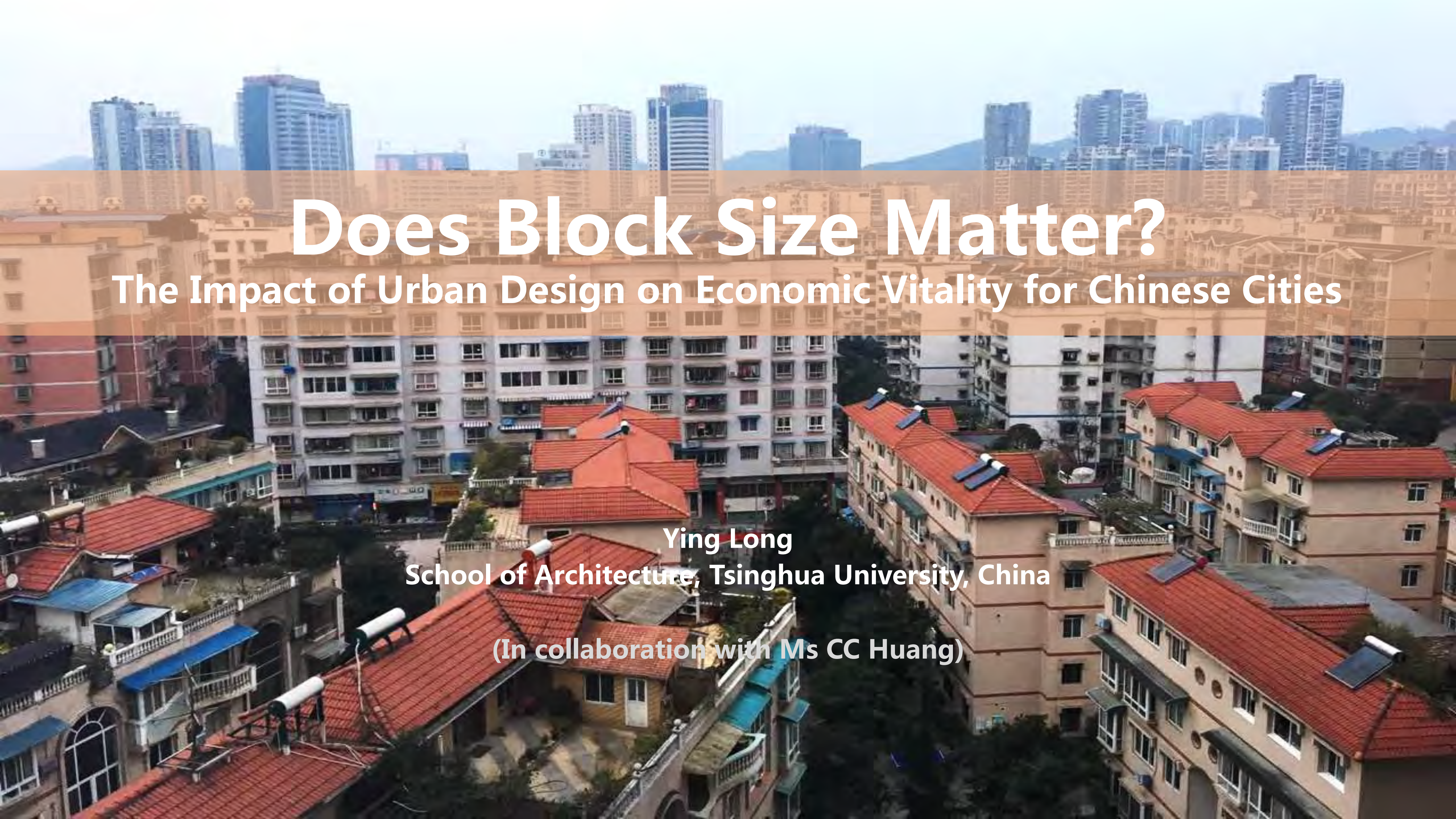


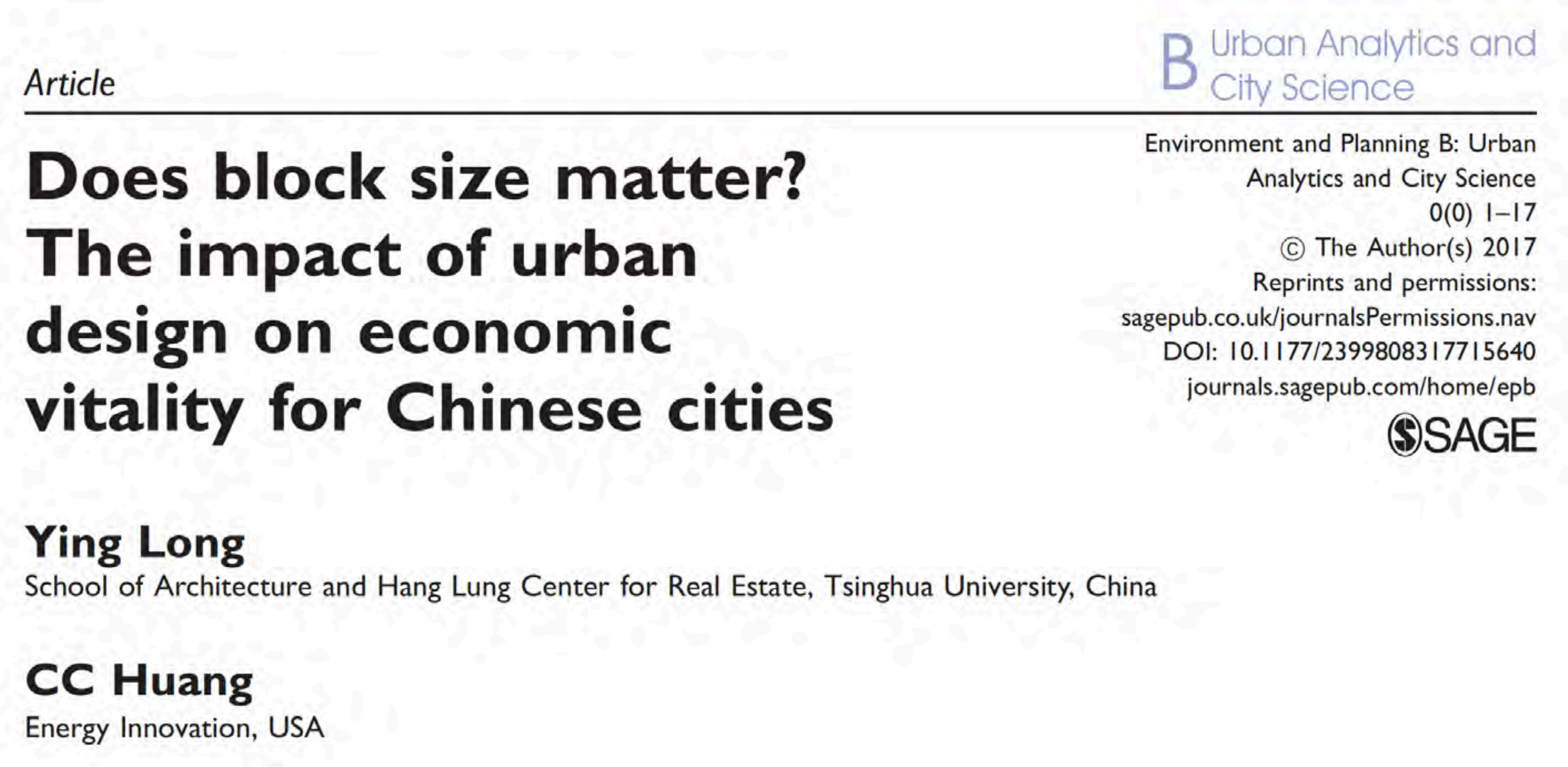
Does Block Size Matter?

The Impact of Urban Design on Economic Vitality for Chinese Cities

Ying Long
School of Architecture, Tsinghua University, China

(In collaboration with Ms CC Huang)

0 The publication in EPB



Article

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Does block size matter? The impact of urban design on economic vitality for Chinese cities

Ying Long
School of Architecture and Hang Lung Center for Real Estate, Tsinghua University, China

CC Huang
Energy Innovation, USA

1 Introduction

Pioneering urbanists like Jacobs (1961) and Lefebvre (1962) were the among the first to specify the features of good urban design (e.g. small blocks) and how it cultivates community, sociocultural vibrancy, and healthy neighborhoods. Other influential urbanists such as Gehl (1971), Lynch (1981), Whyte (1980), Montgomery (1998) also established new ground on ways to understand urban vibrancy.

Economic vitality

명동 占
사주카페
3F
PHIL STAY
5F
K-POP
DVD 클럽
영화 or IPTV 무제한
최신개봉작 & IPTV를 1편 가격으로 무제한 즐기기
놀러와용~
02)774-3339

1

Economic vitality

Shinhan Bank
新韓銀行
兩替
임대문의
[B1~6F]
Tel. 02-2007-5600
2017.11. 준공예정
RIFA

60
파크랜드
HOTEL KOTA

1 Social vitality

1 Ecological vitality

1 Existing studies

- Our literature review shows that while urban form indicators have been widely analyzed, there have only been a handful of studies that look at the impact of urban design on urban or economic vitality through quantitative analysis.
- We assume economic vitality is a dimension of urban vitality in this study, which focuses more on economic vitality rather than the broad urban vitality.

1 Research questions of this study

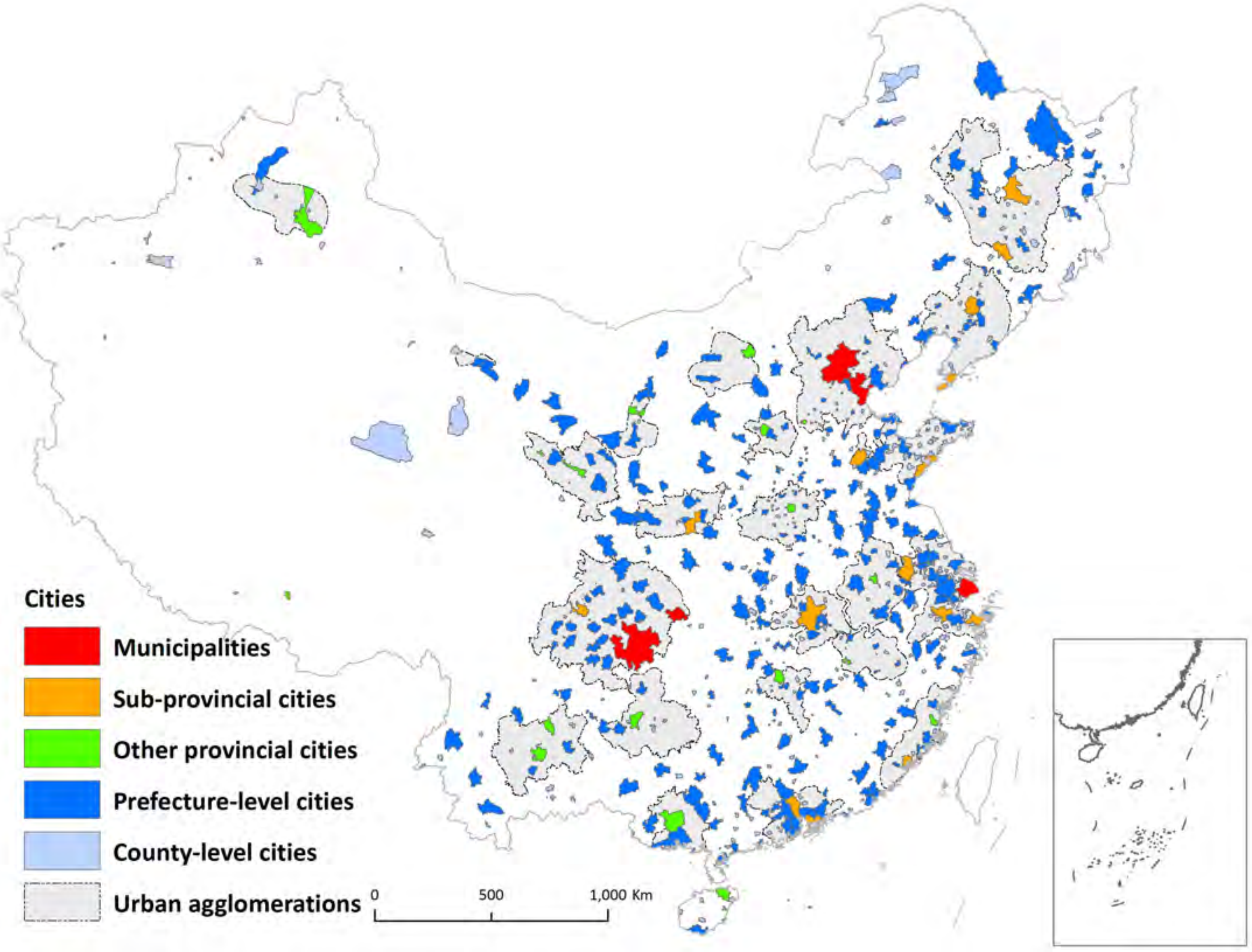
- Do urban design principles positively associate with vibrant cities in terms of economy?
  - How much is a variable such as intersection density correlating with economic vitality compared to other factors?
- Does this relationship vary across cities of different administrative levels?

