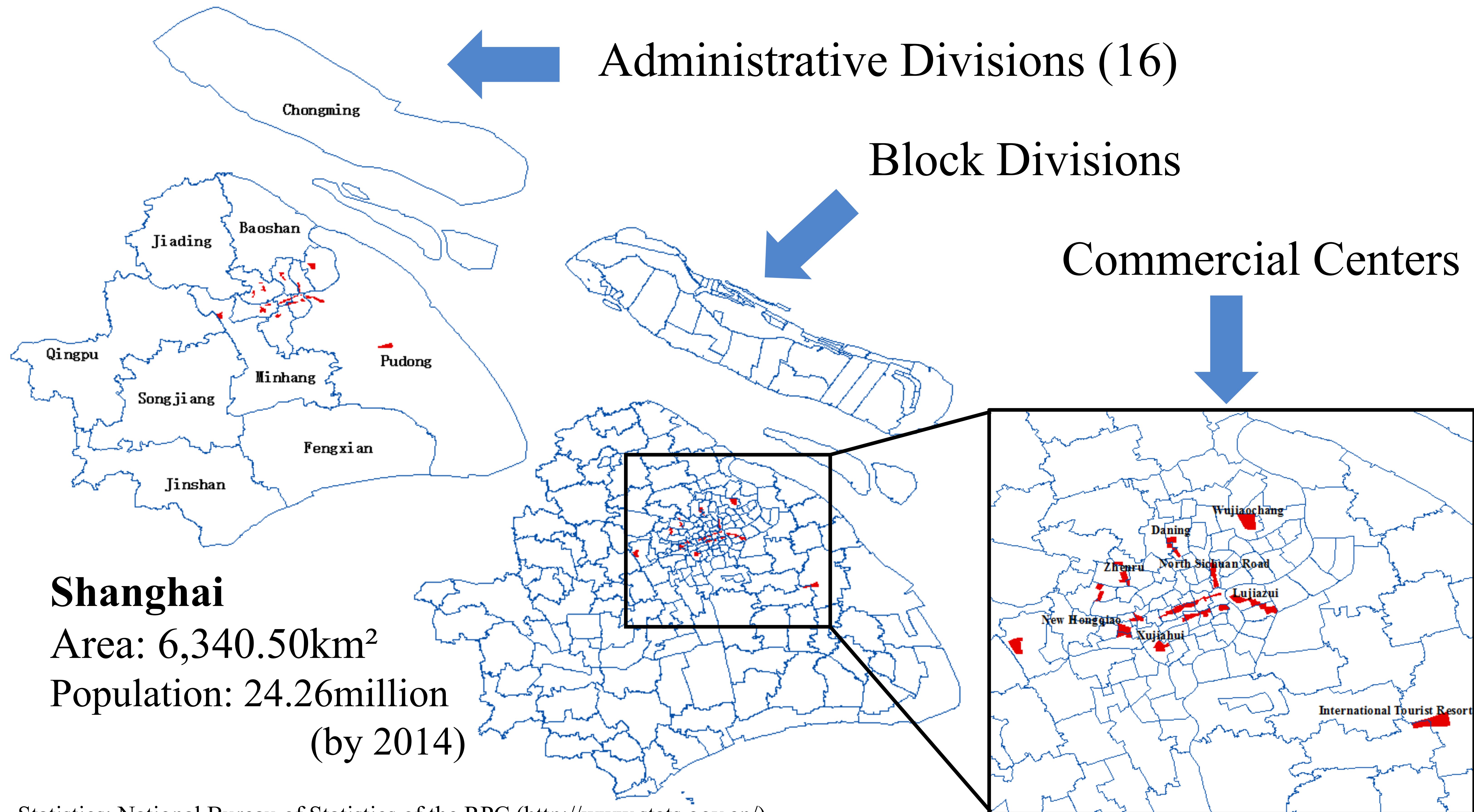


POI

3. Data & Research Area

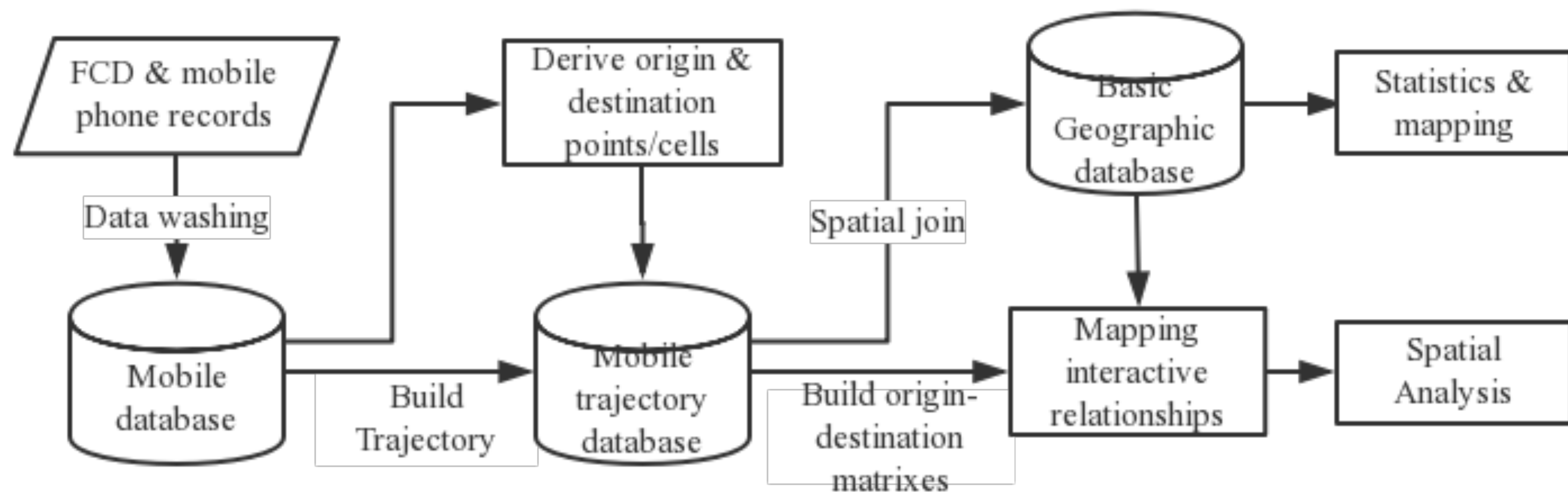


Different Research Scales



Statistics: National Bureau of Statistics of the RPC (<http://www.stats.gov.cn/>)

