



HSR's Effect on Urban Spatial Correlation

A big data analysis of China's largest urban agglomeration

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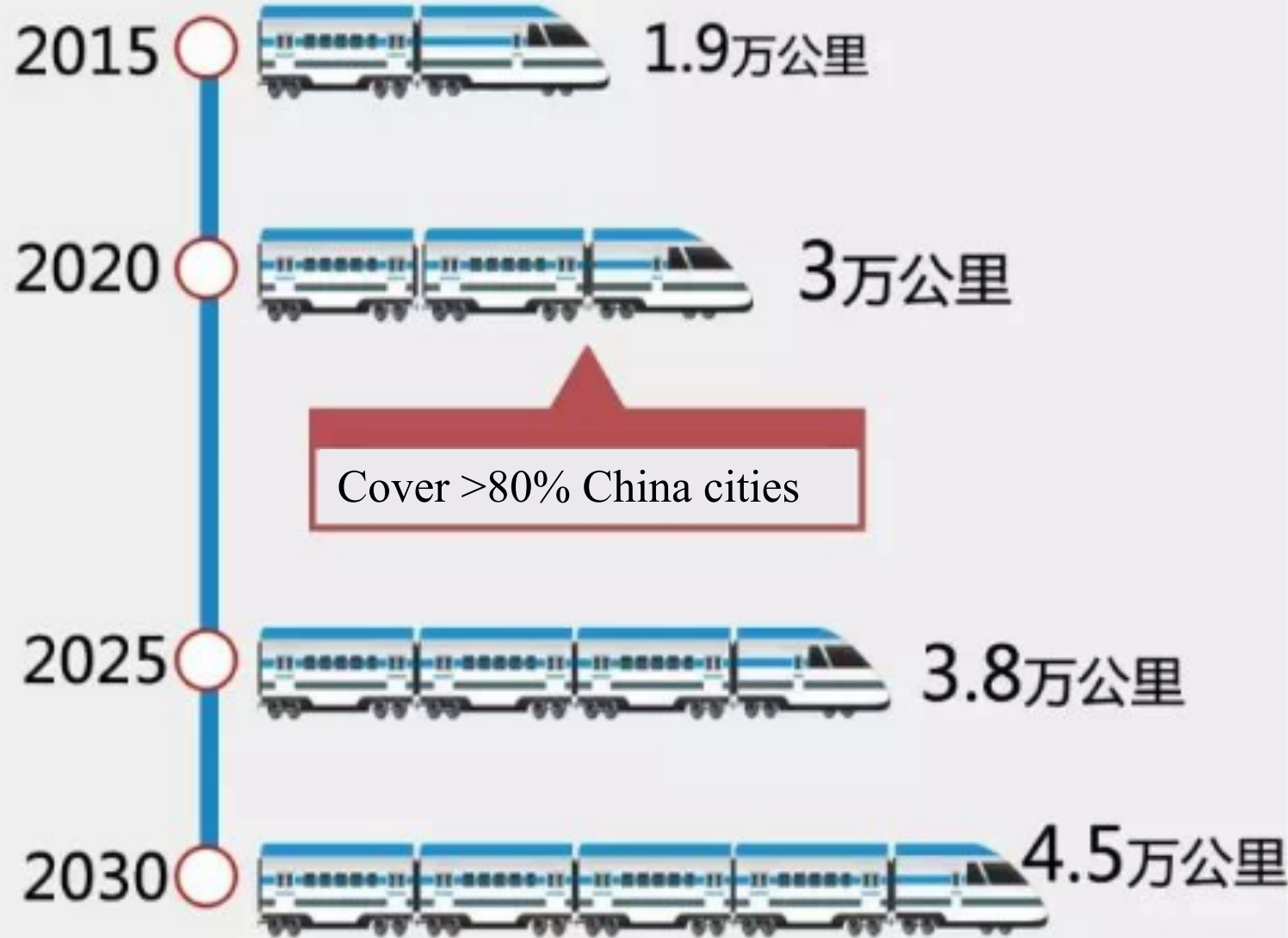


1.

