



@ GSDI - 2016/12/01

# Movements in Taipei City

## data collection, data analysis, and data visualization

Session: S05504b-3

Smart Transportation - SDI for the Smart Homeland

room: 504b time: 13:30-15:00

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Benny Chin, PhD student

NTU Geography

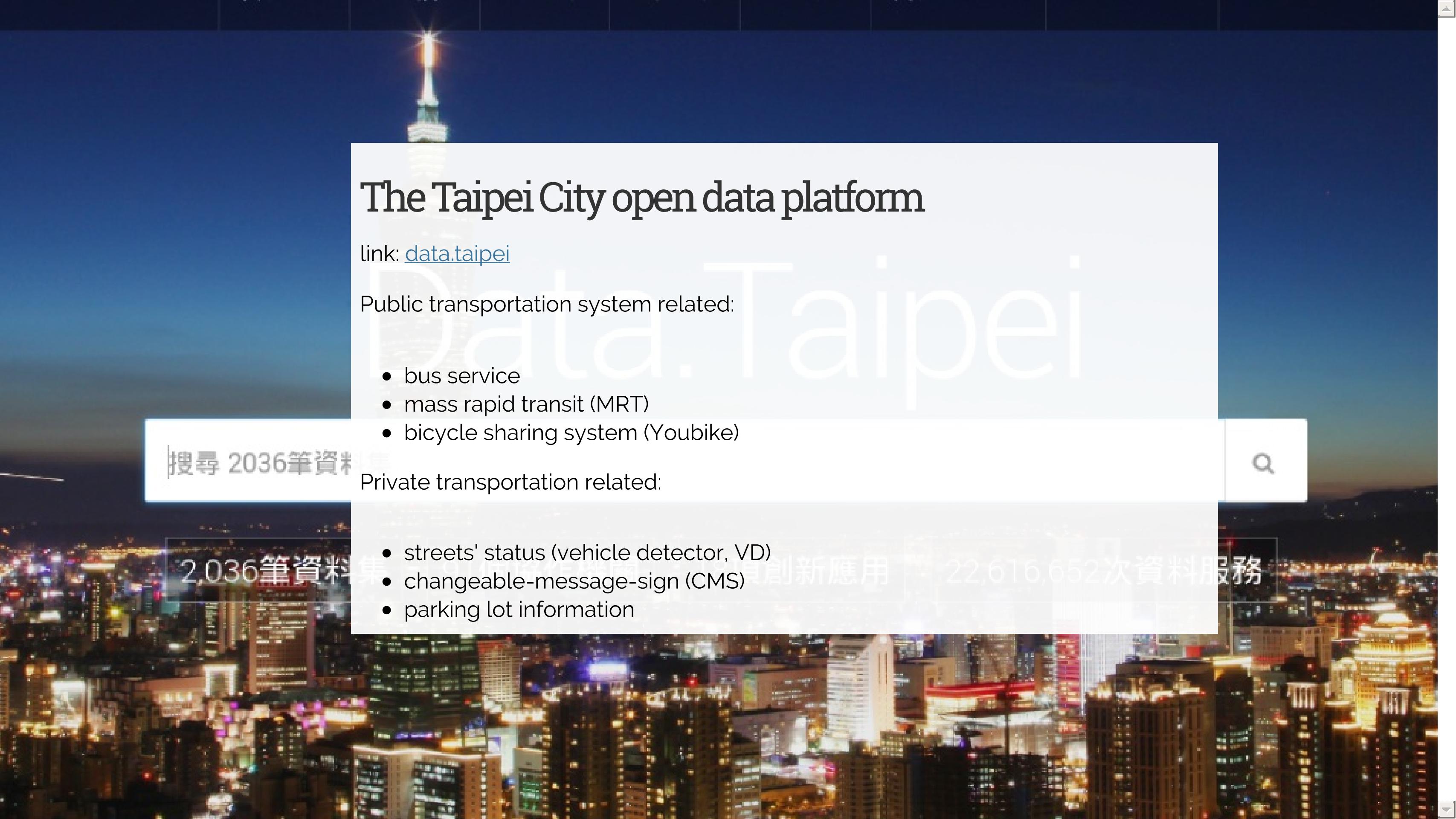
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## about this talk

- the data: detecting urban mobility
- the analysis: modelling movements on urban street system
- the visualization: seeing vehicle movement in urban street system

# detecting urban mobility

- source of data -- Taipei City Open Data Platform
- getting the data



# The Taipei City open data platform

link: [data.taipei](http://data.taipei)

Public transportation system related:

- bus service
- mass rapid transit (MRT)
- bicycle sharing system (Youbike)

Private transportation related:

- streets' status (vehicle detector, VD)
- changeable-message-sign (CMS)
- parking lot information

# 臺北市政府 交通即時資 料開放資料 專區

[Download ZIP](#)

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This project is  
maintained by [taipubliccity](#)

## Public Bus Service

公車即時資料 (說明文件)

