FIG WORKING WEEK 2019

22–26 April, Hanoi, Vietnam

"Geospatial Information for a Smarter Life and Environmental Resilience"

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"Geospatial Information for a Smarter Life and Environmental Resilience"

An Comprehensive Accessibility Evaluation Model for Temporal Public Facilities of Urban Residential Areas Based on Internet Map

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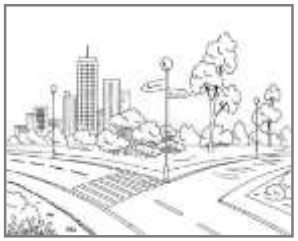
Scientific Background-Traditional urban planning

general economic situation; characteristics of industrial development; situation of land use; urban space; public services…

Statistic data+ descriptive statistical analysis

qualitative analysis and empiricism



paintings

photos

maps

Scientific Background-Big data motivate new methods

Big data can generate significant financial value across sectors

US health care
- $300 billion value per year
- ~0.7 percent annual productivity growth

Europe public sector administration
- €250 billion value per year
- ~0.5 percent annual productivity growth

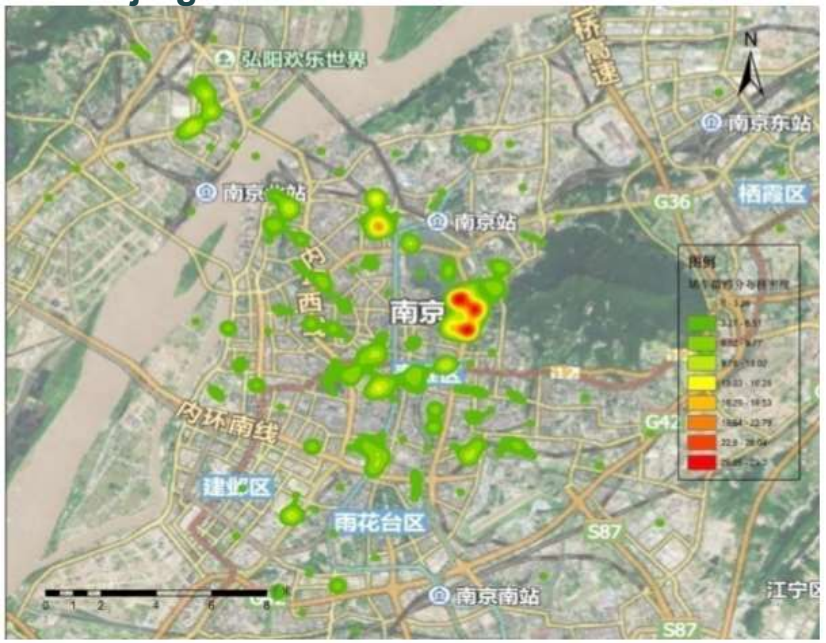
Global personal location data
- $100 billion+ revenue for service providers
- Up to $700 billion value to end users

US retail
- 60+% increase in net margin possible
- 0.5–1.0 percent annual productivity growth

Manufacturing
- Up to 50 percent decrease in product development, assembly costs
- Up to 7 percent reduction in working capital

SOURCE: McKinsey Global Institute analysis

Using weibo to explore the congestion point in Nanjing



Source from professor Zhen Feng

Scientific Background

The homogeneity and accessibility of public services are the key points of urban residential area planning.