HSR's spillover effect on city network development



HSR network mileage in China



Length: $>25 \times 10^3$ km in 2017
(2/3 of world total)

Speed: 307 km/h in average
350 km/h for Fuxing train
(Fastest in the world)





HSR station before and after

In the 1980s



Shanghai railway station

After the 2000s



- Improvement of travel comfortableness
- Time-saving: 4 hours 38 mins (Shanghai - Beijing)
- TOD effect on the regional development

- Side-effects: public health, noise disturbance, Land occupation, over-agglomeration of economy and population in some megacities

• HSR's effect on city network



Japan: 1h from neighboring cities to mega city center (about 50k) by train

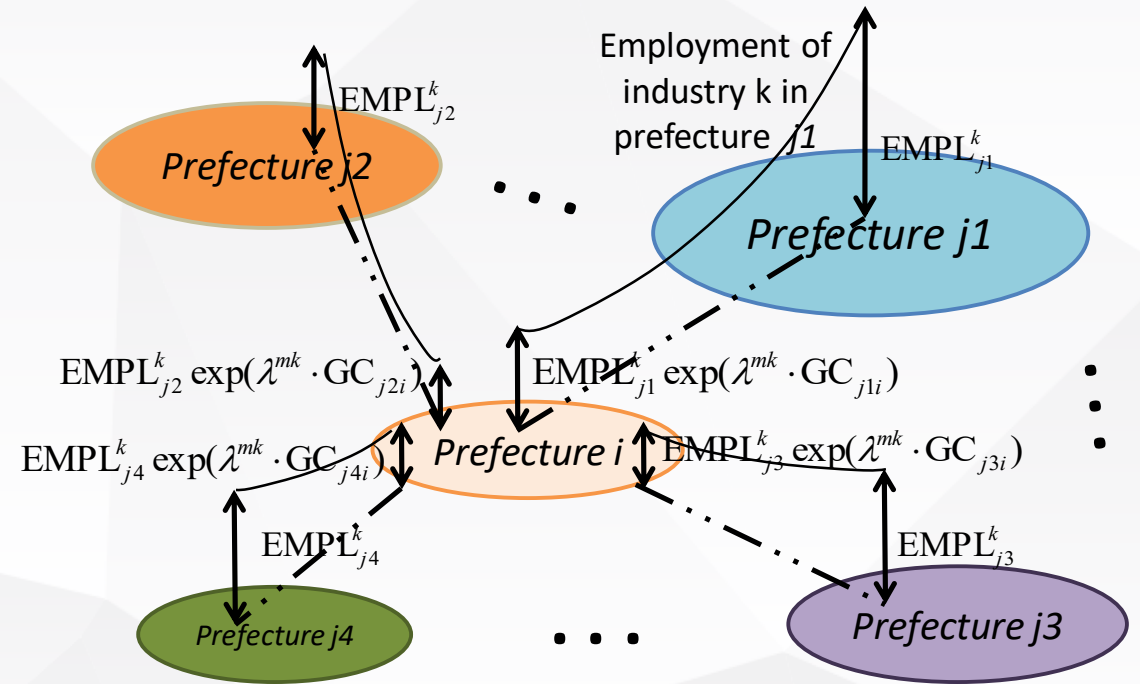
US: 1h from neighboring cities to mega city center (about 50k) by car

China: Commute faster by HSR than train
No need driving license, elder, children,
or a group

苏州大学 ⊙ 苏州北火车站 ⊙ 上海虹桥火车站 ⊙ 人民广场

Deficiencies of traditional method and data

- Correlation is usually defined as a scalar rather than a vector;
- Correlations are analyzed based on the modeled flows between two cities rather than the real flows (such as population flow, trade flow, and traffic flow) occurred, which may deviate from the reality;
- The time and space resolutions of statistical data are relatively low;
- The real terrain and transport conditions between cities are usually neglected.