資料集	說明	頻率	連結
PathDetail	路線路數與始終點座標	每小時	<a href="http://data.taipei/oas/PathDetail">http://data.taipei/oas/PathDetail</a>
CarInfo	車輛基本資料	每小時	<a href="http://data.taipei/oas/CarInfo">http://data.taipei/oas/CarInfo</a>
OrgPathAttribute	路線、空運量調查	每小時	<a href="http://data.taipei/oas/OrgPathAttribute">http://data.taipei/oas/OrgPathAttribute</a>
PROVIDER	路網空橋(不含MRT)	每小時	<a href="http://data.taipei/oas/Provider">http://data.taipei/oas/Provider</a>
ROUTE	路線	每小時	<a href="http://data.taipei/oas/ROUTE">http://data.taipei/oas/ROUTE</a>
ROUTEGeom	公車路線 (GeoJSON)	每小時	<a href="http://data.taipei/oas/ROUTEGeom">http://data.taipei/oas/ROUTEGeom</a>
DownloadShip	公車站牌 (zip 格式)	每小時	<a href="http://data.taipei/oas/DownloadShip">http://data.taipei/oas/DownloadShip</a>
TimeTable	營運時間表	每小時	<a href="http://data.taipei/oas/TimeTable">http://data.taipei/oas/TimeTable</a>
SemiTimeTable	半動態時間表	每分鐘	<a href="http://data.taipei/oas/SemiTimeTable">http://data.taipei/oas/SemiTimeTable</a>
BUSDATA	定期車輛行駛	每分鐘	<a href="http://data.taipei/oas/BUSDATA">http://data.taipei/oas/BUSDATA</a>
BUSEVENT	空橋應變事件	每分鐘	<a href="http://data.taipei/oas/BUSEVENT">http://data.taipei/oas/BUSEVENT</a>
ISStopPath	智慧型站牌行駛路徑	每分鐘	<a href="http://data.taipei/oas/ISStopPath">http://data.taipei/oas/ISStopPath</a>
ISStop	智慧型站牌	每分鐘	<a href="http://data.taipei/oas/ISStop">http://data.taipei/oas/ISStop</a>
Stop	站牌	每分鐘	<a href="http://data.taipei/oas/Stop">http://data.taipei/oas/Stop</a>
CarUnusual	車輛異常資訊	每分鐘	<a href="http://data.taipei/oas/CarUnusual">http://data.taipei/oas/CarUnusual</a>
StopLocation	站位資訊	每分鐘	<a href="http://data.taipei/oas/StopLocation">http://data.taipei/oas/StopLocation</a>
EstimateTime	預估到站時間	每分鐘	<a href="http://data.taipei/oas/EstimateTime">http://data.taipei/oas/EstimateTime</a>

## Metro (MRT)

捷運列車即時資料 (說明文件)

資料集	說明	頻率	連結
捷運列車即時資料	捷運列車 到站資料 分鐘	每5 分鐘	<a href="http://data.taipei/oas/mrtArrivalDetail?scope=route&amp;id=55466&amp;dt=2013-04-25T17:16">http://data.taipei/oas/mrtArrivalDetail?scope=route&amp;id=55466&amp;dt=2013-04-25T17:16</a>

## Automobiles

交際即時資料 (說明文件)

資料集	說明	頻率	連結
VD	捷運速率	每分鐘	<a href="http://data.taipei/oas/VD">http://data.taipei/oas/VD</a>
VODATA	車輛機率(VD)資料	每分鐘	<a href="http://data.taipei/oas/VODATA">http://data.taipei/oas/VODATA</a>
CMS	捷運即時資料(CMS)顯示內容	每分鐘	<a href="http://data.taipei/oas/CMS">http://data.taipei/oas/CMS</a>

停車場即時資料 (說明文件)

資料集	說明	頻率	連結
TOWER_ALL_DESC	臺北市停車塔資訊	每分鐘	<a href="http://data.taipei/oas/tower/alldesc">http://data.taipei/oas/tower/alldesc</a>
TOWER_ALL_AVAILABLE	可停車位資訊	每分鐘	<a href="http://data.taipei/oas/tower/allavailable">http://data.taipei/oas/tower/allavailable</a>

YouBike 即時資料 (說明文件)

資料集	說明	頻率	連結
youbike	youbike即時資訊	每分鐘	<a href="http://data.taipei/youbike">http://data.taipei/youbike</a>

## Bicycle Sharing System



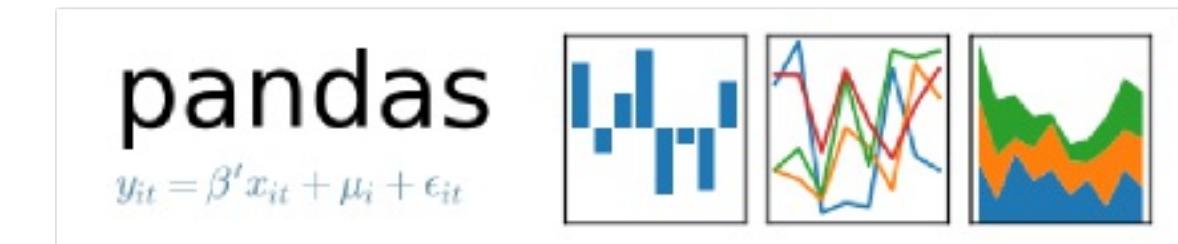
## Tools for interfacing the open data API

- getting data (python)
- preparing table and push to database and csv (python-pandas)
- storing data (postgresql)
- operating system (lubuntu)
- remote backup (openmediavault+rsync)



