2018 | Q2

Traffic Analysis Reports
Of Major Cities in China

高德地图
amap.com

The Statement

This research report is made by AutoNavi Traffic Big-data Team of AutoNavi Software Co., and its entire contents are for reference only. The report is made via big data mining and calculation based on AutoNavi accumulated massive traffic and travel data. The generic algorithms and theories ensure its rationality and scientificity. The report uses the “congestion delay index” as a metric for urban congestion, i.e., the ratio of urban residents’ average actual travel time for one outgoing to their travel time under free flowing. From the perspective of traffic travelers, the index express the time costs imposed on travelers due to traffic congestion in a simple and understandable way. This report objectively reflects, in multiple dimensions, the traffic congestions in cities and the solution for relieving congestions in an as much accurate, detailed and precise way as possible, which provides valuable theoretical reference for government decision making.

- For more information about the data of urban congestion in your city, please visit: http://report.amap.com/
- Thanks for your attention, please wait for more research publication coming soon

Report Description

AutoNavi’ s massive traffic data is composed of traffic vehicle data and 700 million + AutoNavi users’ data

Cities

364 cities+ national wide highway

Select

100 cities

* Select urban planning central areas or built-up areas as an evaluation range of overall urban road network
* Select major cities with large enough data samples for congestion ranking and level computing
* AutoNavi traffic big-data can support 364 Chinese cities in terms of traffic index analysis and calculation
* No public transportation data was included for traffic flow calculation in report

Data

All day：06:00~22:00 Morning Peak: 07:00~09:00 Evening Peak: 17:00~19:00

$$\text{Congestion delay index} = \frac{\text{Peak travel time}}{\text{Free-flow (non-congestion) travel time}}$$

See Appendix A for details

* Higher Index means higher level of congestion level

Time

Whole day：06:00~22:00 Morning peak：07:00~09:00 Evening peak：17:00~19:00

* If no specified, the statistical time periods for this report was from Apr.1st to Jun. 30th 2018

Summary

“Traffic Analysis Reports for Major Cities in China” is proposed by AutoNavi, and it is based on AutoNavi traffic big-data publishing platform, data open platform, Ali cloud MaxCompute and related data mining technology support . The report describes the urban congestion level, presents the congestion change rules, predicts the future development trend, and focuses on the congestion causes and countermeasures. This first quarterly report is jointly published by “Joint Laboratory for Future Transport and Urban Computing”, Transport Planning and Research Institute of the Ministry of Transport, Tsinghua-Daimler Joint Research Center for Sustainable Transportation, Ali Cloud and other organizations. AutoNavi is willing to open our data to governments, enterprises or education institutions, in order to build a traffic community together.

Cooperate organization

Joint Laboratory for Future Transport and Urban Computing

清華大學 DAIMLER 可持续交通联合研究中心
Tsinghua-Daimler Joint Research Center for Sustainable Transportation

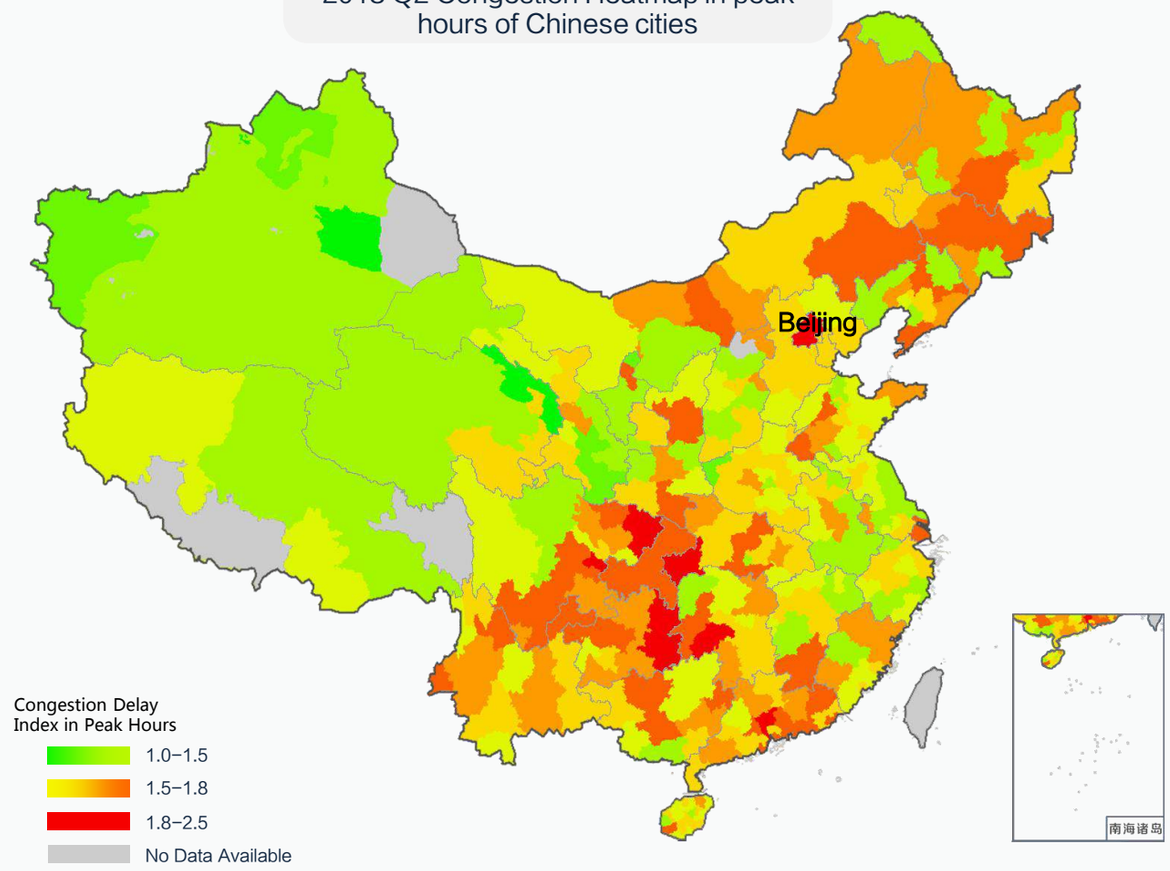
Alibaba Cloud

Urban Congestion Portrait

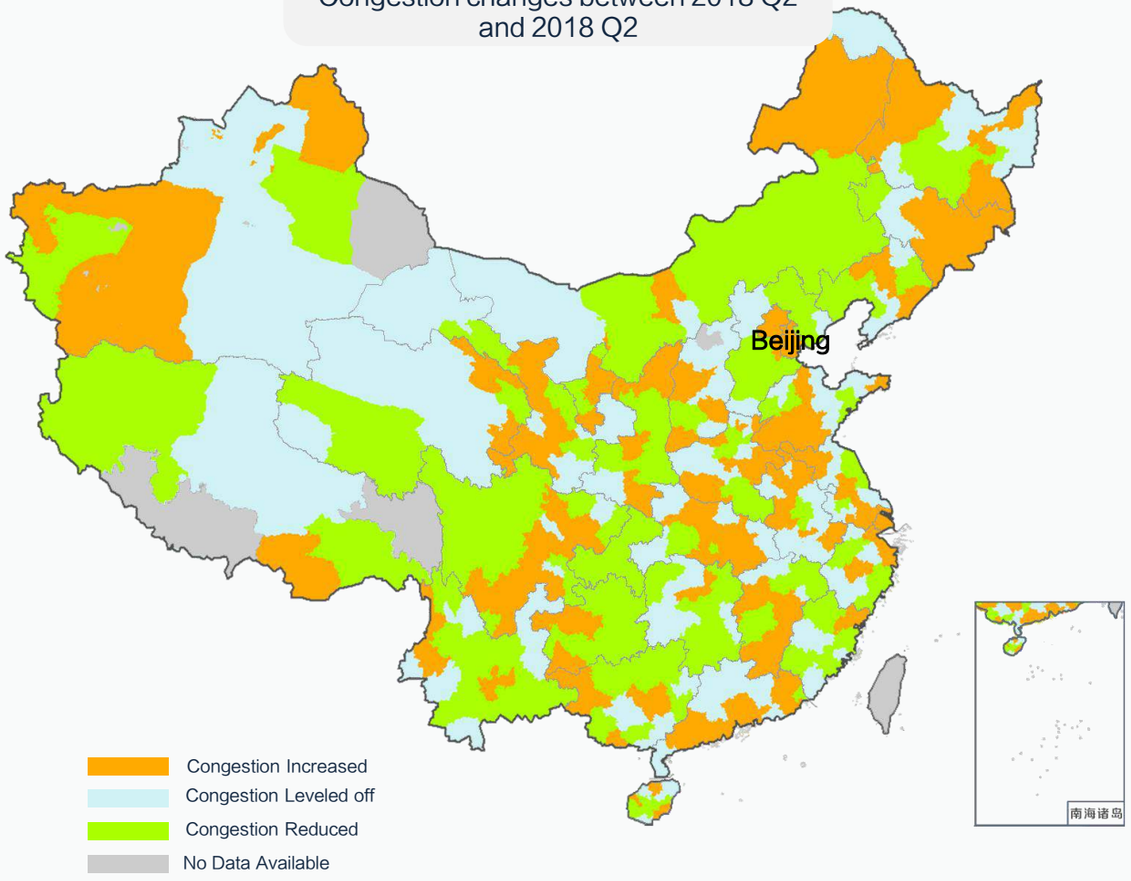
Congestion Delay Index — The index leveled off or reduced for 62% of all recorded cities compared to 2017 Q2

For all recorded 361 cities from AutoNavi big data analysis platform, during peak hours, 15% of cities was congested, 59% of cities had slow driving speed, and only 26% of cities was without congestion. Compared to 2017 Q2, in 2018 Q2, 32% of cities' congestion level were reduced, 30% of cites' congestion level kept still and 38% of cities had their congestion increased. Among all cities, the congestion of southern Shandong province and the coastal cities of Guangdong increased comparably more, but cities such as Inner Mongolia, Yunnan, Guizhou have their congestion reduced comparably more.

2018 Q2 Congestion Heatmap in peak hours of Chinese cities



Congestion changes between 2018 Q2 and 2018 Q2



Congestion Delay Index — The top 10 congested cities in peak hours in 2018 Q2

Beijing was back to the top congested list, and Guangzhou was followed by Beijing in 2018

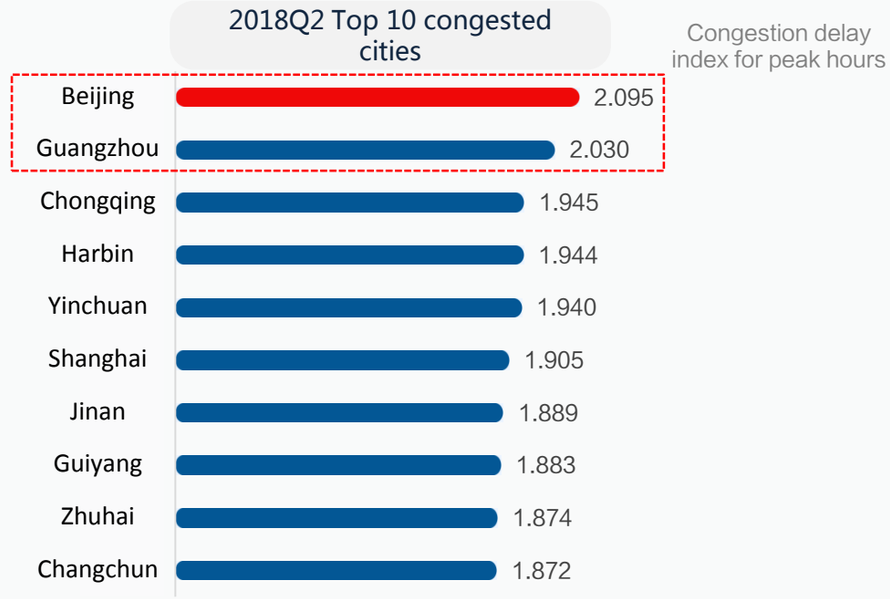
According to the recorded 100 cities from AutoNavi big data Analysis platform, the congestion delay index was 2.095 and 2.030 respectively for Beijing and Guangzhou, two cities ranked top 1 and top 2 respectively in 2018 Q2. The average driving speed was 22.4km/h and 22.60km/h for Beijing and Guangzhou respectively, ranking 9th and 11th at the slowest driving speed. The index of Chongqing, Harbin, Yinchuan and Shanghai was in the second ladder in the list, with the index over 1.90. The index of Jinan, Guizhou, Zhuhai and Changchun was less than 1.90, which was in the third ladder.

Jinan firstly dropped to 7th rank in the list

The index reduced dramatically in Jinan, the congestion of which reduced by 5.7% compared to 2017 Q2. The congestion reduction rate of Jinan ranked 6th among all recorded cities. This reduction was due to the 'camera supervision' action and the network construction of urban expressway.

Guiyang was back to top 10 , and Zhuhai firstly appeared in the list

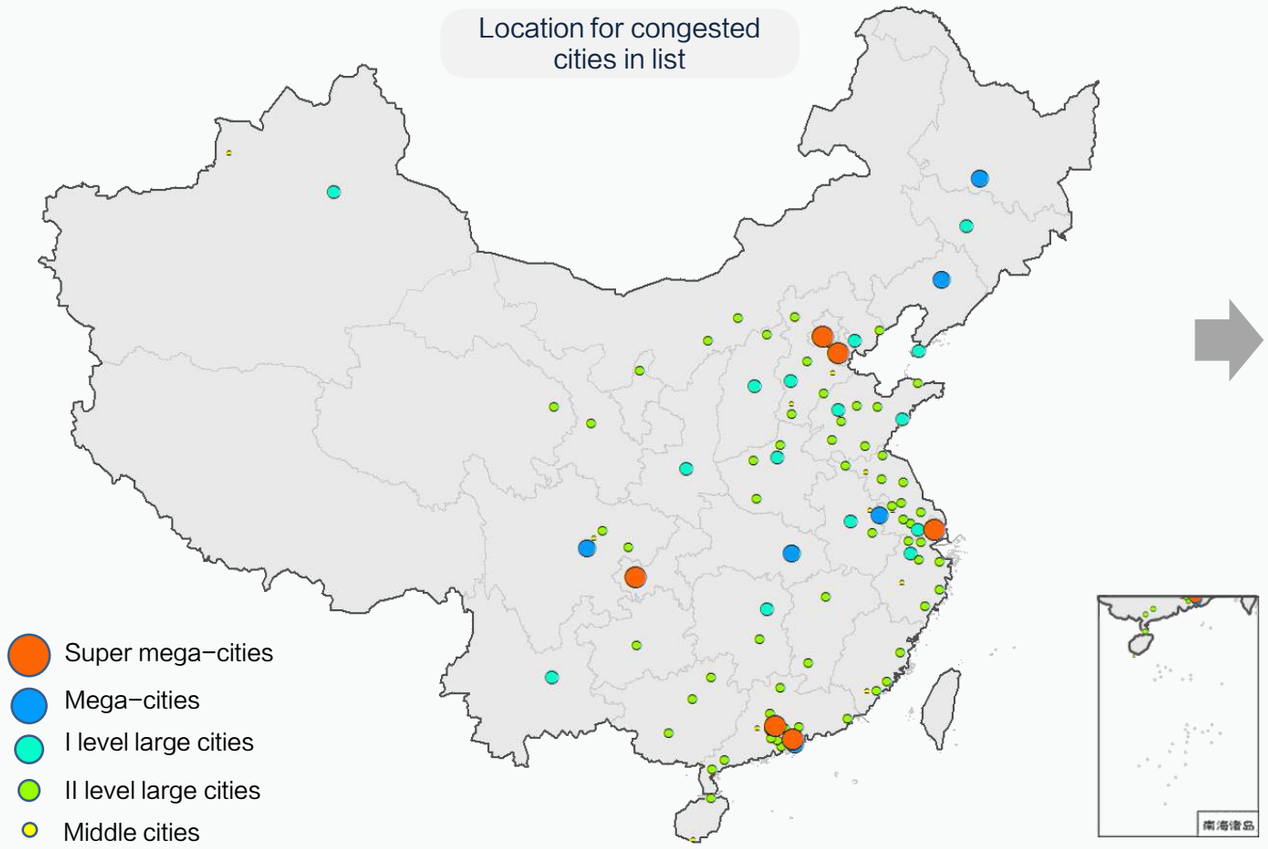
Since license plate restriction policy was imposed, congestion of Guiyang was improved much and the city had not been shown on the list for a long time. However, for 2018 Q2, because of the new policy that common license plate can enter the first ring, Guiyang can be seen on the list again, new policy made the congestion increased by 6.7% in the following two weeks. The reason of Zhuhai firstly shown on the list might due to large scale construction of key points around Tanzhou area.



Congestion Delay Index — Harbin was the most congested cities based on the size of city population and Jinan was the most congested cities among recorded I level large cities

Beijing, Harbin, Jinan, Yinchuan and Xianyang were at the top of each city group based on population size.

According to the different population size of different cities, the major 100 cities have been ranked in order to provide more quantitative reference from more dimension. 100 cities were classified into 5 groups, with 6 for super mega-cities, 5 for mega-cities, 16 for I level large cities, 59 for II level large cities and 13 for middle cities. Among 5 groups, Beijing, Harbin, Jinan, Yinchuan and Xianyang was the top in each group respectively. Harbin was the most congested cities in mega-cities group and Jinan was the most congested cities in I level cities group.