2 Study area and Data

2 The whole Chinese city system as the study area

- Five categories of cities ranging from municipalities to county-level cities

- The city proper of all cities as the study as the study area of the study
  - The administrative boundary
  - 市辖区


Cities
🟥 Municipalities
🟧 Sub-provincial cities
🟩 Other provincial cities
🟦 Prefecture-level cities
🟦 County-level cities
▨ Urban agglomerations
0
500
1,000 Km

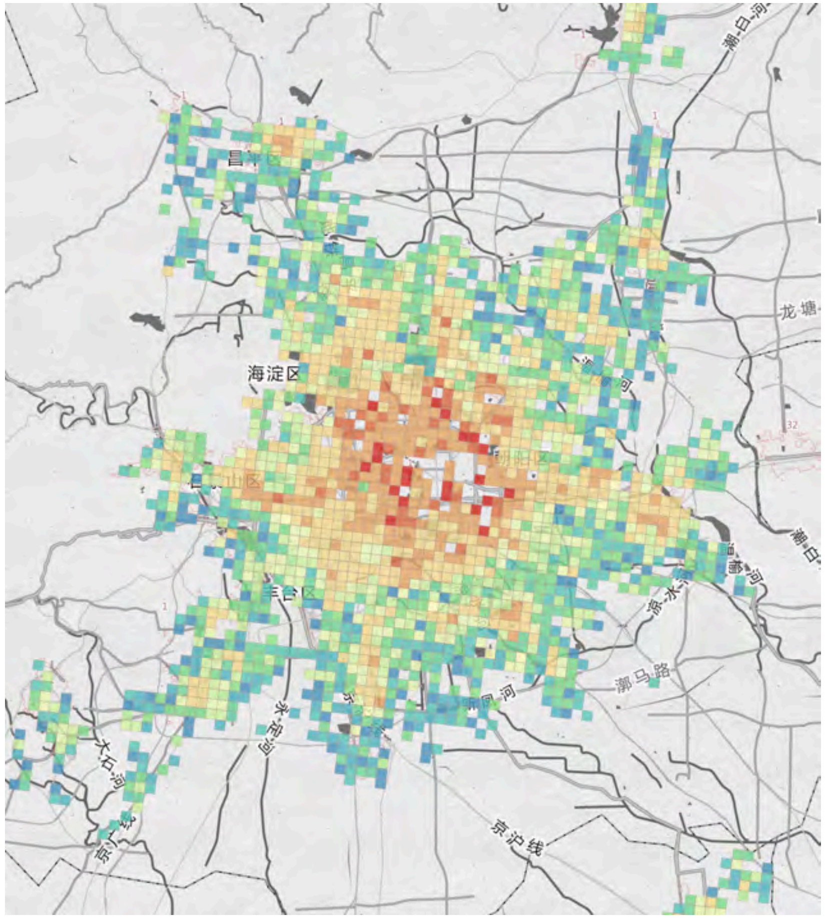
2

Observing economic (consuming) vitality and its impact factors at the 1km-grid level

- Considering data availability and computation load, we regard the 1km by 1km grid as the analysis unit in the study.

- In China, there were a total of 63,425 km² of urban areas in 2010. We categorize any grid that has more than 0.5 km² of urban land areas as an urban grid

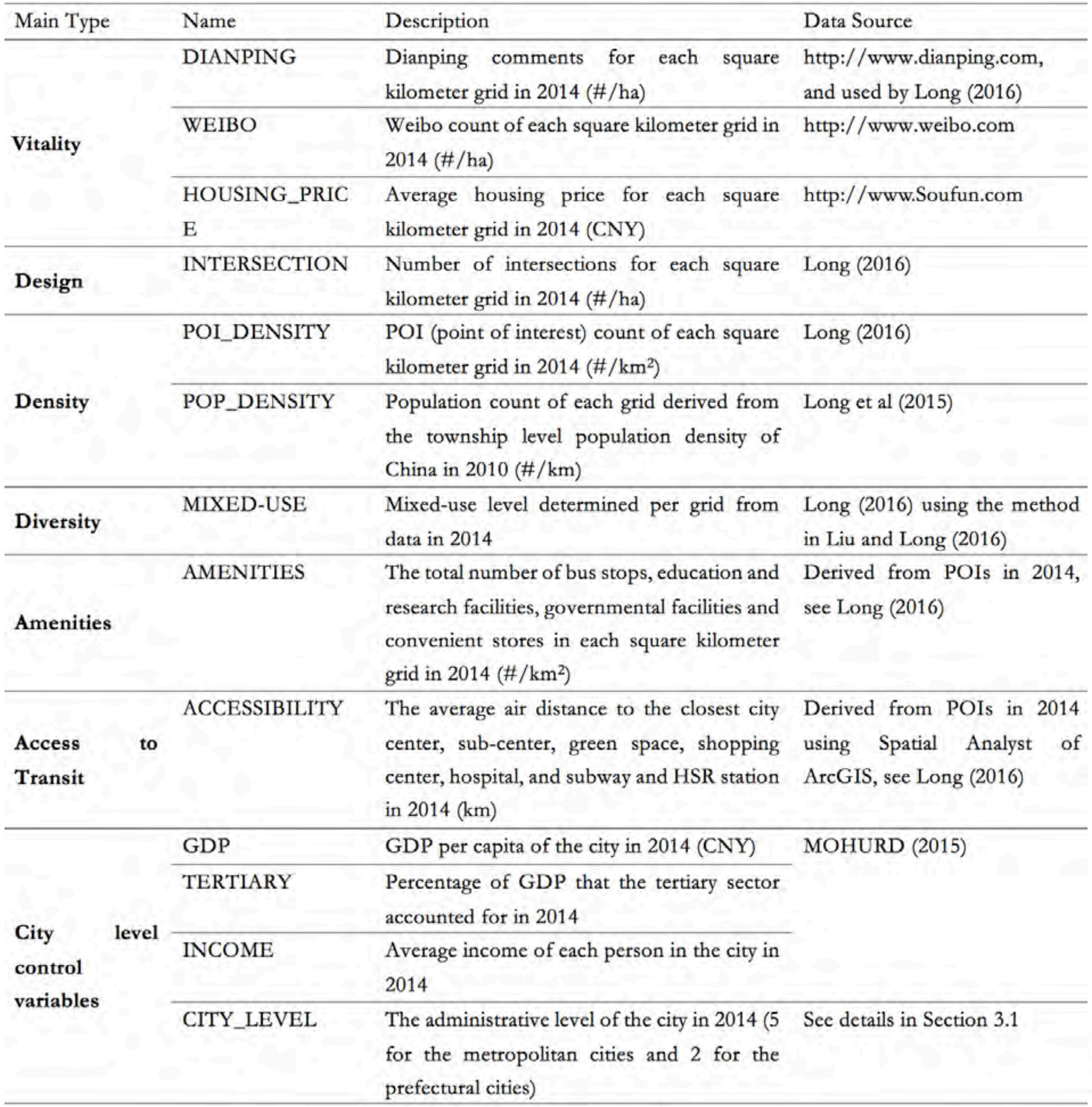
- There are 43,646 urban grids in total within administrative areas of Chinese cities



2

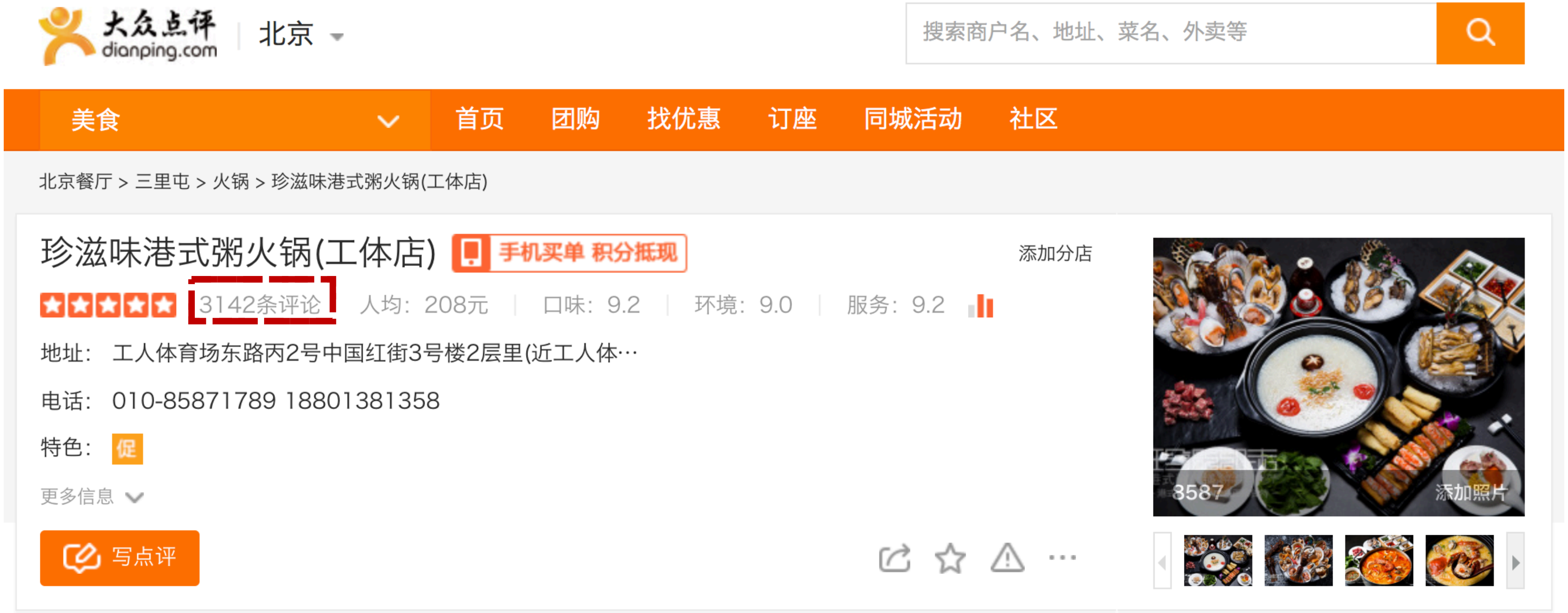
List of variables and data sources used in analysis

- According to three Ds (density, diversity and design) proposed by Bernick and Cervero (1996) and 5 Ds (density, diversity, design, distance to transit and destination accessibility) proposed by Belzer and Autler (2002), we select impact factors contributing to economic vitality for all urban grids
- Sina Weibos and housing prices as auxiliary data to represent urban vitality in other dimensions