PostgreSQL

lubuntu



## Focus on the four moving modes

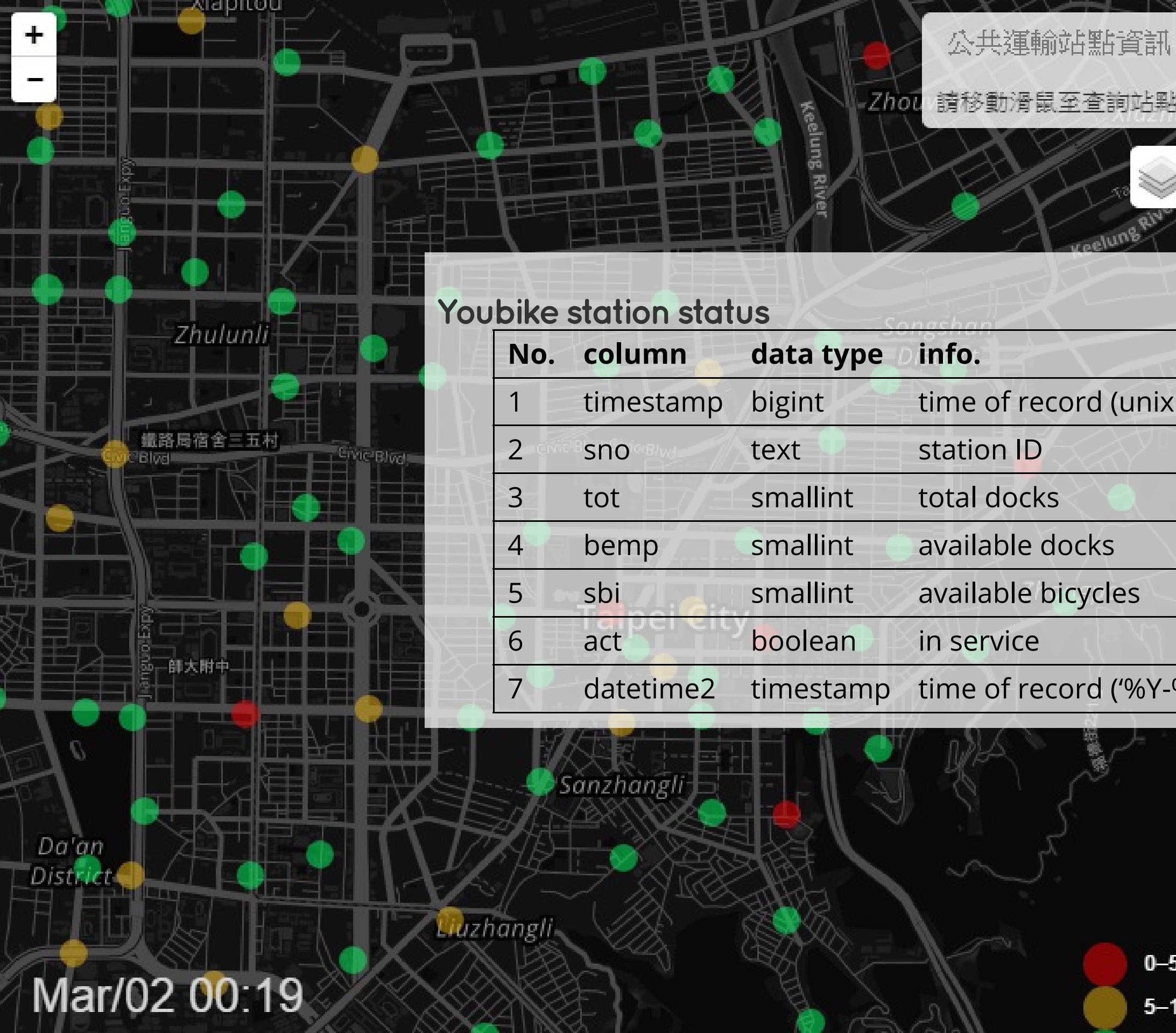
Dataset	format	source	time resolution
Street status (VD)	gzipped XML	<a href="http://data.taipei/tisv/VDDATA">http://data.taipei/tisv/VDDATA</a>	every 5 minutes
Bus Location	gzipped JSON	<a href="http://data.taipei/bus/BUSDATA">http://data.taipei/bus/BUSDATA</a>	every minute
Youbike station status	gzipped JSON	<a href="http://data.taipei/youbike">http://data.taipei/youbike</a>	every 1 minutes
MRT station riderships	csv	<a href="http://data.taipei/opendata/datalist/datasetMeta?oid=1d71c478-205f-42c5-8386-35f86d74fdd1">http://data.taipei/opendata/datalist/datasetMeta?oid=1d71c478-205f-42c5-8386-35f86d74fdd1</a>	every hour

	AvgSpeed	LaneNO	Lvolume	Mvolume	Svolume	Volume	vdid	datetime2	Ltimes
0	60	0	0	51	0	51	V0111C0	2016-08-01 00:03:14	14699
1	53	0	0	23	0	23	V0112A0	2016-08-01 00:03:14	14699
2	66	0	5	20	0	25	V0120C0	2016-08-01 00:03:14	14699
3	59	1	4	55	0	59	V0120C0	2016-08-01 00:03:14	14699
4	73	0	0	0	0	0	29 V0130A0	2016-08-01 00:03:14	14699
5	75	1	0	0	0	0	53 V0130A0	2016-08-01 00:03:14	14699
6	74	2	0	0	0	0	34 V0130A1	2016-08-01 00:03:14	14699
7	71	0	0	0	0	0	34 V0130A1	2016-08-01 00:03:14	14699
8	80	1	0	0	0	0	34 V0130A1	2016-08-01 00:03:14	14699
9	76	2	0	0	0	0	16 V0130A1	2016-08-01 00:03:14	14699
0	74	0	0	0	0	0	30 V0140C0	2016-08-01 00:03:14	14699
1	78	1	0	0	0	0	30 V0140C0	2016-08-01 00:03:14	14699
2	72	0	0	0	0	0	32 V0140C1	2016-08-01 00:03:14	14699
3	66	1	0	0	0	0	35 V0140C1	2016-08-01 00:03:14	14699
4	69	0	0	0	0	0	33 V0150C0	2016-08-01 00:03:14	14699
5	75	1	0	53	0	53	V0150C0	2016-08-01 00:03:14	14699
6	74	2	0	29	0	29	V0150C0	2016-08-01 00:03:14	14699
7	67	0	11	12	0	23	V0150C1	2016-08-01 00:03:14	14699
8	66	1	16	30	0	46	V0150C1	2016-08-01 00:03:14	14699
9	61	2	8	23	0	31	V0150C1	2016-08-01 00:03:14	14699