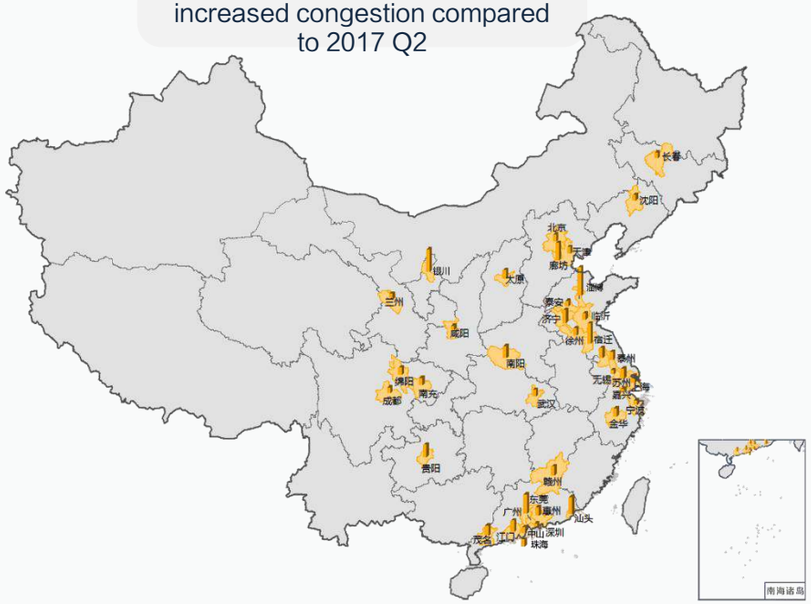


City group	City	Congestion delay index in peak hours	Rank	
Super mega-cities	Beijing	2.095	1	Congestion Feature: Large traffic, excellent infrastructure, large congestion delays but relatively low operational efficiency.
	Guangzhou	2.030	2	
	Chongqing	1.945	3	
	Shanghai	1.905	4	
	Shenzhen	1.832	5	
Mega-cities	Harbin	1.944	1	Congestion Feature: Provincial capital cities, large traffic, highly affected from urban layout and road network structure.
	Chengdu	1.828	2	
	Shenyang	1.807	3	
	Nanjing	1.770	4	
	Wuhan	1.724	5	
I level large cities	Jinan	1.889	1	Congestion Feature: Provincial capitals and developed cities, highly affected from traffic flow and seasonal congestion.
	Changchun	1.872	2	
	Dalian	1.817	3	
	Foshan	1.801	4	
	Kunming	1.790	5	
II level large cities	Yinchuan	1.940	1	Congestion Feature: Cities are relatively small and highly affected from traffic policies and road construction
	Guiyang	1.883	2	
	Zhuhai	1.874	3	
	Hohhot	1.863	4	
	Huizhou	1.839	5	
Middle cities	Xianyang	1.780	1	Congestion Feature: Cities are quite small with low level congestion. Congestion is often due to road construction and traffic policy
	Zhangzhou	1.683	2	
	Jinhua	1.651	3	
	Langfang	1.651	4	
	Suqian	1.642	5	

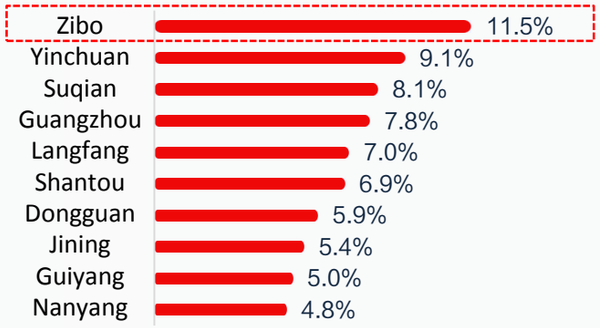
Congestion Delay Index — Congestion reduced or leveled off for 61% of all recorded cities, compared to 2017 Q2

Among 100 recorded major cities in 2018 Q2, 39 cities had their congestion delay index increased by 1.5%, compared to 2017 Q2. Among them, Zibo had the largest increase and it was also the only city with the congestion delay index increased by more than 10%. This increase might due to the urban road construction from south to north. On the other hand, Qingdao had the largest index reduction by 8.7%, this might largely due to the traffic guidance and security check during Shanghai Cooperation Organization Summit. Jinan, as one congested city, ranked 7th on the congestion reduction list, which was largely due to the 'camera supervision' action and the network construction of urban expressway.

Location of cities with the most increased congestion compared to 2017 Q2

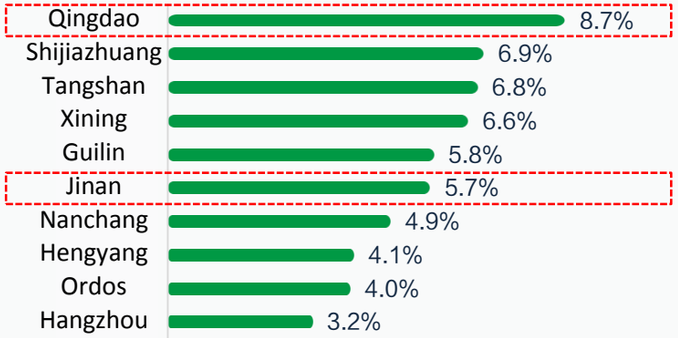


2018Q2 Cities with top 10 increased congestion



Location of cities with the most reduced congestion compared to 2017 Q2

2018Q2 Cities with top 10 reduced congestion



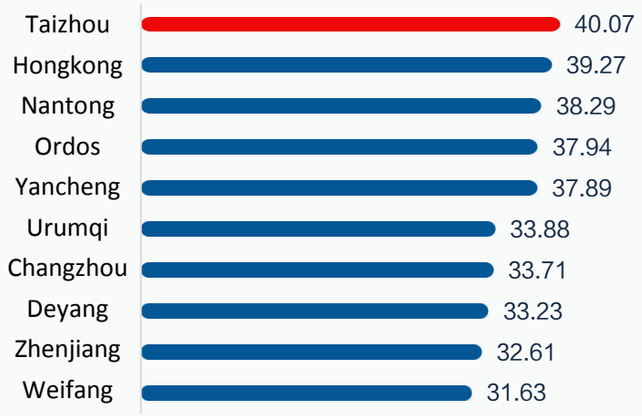
Urban operational efficiency –urban list of fast and slow driving speed in 2018 Q2

Taifeng was of the fastest average driving speed in China, while Shantou was of the lowest average driving speed in peak hours, even lower than the most congested city, Beijing, in each hours.

Average driving speed of Taizhou in peak hours was 40.07km/h, which was the fastest speed among all 100 recorded cities, and this speed was nearly close to the free flow speed of Shanghai. However, Shantou was of the lowest average driving speed which was 20.66km/h, and this speed was even lower than that of Beijing in each hour. Average driving speed for super mega-cities of Shanghai and Beijing ranked 8th and 9th respectively on the slow driving speed list of 2018 Q2.

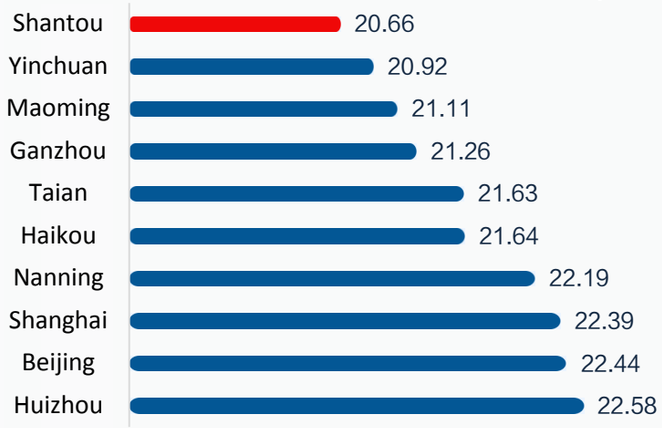
2018Q2 Top10 cites with the fastest driving speed in peak hours

Unit: Km/h

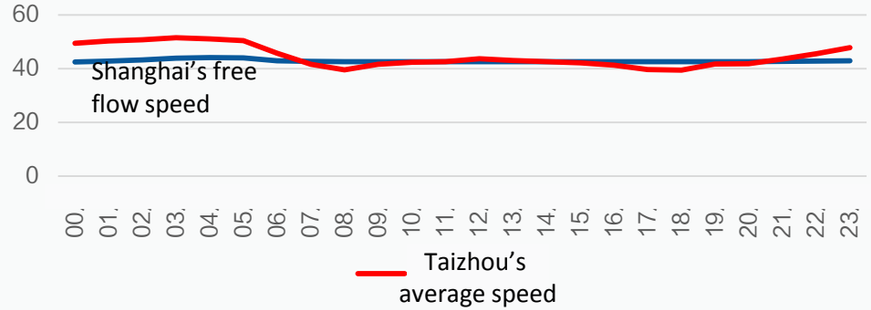


2018Q2 Top10 cities with the slowest driving speed in peak hours.

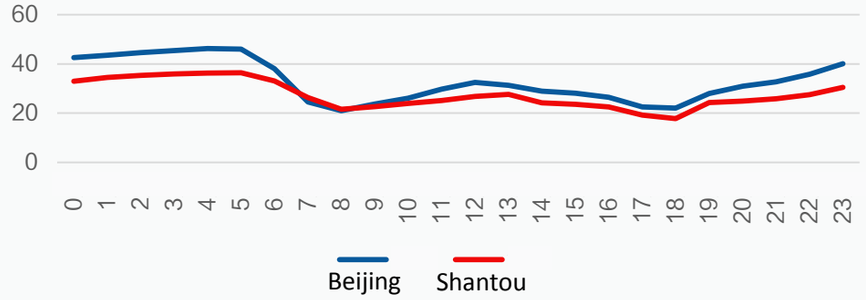
Unit：Km/h



Comparison between Taizhou’s driving speed in peak hours and Shanghai’s free flow speed



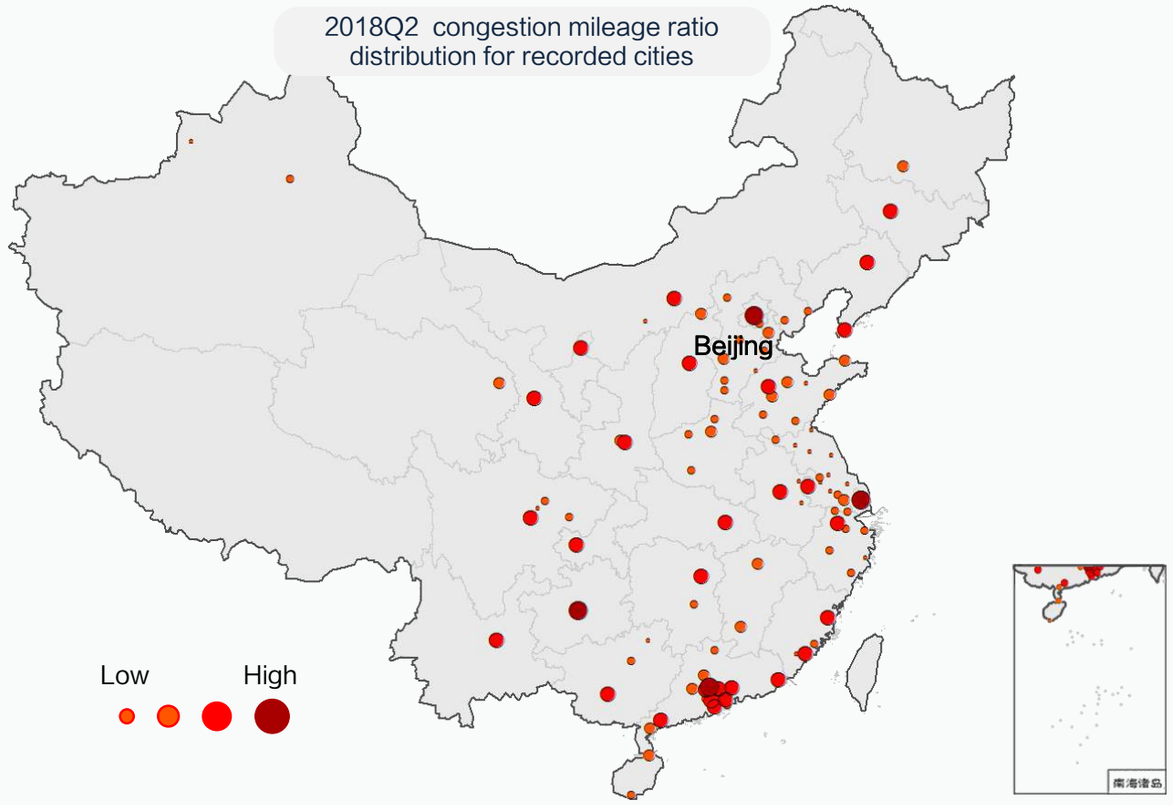
Comparison between Beijing’s driving speed and Shantou’s driving speed

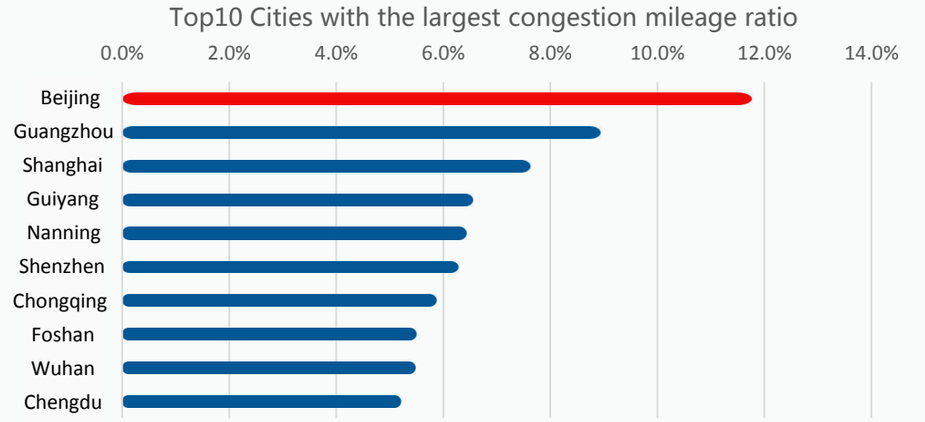


Congestion mileage ratio - Beijing was of the highest congestion mileage ratio in peak of all recorded cities.

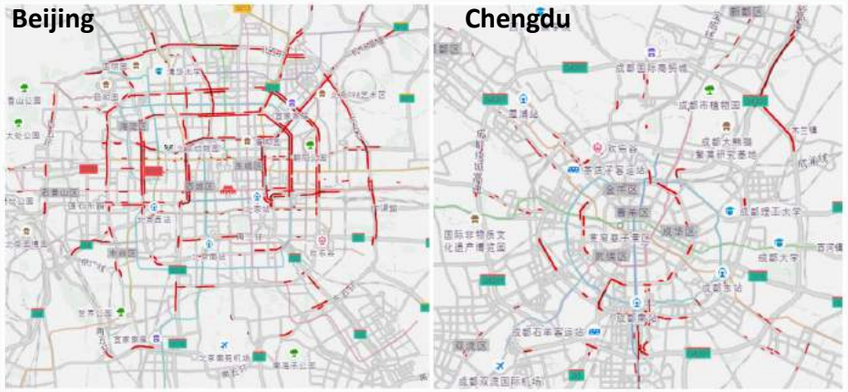
Beijing was of the highest congestion mileage ratio in peak hours of 2018 Q2

The congestion mileage ratio was calculated for the evaluation of middle and serious congestion level based on the proportion of congested road section in each cities. With such ratio, the congestion impact of road network can be clearly found from the view of spatial distribution. According to the calculation rules of national standard indicators, for all recorded major 100 cities in 2018 Q2, large numbers of cities with high congestion mileage ratio were located in the south, and the congestion mileage ratio was generally high in Guangdong Province. Meanwhile, Beijing was of the highest congestion mileage ratio, nearly 495.81 kilometers for congestion every minutes on average, and with 11.8% of congested road mileage to the total network mileage. Such results revealed that 11.8 kms of 100 kms was under congestion or serious congestion in Beijing during peak hours. Comparison of congested road distribution between Chengdu and Beijing, it showed that the congestion mileage of Beijing was clearly higher than the congestion mileage of Chengdu.





2018.4.20.18:00: Congested road distribution between Beijing and Chengdu



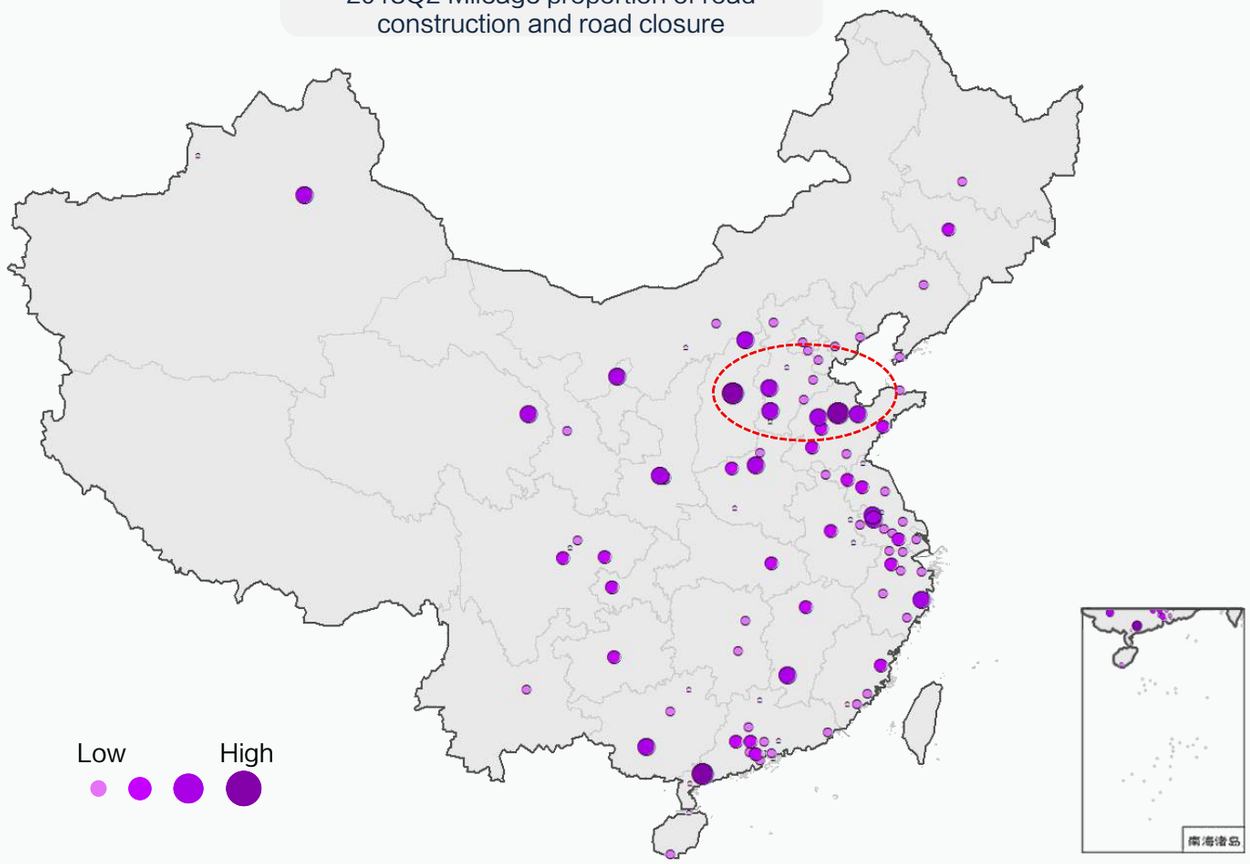
Note: Congestion mileage ratio was calculated under national standard indicators by the reference of 'Road traffic information service – Traffic condition description GB/T29107–2012'

Urban construction road closure – Maoming was of the highest ratio of construction road closures in 2018 Q2

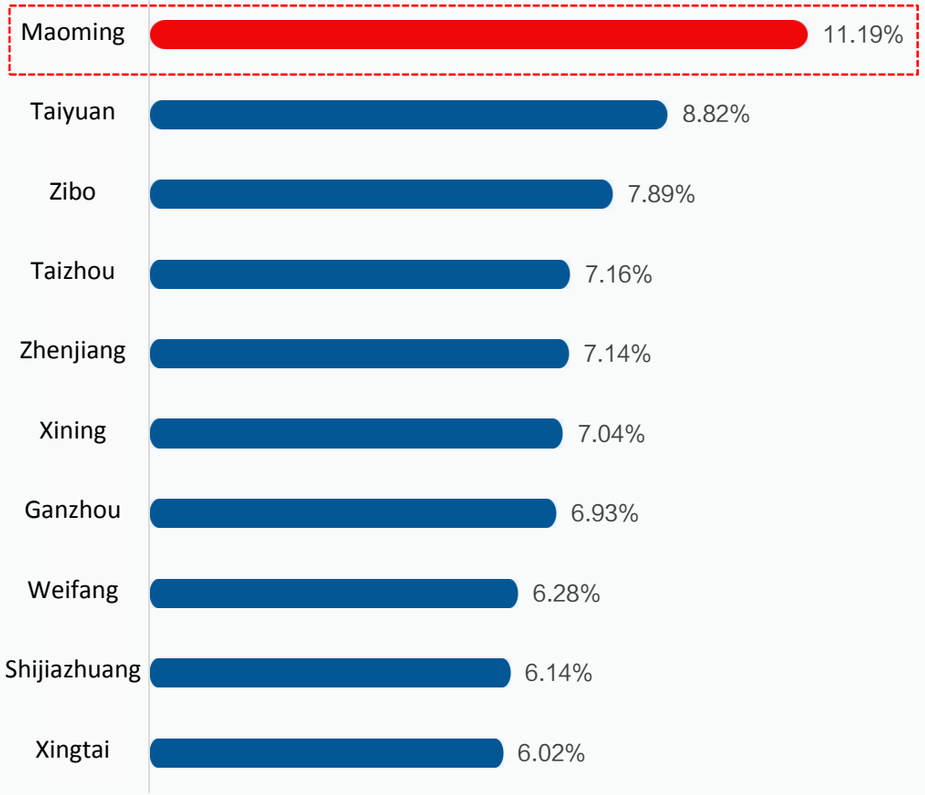
Maoming was of the highest proportion of construction road closures of 2018 Q2.