Main Type	Name	Description	Data Source
Vitality	DIANPING	Dianping comments for each square kilometer grid in 2014 (#/ha)	http://www.dianping.com, and used by Long (2016)
	WEIBO	Weibo count of each square kilometer grid in 2014 (#/ha)	http://www.weibo.com
	HOUSING_PRICE	Average housing price for each square kilometer grid in 2014 (CNY)	http://www.Soufun.com
Design	INTERSECTION	Number of intersections for each square kilometer grid in 2014 (#/ha)	Long (2016)
Density	POI_DENSITY	POI (point of interest) count of each square kilometer grid in 2014 (#/km^2)	Long (2016)
	POP_DENSITY	Population count of each grid derived from the township level population density of China in 2010 (#/km)	Long et al (2015)
Diversity	MIXED-USE	Mixed-use level determined per grid from data in 2014	Long (2016) using the method in Liu and Long (2016)
Amenities	AMENITIES	The total number of bus stops, education and research facilities, governmental facilities and convenient stores in each square kilometer grid in 2014 (#/km^2)	Derived from POIs in 2014, see Long (2016)
Access to Transit	ACCESSIBILITY	The average air distance to the closest city center, sub-center, green space, shopping center, hospital, and subway and HSR station in 2014 (km)	Derived from POIs in 2014 using Spatial Analyst of ArcGIS, see Long (2016)
City level control variables	GDP	GDP per capita of the city in 2014 (CNY)	MOHURD (2015)
	TERTIARY	Percentage of GDP that the tertiary sector accounted for in 2014	
	INCOME	Average income of each person in the city in 2014	
	CITY_LEVEL	The administrative level of the city in 2014 (5 for the metropolitan cities and 2 for the prefectural cities)	See details in Section 3.1

2 Consuming vitality


大众点评
dianping.com
北京
搜索商户名、地址、菜名、外卖等
美食
首页
团购
找优惠
订座
同城活动
社区
手机买单 积分抵现
添加分店
写点评
3587
添加照片

北京餐厅 > 三里屯 > 火锅 > 珍滋味港式粥火锅(工体店)

珍滋味港式粥火锅(工体店)

3142条评论 | 人均：208元 | 口味：9.2 | 环境：9.0 | 服务：9.2

地址： 工人体育场东路丙2号中国红街3号楼2层里(近工人体…

电话： 010-85871789 18801381358

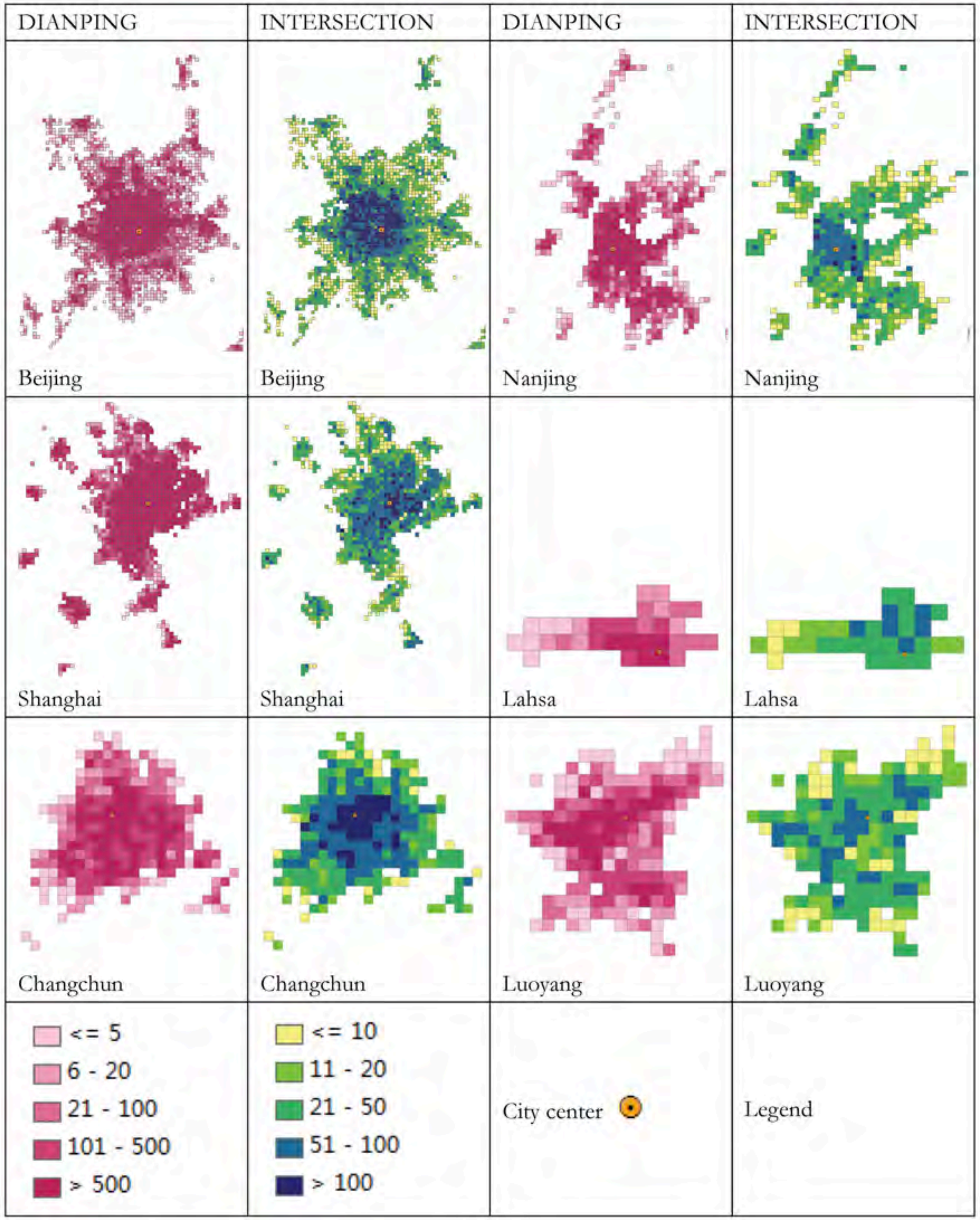
特色： 促

更多信息

- **DIANPING represents Dazhong Dianping, an aggregated social media tool used to rate restaurant and other service industry companies in China**
- China’s Yelp!

2 Consuming vitality

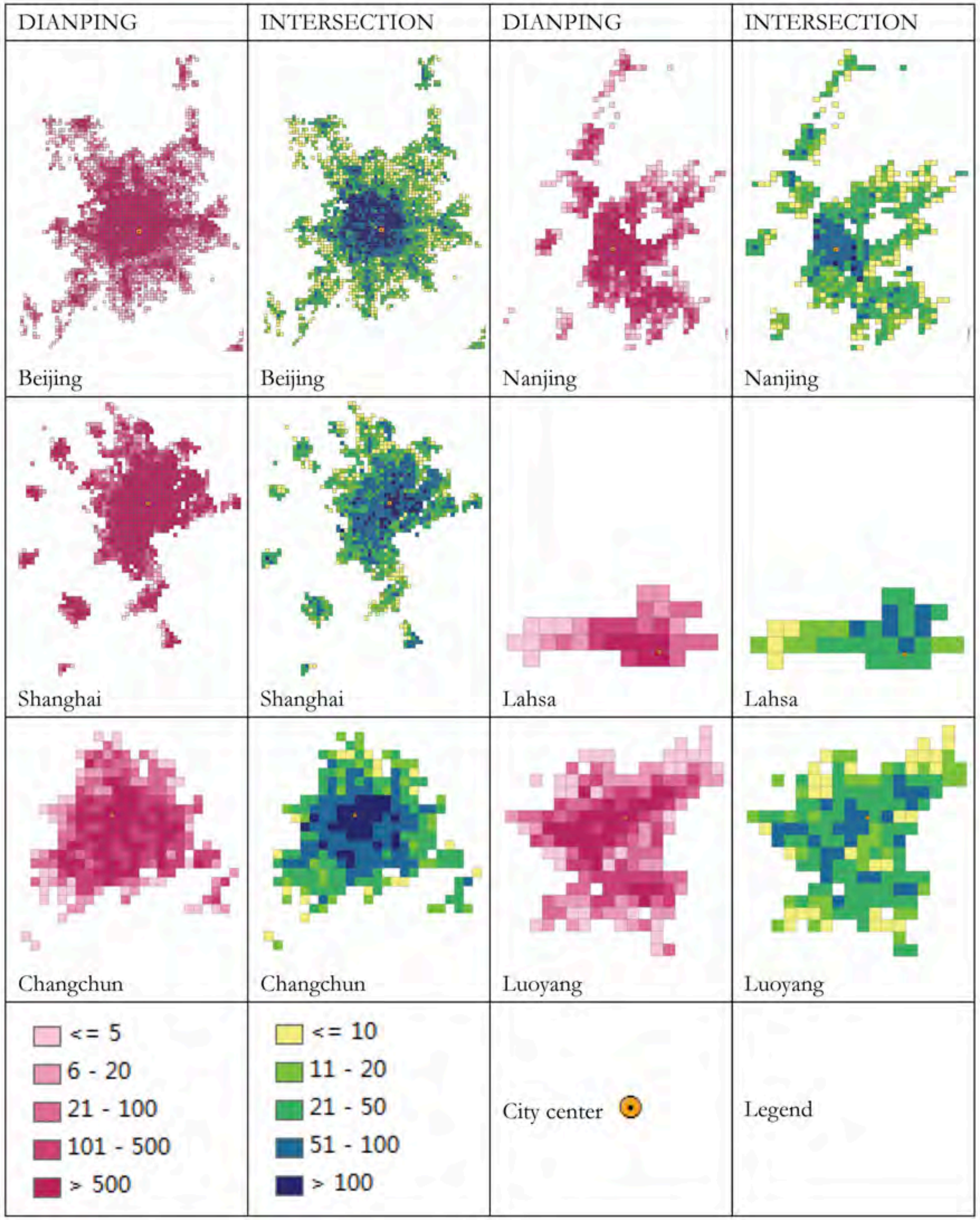
- Collect 13 million POIs, 1.9 m POIs with at least one user comment, and 47 million comments for all POIs in 2014
- Aggregate the fine-grained POIs to urban grids
- The Dianping data not representative for county-level cities since the smallest cities do not always have enough Dianping users, hence we do not analyze county-level cities
- Only include urban grids with at least one user comment, and remove the top 1% of geographic units that contain the most comments to avoid outliers
- 24,512 urban grids used in the further analysis


DIANPING
INTERSECTION
DIANPING
INTERSECTION
Beijing
Beijing
Nanjing
Nanjing
Shanghai
Shanghai
Lahsa
Lahsa
Changchun
Changchun
Luoyang
Luoyang
<= 5
6 - 20
21 - 100
101 - 500
> 500
<= 10
11 - 20
21 - 50
51 - 100
> 100
City center
Legend