4. Methods

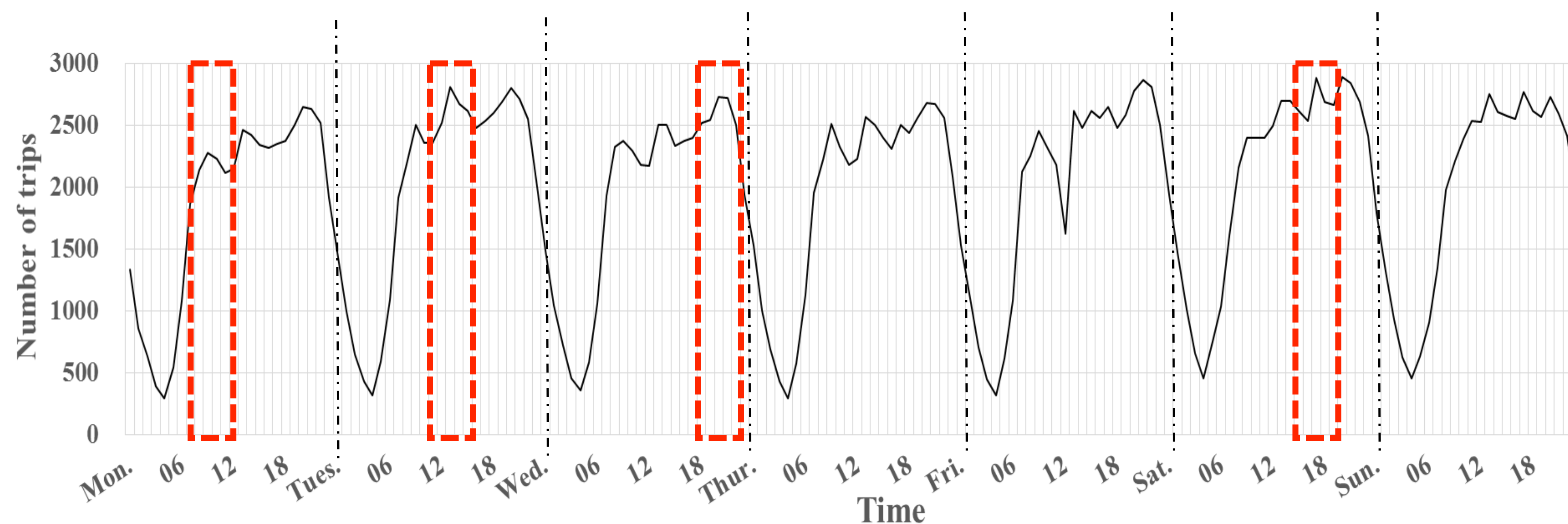


Data computational framework