According to the mileage rate of urban road construction among 100 recorded major cities, parts of cities in Shandong and Hebei Province had relatively higher mileage ratio of road construction. From the national rank, Maoming in Guangdong Province had the highest ratio of road construction in all recorded cities, reaching 11.19%. From the absolute mileage of road construction, Zhengzhou ranked the first and Chongqing ranked the second, with 229 km and 199 km of road construction mileage in total respectively.

2018Q2 Mileage proportion of road construction and road closure



Mileage ratio of road closure and road construction for cities calculated from major areas*



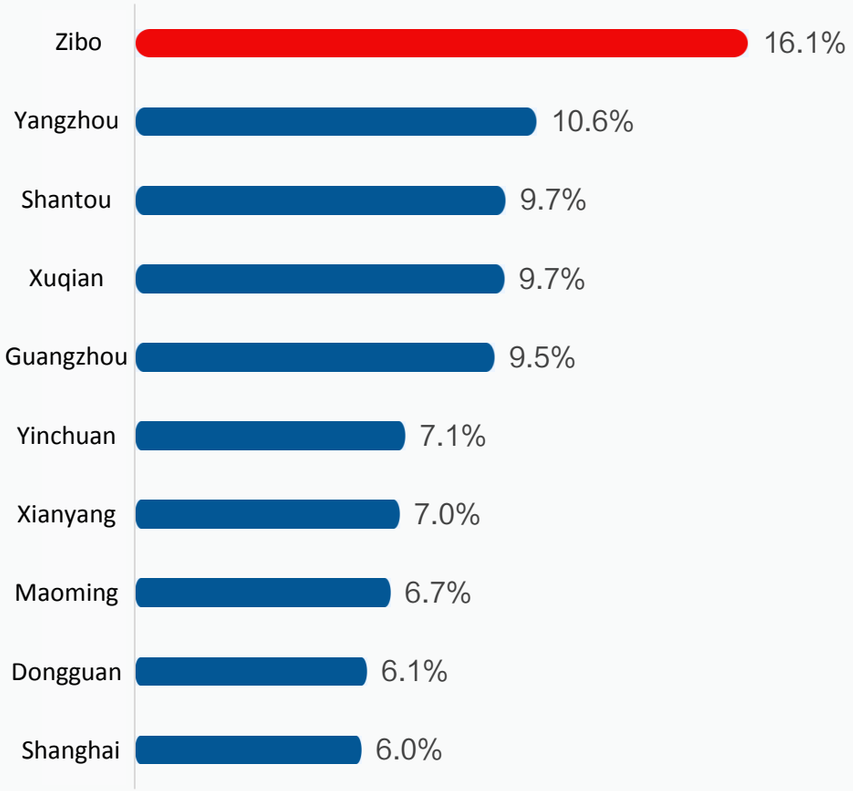
Note：Scales of major areas for one cities were the areas recorded by our traffic report

Urban construction road closure – The highest reduction rates on the driving speed of Zibo was highly related to the large scale of road construction of Zibo

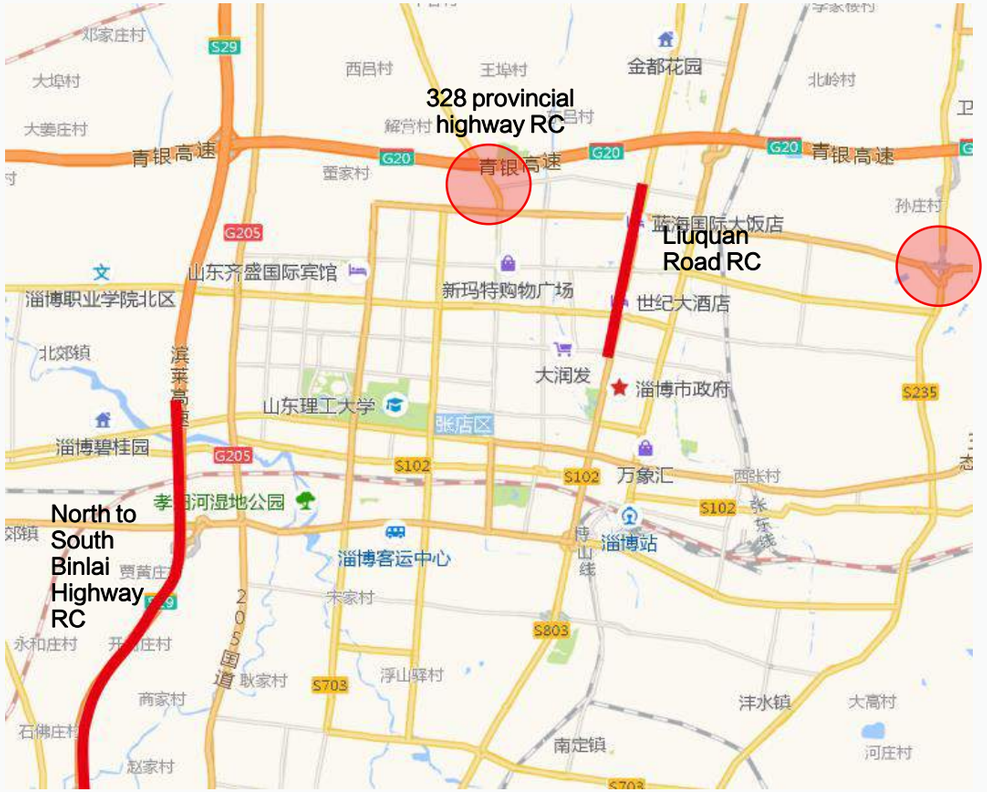
Driving speed of Zibo has reduced by 16.1% in 2018 Q2, compared to 2017 Q2, with 3rd rank on the mileage of road construction

In 2018 Q2, Zibo had the highest increase rate of congestion, with 16.1% reduction on driving speed, compared to 2017 Q2. Meanwhile, the road construction mileage ratio of Zibo was 7.89% in 2018 Q2, ranked the third among all recorded cities. In terms of location distribution of road construction, the construction places were mainly located in the urban trunk and urban freeway from south to north, and such road construction were easy to make travel inconvenient, increasing traffic flow pressure and congestion as well. It is recommended to start road construction based on traffic flow distribution and traffic demand.

Top 10 Cities with reduced average driving speed



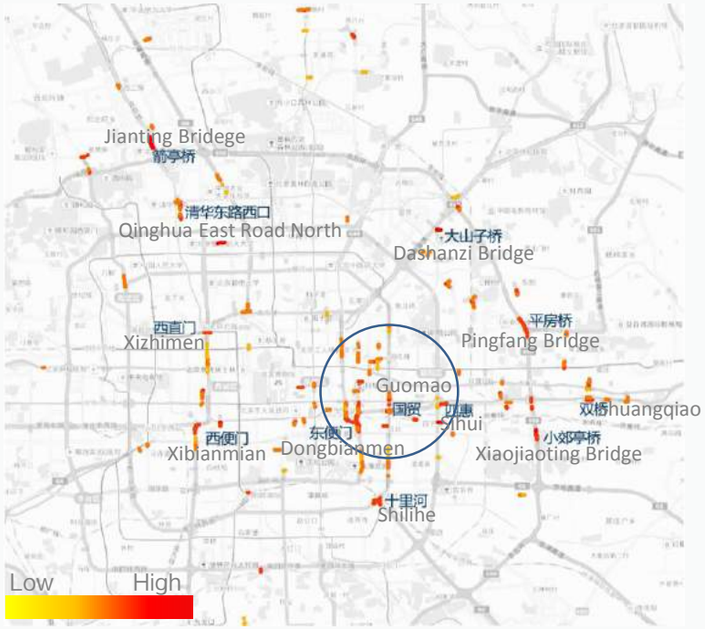
Location of road construction as for north–south urban trunk for Zibo



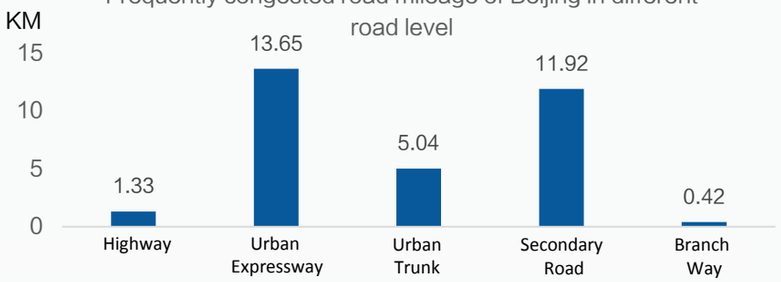
Frequent congestion mileage ratio – Distribution of frequently congested road in Beijing and Shanghai

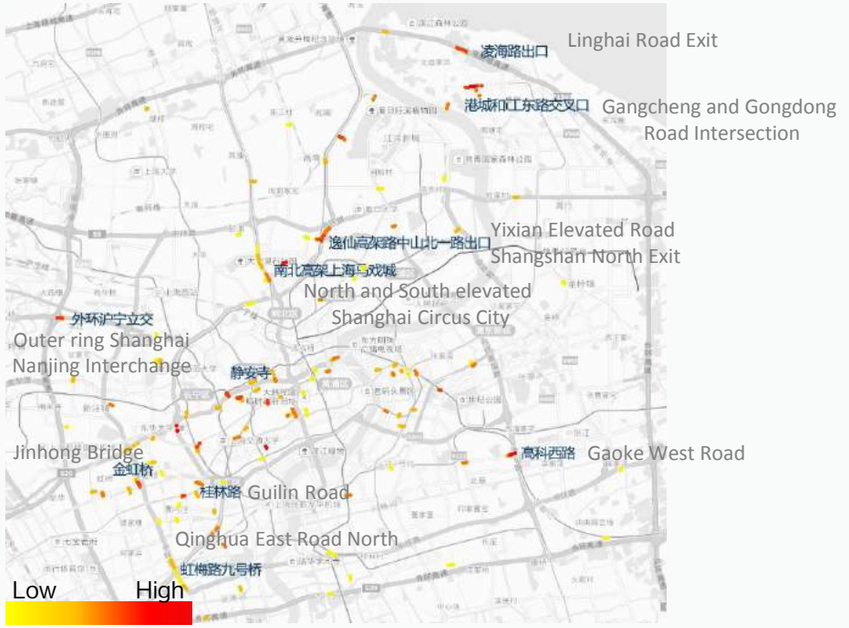
Frequently congested roads in Beijing were located in the east parts of Beijing

For frequently congested roads, it aims to find the spatial distribution and direction of those congested roads, so as to furtherly find the congestion areas and congestion tidal features. Taking Beijing as example, in 2018 Q2, the congestion mileage ratio of urban freeway was the highest, followed by that on secondary road. The frequent congested areas were located in the eastern part of Beijing, with the highest congested level on the areas of Dongbianmen in the east second ring road of Beijing. Besides, areas such as Jiantingqiao, western intersection of Qinghua east road, Xizhimen, Xibianmen, Guomao, Sihui, Pingfangqiao and Dashanzi were also frequently congested areas. Frequently congested roads in Shanghai were fairly distributed, with related higher congestion found in surrounding areas of Jinansi.

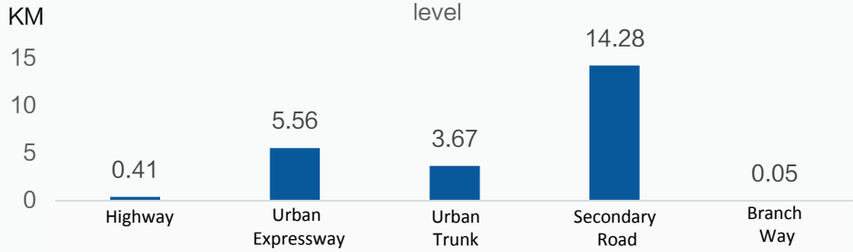


Frequently congested road mileage of Beijing in different road level





Frequently congested road mileage of Shanghai in different road level



Frequent congestion mileage ratio – Top 3 frequently congested roads for those most congested cities

Followed by national standard indicators, we defined frequently severe congested road as follow: Roads with congestion under 1 hour at least everyday, 4 working days at least every week and 3 weeks at least every month. Traffic policy can be referred by discovering top 3 most frequently congested road from the most 10 congested cities. For example, in 2018 Q2, Beijing top3 frequently congested road were as follow: jiantingqiao road in Jingxin expressway in Beijing had 447 congestion hours in total, dashanzi–wangjing street had 428 congestion hours, east fifth ring road–xiaojiaoting road had 307 congestion hours,

Beijing–TOP3		
Road Name	**Description**	**Seasonal Congestion Time**
Jingxin Expressway - Jianting Bridge	Intersection of Jingxin expressway and North fifth ring road, around jiantingqiao	447 Hours
Dashanzi–Wangjing Street	Dashanzi Intersection	428 Hours
East fifth ring road–Xiaojiaoting	Intersection of East fifth ring road and guangqu road, around Xiaojiaoting	307 Hours

Guangzhou–TOP3		
Road Name	**Description**	**Seasonal Congestion Time**
Zhujiang North - Yanjiang West Road	Yanjiang West Road（North or Haifan Hotel）	426 Hours
Baiyun District–Guangqing tool station	Intersection west of Xuguang expressway and Shenhai expressway of Guangzhou branch	403 Hours
Jiawan Lake–Huangsha Main Road	Exit of Huangsha Main Road (west of Jiawan Lake west gate)	295 Hours

Chongqing–TOP3		
Road Name	**Description**	**Seasonal Congestion Time**
Yuzhong District–Xiaoshizi intersection	Intersection of Xiaoshizi subway	425 Hours
Hongen Temple –Hongen Road	Northwestern gate of Chongqing gas building	416 Hours
Yuzhong District–Daxigou Street	Northwest of Huaxin Mansion	402 Hours

Harbin–TOP3		
Road Name	**Description**	**Seasonal Congestion Time**
Nangang District–Haiguan Street	National Exhibition. Zhengda Shopping Plaza (northeast gate) East	296 Hours
Daowai District–Hadong Street	North of the youth farm community integrated service center	189 Hours
Nangang District–Mujie Street	Renmintongtai Medicine Shop	176 Hours

Yinchuan–TOP3		
Road Name	**Description**	**Seasonal Congestion Time**
Xincheng–Tongda South Street	ICBC West	160 Hours
Xincheng–Tongda North Street	East of new Hualian Shopping Center	155 Hours
Xincheng–Minzu South Street	Yinchuan Xingguang kindergarten	121 Hours

Shanghai–TOP3		
Road Name	**Description**	**Seasonal Congestion Time**
Gaoqiao–gangcheng road	Near the northeast gate of Shanghai dongsheng gongyongdian equipment factory	363 Hours
Changning district–inner ring of expressway	South to the overpass of inner ring and yananxi road	341 Hours
Hongkou district–yixian expressway	Jingwu park (west to oushipenquan square)	278 Hours

Jinan–TOP3		
Road Name	**Description**	**Seasonal Congestion Time**
Wuyingshan–xiaoqinghenan road	Crossing of xiaoqinghenan road and wuyingshan road	297 Hours
Jinan zoo–xigongshanghe road	Crossing of xigongshanghe road and wuyingshannan road	217 Hours
Tianqiao district–beiyuan expressway	Near jinan coach station south area (north gate)	198 Hours

Guiyang–TOP3		
Road Name	**Description**	**Seasonal Congestion Time**
Yuzhong District–Xiaoshi Crossing	Xiaoshizi Subway Crossing	516 Hours
First Ring–Zhongshan West Road	Dashizi Square South	429 Hours
Yunyan District–Shibei Road	Intersection of Shibei Road and Bianjing Alley	360 Hours

Zhuhai–TOP3		
Road Name	**Description**	**Seasonal Congestion Time**
Xiangzhou District - Zhuhai Avenue auxiliary Road	North West Gate of the Pearl River South Bay	107 Hours
Xiangzhou district - Gongye Road	Intersection south of Jingye Road and Meihua West Road	87 Hours
Guihua South Road North – Guihua South Road	Intersection of Guihua South Road and Changsheng Road	74 Hours