### Street status (Vehicle Detector)

No.	column	data type	info.
1	timestamp	bigint	time of record (unix timestamp)
2	vdid	text	ID code of VD
3	LaneNo	integer	lane number of the street
4	AvgSpeed	numeric	average speed
5	Lvolume	integer	volume of large vehicle
6	Mvolume	integer	volume of medium vehicle
7	Svolume	integer	volume of small vehicle
8	Volume	integer	total volume
9	datetime2	timestamp	time of record ('%Y-%m-%d %H:%M:%S')

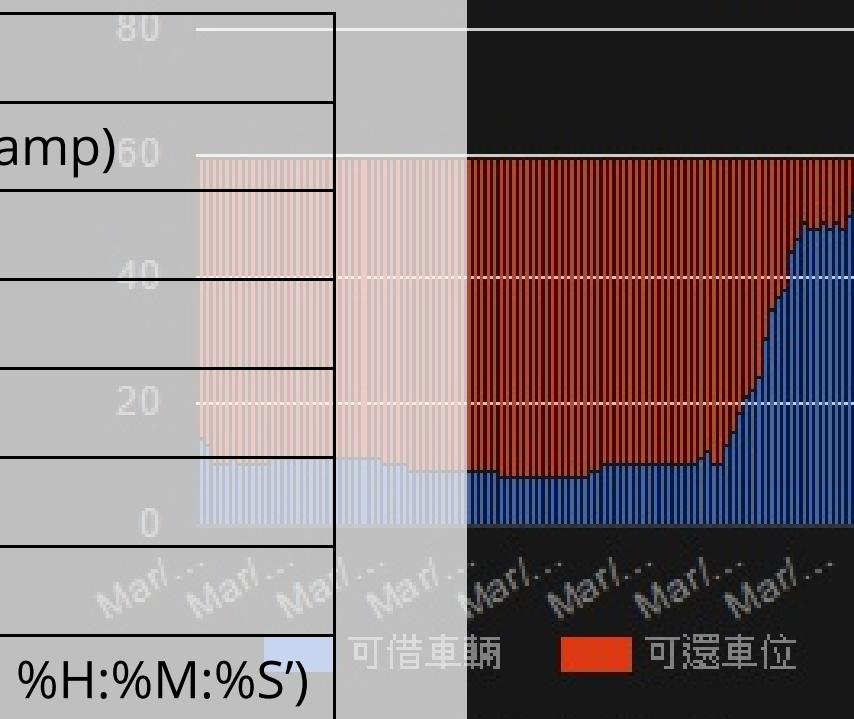
azimuth	BusID	CarID	DutyStatus	GoBack	Latitude	Longitude	RouteID	Speed	datetime2
244.2	709-FL	222222427		2	0	25.048493	121.441202	10942	02016-06-0
10.7	020-FQ	222226933		2	1	25.032803	121.613352	101810	02016-06-0
250.3	049-FR	222233854		2	0	25.094118	121.519825	153340	02016-06-0
85.4	317-FR	222234259		2	1	24.985375	121.5524	10736	02016-06-0
0176-U7		222234111	Bus location	1	1	25.088766	121.464264	104170	0.592642016-06-0
103.9	916-FR	222234270		1	1	25.097222	121.42225	101910	02016-06-0
317.9	200-FR	222234034		2	1	25.065717	121.628973	15638	02016-06-0
229.1	045-FR	222234350		3	0	25.074441	121.519855	153340	02016-06-0
80.8	055-FR	222234359		4	0	25.064123	121.51989	153340	02016-06-0
356	339-FR	222234248		5	1	25.05122	121.496567	108610	02016-06-0
67.9	272-FY	222234119		6	0	25.041022	121.642808	15191	02016-06-0
140.7	829-FX	222234136		7	1	25.03174	121.52166	11742	02016-06-0
247.6	439-FS	222234617		8	1	25.02672	121.56158	102330	02016-06-0
258.7	857-FR	222234132		9	1	25.026795	121.567197	157685	02016-06-0
238	502-FR	222234094		10	1	25.015272	121.42527	11881	02016-06-0
254.779999	006-U3	222234235		11	1	25.01112	121.41422	28.11336	2016-06-0
314	463-FW	222235664		1	0	25.00236	121.58325	157438	02016-06-0
106.9	081-FS	222233825		2	1	24.960498	121.48323	157541	02016-06-0
59.8	855-FR	222234130		2	0	25.068115	121.567377	157462	02016-06-0
267.7	282-FR	222234181		2	1	25.039285	121.570192	111520	02016-06-0
205.5	325-FR	222234204		2	1	25.015198	121.496708	108610	02016-06-0