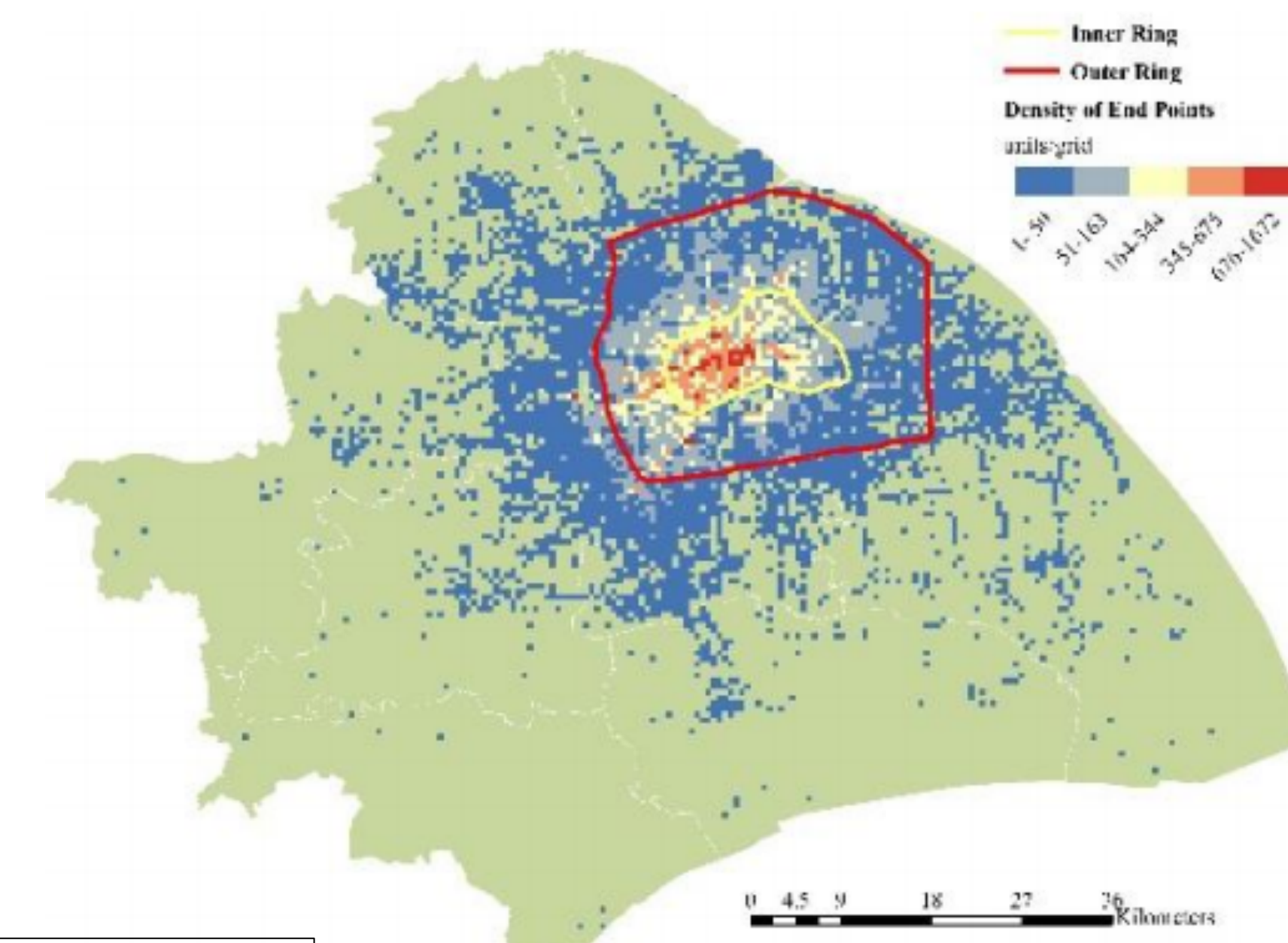
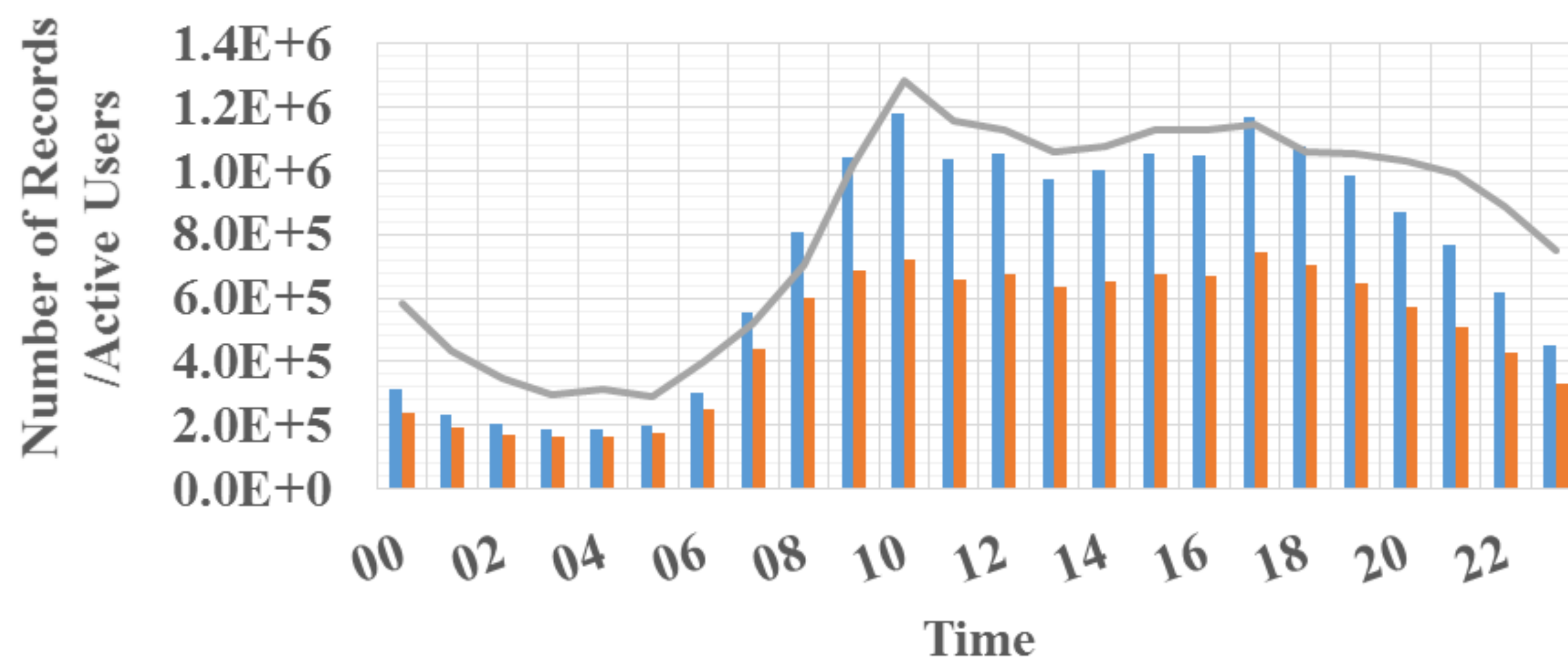
4. Discussions