Statistical-data based Gravity model



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2 . A big-data based method



“12306” -- HSR ticket booking website

- Real flow data
- Hourly interval
- Vectorial data
- Informative: OD station, coach type, departure time, and remained ticket number of each seat class.



“Bus Steward” – Bus ticket booking website

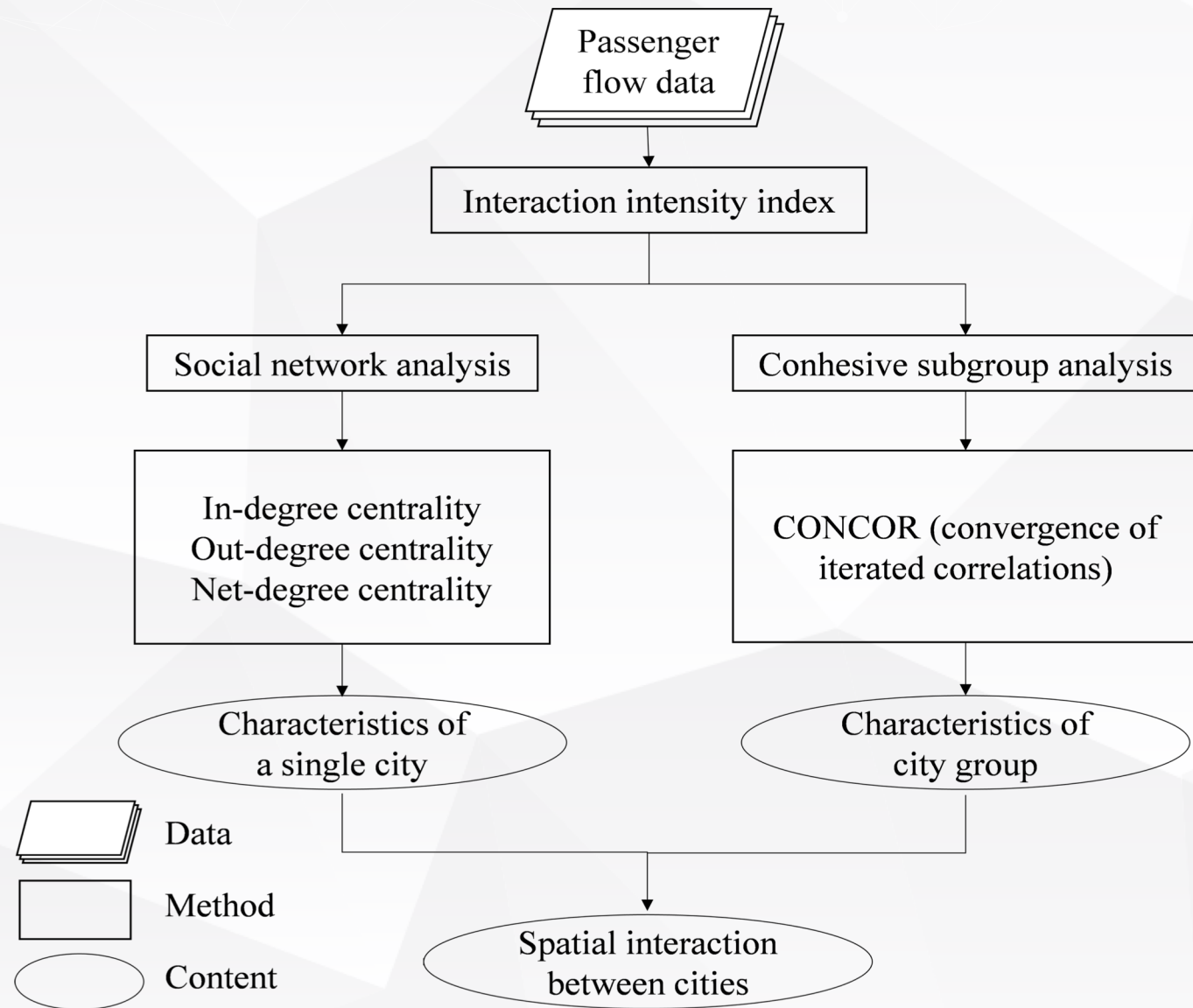
Origin	Destination	Coach type	Departure time	Remained Ticket
Shanghai	Wuxi	Large	10:00	10
Nanjing	Changzhou	Large	15:20	18
Suzhou	Zhenjiang	Medium	21:15	5
⋮	⋮	⋮	⋮	⋮