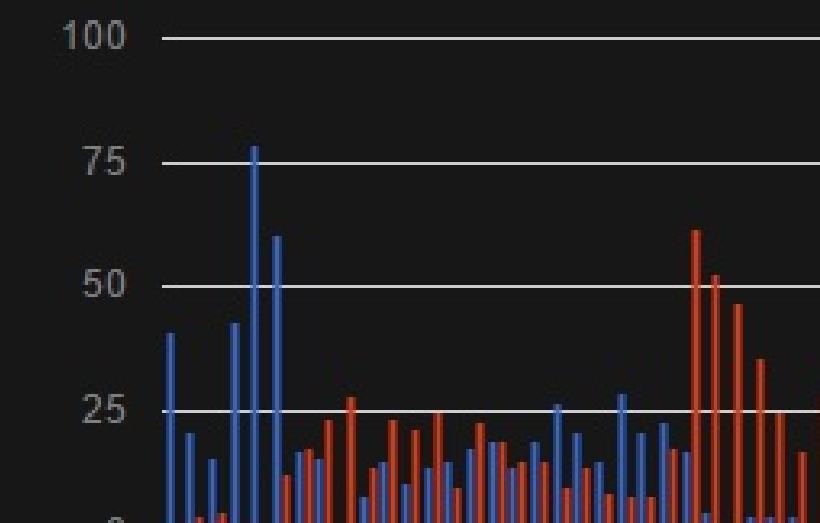
起始日期  
2016-03-01

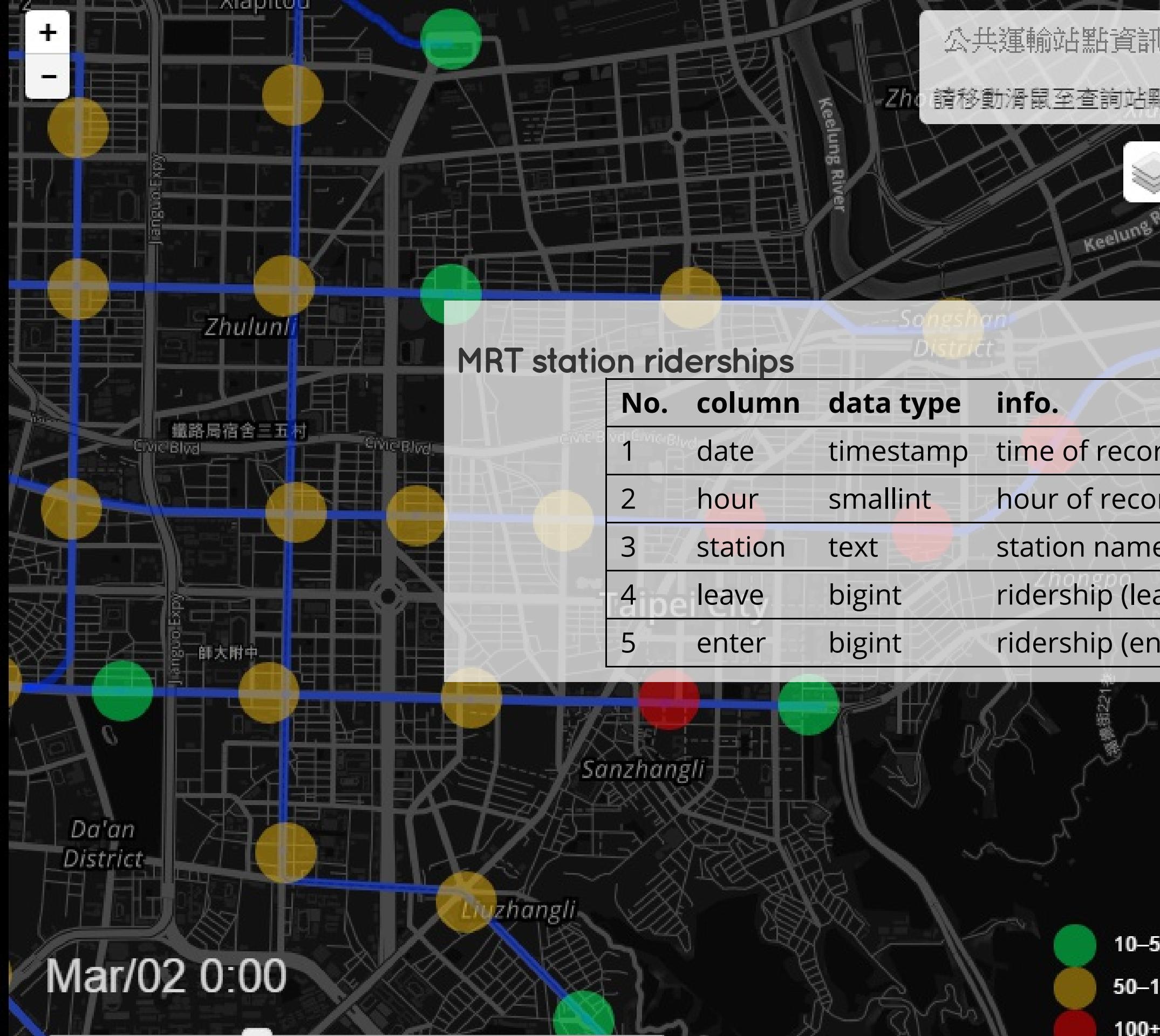
結束日期  
2016-03-03

松仁路/松仁路95巷(東南側)