UDC

中华人民共和国建材行业标准

GB

P

GB 50180-93

城市居住区规划设计规范

Code of urban Residential Areas Planing & Design

1993-07-16 发布

1994-02-01 实施

国家技术监督局
中华人民共和国建设部

联合发布

Scientific Background-Challenge

The service facilities are diversified

The community scale is very micro-scale

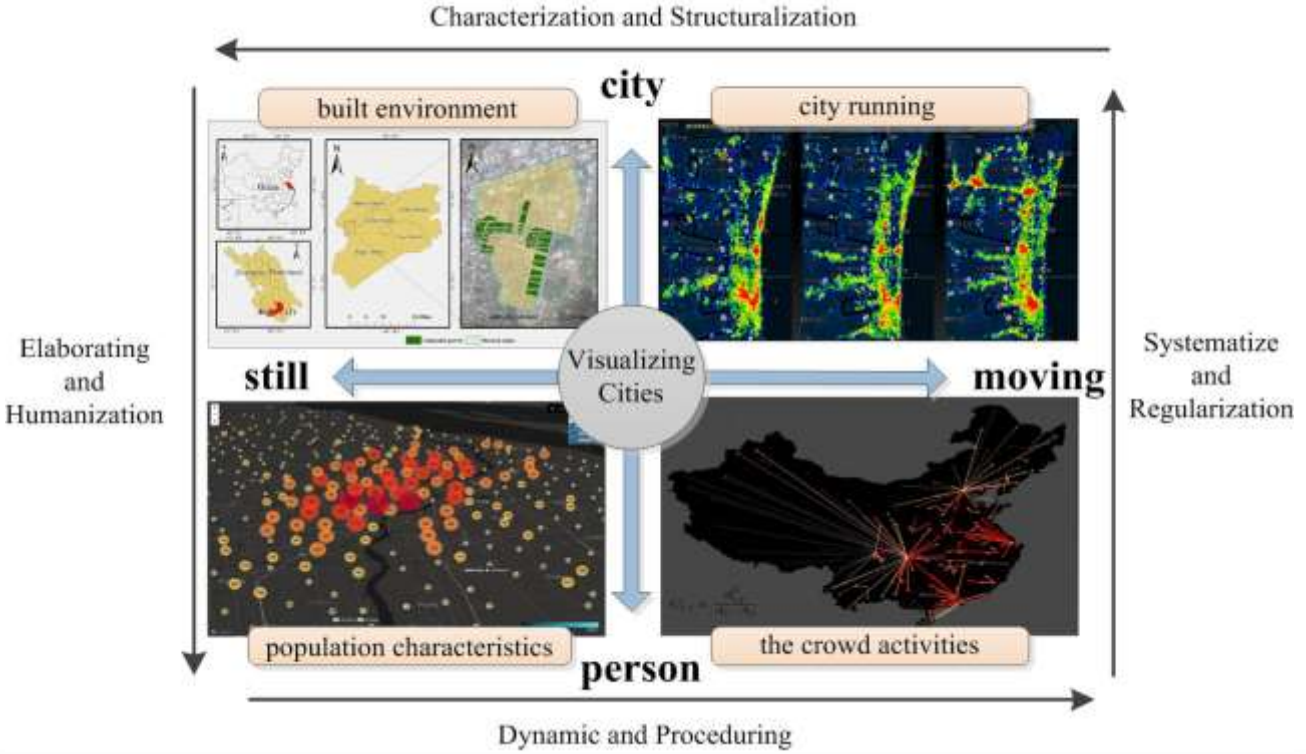
Travel distance relies on accurate road network data

The service facilities change dynamically every year

Scientific Backgound-Research status

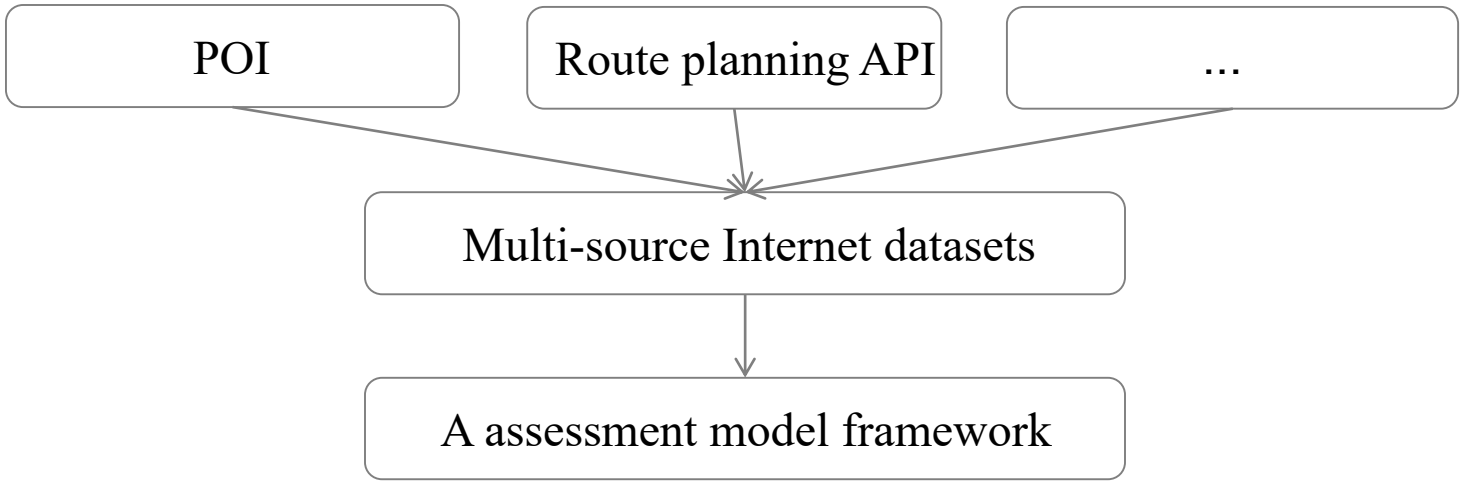
Research Field	Author	Year	Research Summary
diversified service facilities	Song Gao	2017	urban functional regions Extracting
community research	Tayebeh Saghapour	2019	The role of neighbourhoods accessibility in residential mobility
Travel distance	Xia, Nan	2018	Accessibility based on Gravity-Radiation model and Google Maps API
service facilities change	Jamtsho, Sonam	2015	Spatio-temporal analysis of spatial accessibility to primary health care

Scientific Background-The deficiency of current research is the lack of multi-year dynamic studies