2

Road intersection density representing block size

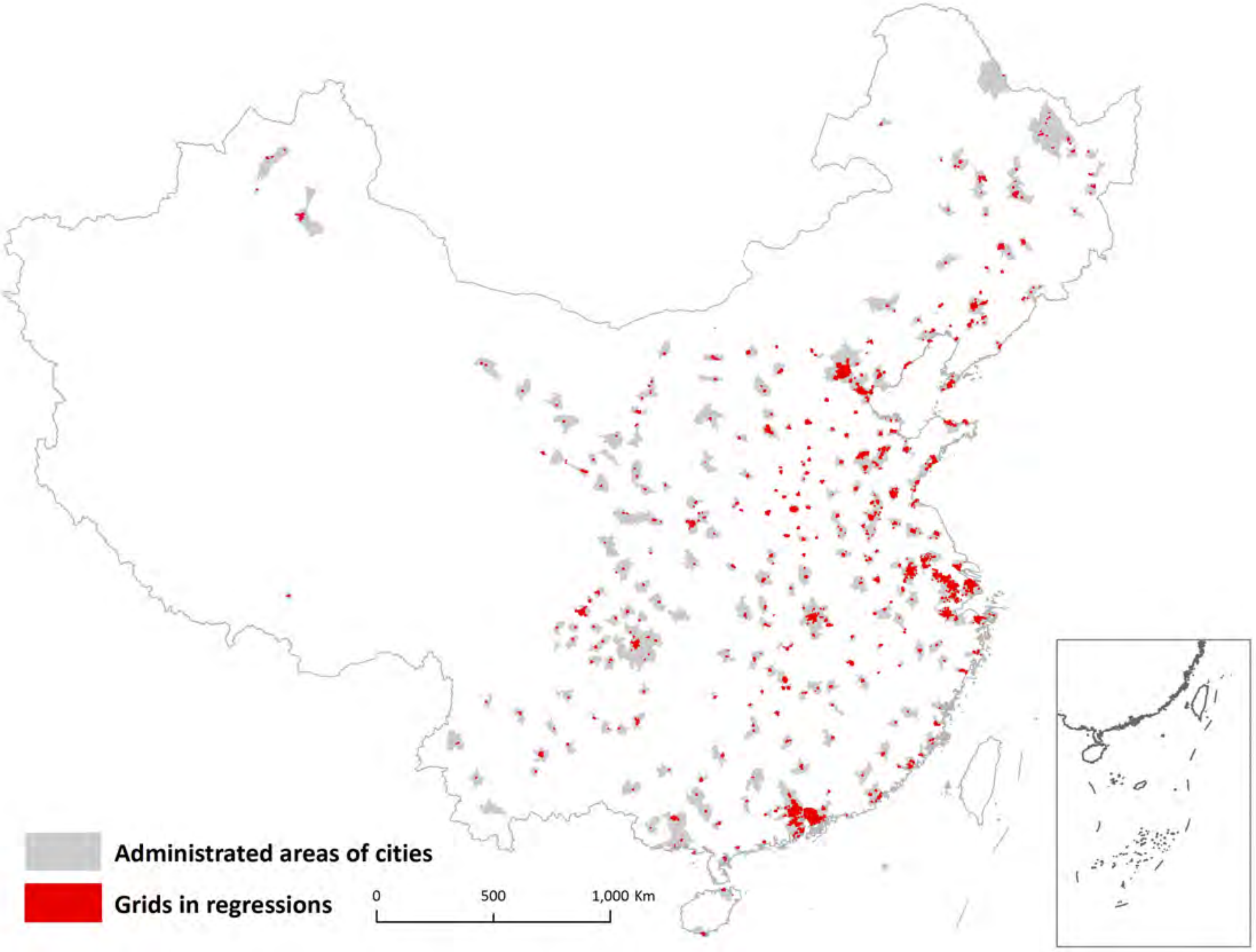
- # road intersections for each urban block to represent urban design in the spatial dimension
- The Impact of ” Urban Design” on Economic Vitality for Chinese Cities


DIANPING
INTERSECTION
DIANPING
INTERSECTION
Beijing
Beijing
Nanjing
Nanjing
Shanghai
Shanghai
Lahsa
Lahsa
Changchun
Changchun
Luoyang
Luoyang
<= 5
6 - 20
21 - 100
101 - 500
> 500
<= 10
11 - 20
21 - 50
51 - 100
> 100
City center
Legend

2

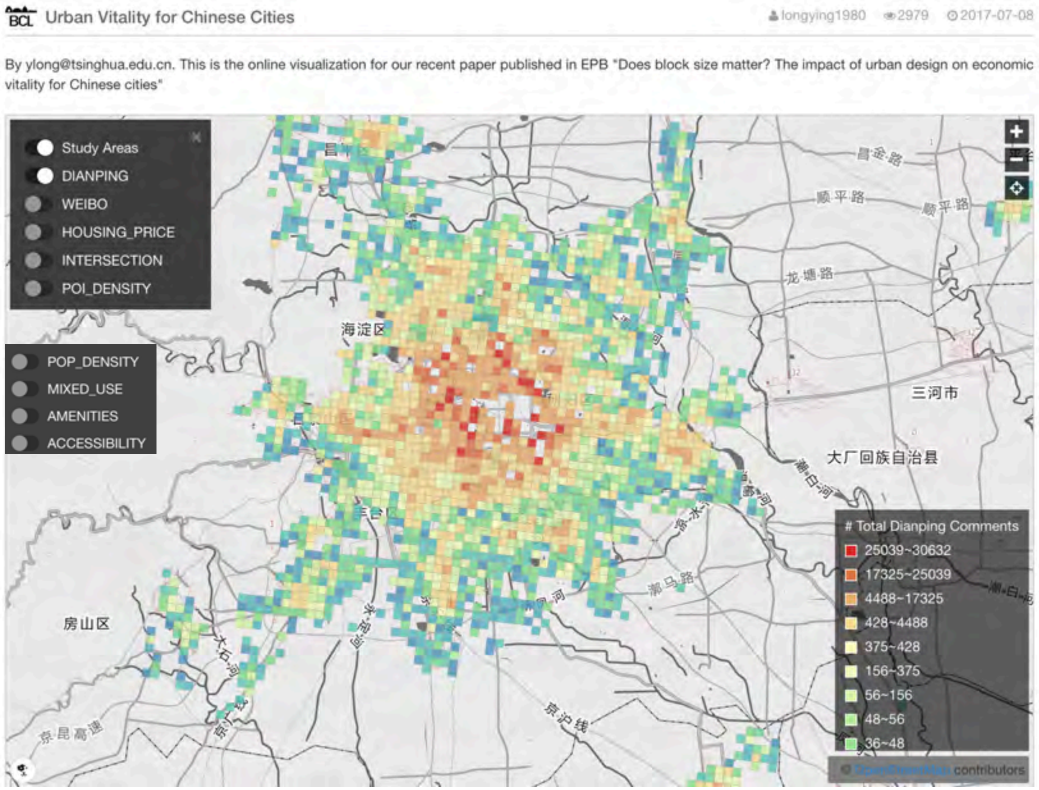
24,512 urban grids in the further analysis

- After this process of improving data quality, of all of the geographic units we aggregated, there were 24,512 urban geographical units in Tier 1, Tier 2, Tier 3, and Tier 4 cities that met the requirements outlined above.
- These 24,512 geographic units are the final units used in this analysis.


Administrated areas of cities
Grids in regressions
0
500
1,000 Km

2

More details about the data used in the study



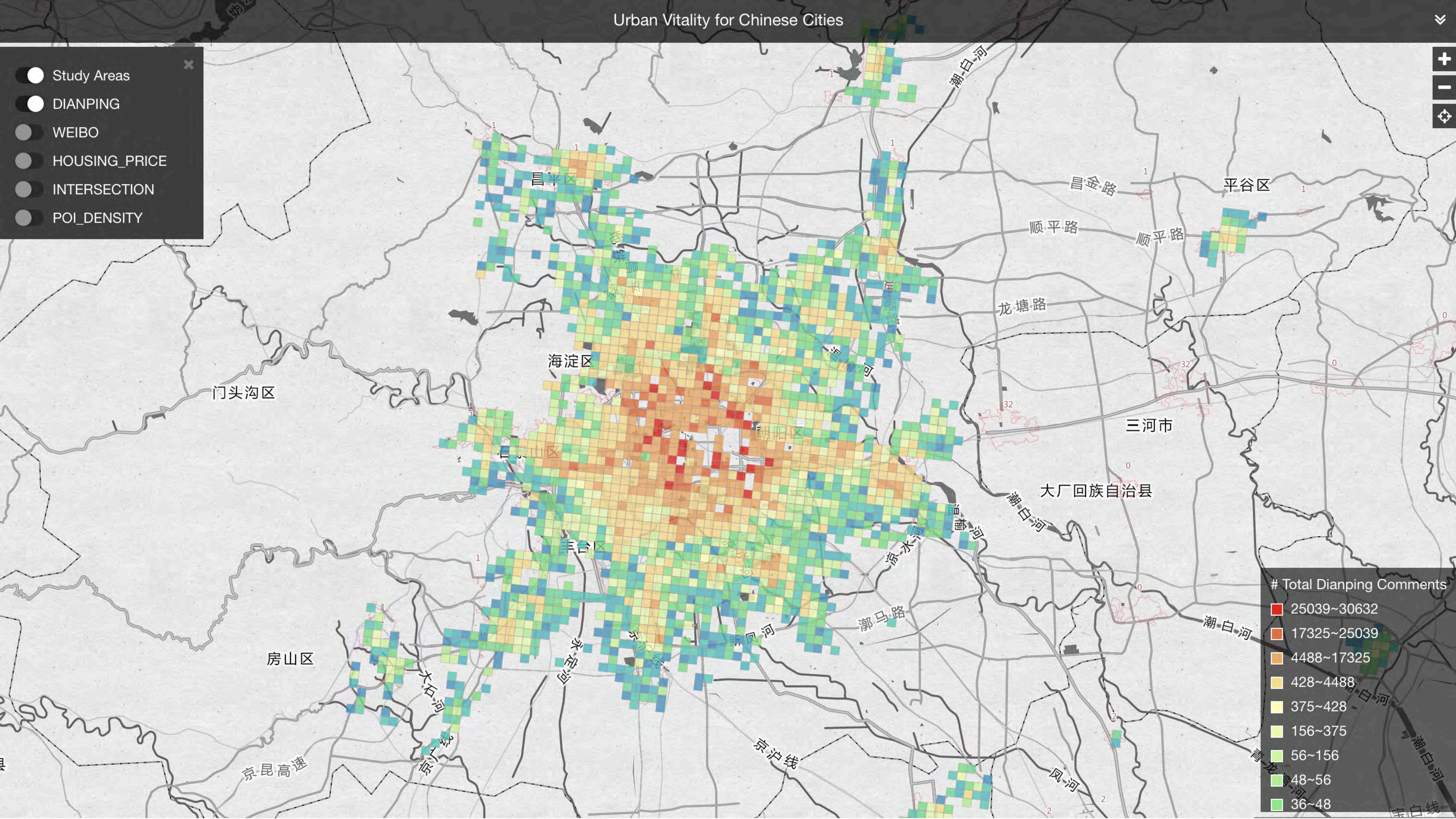
Urban Vitality for Chinese Cities

longying1980 2979 2017-07-08

By ylong@tsinghua.edu.cn. This is the online visualization for our recent paper published in EPB "Does block size matter? The impact of urban design on economic vitality for Chinese cities"

BCL
Study Areas
DIANPING
WEIBO
HOUSING_PRICE
INTERSECTION
POI_DENSITY
POP_DENSITY
MIXED_USE
AMENITIES
ACCESSIBILITY
昌金路
顺平路
顺平路
龙塘路
海淀区
三河市
大厂回族自治县
潮白河
房山区
京沪线
京昆高速
# Total Dianping Comments
25039~30632
17325~25039
4488~17325
428~4488
375~428
156~375
56~156
48~56
36~48
contributors

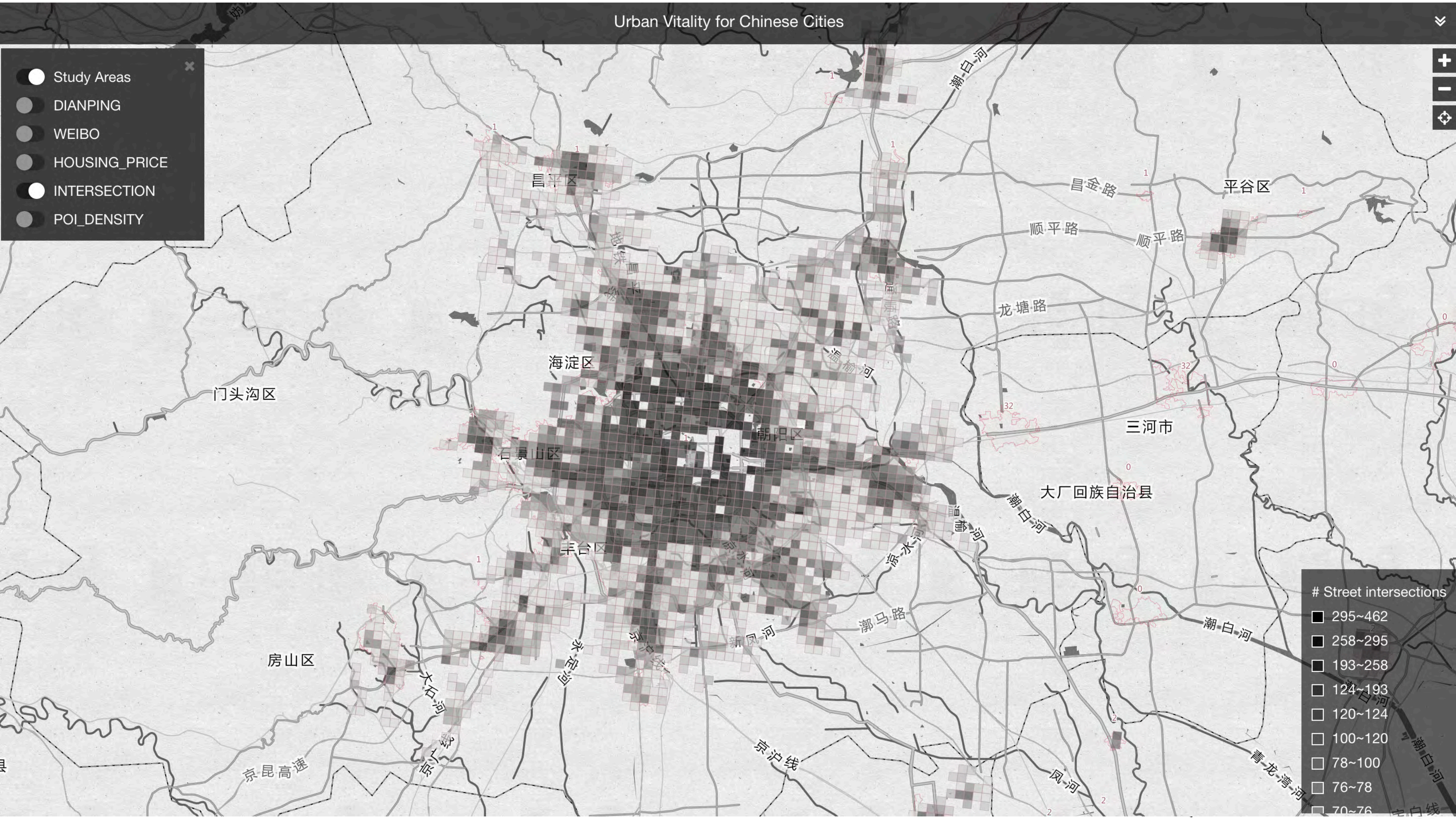
- https://geohey.com/apps/dataviz/2fdcf9c298b9447a8ff7ba528a3243fd/share?ak=ZmYzNmY0ZWJhYjcwNGU2ZGExNDgxMWUxNmZiOWNhNGY
- **http://geohey.com/gallery/bcl**