YouBike 使用頻率分布圖



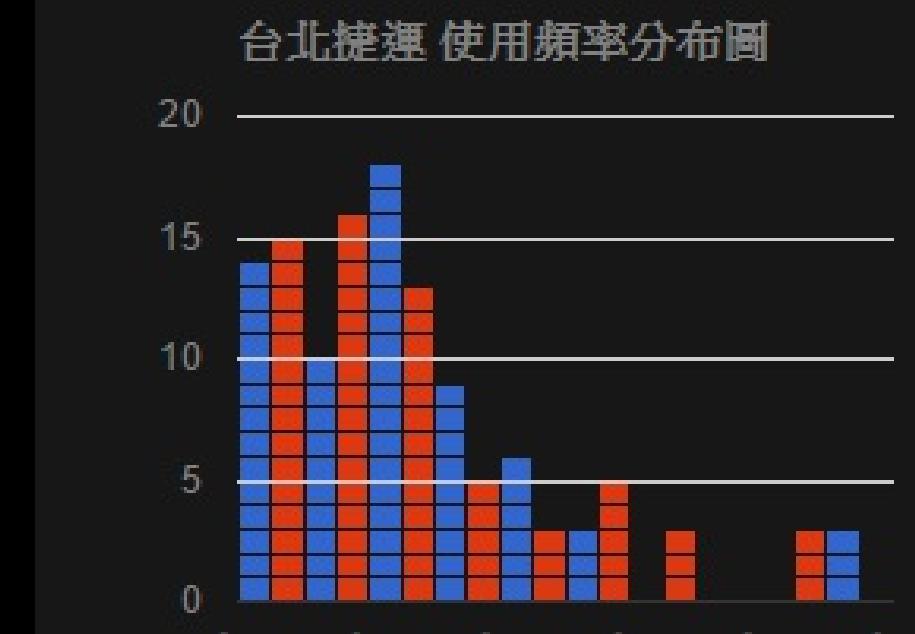
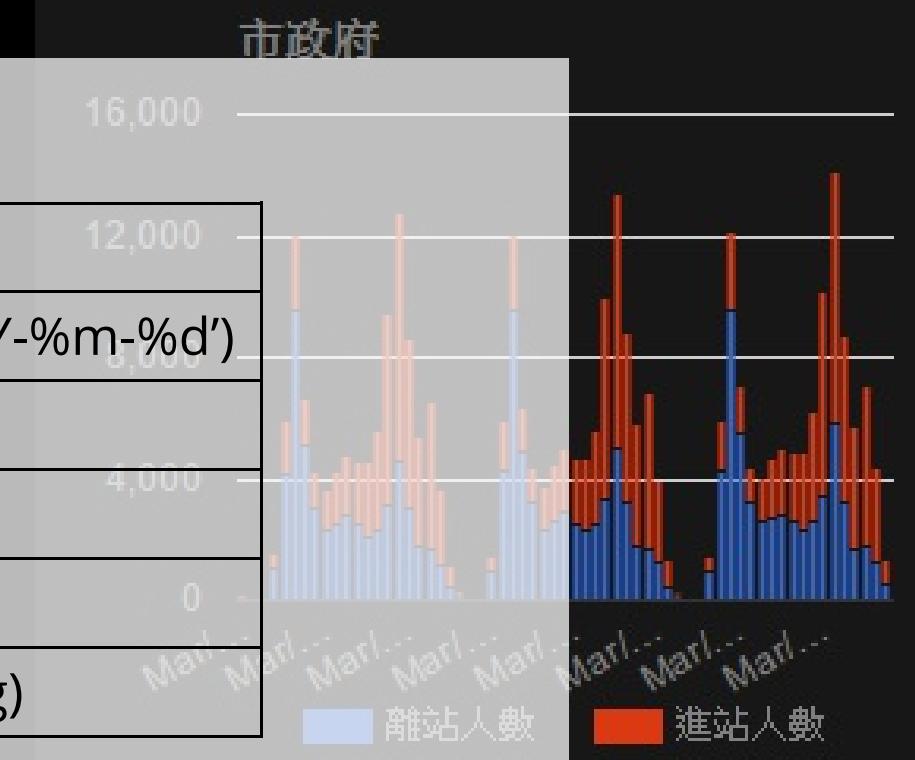