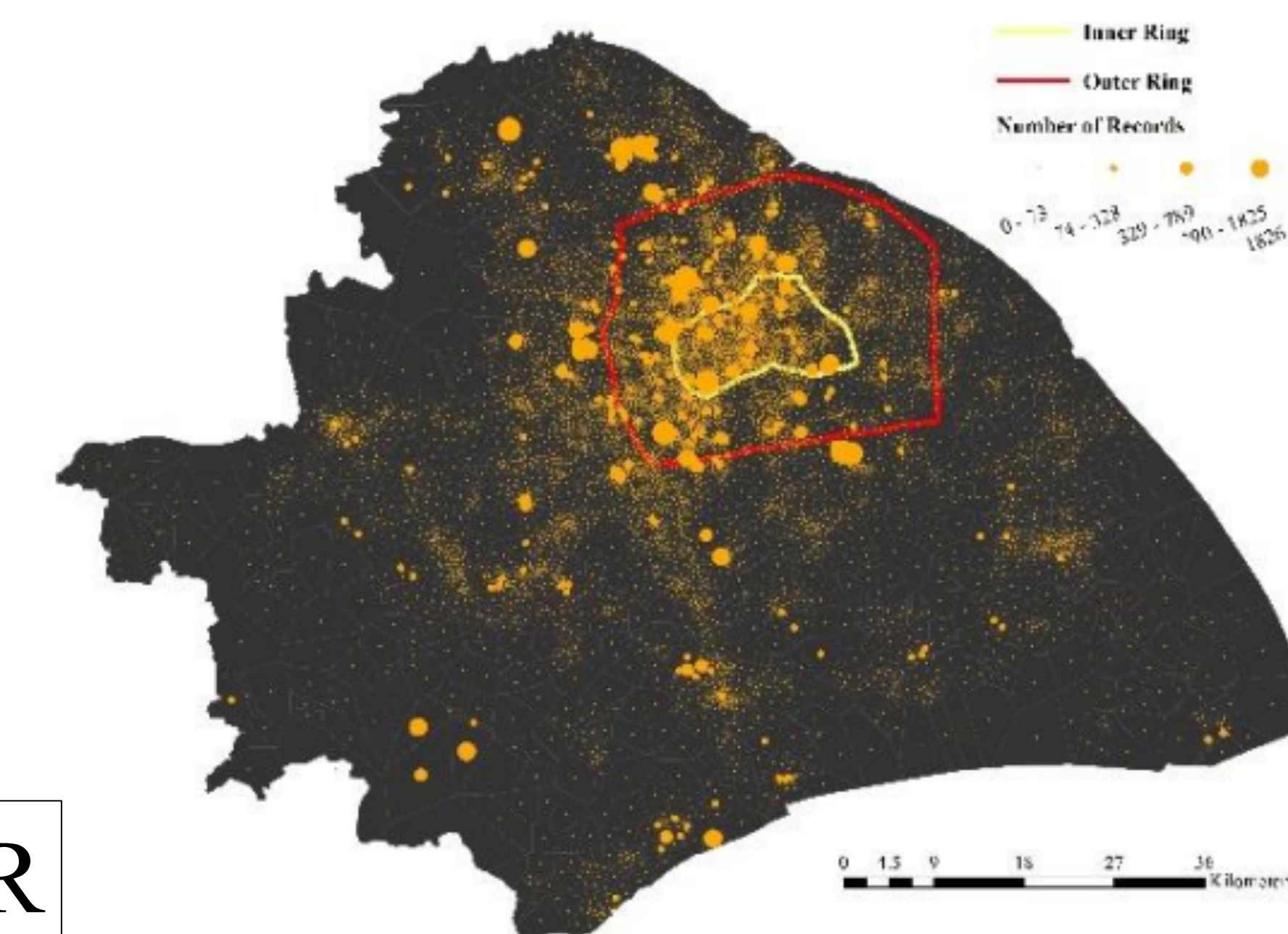
When and where will residents be active?