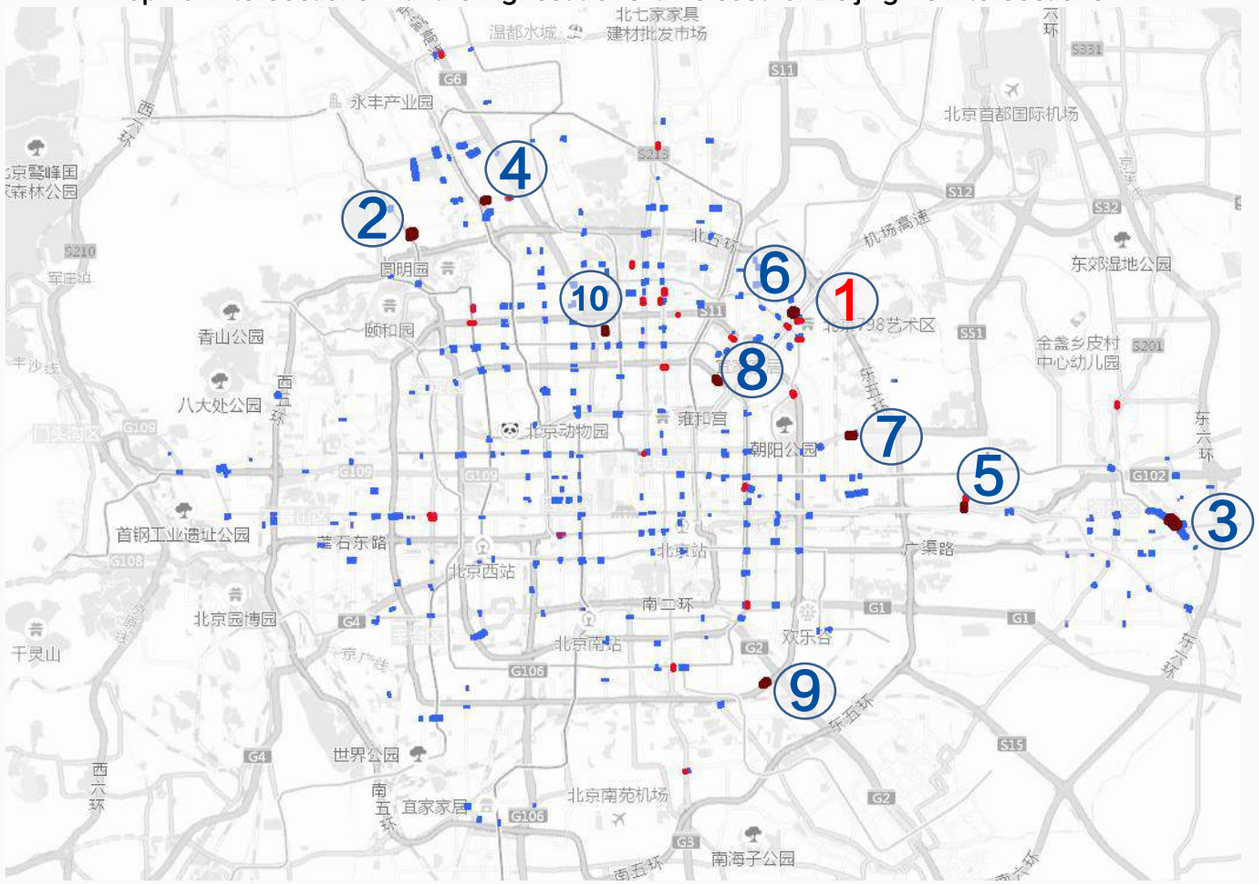
Chuangchun–TOP3		
Road Name	**Description**	**Seasonal Congestion Time**
Chaoyang District - Mengjiagong Train Bradge	Near the Eurasian Store	214 Hours
Nanguan District–East Sima Road	Intersection west of east Sima Road and Yasai Street	195 Hours
Chaoyang District–Kaiyun Street	Near the Eurasian Store	172 Hours

Travel time cost on intersection – intersection of Beijing Dashanzi Bridge (Wangjing east Road- Jiuxianqiao north Road) had the longest travel cost

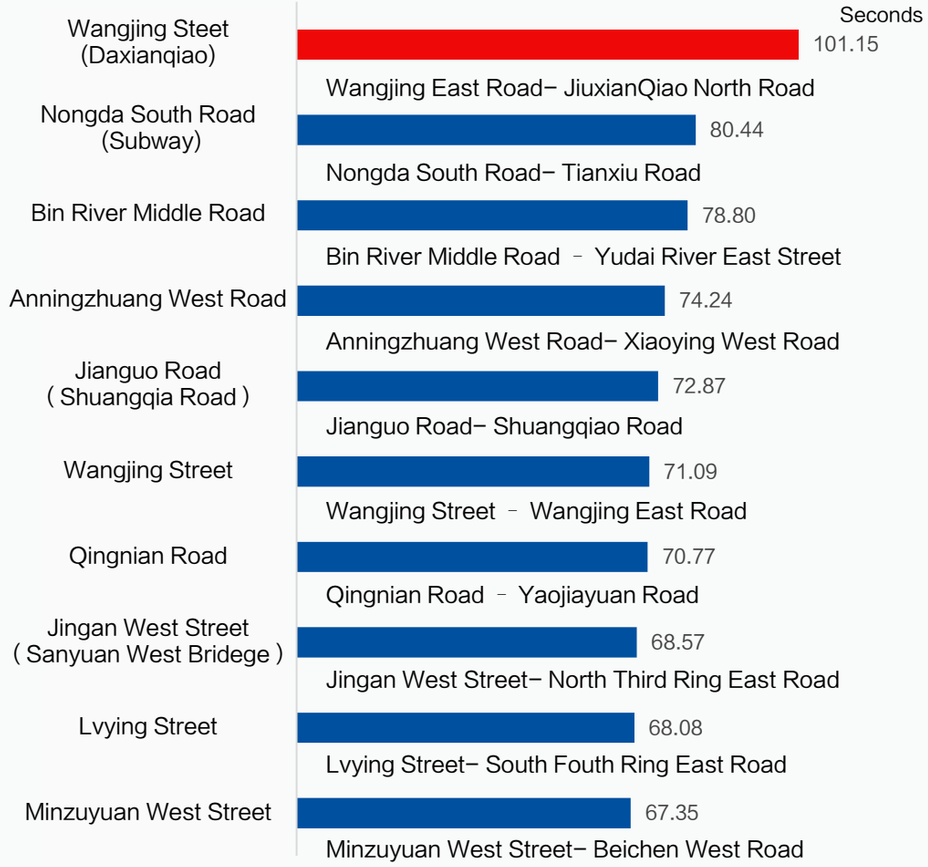
Dashanzi Bridge became the intersection with the longest travel time

Time of passing intersection was referenced by the average travel time cost of users of 80m ahead of the intersection, and this has considered many factors including traffic light interval and congestion, aiming to evaluate the waiting time when passing intersections and reflect operational efficiency for intersections of different areas. From the top 10 highest travel time cost on intersections for Beijing in peak hours, the locations were mainly on intersections on the northern part of third ring road, and among them, the waiting time of Wangjing Street(Dashanqiao) was the highest, reaching at 101.15 seconds, and this was followed by the intersection of Nongda Sourth Street (Nongda South Street– Tianxiu Road), with average waiting time of 80.44 seconds.

Top 10 intersections with the highest travel time cost for Beijing’s intersections



Top10 intersections for Travel time cost of in peak

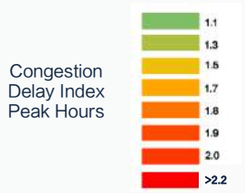


Time of urban congestion –Guangzhou was of the longest average accumulated congestion time

Guangzhou was of all-day accumulated congestion time for 7 hours, and the congestion delay index was over 1.8.

From the accumulation of time with the congested delay index over 1.8 for different cities hours by hours, Guangzhou had 7 accumulated hours on average with the congestion delay index over 1.8, and also with the longest average congestion accumulation time. Among all congested hours, the evening peak congestion lasted the longest. Besides, the congestion lasted 5 hours for Beijing and 3 hours for Shanghai on average.

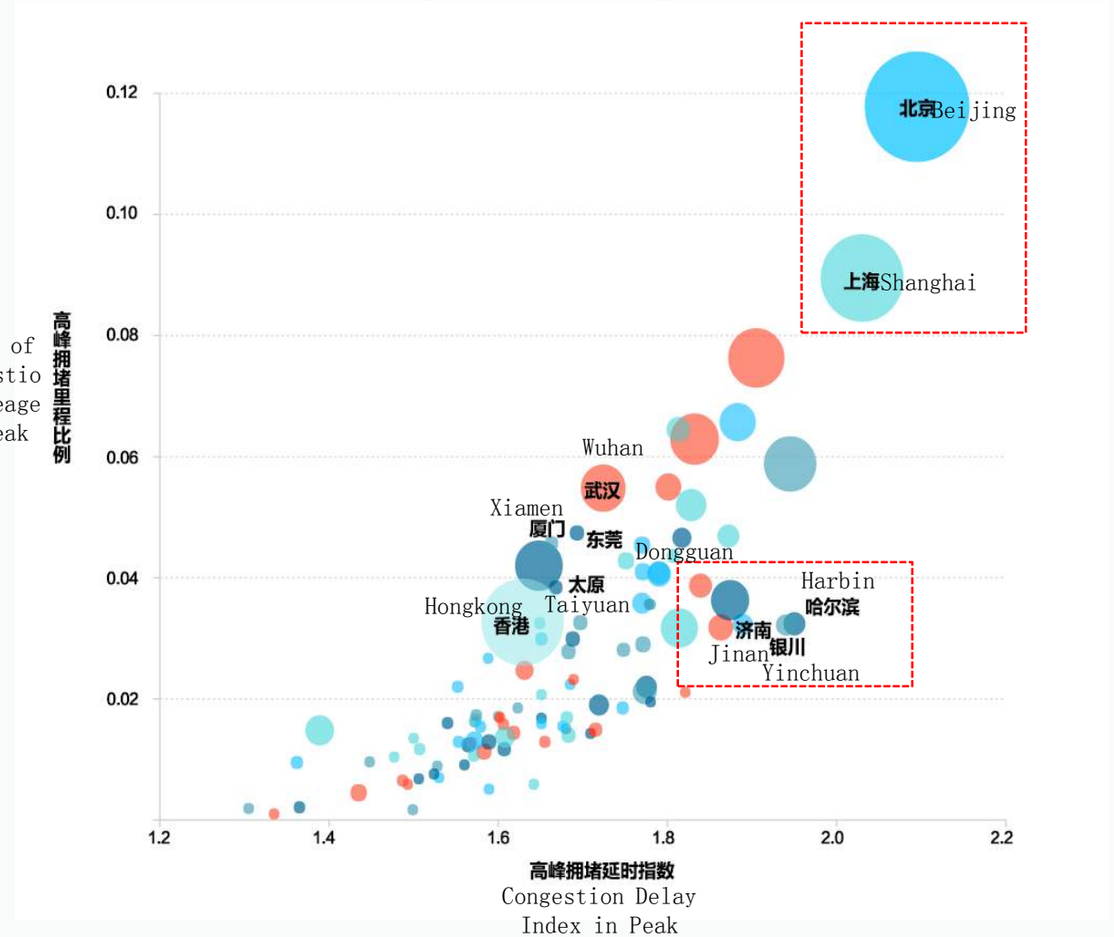
	Name	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Accumulated hours with the index higher than 1.8
Guangzhou	广州																									7
Beijing	北京																									6
Yinchuan	银川																									4
Chengdu	成都																									3
Ganzhou	赣州																									3
Harbin	哈尔滨																									3
Nanning	南宁																									3
Shanghai	上海																									3
Shenzhen	深圳																									3
Shenyang	沈阳																									3
Changchun	长春																									3
Chongqing	重庆																									3
Guiyang	贵阳																									3
Foshan	佛山																									3
Zhuhai	珠海																									3
Dalian	大连																									3
Hohhot	呼和浩特																									2
Huizhou	惠州																									2
Shantou	汕头																									2
Jinan	济南																									2



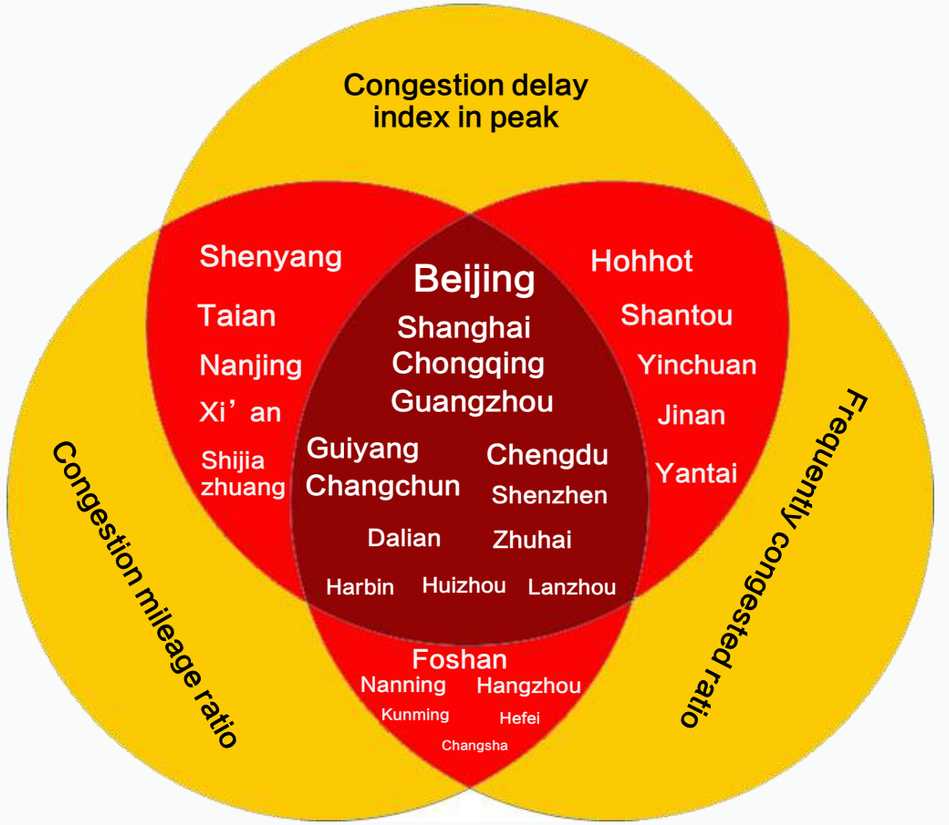
Congestion spatial analyses in many dimensions – comprehensive analyses integrated with congestion delay, congestion mileage and frequent congestion locations.

Integrated with indicators including congestion delay index in peak hours, congestion mileage ratio and frequent congestion location ratio, we have finished a comprehensive analyses, and the results were shown by a three-dimensional distribution figure. With the figure, we can find three indexes were relative high in Beijing, Shanghai, Chongqing, Guangzhou and Guiyang, which reflected that congestion of these cities was quite serious. The congestion mileage ratio was quite small but the congestion delay was quite high for cities including Harbin, Jinan and Yinchuan, this reflected congestion was quite centralized among these cities to some extents.

Scattered map considering congestion delay, congestion mileage and frequent congestion cities



Congestion Delay Index + Congestion mileage + Frequently Congested City

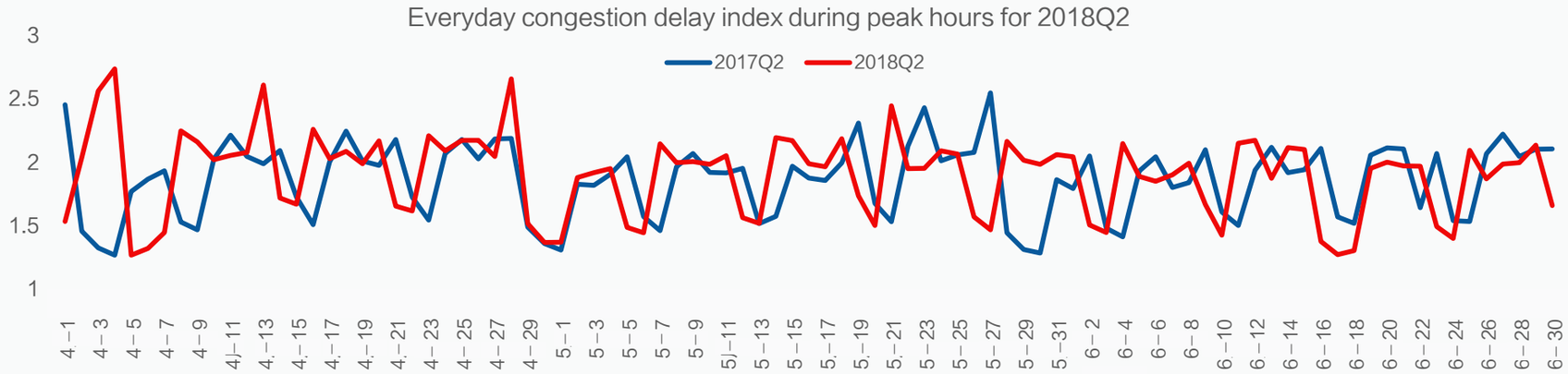


Cities was selected from cities with 2 or more indexes were in top 30

Congestion reason analysis – Beijing

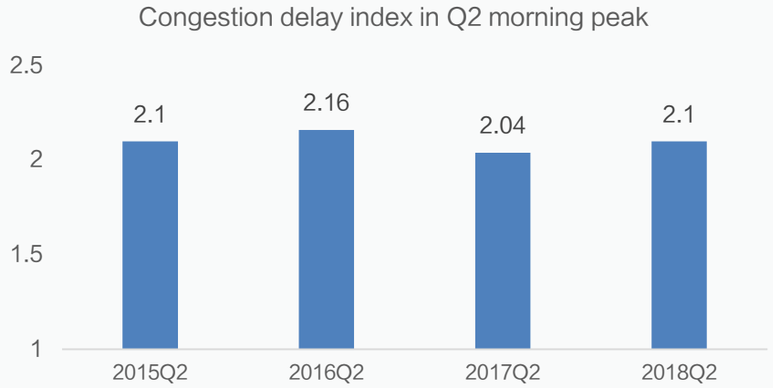
Plate number limitation on Monday has been 4 and 9, which increases congestion on Monday peak hours.

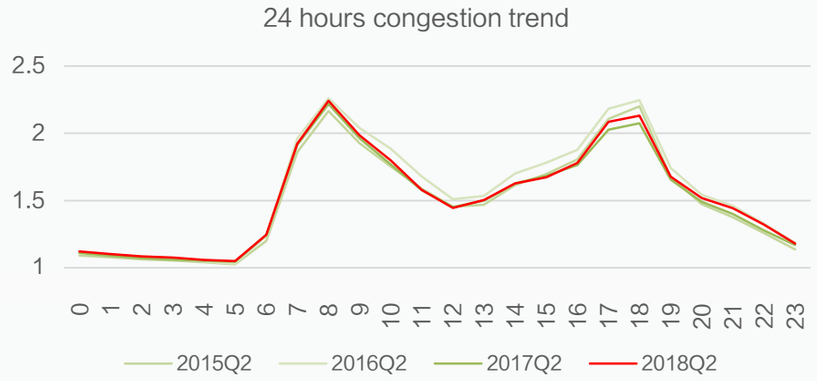
Congestion of April in Beijing was the highest during 2018 Q2, then, the congestion reduced in June, with a similar trend as 2017 Q2. Compared to 2017 Q2, the congestion has increased by 2.73% in general in 2018 Q2, this increase largely due to the change of plate number limitation. For example, from April 1st to April 8th, the plat number of 4 and 9 cannot be drive on road on Friday, but from April 9th to July 8th , this policy changed from Friday to Monday. Therefore, the congestion increased clearly during morning peak, and Monday and Friday has been the most congested day in morning peak.