Crawler program & method flowchart

Pseudo-code of the crawler program

```
load the 'httr' and 'xml2' packages
Counterfeit a request header
for(j in the set of origin cities){
  for(k in the set of destination cities)){
    if (origin city is not equals to destination city){
      establish the request body
      post the request header and body to
the target website
      if (the required data exist){
        for (data in the repository) {
          download the data
        }
      }
    }
  }
}
Store the data
```





Socioeconomic status of HSR passengers

A predominance of middle- and upper-class income users was found.

- Passengers having an annual income of 60–100,000 yuan accounting for 33.3%
- Passengers with an income of more than 100,000 yuan accounting for 29.8% of the total

Attributes		Proportion
Gender	Male	71.6%
	Female	28.4%
Age (year)	<18	0.7%
	18–35	75.2%
	35–65	23.7%
	>65	0.4%
Level of education	Primary school or lower	0.7%
	Junior high school	9.6%
	High school or technical secondary school	16.7%
	University or college	55.0%
	Above bachelor degree	18.0%
Duration of residence in the city (year)	<0.5	6.4%
	0.5–1	5.7%
	1–3	12.4%
	3–5	10.3%
	>5	65.2%
Annual income (yuan)	≤30,000	11.0%
	30,000–60,000	25.9%
	60,000–100,000	33.3%
	100,000–150,000	17.4%
	>150,000	12.4%