Records Active Users Records Per User



● FCD



● MPR

Temporal characteristics

7~9 am → Morning 11~13 am → Noon

17~19 pm → Evening 21~23 pm → Night

Spatial characteristics

FCD: aggregative

MPR: discrete

4. Discussions



Interactive patterns under administrative divisions scale

Pattern 1 Morning outflow & Evening/ Night inflow

Suburban areas/ Yangpu/ Putuo

Residence

Pattern 2 Morning inflow & Evening/ Night outflow

Xuhui/ Huangpu/ Pudong

Business/ Entertainment/ Residence

Pattern 3 Morning inflow & Evening/ Night inflow

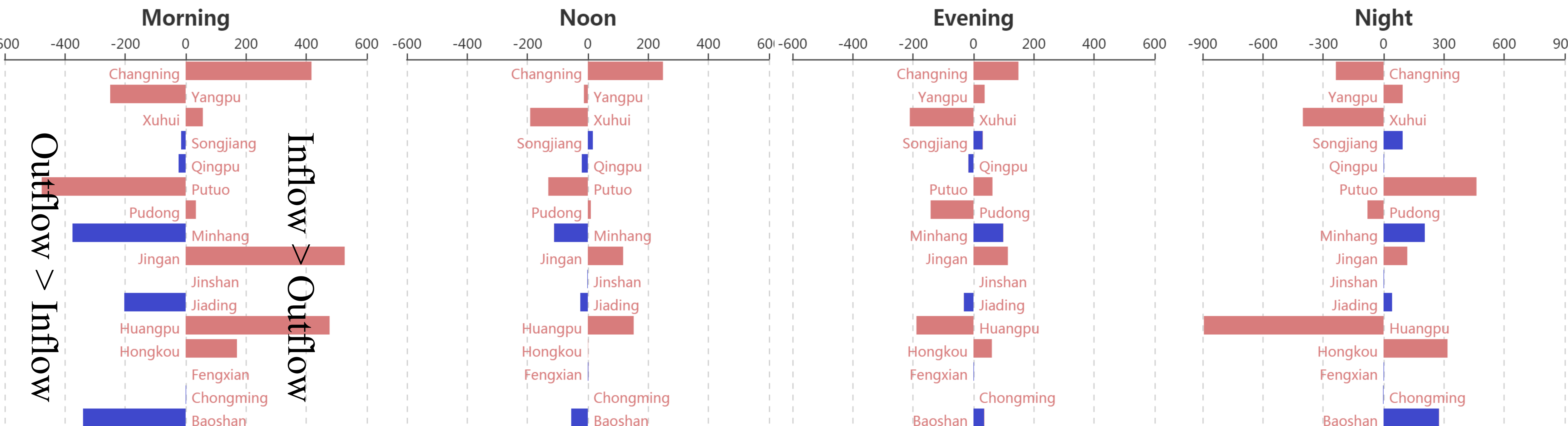
Jing'an/ Hongkou

Business/ Residence

Pattern 4 Morning/ Evening inflow & Night outflow

Changning

Business/ Entertainment/ Residence

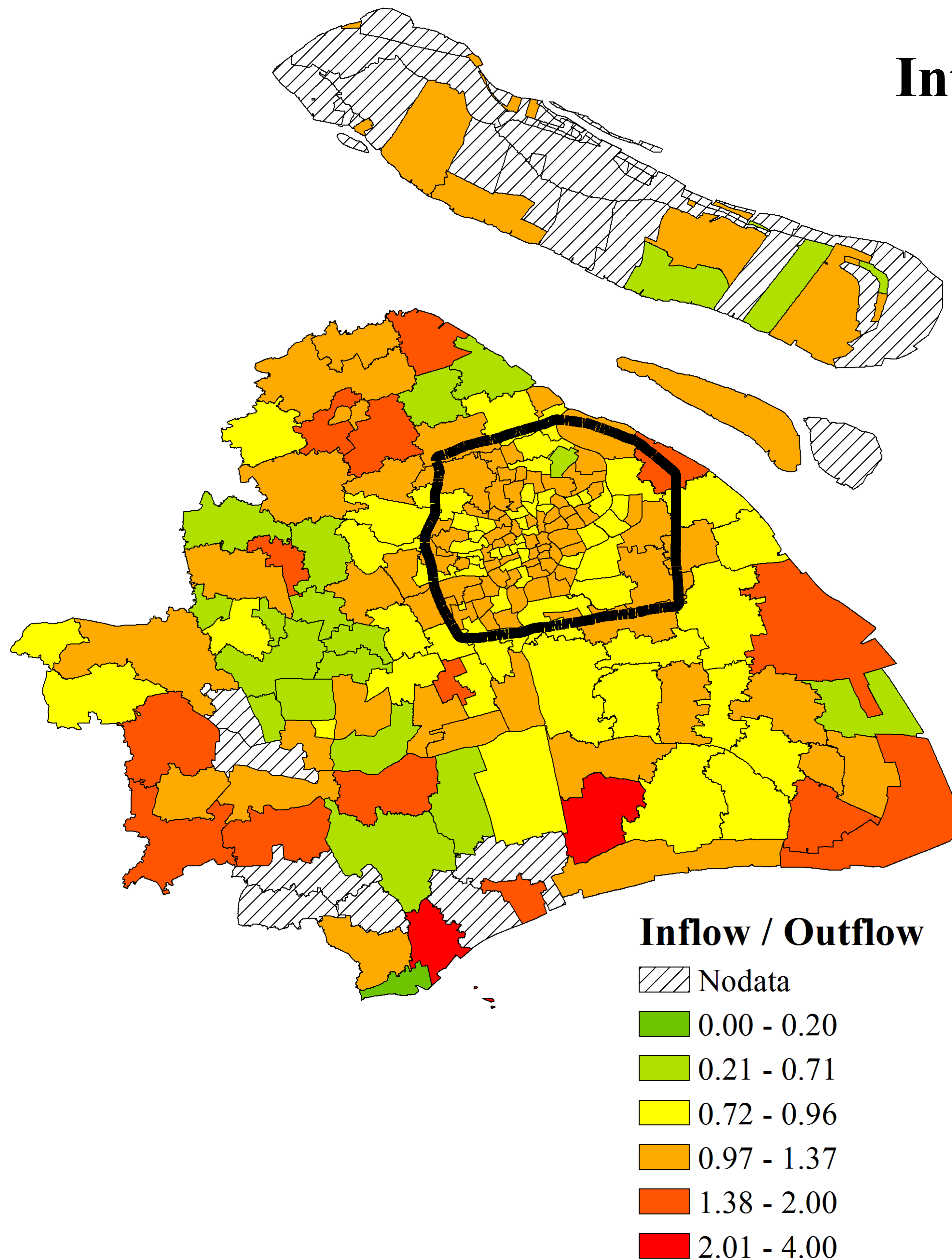


Red represents urban areas, and blue represents suburban areas.