Notable seasonal congestion feature, with Beijing ranking first in successive four years Q2.

in 2018 Q2, congestion was quite common in Beijing, the congestion of Beijing ranked first in each Q2 from 2015 to 2017. From 24 hours congestion trend in last successive 4 years, the congestion in morning peak was slightly higher for 2018 Q2, compared with other years' Q2.

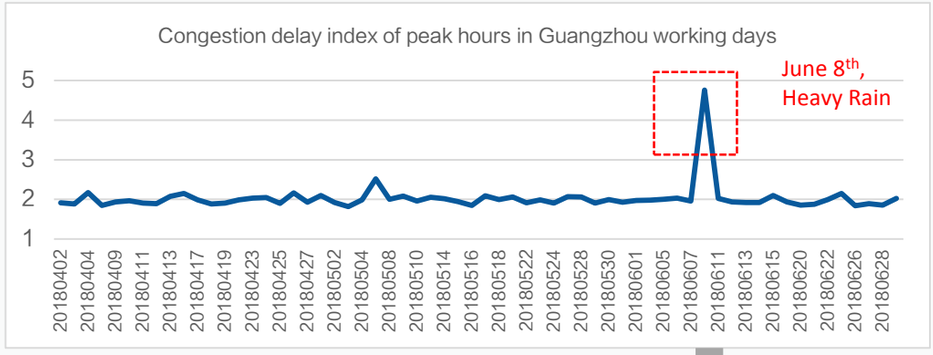




Congestion reason analysis – Guangzhou

Heavy rain caused severe traffic congestion in Guangzhou

Heavy rain in June 8th, Guagnzhou caused severe traffic congestion, and this day has been the most congested day in 2018 Q2. Compared with normal, the range of congested road has been quite larger, nearly 3 times than normal.



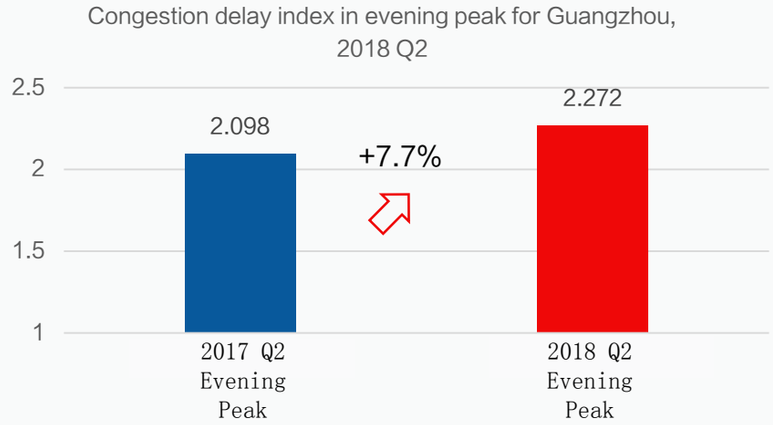
May 24th, 18:00~19:00
Congestion distribution on normal day

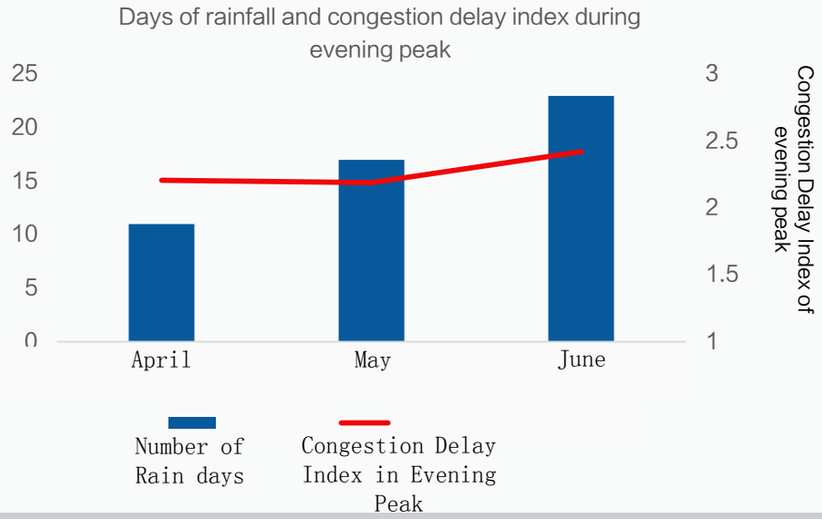
June 8th, 18:00~19:00
Congestion distribution on heavy rain day

Note: weather figures were gathered from Internet

Total 51 days of rainfall in 2018Q2 resulted in an increase in congestion

Guangzhou accumulated a total of 51 days of rainfall in 2018 Q2, mainly in June. The congestion increased to some extent in rain days. There were 33 days of rain on working days, and the congestion delay index increased by 5.9% in peak hours of rain days, compared with the same index on normal weather.



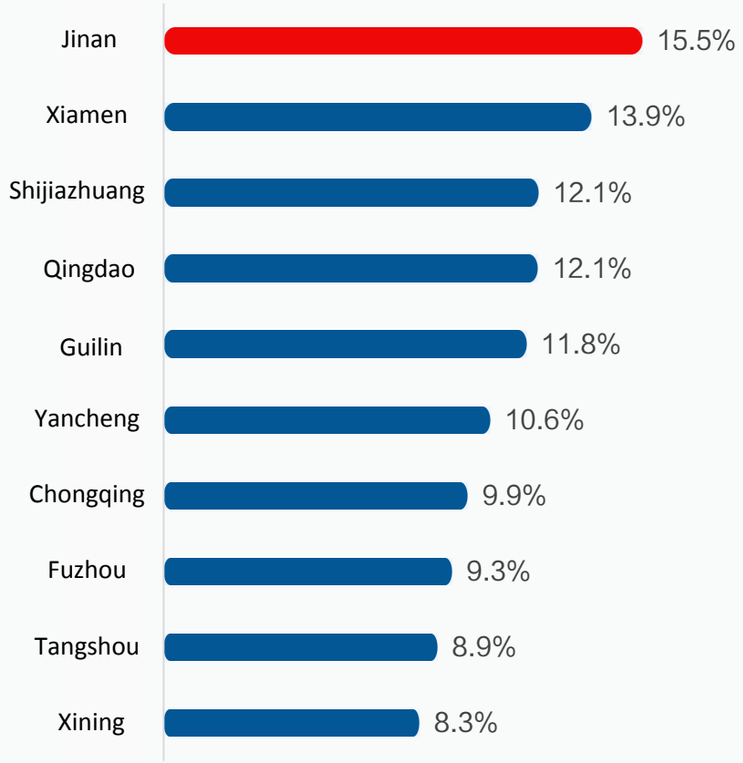


The average driving speed of Jinan increased most by 3.35km/h

Recording average speed of Jinan in peak hours, the figures showed the average speed of Jinan increased by 15.5% in 2018 Q2, compared with 2017 Q2, and this increase was also the largest increase, from 21.60km/h in 2017 Q2 to 24.95km/h in 2018 Q2, compared with other cities.

Top 10 cities with increased average driving speed

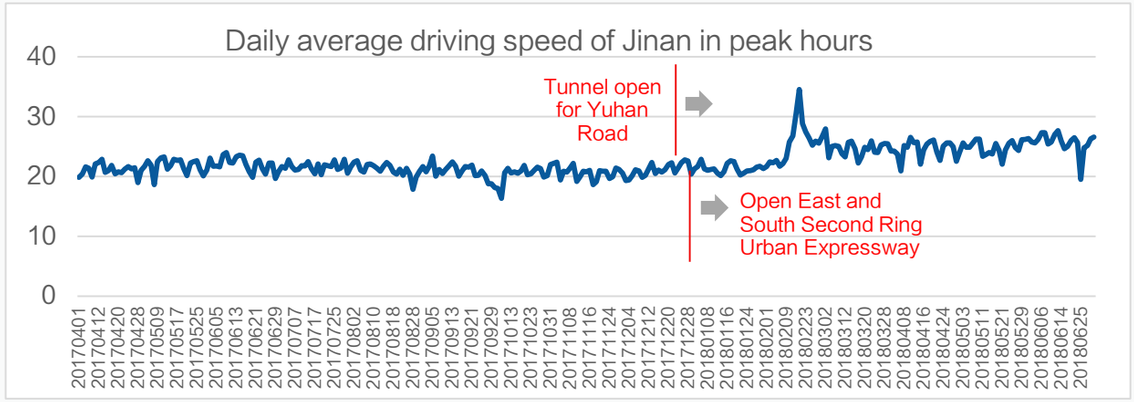
Unit: km/h



The average driving speed of Jinan increased most by 3.35km/h

The increase on the average speed of Jinan might be related to the open of Jinan’s expressway. During 2016 when construction of linking Jinan’s expressway and highway, the congestion was quite severe, which made travel inconvenient for a short time. Since 2018, when the linking project gradually finished, the congestion reduced gradually and the driving speed increased dramatically as well, based on the congestion delay index in 2018 Q1 and 2018 Q2.

Average driving speed of Jinan clearly increased, due to expressway linking as network in 2018



Peak Congestion Rank 1~25

Note: Construction Enclosure Mileage Ratio has been added in 2018 Q2 report, which can reflect congestion level and congestion reason in different perspective.

Rank	Change Rate vs 2017 Q2	City Name	Congestion Delay index in peak	Peak Speed	Congestion Delay index all day	Congestion delay index morning peak	Congestion delay index evening peak	Congestion delay index non peak	Free flow speed	Construction enclosure ratio (report analysis range)
1	2.7%	Beijing	2.095	22.44	1.729	2.082	2.108	1.607	47.01	2.2%
2	7.7%	Guangzhou	2.030	22.60	1.749	1.787	2.272	1.656	45.88	0.8%
3	-2.6%	Harbin	1.950	23.02	1.609	2.053	1.848	1.494	44.90	2.1%
4	-2.3%	Chongqing	1.945	25.22	1.593	2.017	1.873	1.475	49.05	3.6%
5	9.1%	Yinchuan	1.940	20.92	1.681	1.889	1.989	1.593	40.57	4.3%
6	2.7%	Shanghai	1.905	22.39	1.607	1.955	1.855	1.507	42.64	2.8%
7	-5.7%	Jinan	1.889	24.95	1.596	1.920	1.859	1.498	47.14	4.7%
8	5.0%	Guiyang	1.883	25.22	1.572	1.813	1.952	1.468	47.47	2.5%
9	2.9%	Zhuhai	1.874	25.53	1.532	1.767	1.979	1.418	47.83	2.4%
10	2.4%	Changchun	1.872	24.05	1.552	1.970	1.774	1.445	45.02	3.5%
11	-0.7%	Hohhot	1.863	24.78	1.556	1.865	1.861	1.451	46.17	2.1%
12	3.4%	Huizhou	1.839	22.58	1.546	1.773	1.904	1.447	41.53	0.8%
13	2.8%	Shenzhen	1.832	25.87	1.619	1.703	1.961	1.548	47.40	1.8%
14	2.3%	Chengdu	1.828	25.61	1.596	1.766	1.889	1.518	46.80	3.4%
15	3.7%	Ganzhou	1.821	21.26	1.645	1.764	1.876	1.585	38.71	6.9%
16	0.2%	Dalian	1.817	26.14	1.513	1.914	1.721	1.411	47.50	1.8%
17	6.9%	Shantou	1.814	20.66	1.578	1.591	2.025	1.499	37.48	2.6%
18	-0.4%	Nanning	1.813	22.19	1.609	1.669	1.953	1.541	40.23	5.9%
19	2.4%	Shenyang	1.807	24.77	1.524	1.875	1.738	1.429	44.75	2.7%
20	0.4%	Foshan	1.801	24.27	1.544	1.669	1.930	1.458	43.69	3.0%
21	-1.6%	Kunming	1.790	24.21	1.567	1.682	1.896	1.491	43.35	2.3%
22	2.4%	Lanzhou	1.790	23.26	1.578	1.767	1.811	1.506	41.63	2.1%
23	1.5%	Xianyang	1.780	22.71	1.589	1.747	1.813	1.524	40.43	5.6%
24	0.3%	Haikou	1.780	21.64	1.545	1.594	1.961	1.466	38.52	0.7%
25	4.1%	Maoming	1.778	21.11	1.607	1.656	1.899	1.549	37.54	11.2%

Peak Congestion Rank 26~50

Rank	Change Rate vs 2017 Q2	City Name	Congestion Delay index in peak	Peak Speed	Congestion Delay index all day	Congestion delay index morning peak	Congestion delay index evening peak	Congestion delay index non peak	Free flow speed	Construction enclosure ratio (report analysis range)
26	−0.2%	Yantai	1.775	25.49	1.492	1.813	1.736	1.396	45.24	2.2%
27	2.4%	Taian	1.773	21.63	1.549	1.811	1.734	1.472	38.33	3.3%
28	−0.4%	Qingyuan	1.771	23.44	1.539	1.638	1.900	1.461	41.53	1.6%
29	−3.1%	Xi'an	1.771	25.39	1.564	1.720	1.822	1.495	44.98	2.8%
30	−1.8%	Changsha	1.770	24.62	1.513	1.703	1.838	1.427	43.59	1.8%
31	−1.1%	Nanjing	1.770	24.90	1.516	1.772	1.768	1.431	44.07	2.0%
32	−2.1%	Hefei	1.751	25.23	1.483	1.724	1.778	1.393	44.17	3.9%
33	−2.9%	Fuzhou	1.748	26.42	1.515	1.677	1.819	1.437	46.19	2.8%
34	2.9%	Mianyang	1.747	28.28	1.525	1.758	1.735	1.450	49.40	2.6%
35	2.6%	Wuhan	1.724	28.16	1.460	1.724	1.724	1.371	48.54	2.8%
36	−0.3%	Datong	1.719	25.97	1.536	1.702	1.736	1.474	44.65	4.8%
37	5.4%	Jining	1.715	27.52	1.524	1.685	1.746	1.458	47.21	4.1%
38	2.9%	Nanchong	1.709	23.62	1.549	1.719	1.700	1.494	40.37	3.7%
39	−6.9%	Shijiazhuang	1.697	28.89	1.451	1.718	1.676	1.368	49.01	6.1%
40	5.9%	Dongguan	1.693	29.77	1.482	1.588	1.797	1.411	50.38	1.7%
41	0.1%	Zhanjiang	1.689	23.00	1.504	1.536	1.838	1.441	38.84	0.8%
42	2.4%	Zhongshan	1.688	28.02	1.455	1.640	1.735	1.378	47.29	2.9%
43	11.3%	Zibo	1.685	26.48	1.467	1.660	1.710	1.393	44.61	7.9%
44	−1.6%	Cangzhou	1.683	26.75	1.486	1.707	1.660	1.420	45.03	2.3%
45	2.9%	Tianjin	1.683	28.24	1.437	1.739	1.628	1.355	47.52	2.1%
46	−6.6%	Xining	1.681	29.58	1.510	1.615	1.746	1.451	49.71	7.0%
47	−0.5%	Zhangjiakou	1.680	30.36	1.470	1.697	1.663	1.398	51.00	2.1%
48	0.1%	Luoyang	1.676	24.00	1.545	1.642	1.709	1.501	40.22	3.8%
49	3.7%	Taiyuan	1.668	29.75	1.448	1.682	1.655	1.374	49.63	8.8%
50	−2.1%	Xiamen	1.663	28.07	1.447	1.587	1.740	1.375	46.69	2.0%

Peak Congestion Rank 51~75

Rank	Change Rate vs 2017 Q2	City Name	Congestion Delay index in peak	Peak Speed	Congestion Delay index all day	Congestion delay index morning peak	Congestion delay index evening peak	Congestion delay index non peak	Free flow speed	Construction enclosure ratio (report analysis range)
51	-6.8%	Tangshan	1.655	27.14	1.466	1.643	1.666	1.403	44.91	2.9%
52	3.3%	Jinghua	1.651	22.60	1.487	1.606	1.695	1.432	37.32	2.0%
53	-4.1%	Hengyang	1.651	25.85	1.475	1.621	1.680	1.416	42.67	2.0%
54	-2.9%	Zhengzhou	1.651	29.38	1.482	1.626	1.676	1.425	48.50	5.3%
55	7.0%	Langfang	1.651	28.61	1.431	1.653	1.649	1.357	47.23	2.0%
56	4.1%	Suzhou	1.649	29.16	1.403	1.689	1.610	1.320	48.10	3.5%
57	-3.2%	Hangzhou	1.648	25.08	1.537	1.657	1.638	1.500	41.33	2.4%
58	8.1%	Suqian	1.642	26.20	1.514	1.628	1.655	1.470	43.01	2.6%
59	-1.8%	Hongkong	1.633	39.27	1.539	1.553	1.701	1.508	64.13	0.3%
60	-4.9%	Nanchang	1.631	26.63	1.439	1.615	1.647	1.375	43.43	3.6%
61	1.6%	Jiaxing	1.623	24.63	1.429	1.621	1.624	1.364	39.96	1.8%
62	-2.4%	Baoding	1.618	30.68	1.437	1.627	1.608	1.376	49.62	1.0%
63	4.8%	Nanyang	1.608	24.09	1.483	1.567	1.647	1.441	38.72	1.3%
64	-0.8%	Qinhuangdao	1.607	30.57	1.428	1.598	1.616	1.368	49.13	2.5%
65	1.7%	Ningbo	1.606	25.96	1.407	1.591	1.621	1.340	41.70	2.2%
66	0.6%	Shaoguan	1.602	27.78	1.428	1.513	1.687	1.369	44.51	0.9%
67	4.6%	Jiangmen	1.600	30.43	1.405	1.541	1.659	1.339	48.69	1.7%
68	1.2%	Deyang	1.589	33.23	1.462	1.589	1.589	1.419	52.78	1.3%
69	-1.9%	Xinxiang	1.589	25.38	1.481	1.545	1.632	1.445	40.32	2.5%
70	-0.3%	Zhaoqing	1.588	27.58	1.406	1.488	1.685	1.345	43.80	4.0%
71	4.0%	Yangzhou	1.583	30.65	1.411	1.565	1.601	1.353	48.51	4.4%
72	0.1%	Sanya	1.579	24.80	1.480	1.444	1.713	1.447	39.16	2.3%
73	-2.9%	Liuzhou	1.574	24.82	1.442	1.500	1.646	1.398	39.06	2.1%
74	-2.0%	Wenzhou	1.573	27.51	1.424	1.539	1.606	1.374	43.26	2.1%
75	-0.8%	Handan	1.572	26.65	1.457	1.557	1.586	1.418	41.89	1.5%