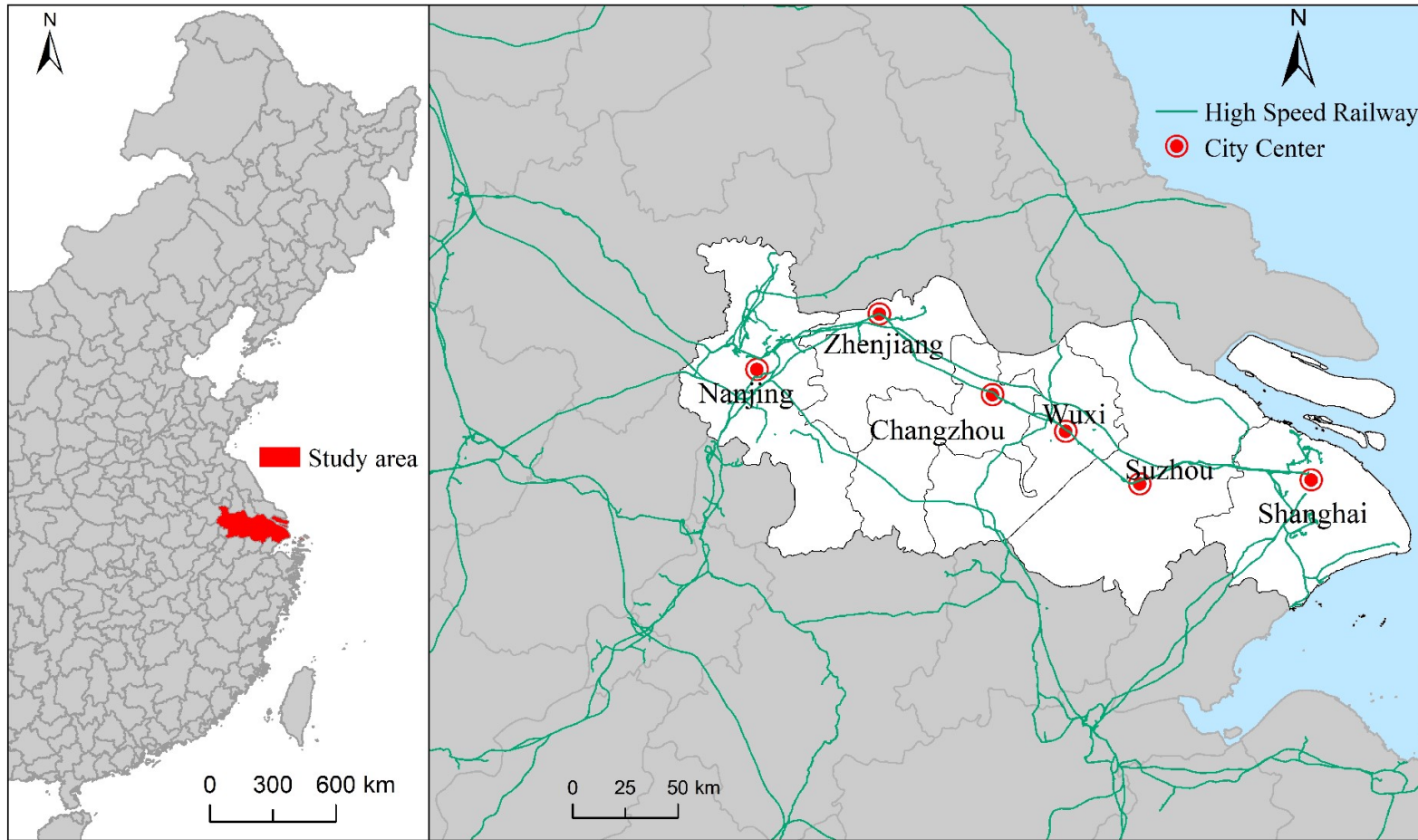


3.