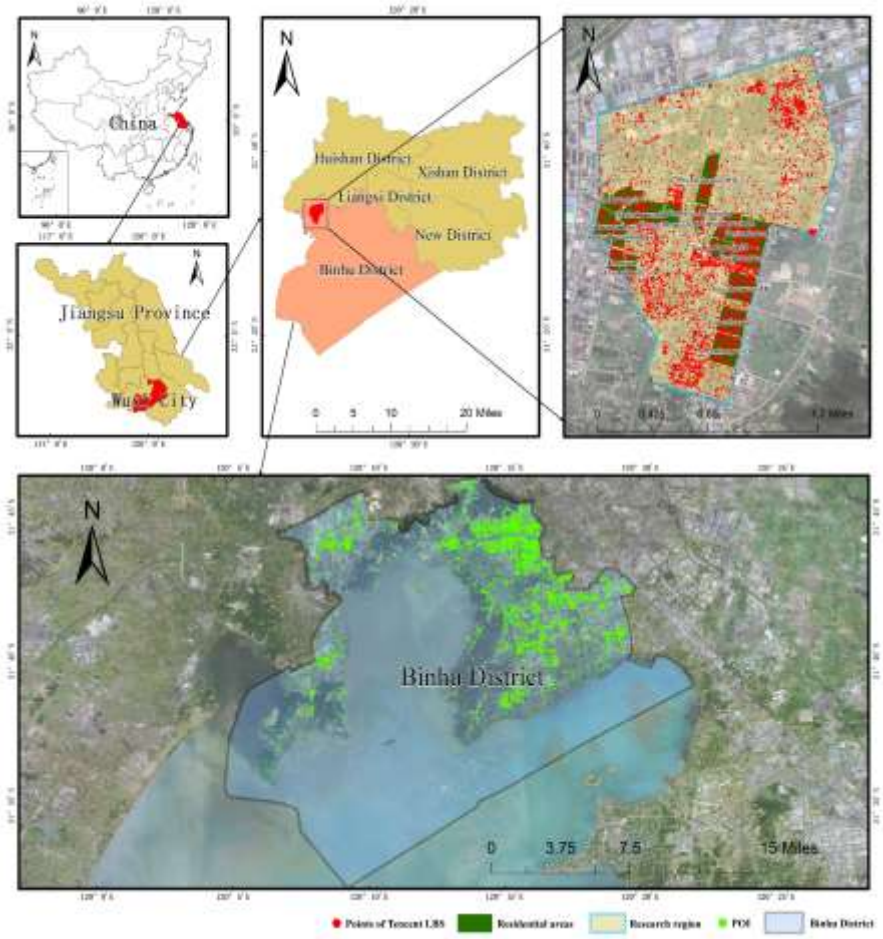
Scientific Question

Based on the above description, the new multi-source Internet datasets, especial internet map data, containing microcosmic and detailed geolocation information will be pertinent to the assessment of the rationality of public facilities in urban residential areas.



Research area

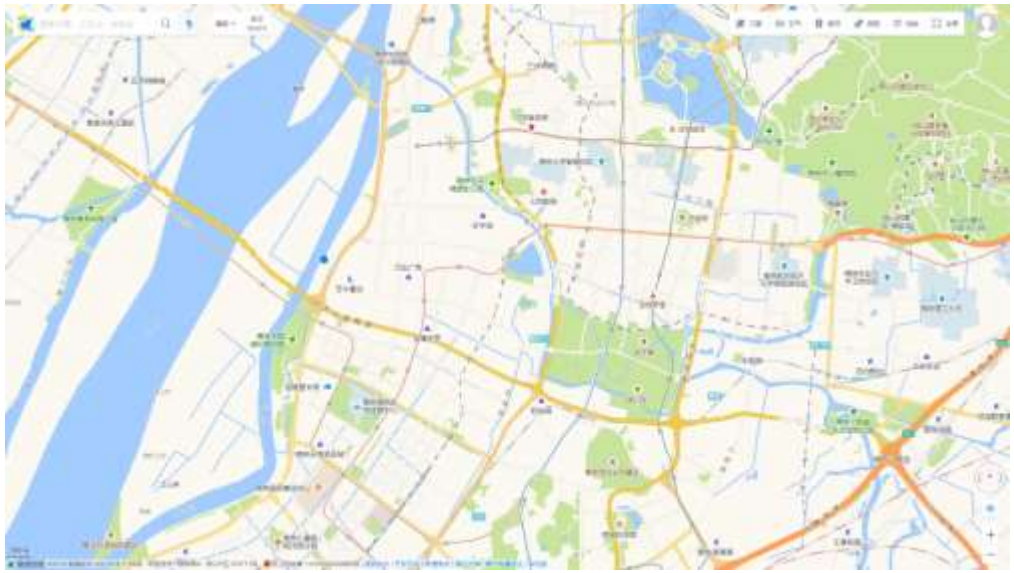
- a 5 km2 area of the urban built-up land in Hudai Town, Binhu New District in Wuxi as the experimental area.
- Wuxi is a typical city in the Yangtze River Delta region of China. It ranked 18th among the top 100 cities in China.
- This paper collected 3 years Amap POI dataset(2016, 2017, 2018) and requested route planning API of Internet maps for travel cost calculating.