Urban Vitality for Chinese Cities

- ● Study Areas
- ● DIANPING
- ○ WEIBO
- ○ HOUSING_PRICE
- ○ INTERSECTION
- ○ POI_DENSITY

# Total Dianping Comments
🟥 25039~30632
🟧 17325~25039
🟧 4488~17325
🟨 428~4488
🟨 375~428
🟩 156~375
🟩 56~156
🟩 48~56
🟩 36~48
昌平区
海淀区
门头沟区
石景山区
朝阳区
丰台区
房山区
平谷区
三河市
大厂回族自治县
昌金路
顺平路
顺平路
龙塘路
潮白河
潮白河
潮白河
温榆河
京沪线
京昆高速
永定河
大石河
新凤河
漷马路
凤河



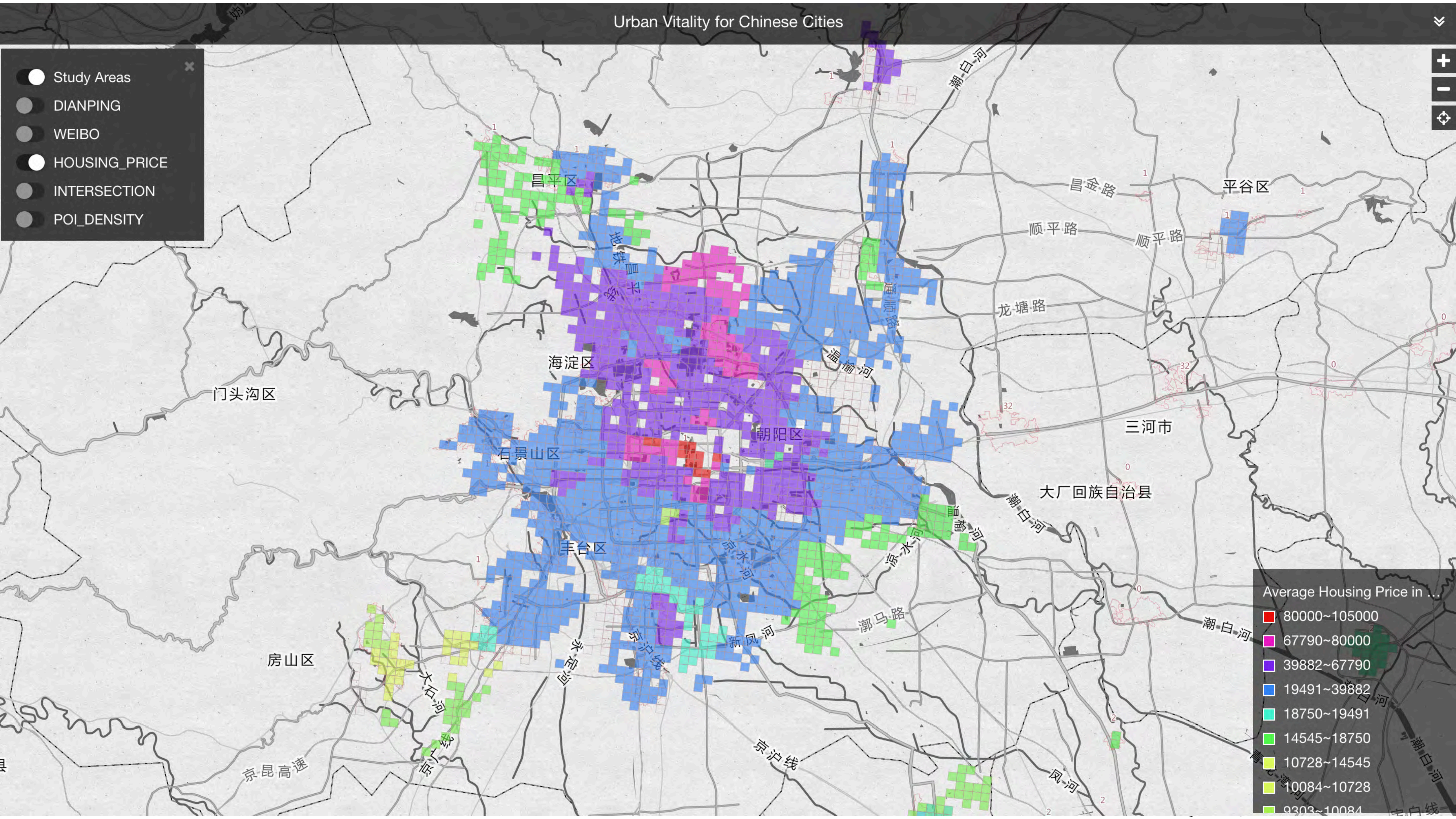
Urban Vitality for Chinese Cities

● Study Areas
○ DIANPING
○ WEIBO
○ HOUSING_PRICE
● INTERSECTION
○ POI_DENSITY

Street intersections

■	295~462
■	258~295
■	193~258
■	124~193
■	120~124
■	100~120
■	78~100
■	76~78
■	70~76

昌平区
平谷区
昌金路
顺平路
顺平路
龙塘路
海淀区
门头沟区
朝阳区
石景山区
三河市
大厂回族自治县
丰台区
房山区
潮白河
温榆河
凉水河
新凤河
永定河
大石河
京昆高速
京沪线
凤河
通马路
青龙湾河



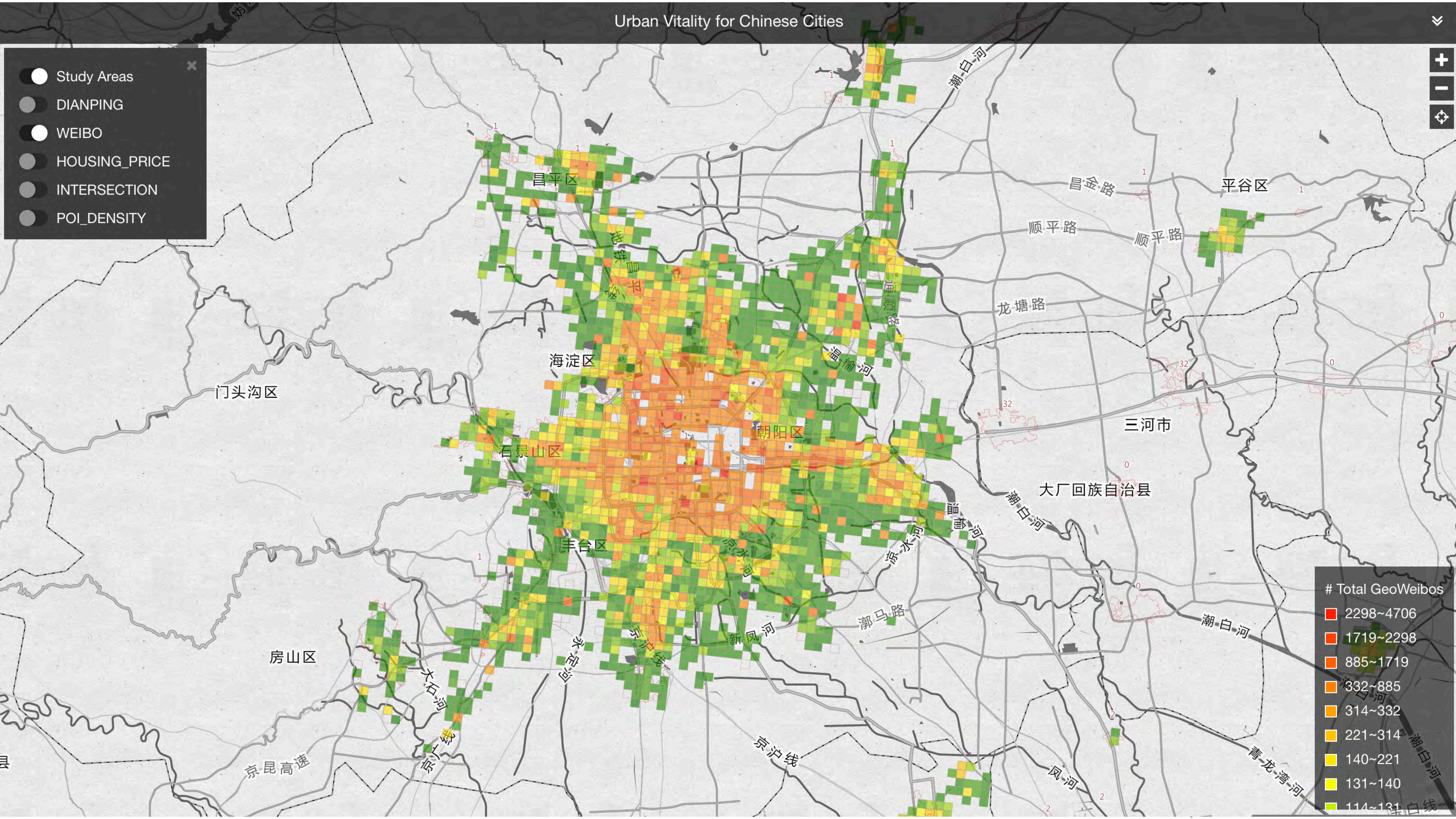
Urban Vitality for Chinese Cities

● Study Areas
○ DIANPING
○ WEIBO
● HOUSING_PRICE
○ INTERSECTION
○ POI_DENSITY

Average Housing Price in ...