HSR's effect on urban spatial correlation in YRD UA



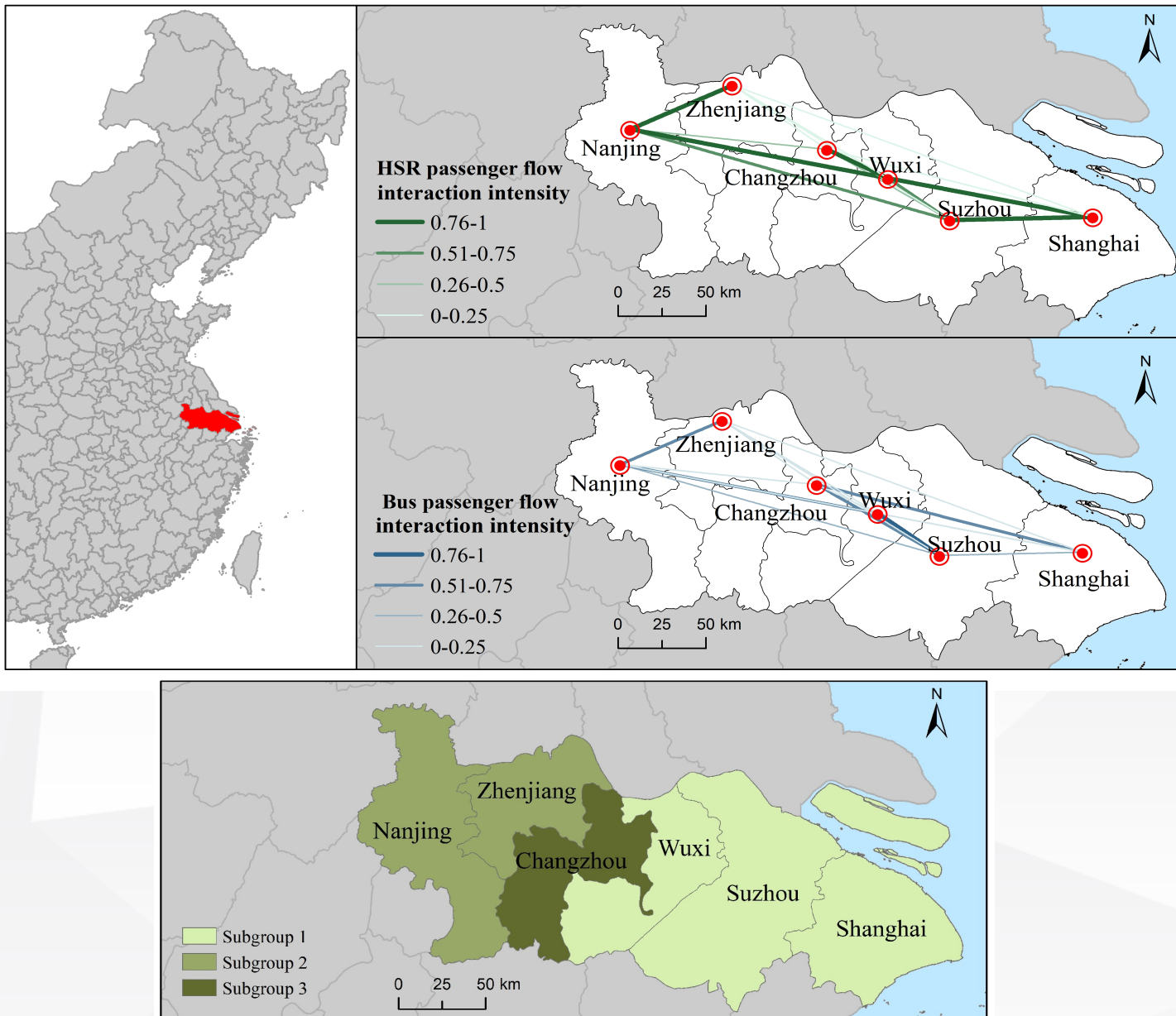
People's concern of HSR's environmental impacts



- Largest UA in China: 25 cities
- Area: 210,000 km² (2% of China total)
- Pop: 80 million (6% of China total)
- GDP: 15 trillion RMB (21% of China total) in 2016
- Plan to build world-class industrial, innovation, and urban clusters with global impact
- Has the earliest constructed and busiest HSR lines in China, its annual passenger turnover volume reaches 0.4 billion