Peak Congestion Rank 76~100

Rank	Change Rate vs 2017 Q2	City Name	Congestion Delay index in peak	Peak Speed	Congestion Delay index all day	Congestion delay index morning peak	Congestion delay index evening peak	Congestion delay index non peak	Free flow speed	Construction enclosure ratio (report analysis range)
76	2.6%	Linyi	1.572	28.88	1.405	1.548	1.596	1.349	45.39	2.1%
77	-5.9%	Guilin	1.571	30.58	1.450	1.500	1.640	1.409	48.04	0.8%
78	-2.0%	Xingtai	1.569	29.22	1.467	1.553	1.585	1.432	45.86	6.0%
79	2.8%	Xuzhou	1.565	28.65	1.426	1.562	1.569	1.379	44.85	1.2%
80	-0.8%	Zhangzhou	1.560	26.32	1.473	1.436	1.676	1.445	41.05	0.4%
81	0.3%	Shaoxing	1.553	28.82	1.390	1.534	1.571	1.335	44.75	2.2%
82	-8.7%	Qingdao	1.552	31.58	1.357	1.563	1.540	1.291	49.01	3.3%
83	1.6%	Wuxi	1.540	30.96	1.355	1.531	1.549	1.293	47.67	1.7%
84	0.3%	Lianyungang	1.530	26.25	1.413	1.507	1.553	1.373	40.17	0.9%
85	0.2%	Weifang	1.528	31.63	1.386	1.528	1.528	1.338	48.33	6.3%
86	1.2%	Dezhou	1.524	30.75	1.407	1.502	1.546	1.367	46.87	1.8%
87	-2.7%	Quanzhou	1.507	30.84	1.382	1.427	1.587	1.340	46.47	2.8%
88	1.0%	Huai'an	1.506	27.90	1.383	1.474	1.537	1.341	42.02	3.1%
89	-0.2%	Huzhou	1.500	29.00	1.361	1.517	1.483	1.315	43.48	1.8%
90	-4.0%	Ordos	1.499	37.94	1.428	1.467	1.529	1.403	56.88	0.6%
91	1.3%	Chuzhou	1.493	27.02	1.395	1.464	1.521	1.362	40.33	0.8%
92	-1.0%	Changzhou	1.487	33.71	1.342	1.494	1.480	1.294	50.13	2.0%
93	-1.8%	Taizhou	1.477	30.49	1.366	1.465	1.489	1.329	45.04	7.2%
94	1.5%	Wuhu	1.448	29.49	1.354	1.428	1.467	1.323	42.69	1.0%
95	-2.0%	Zhenjiang	1.435	32.61	1.328	1.415	1.454	1.292	46.79	7.1%
96	-2.8%	Urumchi	1.389	33.88	1.514	1.221	1.538	1.555	47.05	4.7%
97	-2.2%	Yancheng	1.365	37.89	1.294	1.336	1.393	1.270	51.72	1.7%
98	-1.5%	Nantong	1.362	38.29	1.264	1.344	1.379	1.231	52.13	2.9%
99	0.6%	Yili	1.335	30.56	1.417	1.206	1.425	1.442	40.81	0.7%
100	3.2%	Taizhou	1.305	40.07	1.248	1.292	1.317	1.229	52.28	1.2%

Urban Traffic Incident Page

Value of Urban Traffic Incident Page

Higher authority and higher reliability for urban traffic incident page, due to officially traffic information released from traffic police.

At moment, more than 200 of traffic police units have been cooperated with AutoNavi. Through AutoNavi urban traffic incident page, huge amounts of authorized real-time traffic information can be shared, and near 700 million of AutoNavi users can gain related travel guidance. The ‘urban traffic incident page’ is the officially authorized page of traffic police on AutoNavi platform, which reflects excellent travel information sharing with the public.

Traffic incidents including road construction or road closures can be quickly notified to users through AutoNavi Map

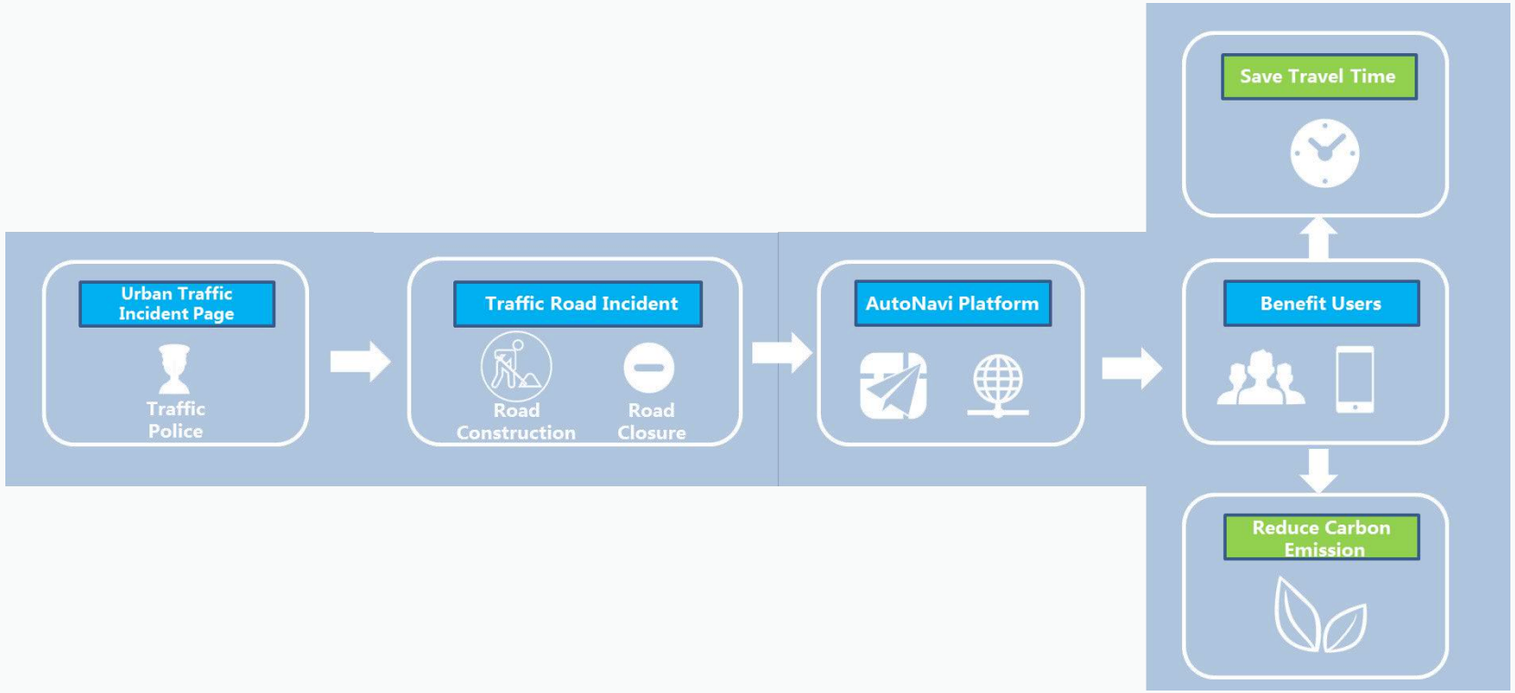
Traffic incidents, such as road closure and road construction, can be shared through AutoNavi Platform.

Optimized travel routes can be provided to users by AutoNavi , after collecting and analyzing information on traffic incident page

Through AutoNavi Platform, users can get more convenient routes, with the feature of ‘fast’, ‘accurate' and ‘time saving' provided.

User satisfaction and feedback can also be quickly fed back to traffic police through AutoNavi Urban Traffic Incident Page

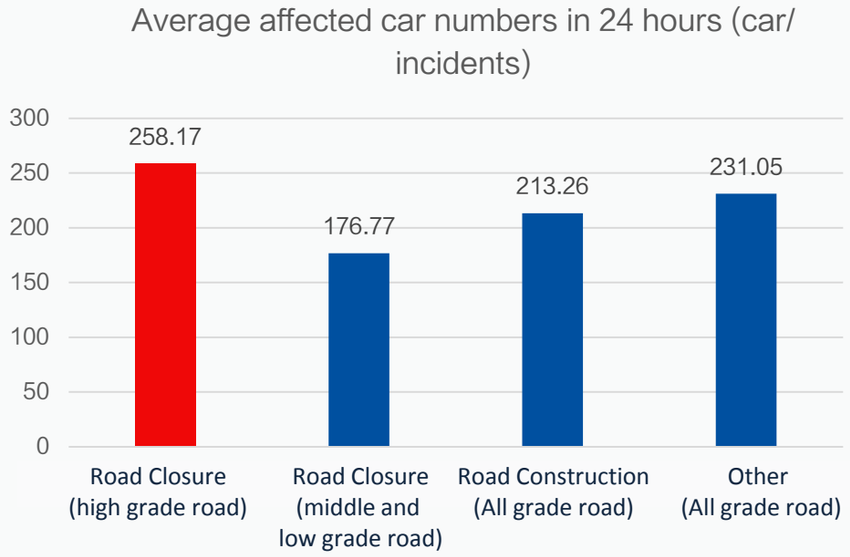
Service effect on traffic police to the public can be directly reflected and fed to urban traffic police through data shown on AutoNavi Urban Traffic Incident Page.

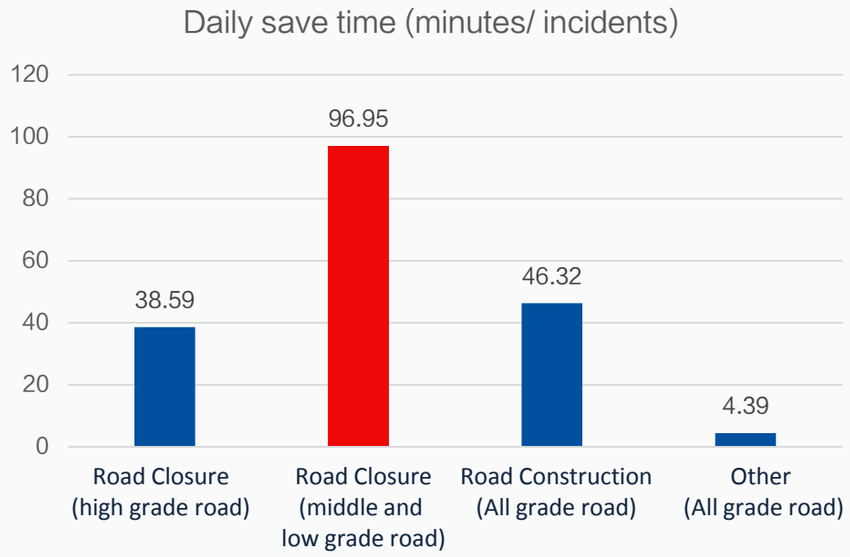


The largest impact came from road closure on high-grade road, and incident notification of high-grade road closure optimized most travel time

Through AutoNavi Urban Traffic Incident Page, 219 vehicles can be affected on average, per traffic incident published by traffic police

Looking at the number of vehicles affected within 24 hours per time, the impact on high-grade road was the largest (258.17 vehicles/traffic incident). Due to relative low traffic flow on middle and low grade road, the impact on the road was lower. In terms of travel time saving, road closure notification of middle and low grade was more significant for users to save travel time, followed by the notification of road construction and high-grade road closure. The significance of notification of other traffic incidents was relatively lower for users to save their travel time.





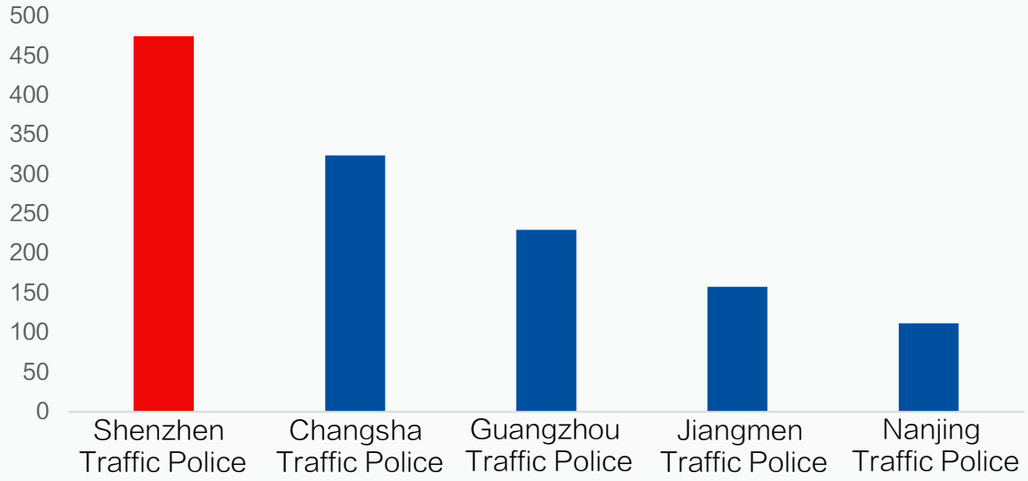
High contribution rate of traffic incidents for Changsha traffic police, and high incident release on Urban Traffic Incident Page for Shenzhen traffic police

Road Construction and road closure produce negative impacts on traffic management, but by publishing traffic incident on Urban Traffic Incident Page, such negative impacts can be improved. Until now, Changsha traffic police made high contribution rate on traffic incidents, and Shenzhen traffic police published the largest number of traffic incidents on Urban Traffic Incident Page.

Traffic Police with the most contributions

长沙交警 Changsha Traffic Police	盐城交警 Yancheng Traffic Police
东莞交警 Dongguan Traffic Police	厦门交警 Xiamen Traffic Police
武汉交警 Wuhan Traffic Police	济南交警 Jinan Traffic Police
广州交警 Guangzhou Traffic Police	江门交警 Jiangmen Traffic Police

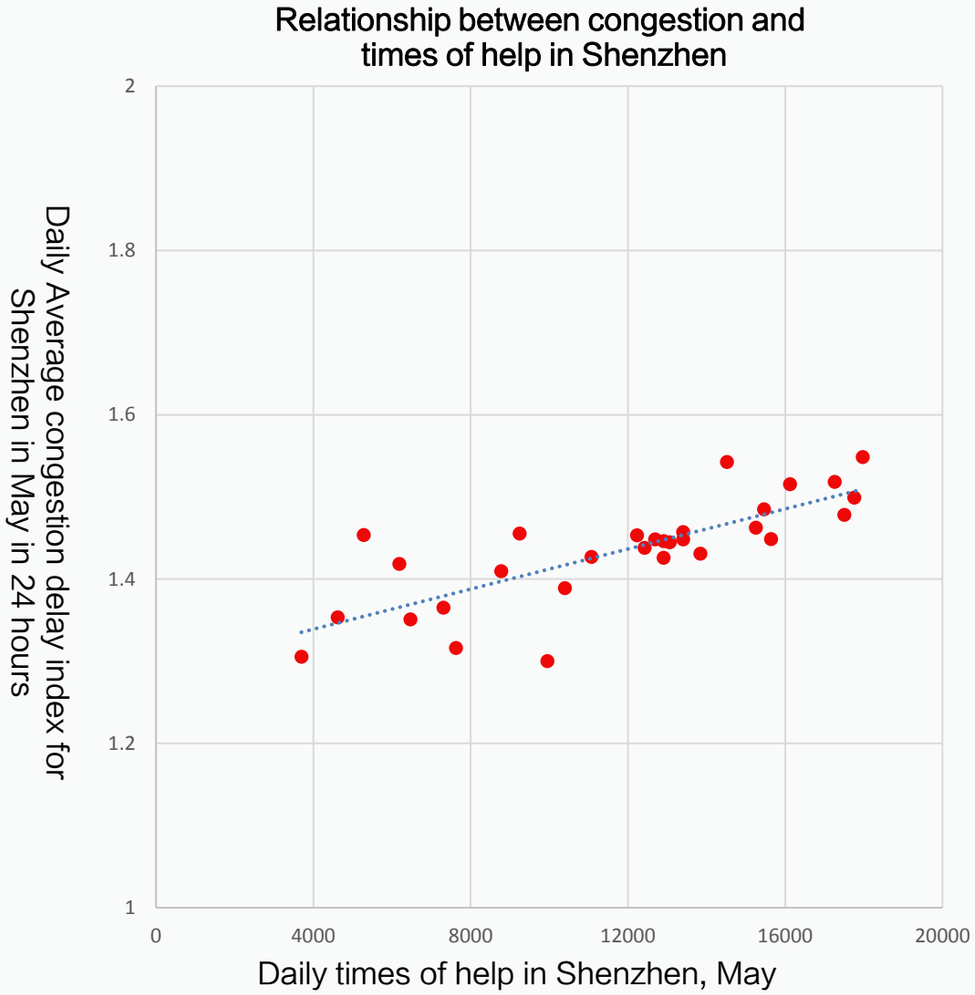
Traffic police in top 5 cities with the largest traffic incidents contribution

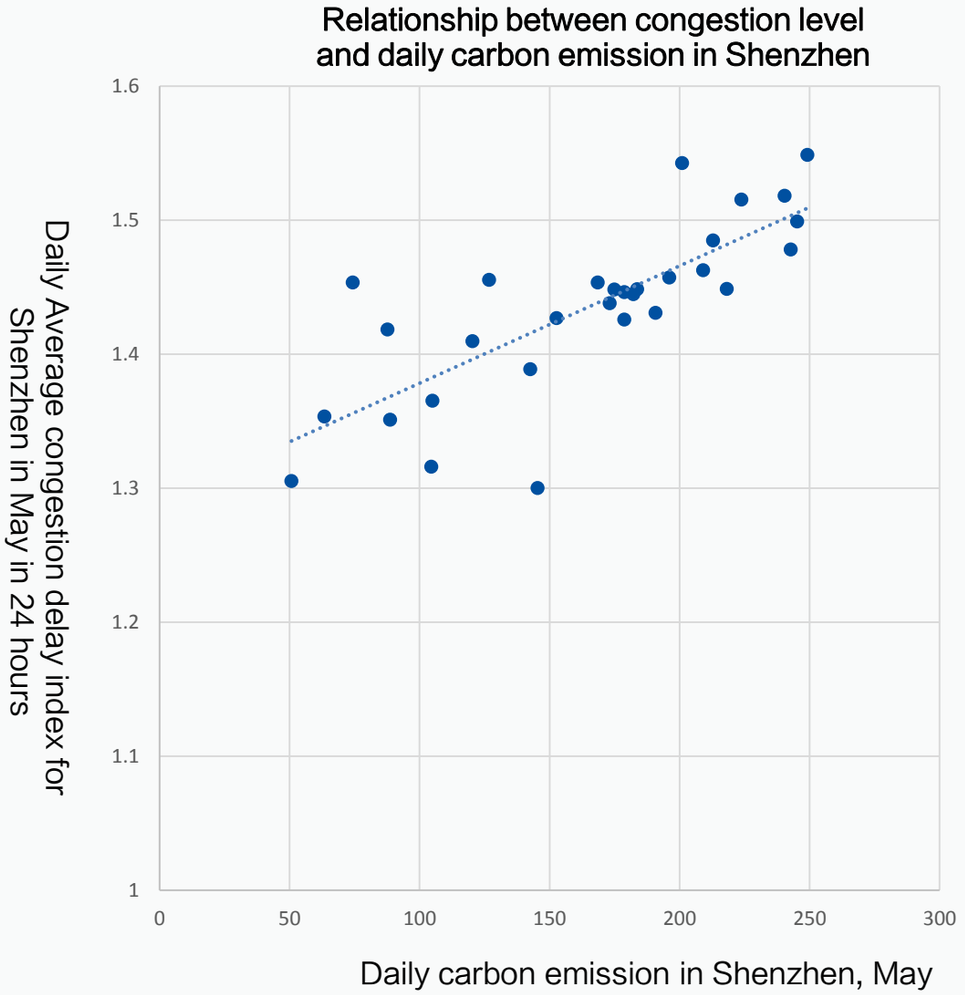


The severer congestion is, the more demand on traffic incident. Then, under such background, the more people will help, and the higher carbon emission will reduce

Liner relationship can be found for Shenzhen in May between congestion level and times of help, and such relationship can also be found between congestion level and carbon emission.