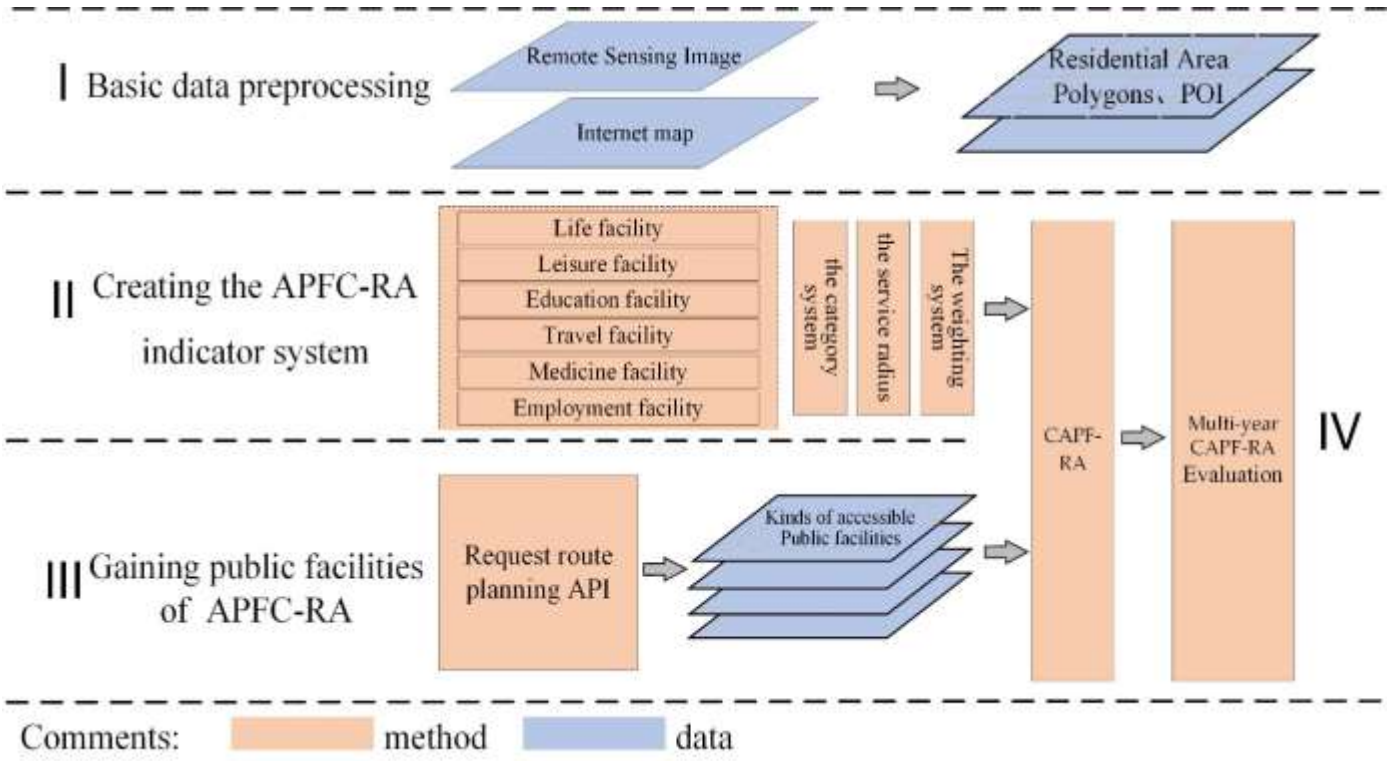
Research data

Amap is one of the most significant internet map service platform operator.

- 100 billion requests per year
- 90% terminals coverage
- 90% domestic travel industry
- 70 million POI data in China



Methodology-Overall assessment roadmap



Methodology-
POI category system

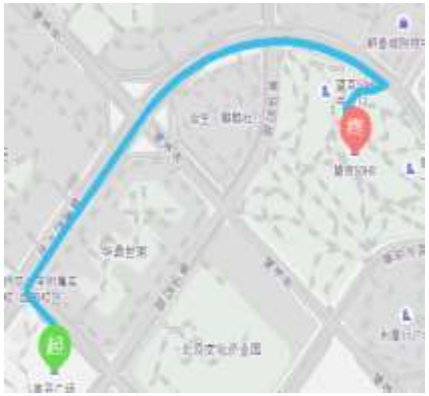
Classification	Service Name	Indicator Interpretation
Life	life service	Life service place, travel agency, information consultation center, ticket office, post office, express delivery, telecommunication business hall, office, water supply business hall, and electric power business hall
	shopping service	Shopping malls, convenience stores, home appliance electronics stores, supermarkets, home building materials markets, stationery stores, sports stores, shoes, hats and leather stores, and personal products/cosmetic stores
	catering service	Catering-related places, Chinese restaurants, foreign restaurants, fast food restaurants, casual restaurant, cafes, tea houses, cold drink shops, pastry shops, and dessert shops
	accommodation service	Accommodation services, hotels, and hotel guest houses
	financial insurance service	Financial and insurance services, banks, automated teller machines (ATMs), insurance companies, securities companies, and finance companies
	public utilities	Public toilets, funded shelters, service facilities, newsstands, and public telephones
	business residence	Related business housing and residential areas
Education	science and culture service	Science and culture education sites, museums, convention centers, art galleries, libraries, science and technology museums, planetariums, cultural palaces, literary and art groups, media organizations, schools, research institutions, and training institutions
Leisure	park facility	Comprehensive parks, zoos, botanical gardens, children's parks, and gardens providing places for residents to enjoy, watch, relax, and enjoy scenic spots
	sports and leisure services	Sports and leisure service places, sports venues, entertainment venues, resorts, leisure venues, and theaters
Travel	parking lot and repair facility	Gas stations, car sales, car repairs, private and public parking lots, parking spaces, auto repair shops, automobile sales service shop
	transportation facilities service	Related airport, railway station, long-distance bus station, subway station, light rail station, bus station, shuttle bus station, parking lot, border port, taxi, ferry station, and ropeway station
	road auxiliary facilities	Road auxiliary facilities, warning information, toll stations, service areas, traffic lights, and street signs
Medicine	medical facility	It mainly includes first-level, second-level, and third-level hospitals, community clinics, private clinics, private hospitals, pharmacies, general hospitals, specialist hospitals, and emergency centers
Employment	public enterprise	Companies, factories, bases with agriculture, forestry, herds, and fish