🟥	80000~105000
🟪	67790~80000
🟪	39882~67790
🟦	19491~39882
🟦	18750~19491
🟩	14545~18750
🟨	10728~14545
🟨	10084~10728
🟩	9303~10084

昌平区
地铁昌平线
海淀区
门头沟区
石景山区
朝阳区
丰台区
房山区
平谷区
三河市
大厂回族自治县
昌金路
顺平路
龙塘路
潮白河
温榆河
凉水河
新凤河
漷马路
永定河
大石河
京沪线
京昆高速
凤河


Urban Vitality for Chinese Cities
Study Areas
DIANPING
WEIBO
HOUSING_PRICE
INTERSECTION
POI_DENSITY
# Total GeoWeibos
🟥 2298~4706
🟥 1719~2298
🟧 885~1719
🟧 332~885
🟧 314~332
🟨 221~314
🟨 140~221
🟨 131~140
114~131
昌平区
海淀区
门头沟区
石景山区
朝阳区
丰台区
房山区
平谷区
三河市
大厂回族自治县
昌金路
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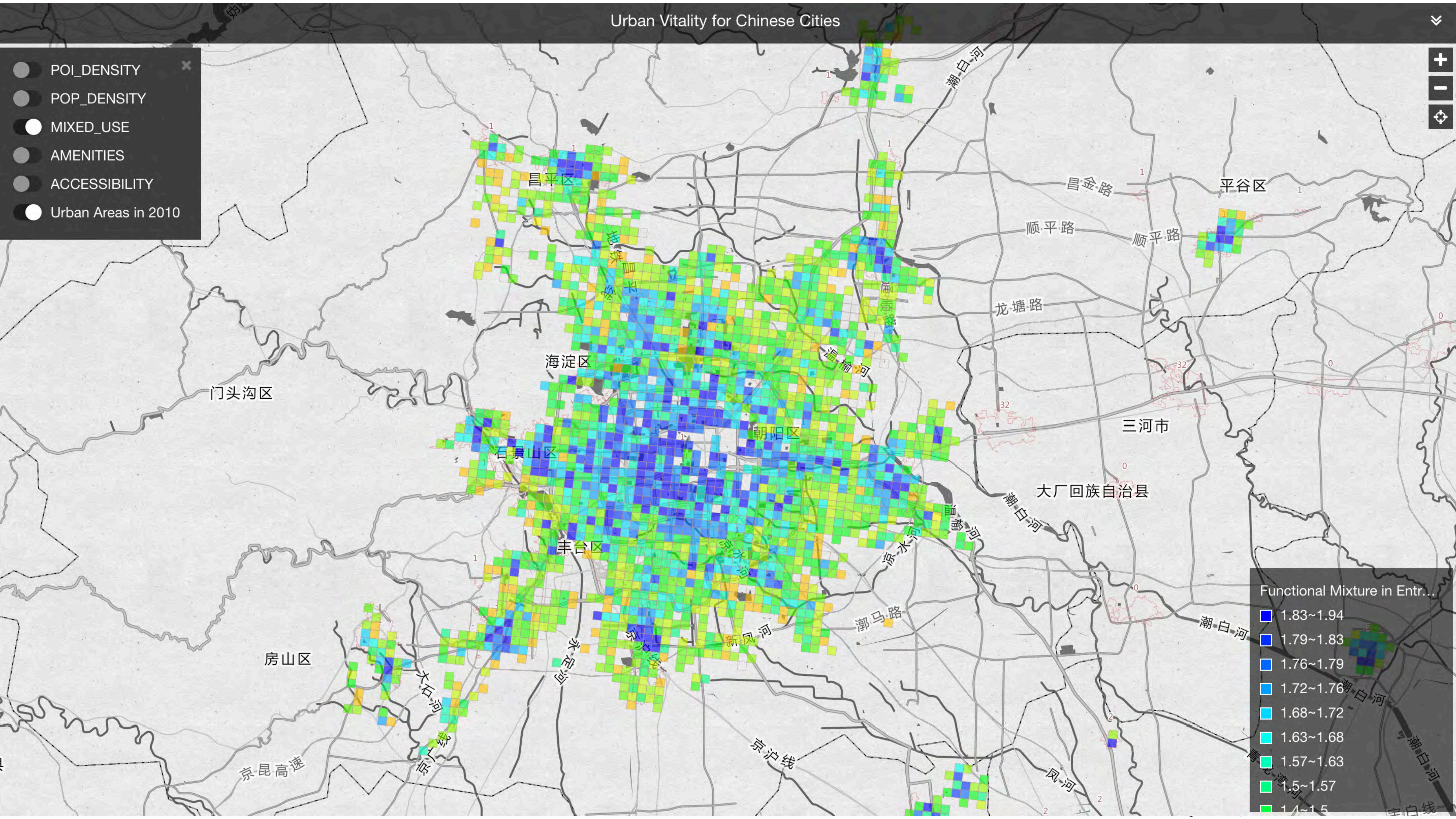
潮白河
温榆河
京沪线
京昆高速
潮马路
新凤河
永定河
大石河
凤河
青龙湾河



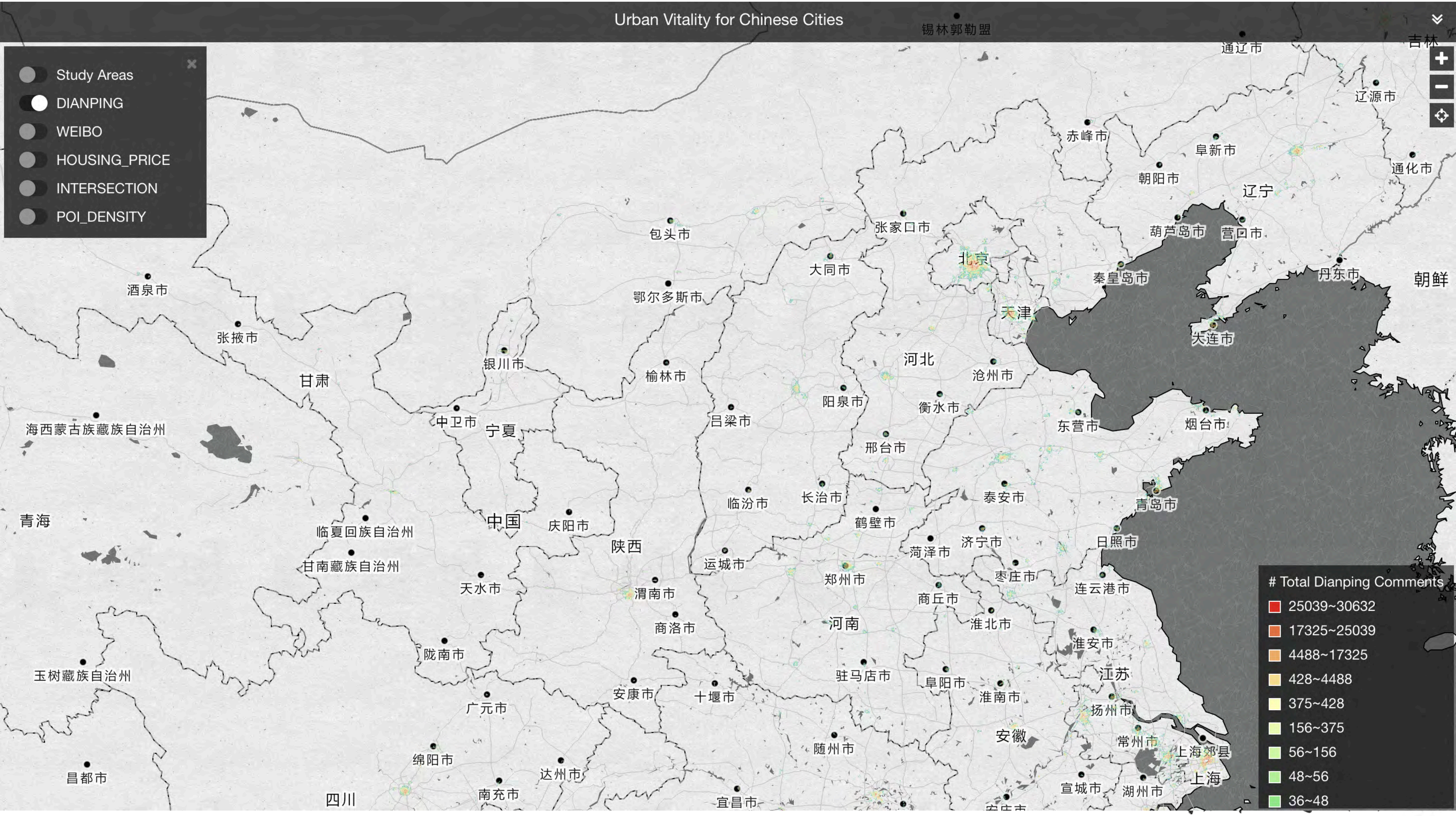
Urban Vitality for Chinese Cities

○ POI_DENSITY
○ POP_DENSITY
● MIXED_USE
○ AMENITIES
○ ACCESSIBILITY
● Urban Areas in 2010

Functional Mixture in Entr...

🟦	1.83~1.94
🟦	1.79~1.83
🟦	1.76~1.79
🟦	1.72~1.76
🟦	1.68~1.72
🟦	1.63~1.68
🟩	1.57~1.63
🟩	1.5~1.57
🟩	1.4~1.5

昌平区
平谷区
昌金路
顺平路
顺平路
龙塘路
海淀区
门头沟区
三河市
朝阳区
石景山区
大厂回族自治县
丰台区
潮白河
温榆河
凉水河
漷马路
新凤河
永定河
大石河
房山区
京沪线
京昆高速
凤河
潮白河

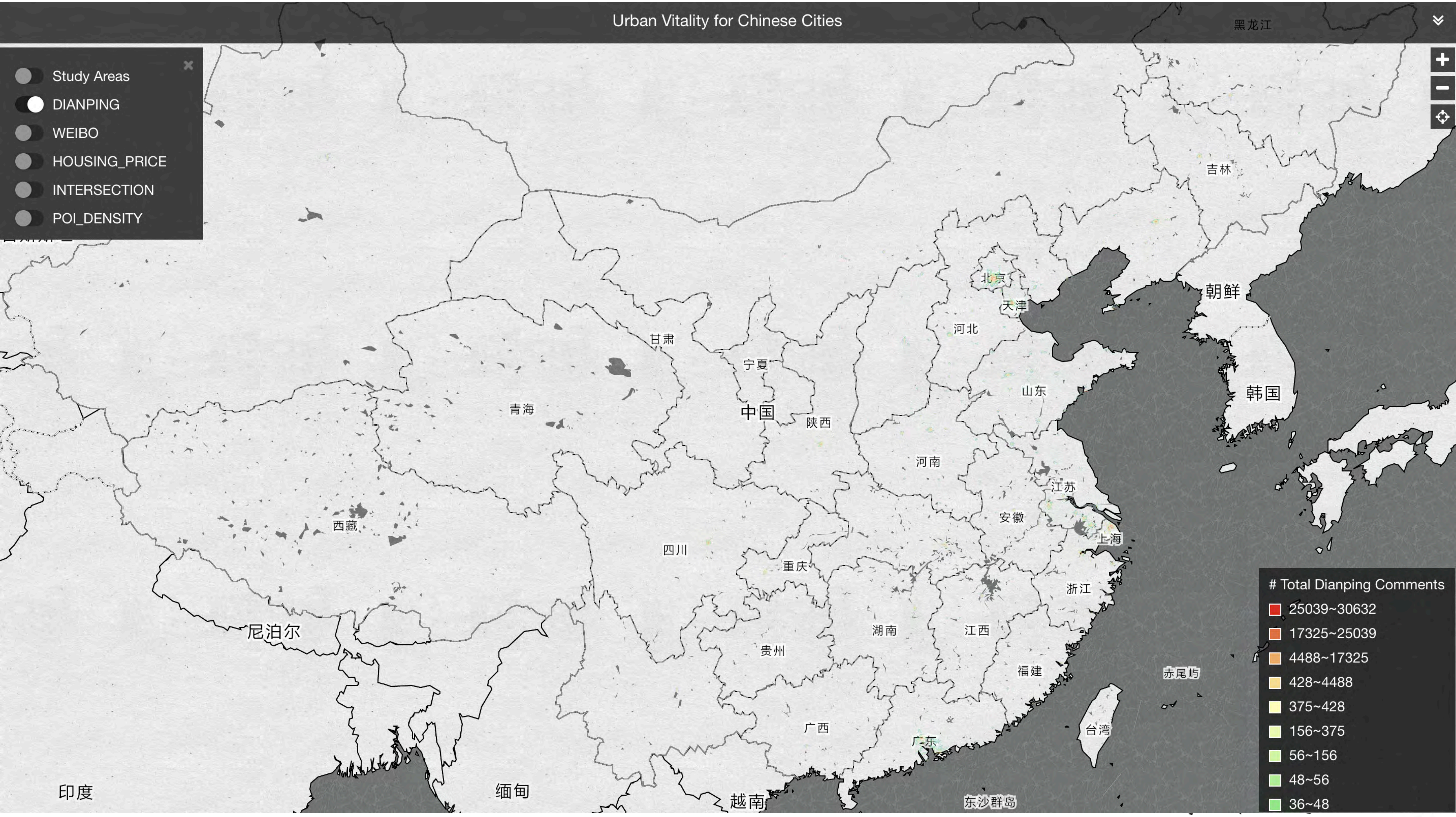


Urban Vitality for Chinese Cities

○ Study Areas
● DIANPING
○ WEIBO
○ HOUSING_PRICE
○ INTERSECTION
○ POI_DENSITY

Total Dianping Comments
🟥 25039~30632
🟧 17325~25039
🟧 4488~17325
🟨 428~4488
🟨 375~428
🟩 156~375
🟩 56~156
🟩 48~56
🟩 36~48