Liner relationship between congestion level and times of help.





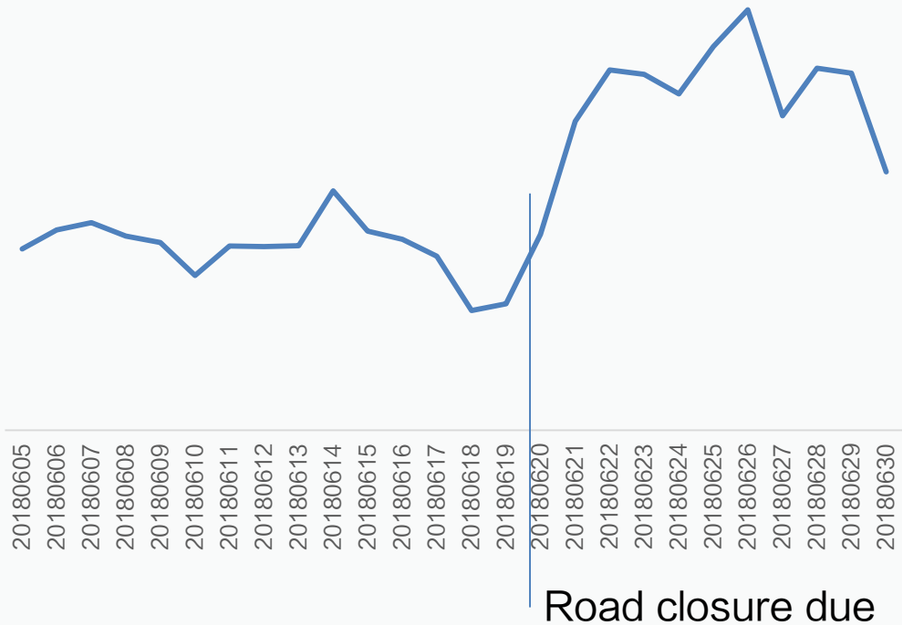
Less detour spent once received AutoNavi road closure notification

After road closure, the traffic flow ratio of non-AutoNavi users has increased, and due to no news received about road closure, this has resulted in more detour spent for some non-AutoNavi users.

From the traffic flow ratio, we can find that from June 5th to June 19th, the ratio of non-AutoNavi driving on the road was relative steady. Since June 20th ,when the second day of road closure, some non-AutoNavi users still drove on the road, but AutoNavi users, who were notified to change driving route, have saved lots of travel time without traveling on detour on closure road.

Due to road closure, driving on the route of Hongmian second road has been avoided

Non-AutoNavi users ratio on daily recorded total traffic flow



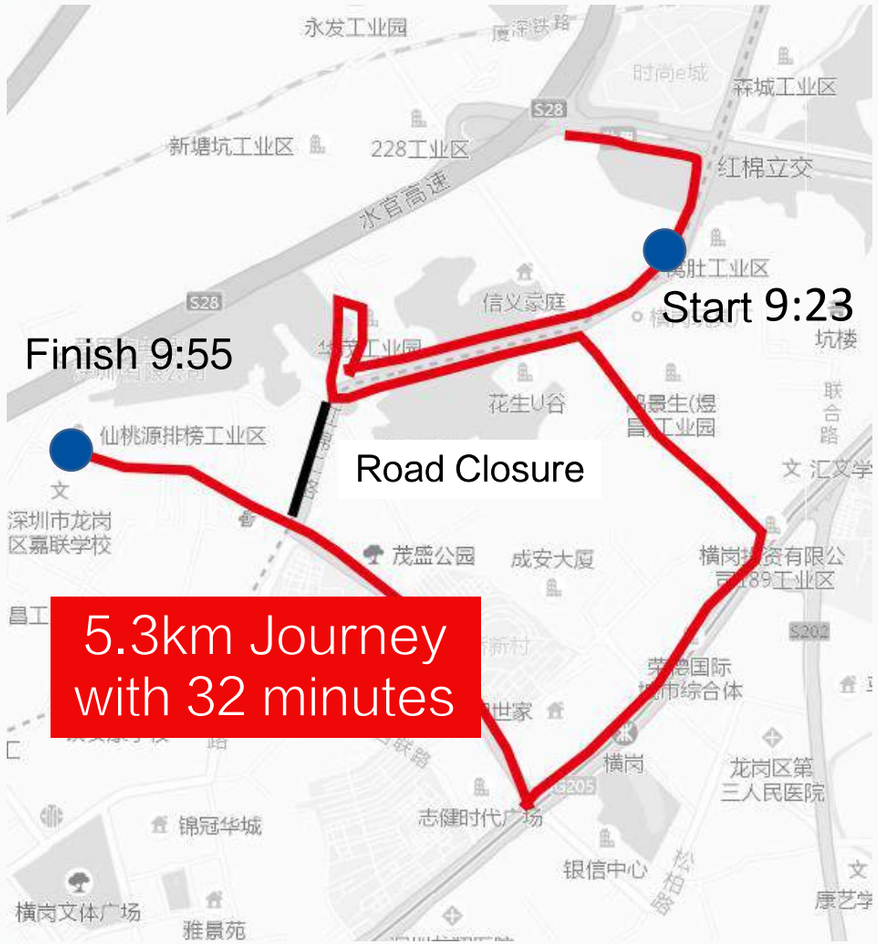
Note: Non-AutoNavi users was the source users we can collect data from, including taxi drivers and logistics vehicle drivers

Driver without avoid notification may take more travel time and petrol consumption to arrive to destination

Driver without avoid notification takes more than 3.5 times on travel time over the driver received notification

From two traces of two types of driver (with notification vs. without notification), the driver without road closure notification took 32 minutes on the journey that less than 3 kilometers; however, AutoNavi user with notification only took 9 minutes to arrive destination by route optimization based on automatic recognition of road closure.

Driver route without road closure notification



Driver route with road closure notification by AutoNavi

Note: Data of driving trace was from 2018.07.10. 9:00~10:00

Cooperative Research Results

×

清華大學 DAIMLER
可持续交通联合研究中心
Tsinghua-Daimler Joint Research Center for Sustainable Transportation

Joint Laboratory for
Future Transport and
Urban Computing

Research Background

Proposing and Defining Detour Problem

Detour is a common issue in public transportation systems design and evaluation. However, not only public transportation systems but also individual drivers will detour in reality, due to reasons like congestion and tolling.

Detour ratio is defined the same as “non-linear coefficient”, which is the ratio of detour distance to straight line distance, and the detour corresponding to straight line is called “non-linear detour”. Moreover, to compare actual travel path and the shortest path, detour index is introduced and defined as the ratio of actual travel distance to the shortest path length, and the detour corresponding to the shortest path is called “selective detour”.

Non-Linear Detour: Detour Over Straight Line

Figure 1 Definition of Detour Ratio

$$\text{Detour Ratio} = \frac{d_{ij}}{d_{ij}^{Eu}}$$

d_{ij} : travel distance between origin and destination

d_{ij}^{Eu}: straight line distance between origin and destination

Selective Detour: Detour corresponds to the Shortest Path

Figure 2 Definition of Selective Detour

$$\text{Detour Index} = \frac{d_{ij}}{d_{ij}^{shortest}}$$

d_{ij} : travel distance between origin and destination

$d_{ij}^{shortest}$: the shortest path distance between origin and destination

Relationship between Detour Ratio and Urban Road Network Density

Table 1 City Structure and Road Network Density

City	City Structure	Total Length of Road in Built-up Area	Size of Built-up Area	Road Network Density
Beijing	Massive Block	$5112.1km$	$912.3km^2$	5.59
Guangzhou	Band Group	$2678.8km$	$381.4km^2$	7.02
Chengdu	Massive Block	$2614.0km$	$326.1km^2$	8.02
New York	Grid Net			13.1

Table 2 Fitting Result and Goodness of Fitting on City Detour Ratio

Within One Month	Beijing	Guangzhou	Chengdu	New York
Minimum	1.327	1.352	1.306	1.368
Average	1.358	1.359	1.313	1.405
Maximum	1.398	1.363	1.323	1.418
Minimum R-Square	0.776	0.916	0.938	0.912

- Beijing has the same city structure as Chengdu. With Chengdu’s road network density leading Beijing by 30%, Beijing’s detour ratio is 3.4% larger than Chengdu.
- Guangzhou’s road network density is 25.6% greater than Beijing’s, but the detour ratio of the tow cities is similar, while Guangzhou’s fluctuation is smaller.
- New York has the greatest road network density and detour ratio. Due to the grid net in Manhattan, travel distance between points is Manhattan Distance, which is a constant no matter how road network density changes.

Detour Ratio Spatial Dependency Analysis on Guangzhou, July 1st, 2017

By dividing central urban area into 10 × 10 grids net (grid side length 1km), an OD matrix of 100 × 100 is formed, and colored by average detour ratio.
Top 10 OD with the greatest detour ratio is marked on the map (3 outliers are wiped out)

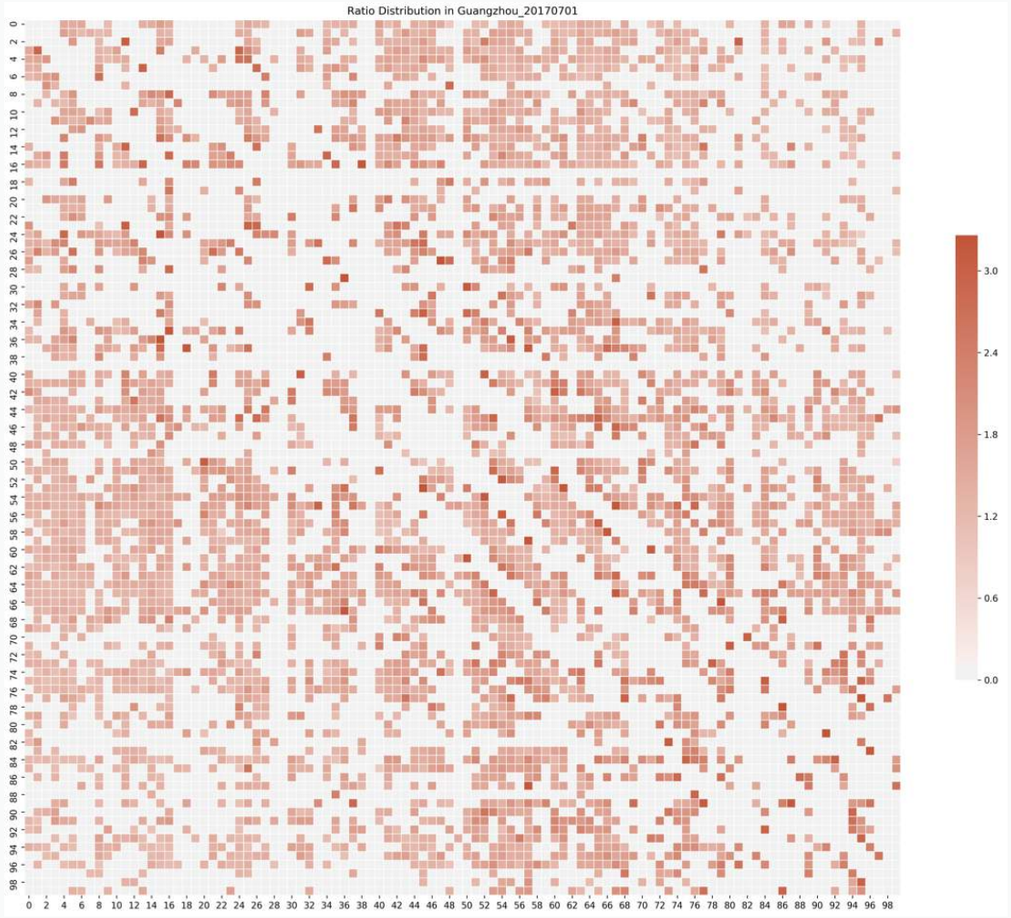


Figure 3 Detour Ratio Distribution in Guangzhou (100 × 100)

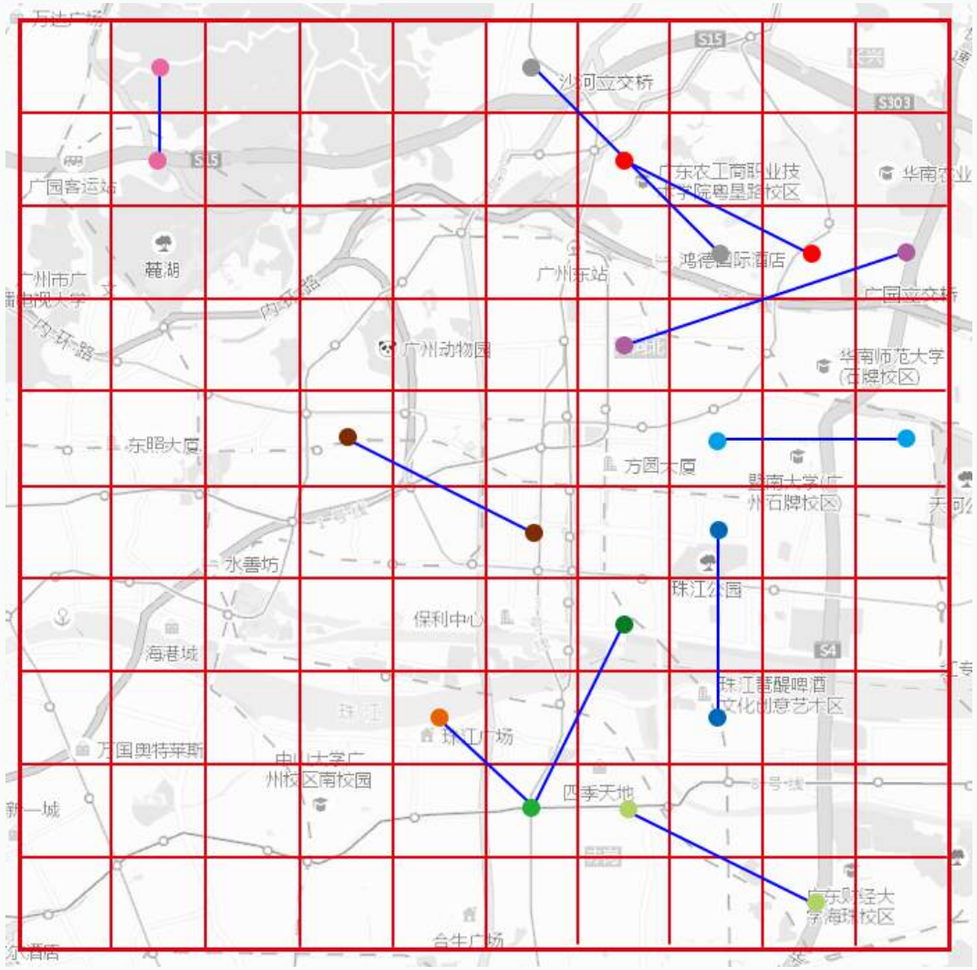


Figure 4 Top 10 OD with the Greatest Detour Ratio in Guangzhou

Detour Ratio Spatial Dependency Analysis on Guangzhou, July 1st, 2017

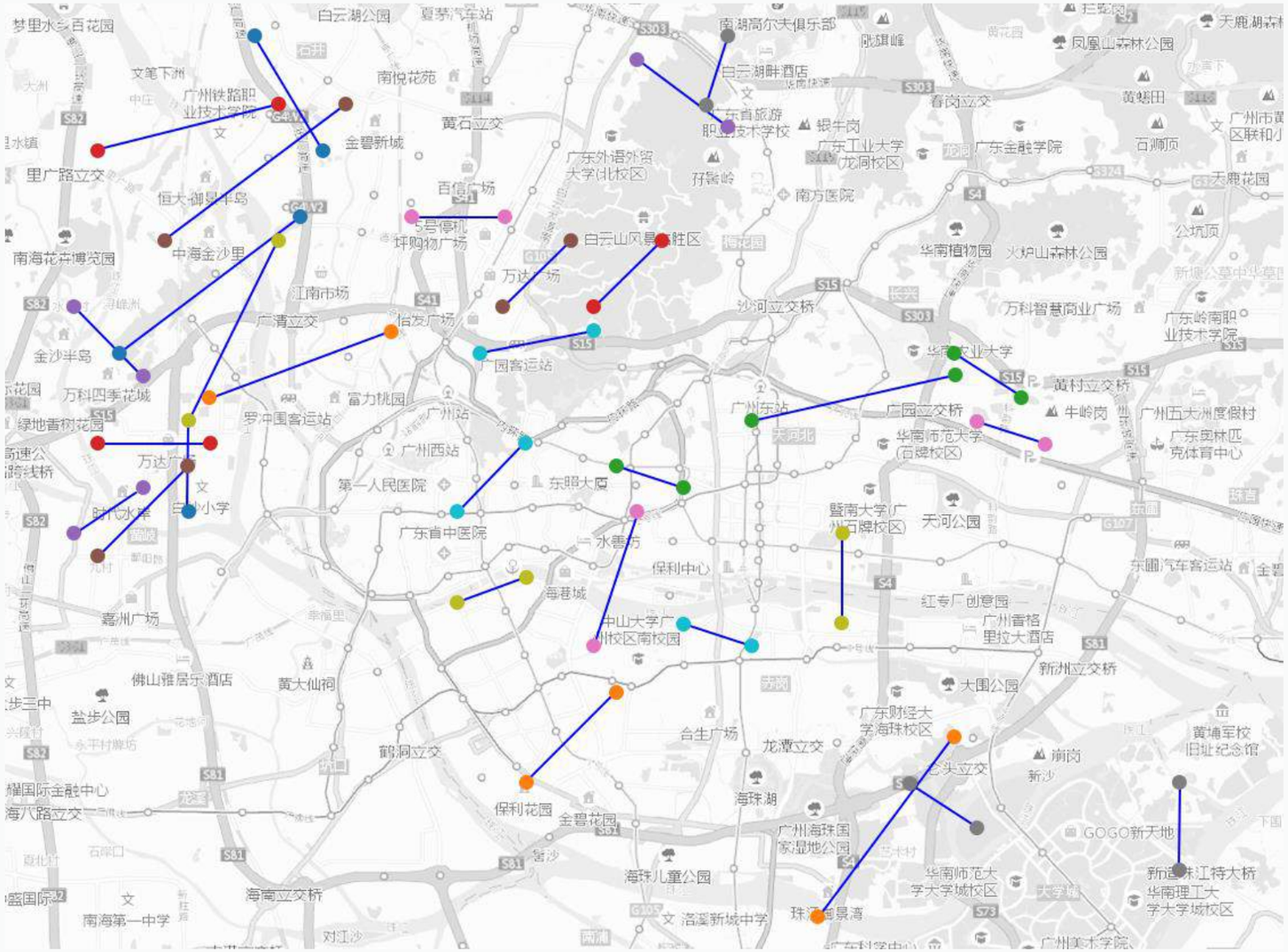


Figure 5 Top 30 OD with the Greatest Detour Ratio in Guangzhou

Out of the top 30 OD pairs with the greatest detour ratio, 12 (40%) are river-crossing, 5 (16.7%) are in mountainous area.