4. Discussions



Interactive patterns under block divisions scale



Sink

Near the Border

Zhuqiao/ Gaodong/ Xinzhuang/ Malu

Source

Parts of suburban areas

Northern Songjiang/ Northeastern Qingpu/
Northern Baoshan

In Balance

Most areas inside the outer ring

Tourist Attractions

East Nanjing Rd./ The Bund/ Qibao

Residential Areas

Siping Rd./ Yichuan Rd.

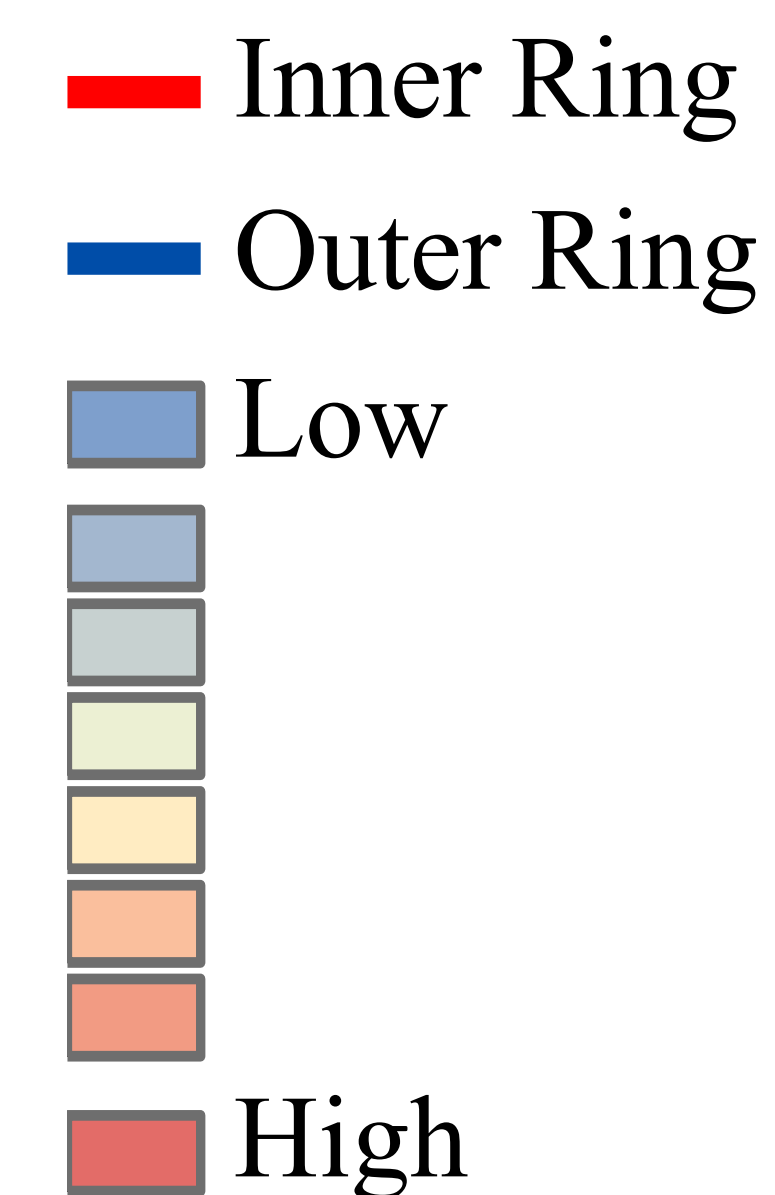
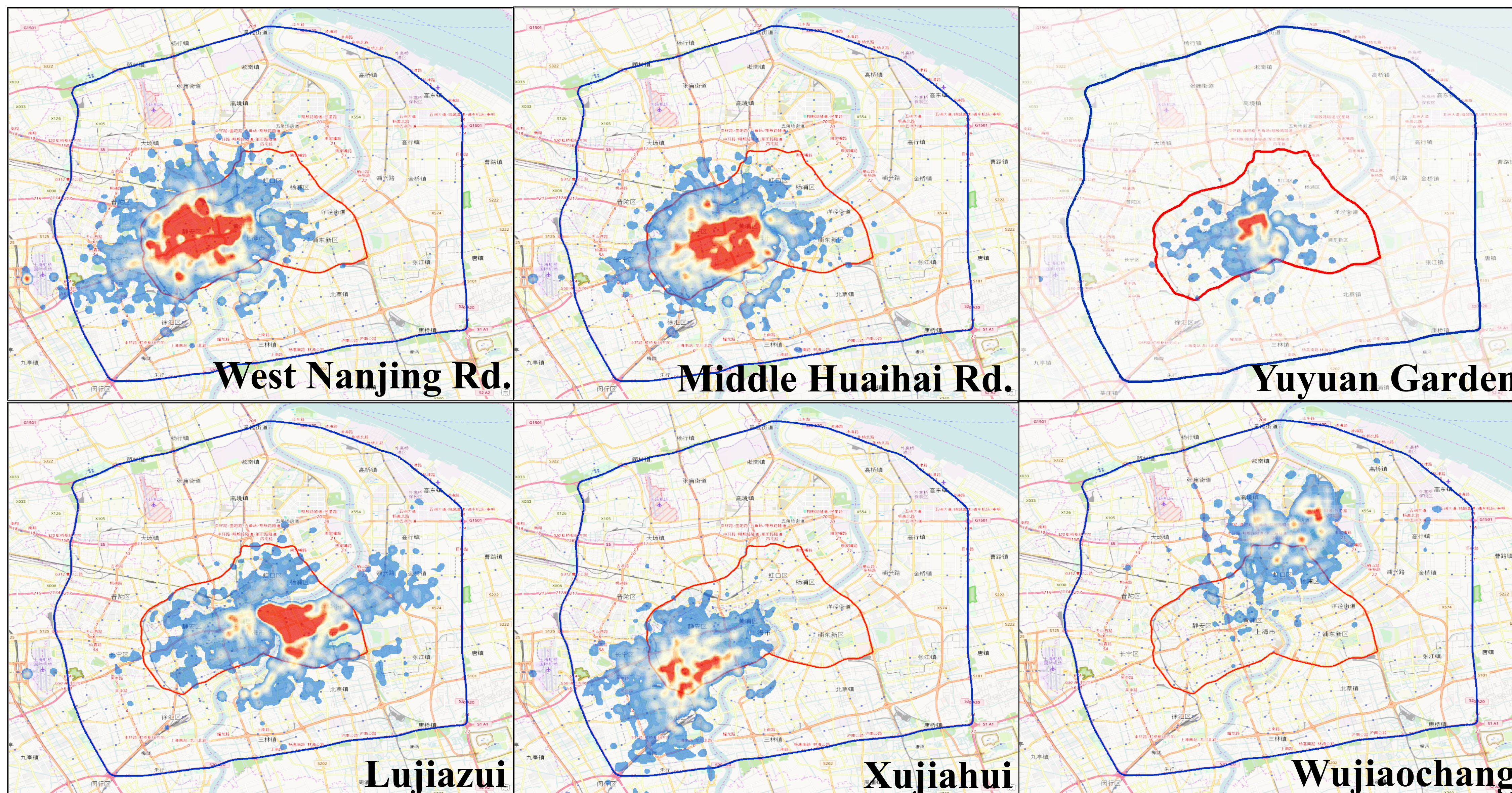
Transportation Hubs