Methodology-Travel distance threshold

How can we go to Wangjing from Shoukai Square?

Walking

Cycling



Public transportation

Driving

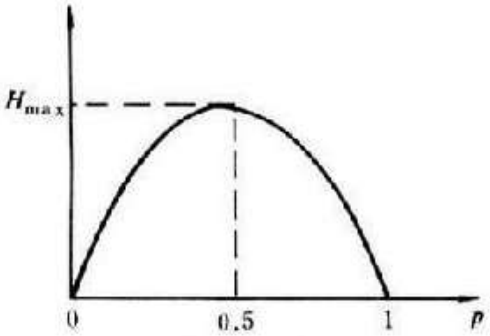
Methodology-Crawler program

Program 1: Gaining service facilities of available service facilities capacity of residential areas (ASFC-RA) through Amap route planning API

```
1  Input: the POI service facilities layer of one experimental area is a list of layer_s; the residential areas layer names layer_D
2  Input: the travel time costs threshold identification list is T=[t1,t2,……tS]
3  Output: a two-dimensional array of different types of service facilities in all the residential areas is named accessArray[D, S]
4  D = count of residential areas
5  S = count of service facilities types
6  for s = 0; s < S; s++ do
7  #Find out the service facilities of corresponding communities in S types of facilities
8      #Get the s service facilities layer deposited in layer_s
9      For j = 0; j < length(layer_s); j++ do
10         #Get the long-lat of the service facilities point j and save them into the facility
11         For I = 0; I < D; i++ do
12             #Get the longitude and latitude of the community i and store them into the residential area
               #Request route planning API, return JSON object and store result, the request form is:
13 #request.url(http://restAPI.amap.com/v3/direction/walking?origin=facility.X, #facility.Y&destination=residential area.X, residential #area.Y&output=json&key=<the key of users>)
14             #get the current path planning time in the result and store it into timeI]
15             if timeI]<T[s] then ## service facilities travel time costs
16                 #Update the row i of the accessArray, and the s column object counts, accessArray[i, s]++
17 return accessArray
```

Methodology-Accumulative opportunity model

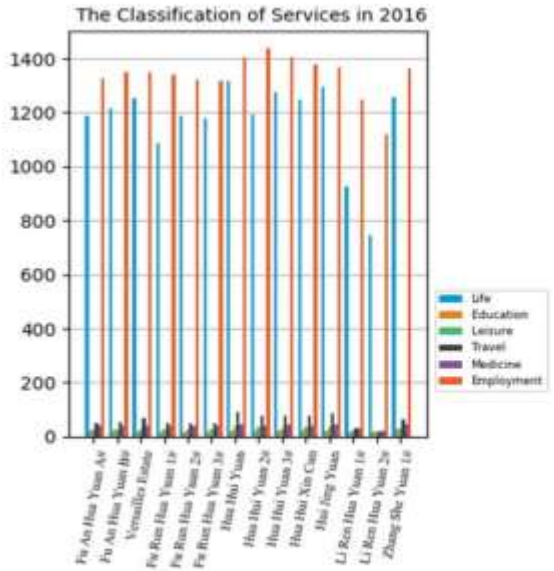
[redacted]