Most of the high detour ratio OD pair has relevantly short straight line distance, reflecting detour ratio and straight line distance might be negative correlated.

Detour Ratio Time Dependency Analysis on Guangzhou, July 1st, 2017

A day can be divided into 144 segments with 10 minutes intervals.

In figure 6, each grid in 144 × 144 matrix counts the amount of trips from time interval a to interval b.

From whole-day perspective, few trips happened in the early morning, while most trips happened at noon, which fits the actual situation.

Average detour ratio is then calculated and colorized for each grid (figure 7).

Figure shows little variation in detour ratio with time changes.

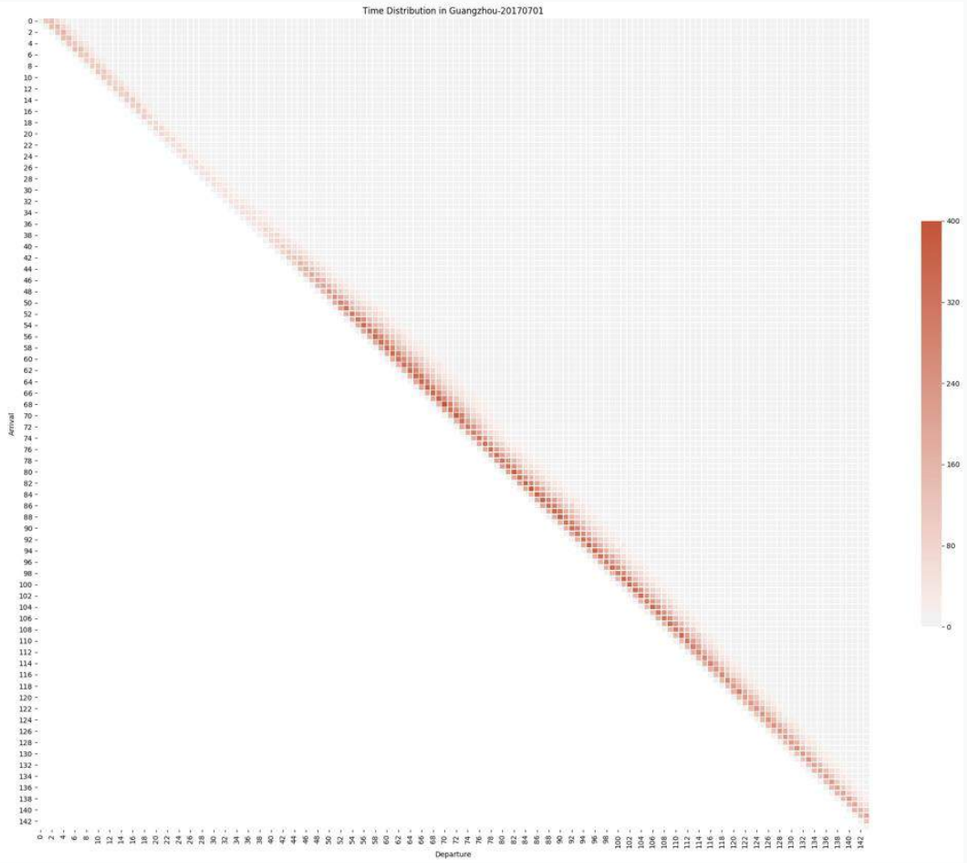


Figure 6 Time Distribution of trips in Guangzhou(144 × 144)

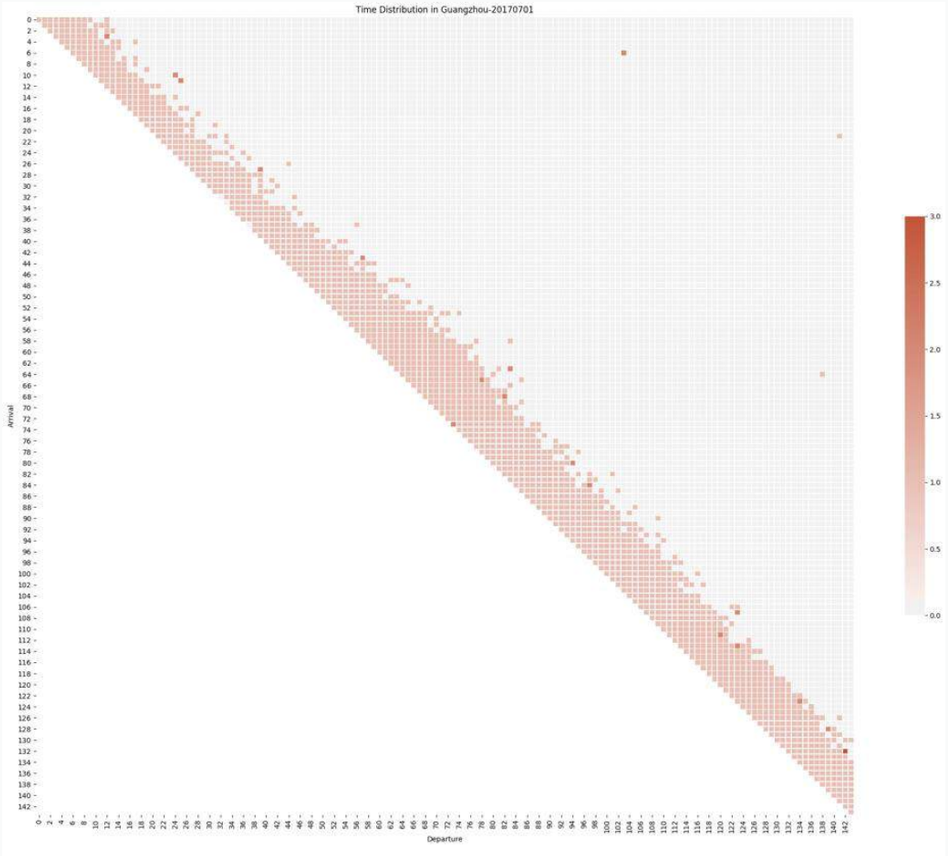


Figure 7 Time Distribution of Average Detour Ratio (144 × 144)

Detour Ratio Time Dependency Analysis on Guangzhou, July 1st, 2017

Figure 8 shows the distribution of traffic volume per hour over the day.
Figure 9 shows the variation of median of detour ratio in each hour.
Figure 10 shows the variation of average travel speed in each hour.
The trending of detour ratio variation is similar to volume variation, while the trending of average speed variation is reversed.
Data shows that, as the traffic grows, congestion increases, detour intensifies, and average speed drops.

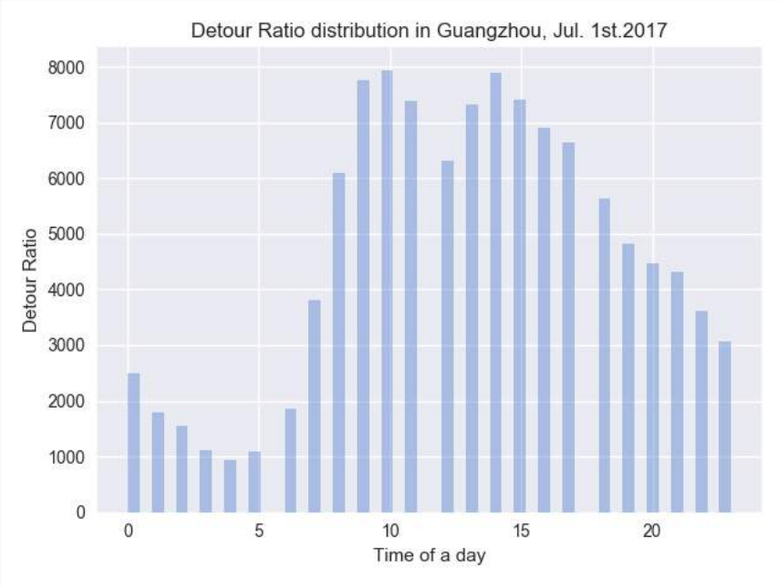


Figure 8 Traffic Volume per Hour in Guangzhou

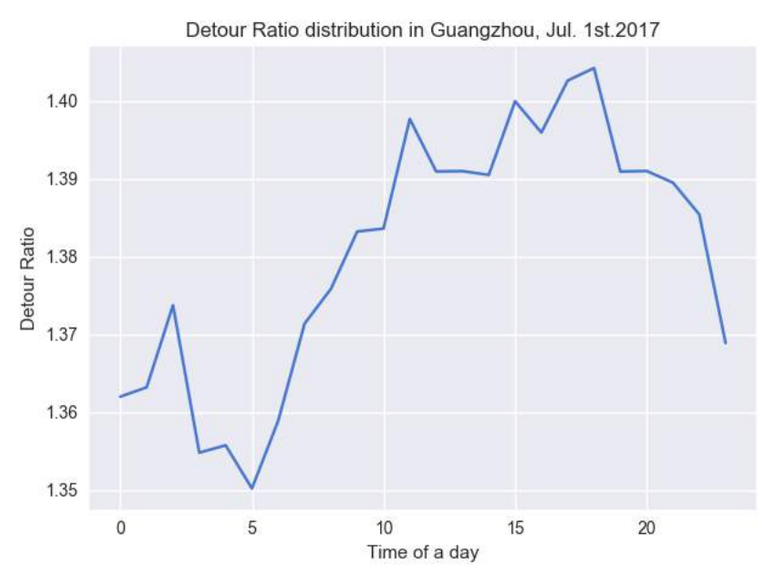


Figure 9 Median of Detour Ratio in Guangzhou

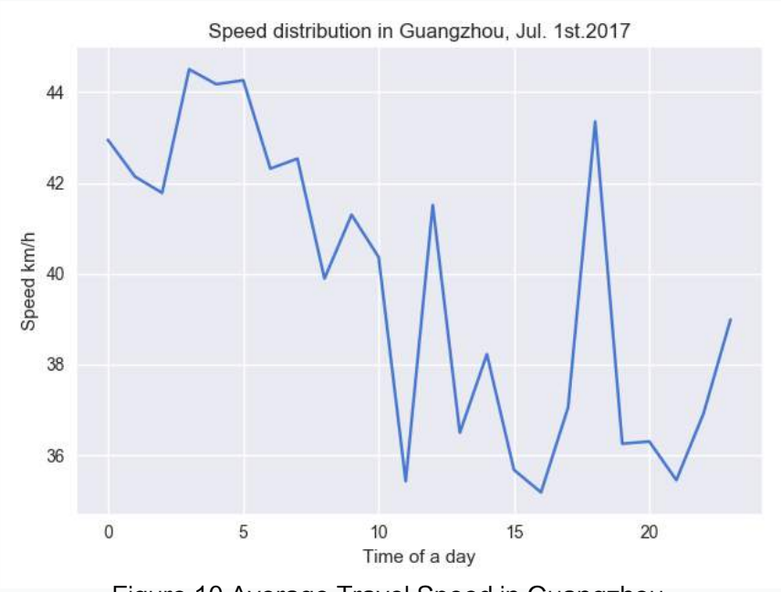


Figure 10 Average Travel Speed in Guangzhou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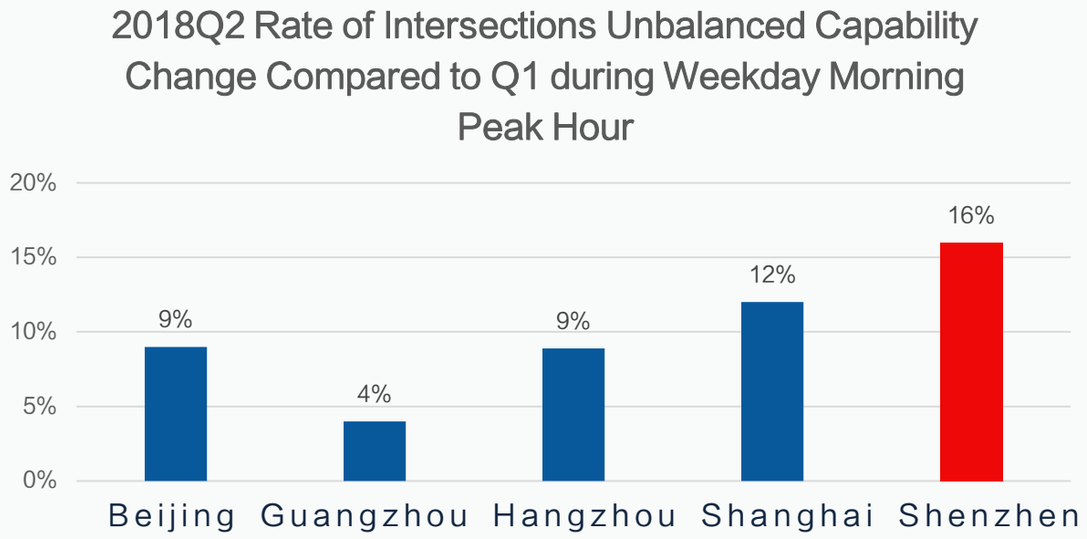
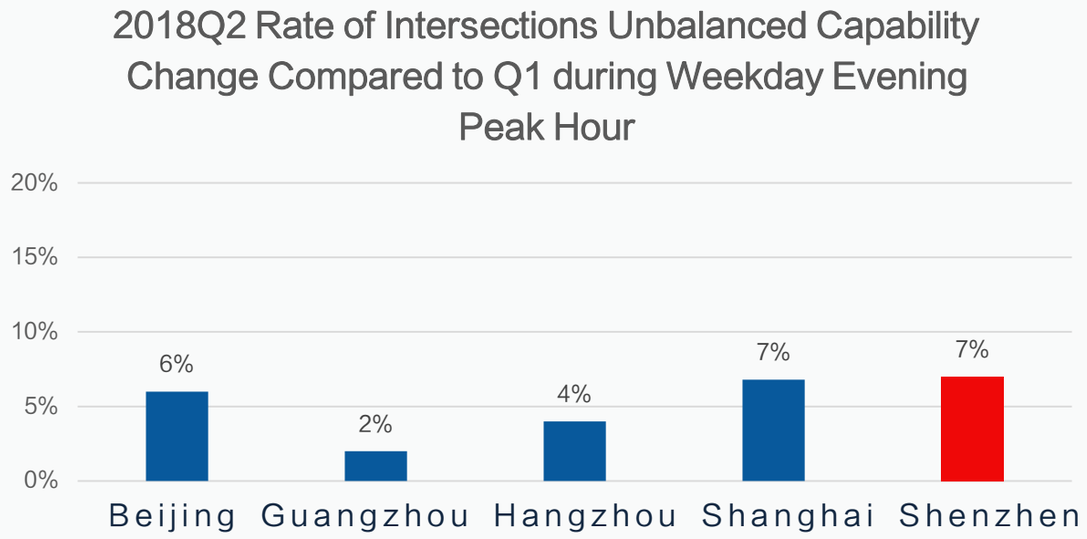
Quarter-on-Quarter: Guangzhou Rises the Least; Shenzhen Varies the Worst

Difference between actual status and equilibrium status (marked as Unbalance Index) is used to evaluate the demand and supply regulating capability of intersection signals. The higher the unbalanced index goes, the more intersection gets unbalanced, the lower intersection signal regulating capability goes. However, unbalanced intersection is not equal to intersection congestion, and when intersection congests, it might not be unbalanced. Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou are chosen as evaluation targets. Comprehensive analysis is carried out on all T-type and cross-type intersections signals in cities urban area during 2018Q2 to find out the rate of capability change compared to Q1.





Weekday Morning Peak Hour

The rate of intersection unbalanced capability change in Shenzhen and Shanghai are more than 10%, where Shenzhen changes most by increasing 16%; while Guangzhou changes least by increasing only 4%.

Weekday Evening Peak Hour

Compared to morning peak hour, evening peak hour intersection unbalanced capability rates lower in all 5 cities, while Guangzhou still changes least by increasing only 2%.

Appendix A

Keyword	Definition
Congestion delay index	Congestion delay index = The travel time under traffic congestion / The travel time under free flow
Congestion delay time	Congestion delay time = The travel time under traffic congestion – The travel time under free flow
Average travel length	The average travel length in a city
Average travel speed	The average travel speed in a city
Average travel time	The average travel time in a city
Average delay time	The average delay time in a city
The most congested day	The day of the highest congestion delay index of a city during a certain time period
Hot business districts	Urban regions with many people, heavy traffics and developed commerce
Daily commuting delay	Congestion time during commuting each day
Peak-period road average travel speed	On a certain road, vehicles' mean speed in morning and evening peaks
Peak-period road travel time	On a certain road, vehicles' mean travel time in morning and evening peaks
Peak-period road travel delay time	A certain road' s delay time; the congestion delay time = the travel time under traffic congestion – the travel time under free flow
Ordinary–period road travel speed	On a certain road, vehicles' mean travel speed in the free-passing and non-congestion state, usually at night
Ordinary–period road travel time	On a certain road, vehicles' mean travel time in the free-passing and non-congestion state, usually at night
Urban trunk	The backbone of urban road networks, connecting the city' s main roads in different districts and playing the role of transport functions
Average daily tempo-spatial oversaturation equivalent	Total oversaturation units in a certain tempo-spatial range;
Oversaturation temporal density	Average daily oversaturation units per kilometer;
Oversaturation spatial density	Average daily oversaturation units per hour;
Carbon oxides (COx)	Collective name for carbon monoxide, carbon dioxide and other oxygen compounds from automobile exhausts.
Popular places going by vehicles	Collect all POI from the users of AutoNavi, no matter about navigation or route planning, based POI classification system, cluster the users going to different POI. The destination with more times of users for navigation or route planning, the higher popularity may be received for this destination.

AutoNavi Map

AutoNavi Transportation

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