Hongqiao Railway Station

4. Discussions



Attractive sphere of different commercial centers



Commercial Center	Number of Trajectories	Maximum Displacement	Distance Decay $F(d) \sim \beta \cdot e^{ad}$
West Nanjing Rd.	11841	35.0km	$y = 1989.7e^{-0.291x}, R^2 = 0.8667$
Lujiazui	7965	22.8km	$y = 3614.4e^{-0.370x}, R^2 = 0.9519$
Wujiaochang	3020	21.6km	$y = 1011.9e^{-0.318x}, R^2 = 0.9478$

5. Conclusions



- (1) Mobile data like FCD and MPRs, along with geographical data like POI, enables us to define human mobility patterns in Shanghai from spatial and temporal perspectives.
- (2) Mobile data helps us to discover “sink” and “source” areas in Shanghai.
- (3) Based on trajectories derived from mobile data, it’s convenient to depict and compare attractive spheres of different commercial centers.
- (4) A comprehensive analysis of multi-temporal mobile data will make it possible to forecast developments of commercial centers, administrative regions, and even the city.

6. Acknowledgement



We thank China Mobile for providing mobile phone records data. We are indebted to Prof. Hangbin Wu for providing the block division data.

Thanks

cyf0923@tongji.edu.cn

College of Surveying and Geo-Informatics
Tongji University