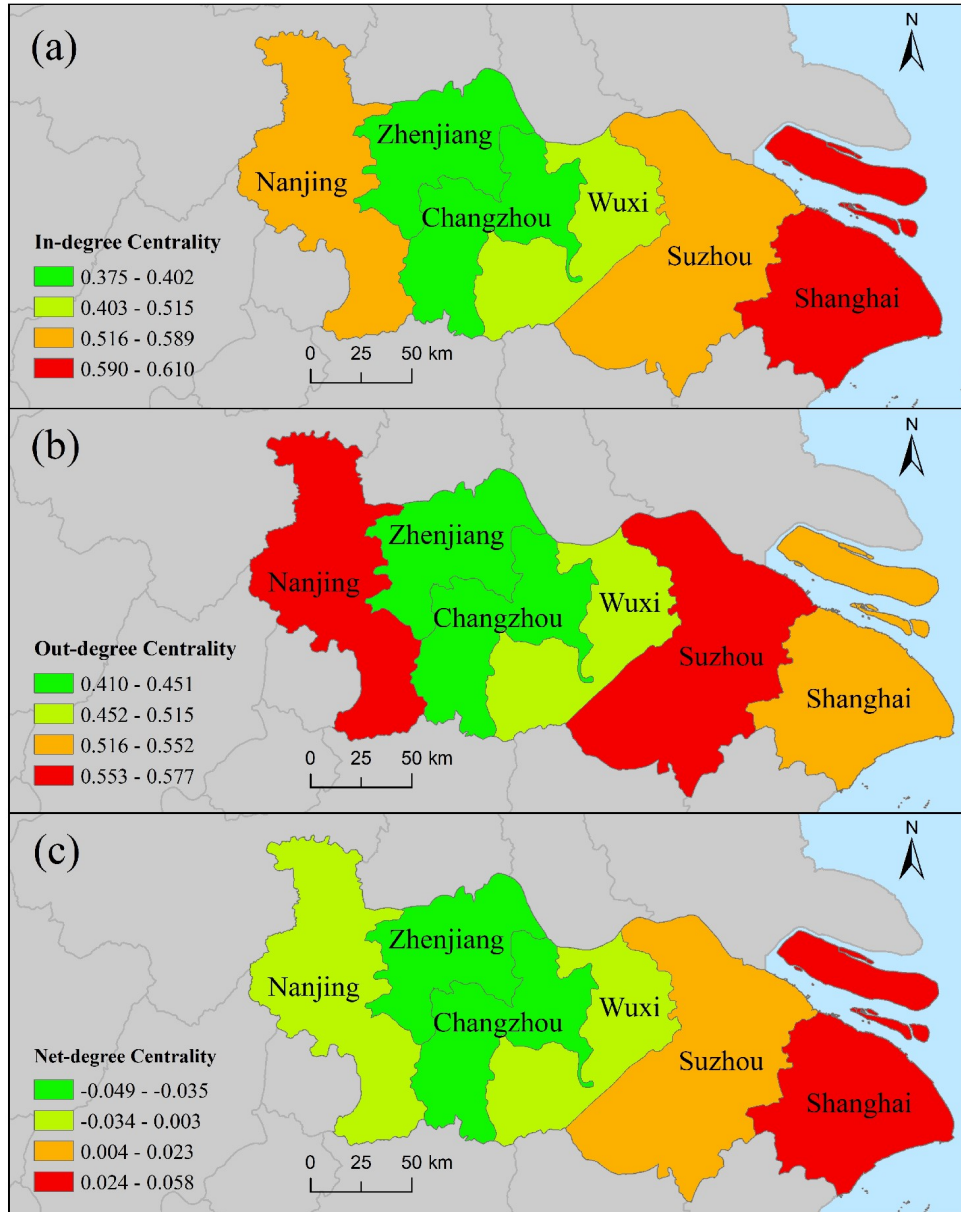
Correlation intensity & Cohesive subgrouping



- HSR has significantly improved the urban spatial correlation between cities comparing to the road passenger transport
- Dual core cities in YRD UA, namely Nanjing and Shanghai, appears due to HSR construction
- Nanjing is planned to be the important node city to ensure the shift of manufacturing industries from east to the west YRD



Degree centrality of cities in YRD UA



- Shanghai and Suzhou are attracting HSR passenger flows, while Nanjing, Zhenjiang, Changzhou, and Wuxi are sending out passengers.
- Work, tourism, and visits to friends and relatives are the top three purposes
- Shanghai: per capita income was 54000 RMB and provided 0.6 million new job opportunities in 2016, it attracts massive population inflows with the annual growth rate of net population immigration reaching 5% in 2016