锡林郭勒盟
通辽市
吉林
辽源市
赤峰市
阜新市
通化市
朝阳市
辽宁
葫芦岛市
营口市
包头市
张家口市
北京
秦皇岛市
丹东市
朝鲜
酒泉市
大同市
鄂尔多斯市
天津
大连市
张掖市
银川市
河北
甘肃
榆林市
沧州市
阳泉市
衡水市
东营市
烟台市
海西蒙古族藏族自治州
中卫市
宁夏
吕梁市
邢台市
泰安市
青岛市
长治市
临汾市
青海
中国
庆阳市
鹤壁市
临夏回族自治州
济宁市
日照市
陕西
菏泽市
甘南藏族自治州
运城市
郑州市
枣庄市
连云港市
天水市
渭南市
商丘市
商洛市
河南
淮北市
淮安市
陇南市
江苏
玉树藏族自治州
驻马店市
阜阳市
安康市
十堰市
淮南市
扬州市
广元市
安徽
常州市
上海郊县
绵阳市
随州市
达州市
上海
昌都市
宣城市
湖州市
四川
南充市
宜昌市
安庆市



Urban Vitality for Chinese Cities

○ Study Areas
● DIANPING
○ WEIBO
○ HOUSING_PRICE
○ INTERSECTION
○ POI_DENSITY

Total Dianping Comments
🟥 25039~30632
🟧 17325~25039
🟧 4488~17325
🟨 428~4488
🟨 375~428
🟨 156~375
🟩 56~156
🟩 48~56
🟩 36~48

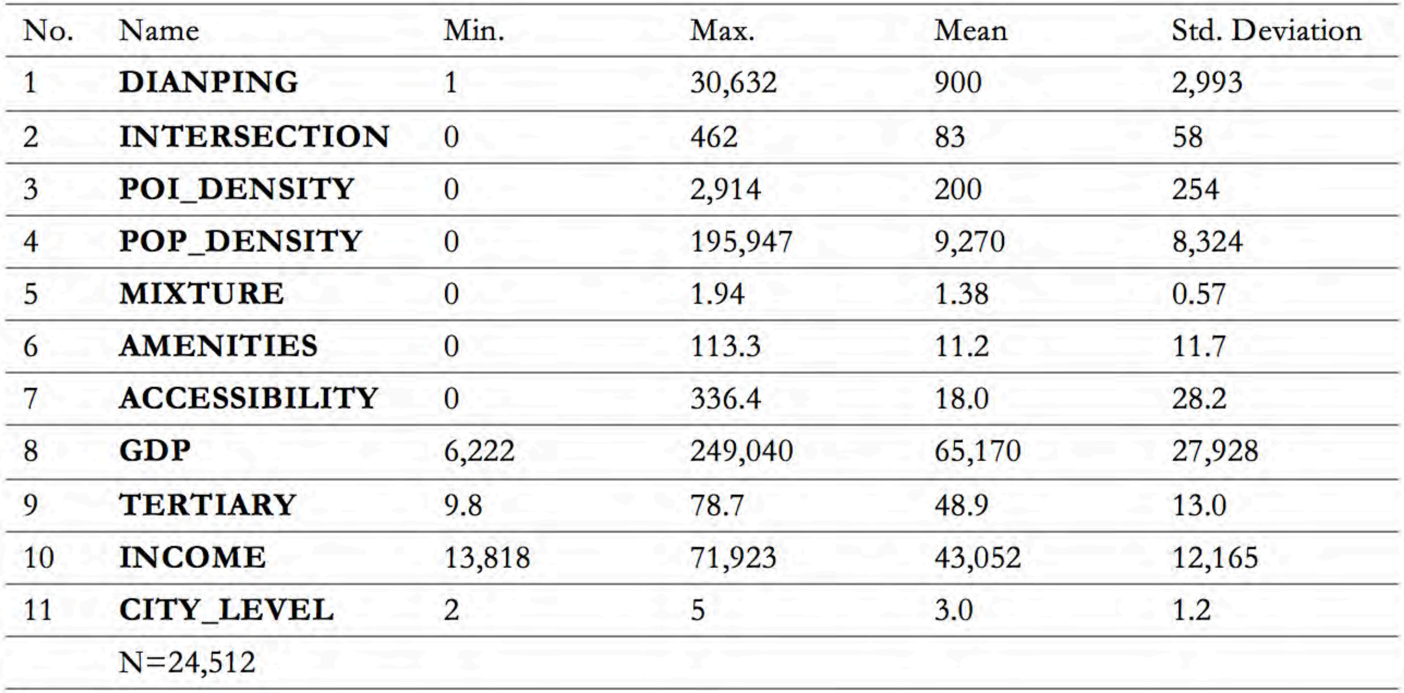
黑龙江
吉林
北京
天津
河北
朝鲜
韩国
甘肃
宁夏
山东
青海
中国
陕西
河南
江苏
安徽
上海
西藏
四川
重庆
浙江
尼泊尔
湖南
江西
贵州
福建
赤尾屿
台湾
广西
广东
印度
缅甸
越南
东沙群岛

$$
\begin{aligned}
\mathrm{Ln(DIANPING)} = \text{ß}0 &+ \text{ß}_1 * \mathrm{INTERSECTION} \\
&+ \text{ß}_2 * \mathrm{POI\_DENSITY} + \text{ß}_3 * \mathrm{POP\_DENSITY} \\
&+ \text{ß}_4 * \mathrm{MIXTURE} + \text{ß}_5 * \mathrm{AMENITIES} \\
&+ \text{ß}_6 * \mathrm{ACCESSIBILITY} + \text{ß}_7 * \mathrm{GDP} + \text{ß}_8 * \mathrm{TERTIARY} \\
&+ \text{ß}_9 * \mathrm{INCOME} + \text{ß}_{10} * \mathrm{CITY\_LEVEL}
\end{aligned}
$$

3 Results

3 The profile of variables in regressions

- The dependent variable DIANPING, representing total number of comments accrued per geographical unit ranges from 1 to 30,632 per km^2 and exhibits a long-tailed distribution, shows that there are more units with a very high number of comments than units with a very low number. To balance this, we take the natural log of DIANPING for the regressions.
- AMENITIES and ACCESSIBILITY are long-tailed distributed as well.
- In contrast, INTERSECTION, ranging from 0 to 462 intersections per square kilometer, exhibits a left-skewed normal distribution.
- MIXTURE is right-skewed and normally distributed.



No.	Name	Min.	Max.	Mean	Std. Deviation
1	**DIANPING**	1	30,632	900	2,993
2	**INTERSECTION**	0	462	83	58
3	**POI_DENSITY**	0	2,914	200	254
4	**POP_DENSITY**	0	195,947	9,270	8,324
5	**MIXTURE**	0	1.94	1.38	0.57
6	**AMENITIES**	0	113.3	11.2	11.7
7	**ACCESSIBILITY**	0	336.4	18.0	28.2
8	**GDP**	6,222	249,040	65,170	27,928
9	**TERTIARY**	9.8	78.7	48.9	13.0
10	**INCOME**	13,818	71,923	43,052	12,165
11	**CITY_LEVEL**	2	5	3.0	1.2
	N=24,512				

3 The positive contribution of intersection density on economic vitality

- **All variables pass correlation analysis and VIF examinations, showing that there is no multicollinearity**
- **We use several regression models to understand the effect of urban form on economic vitality.**
- **All three models suggest that intersection density positively contributes to economic vitality and it is also the most important factor compared to all other variables used in the model.**

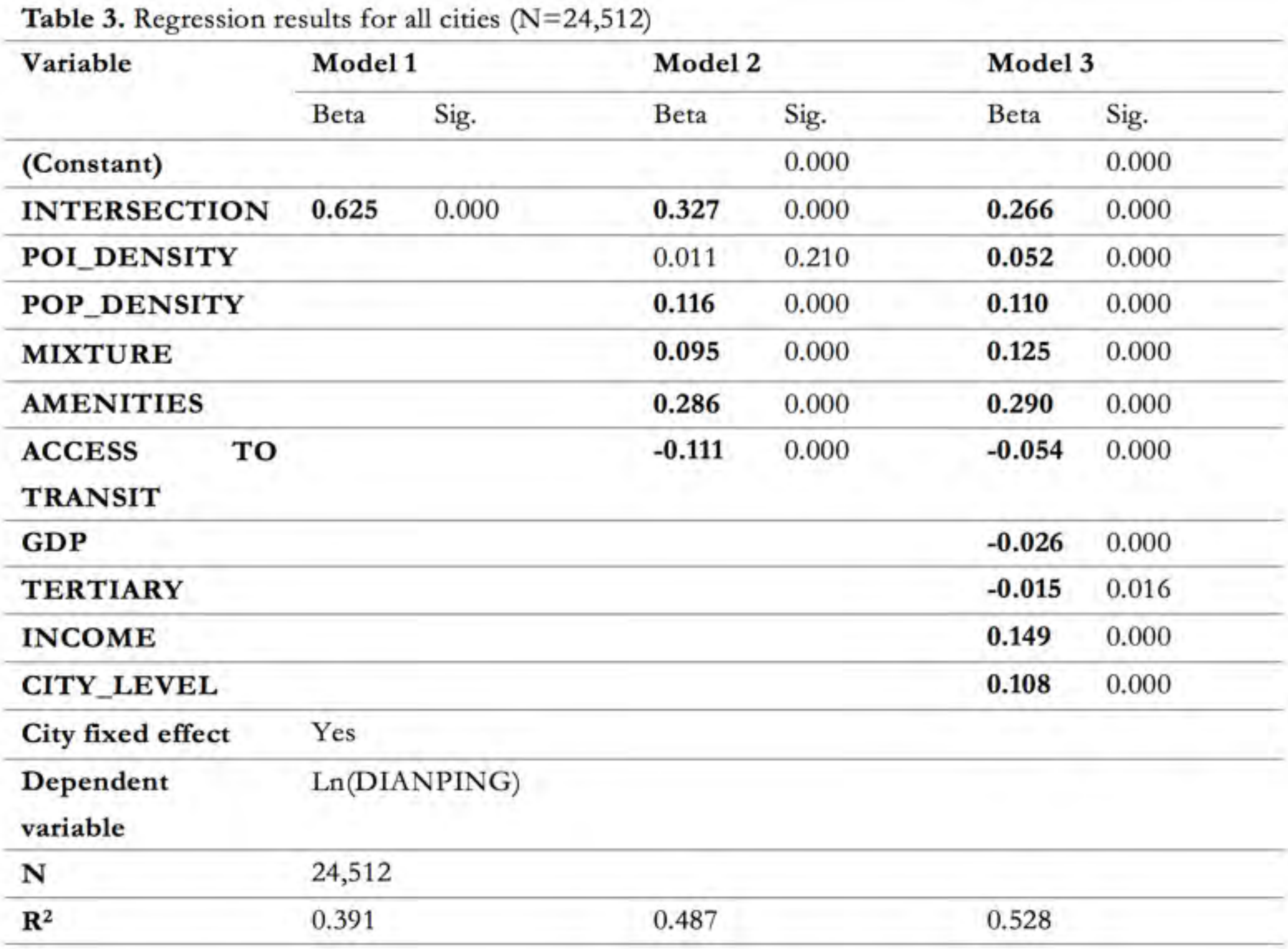


Table 3. Regression results for all cities (N=24,512)