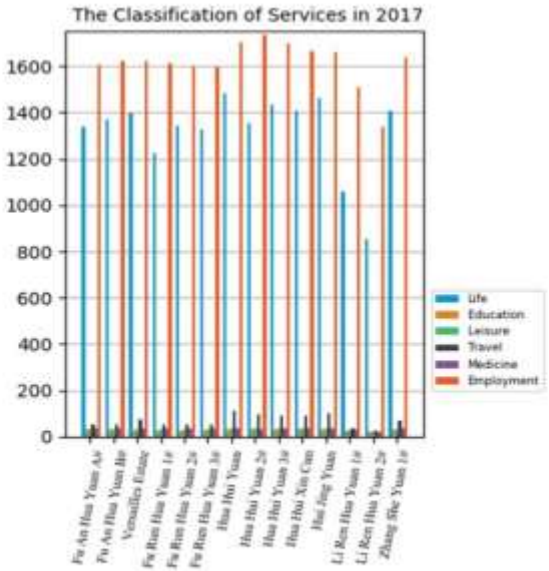
$$V_{CAPF-RA}(i) = f_i(WQ) = \sum_{k=0}^{r} w_{ki} * q_{ki} \qquad k \in [1, r] \qquad (1)$$

$$V_{CAPF-RA} = \sum_{i=1}^{m} V_{CAPF-RA}(i) \qquad i \in [1, m] \qquad (2)$$

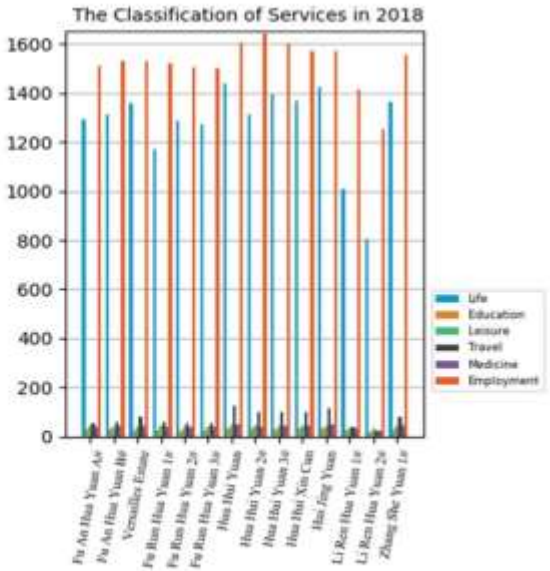
Result-The quantities of various types of service facilities in residential areas