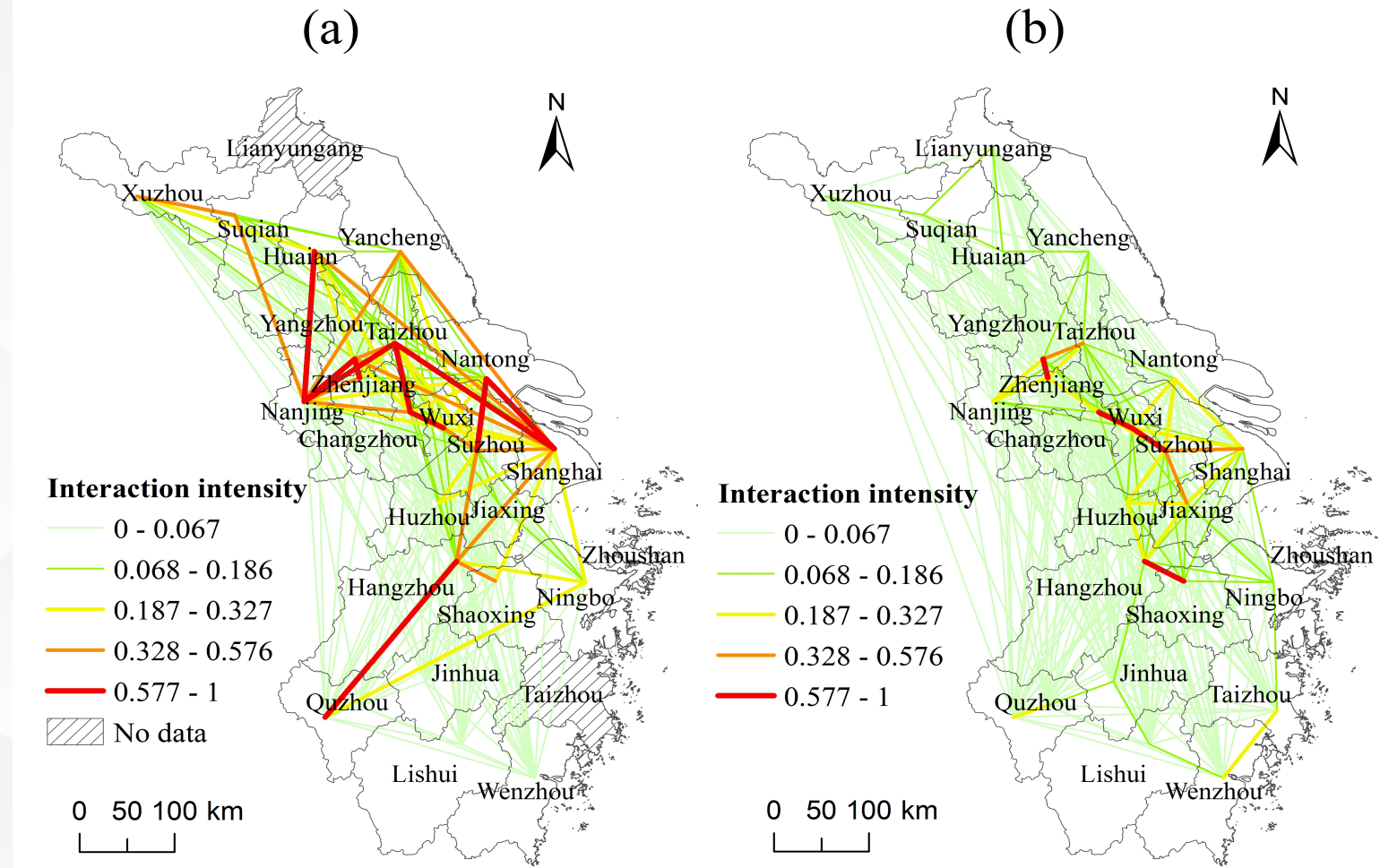


4. Summary and some thinking



Summary and some thinking

- Big data provide vectorial, realistic, and high spatiotemporal resolution information of urban correlation than the traditional statistical data.
- It serves as a supplement to the existing data and methods for spatial urban correlation analysis.





Policy implications

- **High income level and massive job opportunity** could be the main factors driving Shanghai to be the largest passenger inflow city in YRD UA.
- **HSR has significantly improved the urban spatial correlation** between cities when comparing to the road passenger transport





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Thank you!



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