Variable	Model 1		Model 2		Model 3	
	Beta	Sig.	Beta	Sig.	Beta	Sig.
(Constant)				0.000		0.000
INTERSECTION	**0.625**	0.000	**0.327**	0.000	**0.266**	0.000
POI_DENSITY			0.011	0.210	**0.052**	0.000
POP_DENSITY			**0.116**	0.000	**0.110**	0.000
MIXTURE			**0.095**	0.000	**0.125**	0.000
AMENITIES			**0.286**	0.000	**0.290**	0.000
ACCESS TO TRANSIT			**-0.111**	0.000	**-0.054**	0.000
GDP					**-0.026**	0.000
TERTIARY					**-0.015**	0.016
INCOME					**0.149**	0.000
CITY_LEVEL					**0.108**	0.000
City fixed effect	Yes					
Dependent variable	Ln(DIANPING)					
N	24,512					
R^2	0.391		0.487		0.528	

3 The positive effect holds for all categories of cities

- **The regression results based on administrative level still show that intersection density and the other urban design indicators have a positive effect on economic vitality. Moreover, we find that the effect is larger for the highest tier cities.**

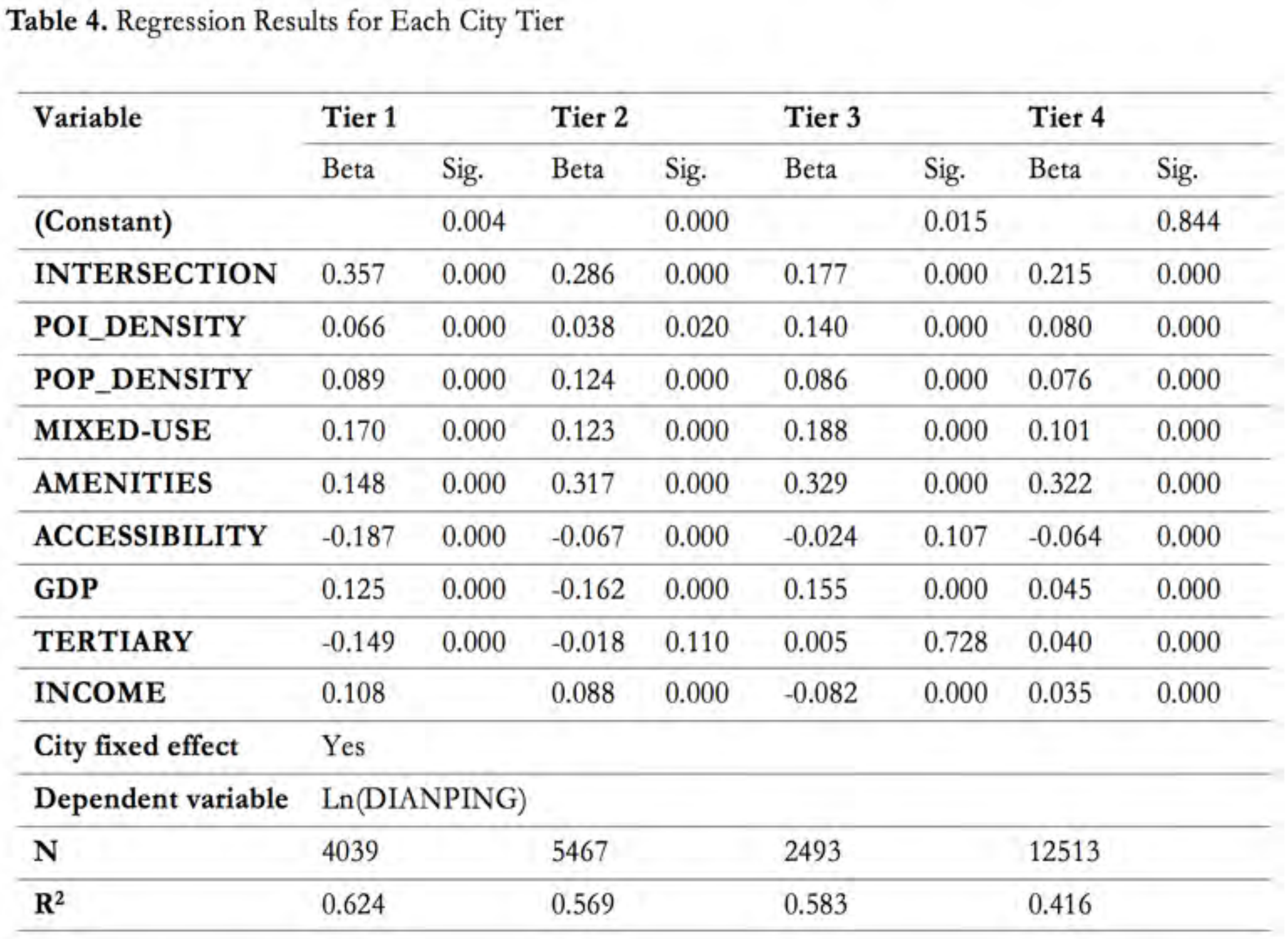


Table 4. Regression Results for Each City Tier

Variable	Tier 1		Tier 2		Tier 3		Tier 4	
	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.
(Constant)		0.004		0.000		0.015		0.844
INTERSECTION	0.357	0.000	0.286	0.000	0.177	0.000	0.215	0.000
POI_DENSITY	0.066	0.000	0.038	0.020	0.140	0.000	0.080	0.000
POP_DENSITY	0.089	0.000	0.124	0.000	0.086	0.000	0.076	0.000
MIXED-USE	0.170	0.000	0.123	0.000	0.188	0.000	0.101	0.000
AMENITIES	0.148	0.000	0.317	0.000	0.329	0.000	0.322	0.000
ACCESSIBILITY	-0.187	0.000	-0.067	0.000	-0.024	0.107	-0.064	0.000
GDP	0.125	0.000	-0.162	0.000	0.155	0.000	0.045	0.000
TERTIARY	-0.149	0.000	-0.018	0.110	0.005	0.728	0.040	0.000
INCOME	0.108		0.088	0.000	-0.082	0.000	0.035	0.000
City fixed effect	Yes							
Dependent variable	Ln(DIANPING)							
N	4039		5467		2493		12513	
R^2	0.624		0.569		0.583		0.416	

3 The effect of road intersection on other dimensions of urban vitality

- **We look at the average residential housing price per one square kilometer unit and also Sina Weibo records.**
  - **400,000 housing price records from www.Soufun.com**
  - **30.3 million Weibo records that had geographical information from www.weibo.com**
- **The effect still holds for both models.**
- **And for each category of cities as well.**

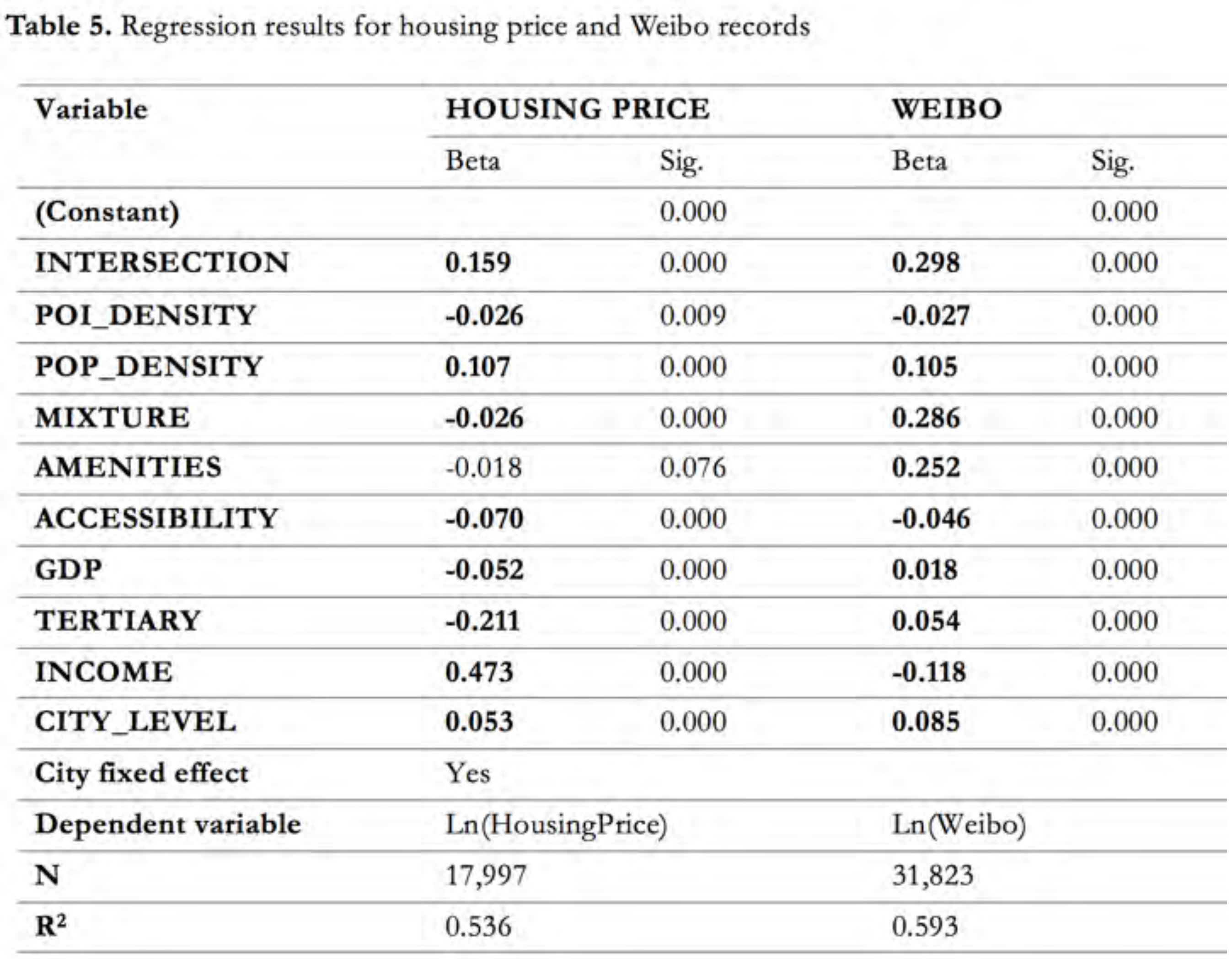


Table 5. Regression results for housing price and Weibo records

Variable	HOUSING PRICE		WEIBO	
	Beta	Sig.	Beta	Sig.
(Constant)		0.000		0.000
INTERSECTION	**0.159**	0.000	**0.298**	0.000
POI_DENSITY	**-0.026**	0.009	**-0.027**	0.000
POP_DENSITY	**0.107**	0.000	**0.105**	0.000
MIXTURE	**-0.026**	0.000	**0.286**	0.000
AMENITIES	-0.018	0.076	**0.252**	0.000
ACCESSIBILITY	**-0.070**	0.000	**-0.046**	0.000
GDP	**-0.052**	0.000	**0.018**	0.000
TERTIARY	**-0.211**	0.000	**0.054**	0.000
INCOME	**0.473**	0.000	**-0.118**	0.000
CITY_LEVEL	**0.053**	0.000	**0.085**	0.000
City fixed effect	Yes			
Dependent variable	Ln(HousingPrice)		Ln(Weibo)	
N	17,997		31,823	
R^2	0.536		0.593	

4 Discussion

4 Concluding remarks

- A data intensive urban study
  - Multiple emerging big/open datasets
  - 24,512 urban grids
  - 286 Chinese cities

- Yes, the block size really matters!
  - Findings from the whole city system, rather a single city
  - Findings hold for each category of cities
  - For each dimension of urban vitality as well

- Informing our findings to stakeholders
  - Real estate developers
  - Local decision makers
  - Planners and designers

4 Potential practical applications

- The positive effect of intersection density on economic vitality should encourage real estate developers to propose urban planning schemes with smaller blocks.
  - Through our sponsor Energy Innovation who has been working with World Bank
- Our findings should also be considered by local governments and developers when creating long-term urban development plans.
  - Through our sponsor Energy Innovation who has been working with World Bank
- The database that we created for this analysis will be released in the public domain. We hope that the shared dataset can be used for other urban studies as well.

4 Next steps

- **Extending the study to the urban block level**
- **Collecting more emerging new (big) urban data as a proxy of urban vitality**
- **Zooming into a specific city and combining field survey with data analysis**

- **From UNDERSTANDING to CREATING**
  - **Data Augmented Design**

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