2016

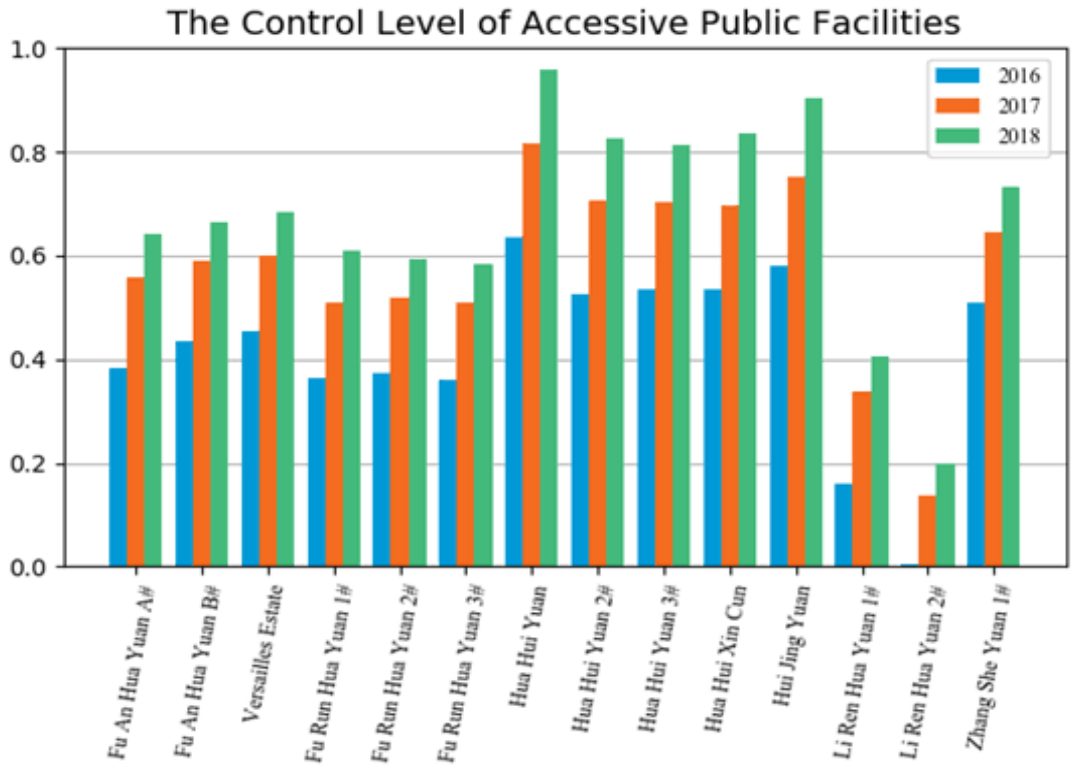


2017



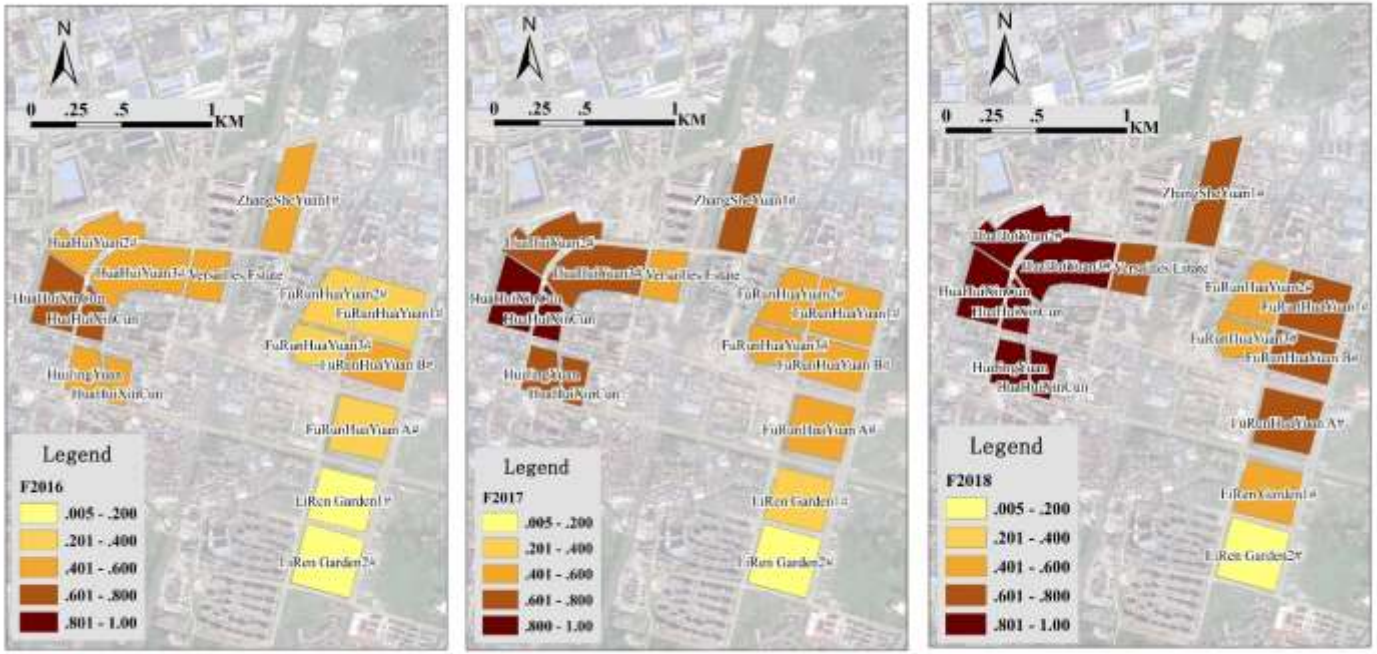
2018

Result-The CAPF-RA values in 14 communities



Result-The spatial distribution of CAPF-RA map results in 3 years

2016 2017 2018



(a) (b) (c)

Conclusion

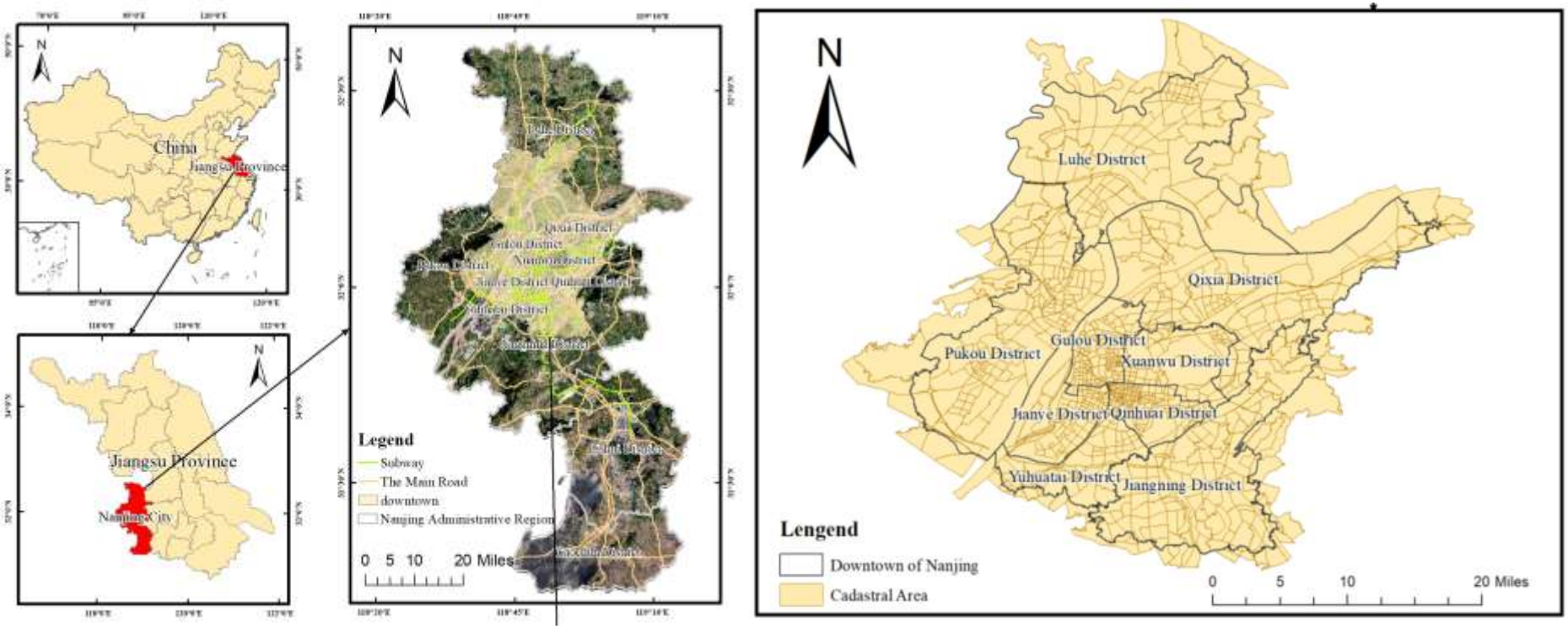
- The internet map provides new verification data for the micro-scale public service facility synthetical accessibility research, which has practical value for the implementation evaluation of urban detailed planning and design.
- It is found that the overall service resource supply level in the experimental area is higher on the northwest side and lower on the southeast side, and the high and low level cells show a strong agglomeration phenomenon in space. And the distribution of the five major types of services also shows obvious spatial agglomeration. This conclusion can help the government understand the regional dominance.
- The comprehensive acessibility of public service facilities emerge consistent growth, which declare that the increasing invest in infrastructure of experimental area stimulates service facilities to develop.

Discussion

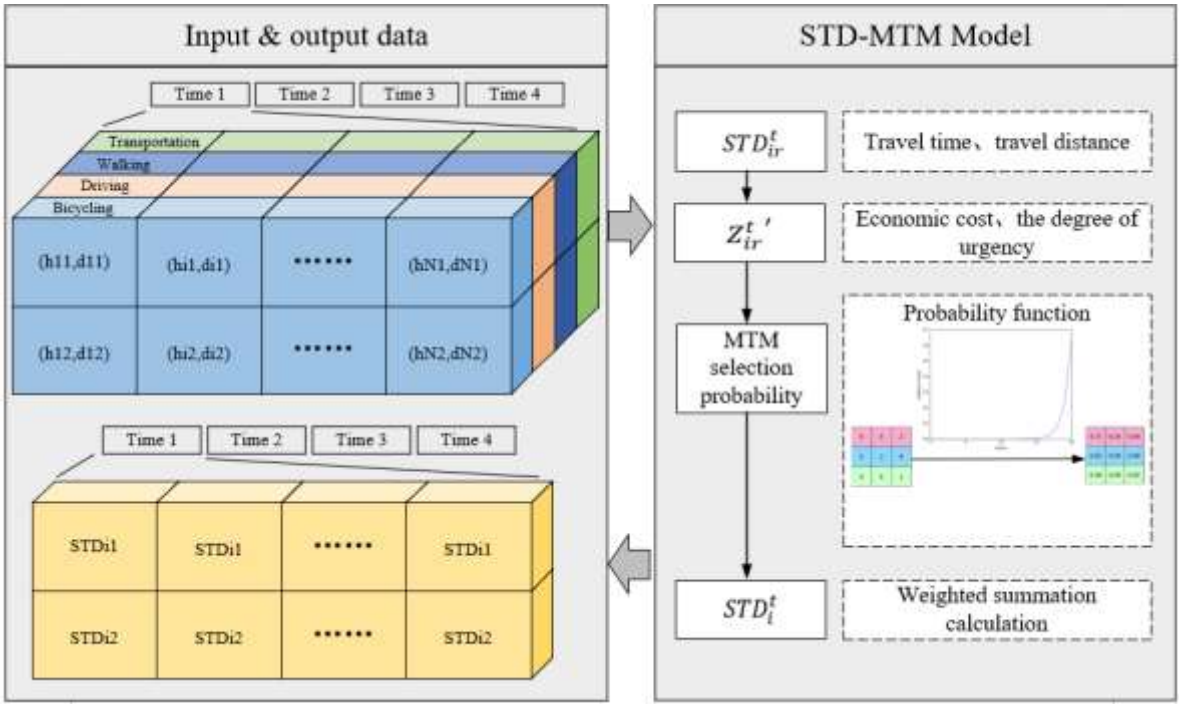
This research has made great progress in the application of internet map data to comprehensive accessibility measurement, but it is still limited by the incompleteness of data acquisition, and there are some shortcomings. The following points are worth further improvement and improvement:

- The experimental area is small, and the latter can select a representive metropolitan as complete research area.
- The number and scale of public service facilities are two important indicators for measuring the supply of public service facilities. Due to the lack of scale data of POI, this study has certain limitations. Access to data on the scale of each service facility through the means of open data on the Internet is also worthy of further study.

Discussion-Metropolitan area study



Discussion-Multimodal transport modes



Thank you!

Other related papers:

Zhou, X., Ding, Y., Wu, C., Huang, J., & Hu, C. (2019). Measuring the Spatial Allocation Rationality of Service Facilities of Residential Areas Based on Internet Map and Location-Based Service Data. *Sustainability, 11*(5), 1337.