起始日期: 2016-03-01

結束日期: 2016-03-03

搜尋

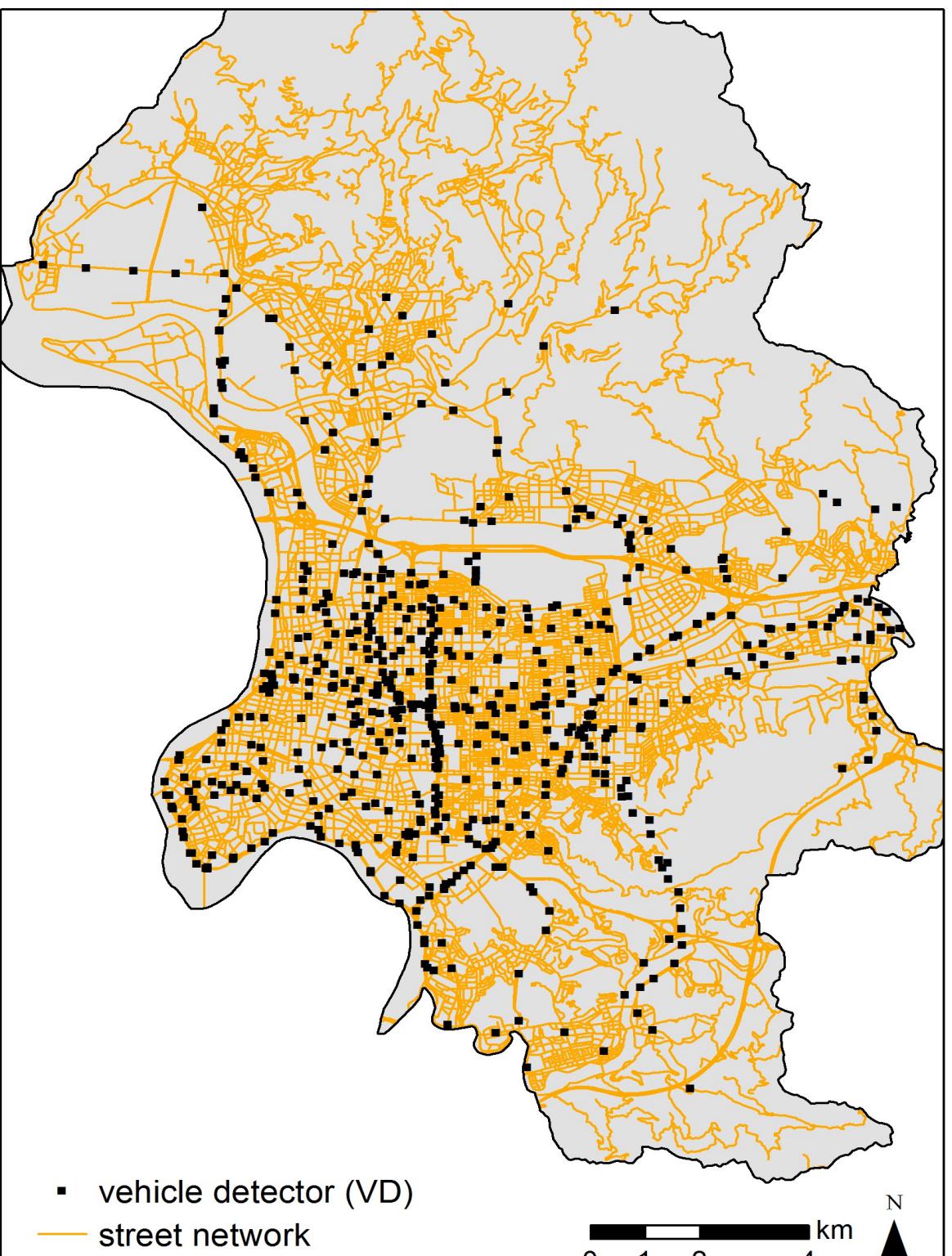
即時資訊



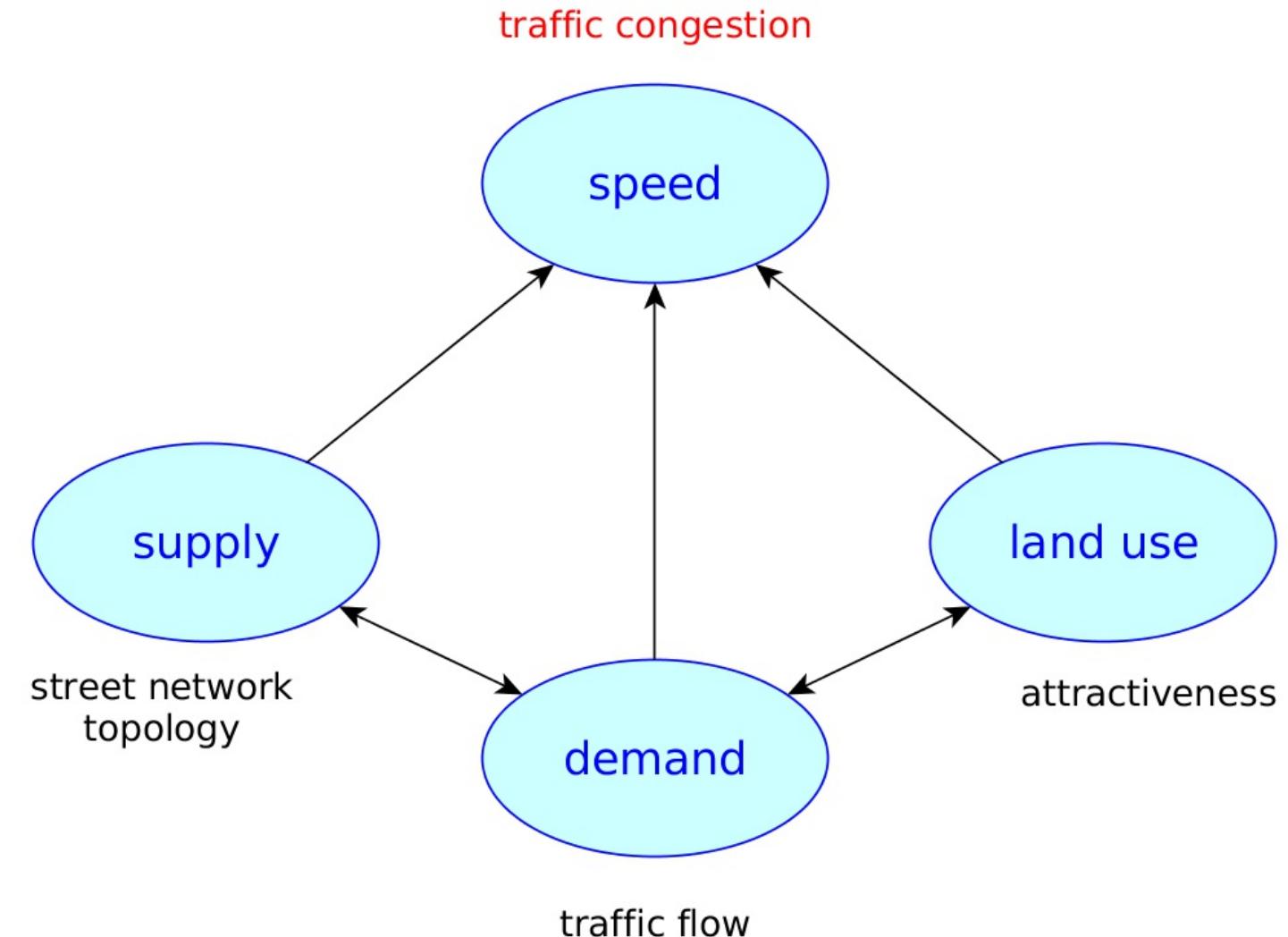
# modelling movements on street system

- the movements
- the congestions

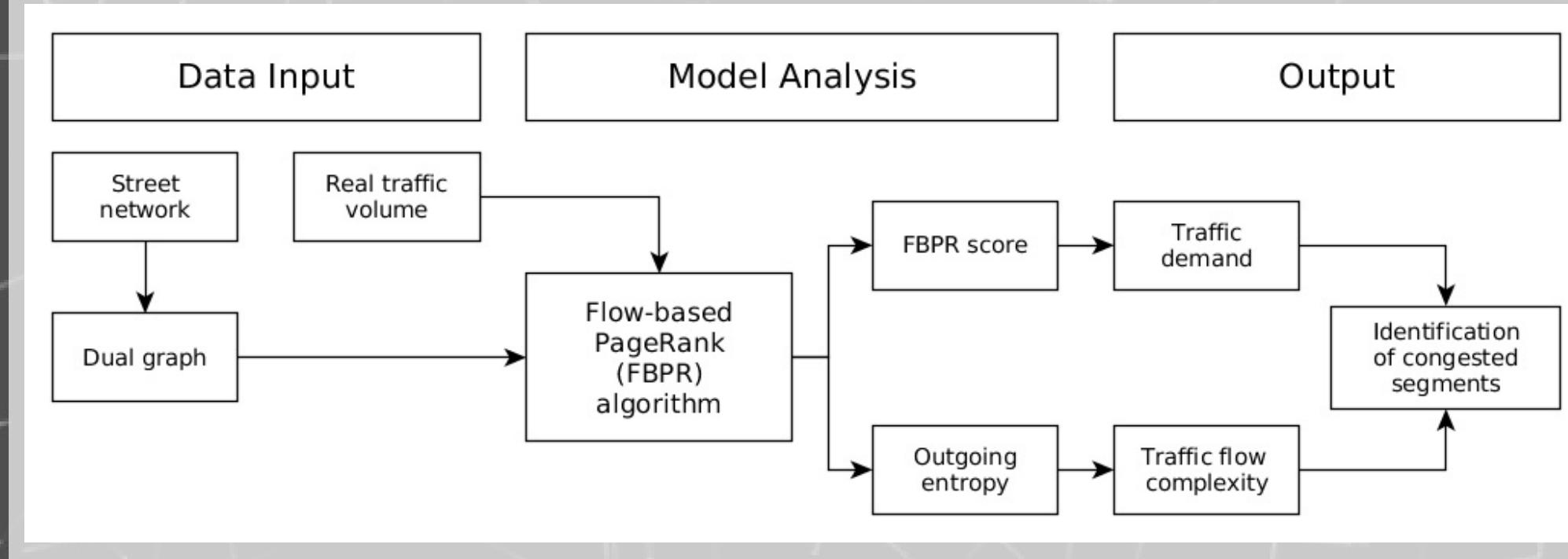
## Locations of Vehicle Detector (VD)



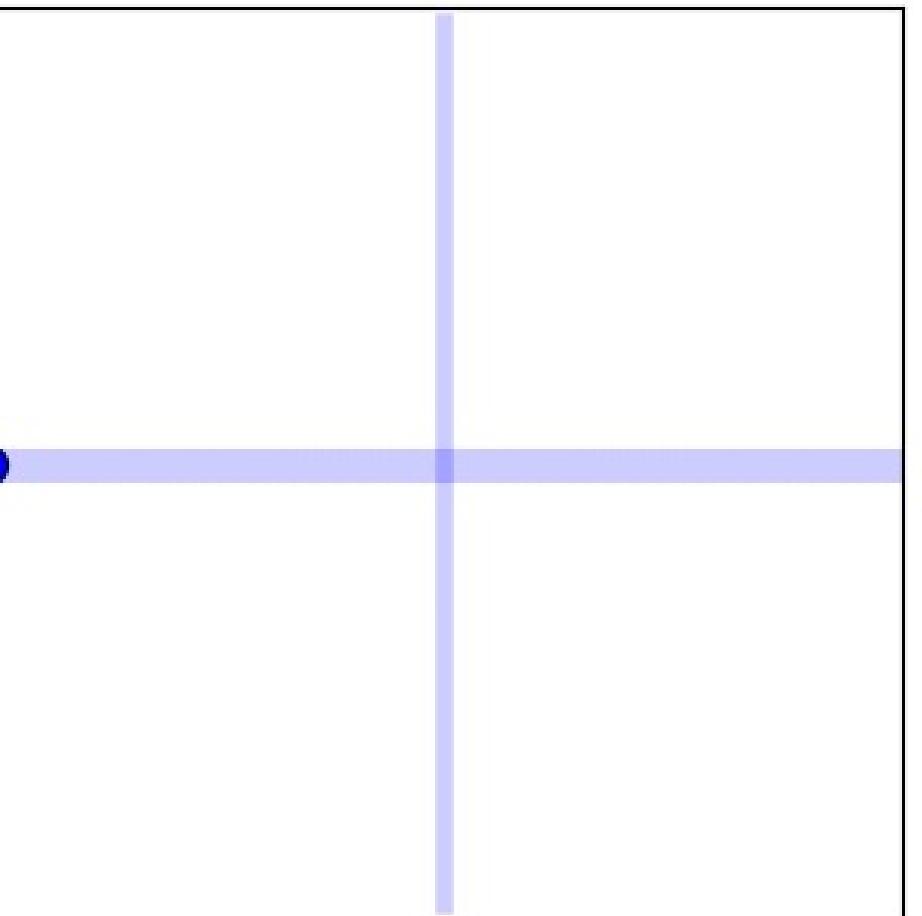
# modelling vehicle movements



# study framework



## A random walk model





A random walk model on Taipei City street system <https://vimeo.com/168713881>

## Google's PageRank and traffic flow

PageRank is an algorithm for identifying where people would gather under the movement within a networked space.

It uses a random move model (random surfer), and analyses the hyperlink connectivity, namely the referencing network to identify the key webpages

basic form of PageRank algorithm

$$PR_t(i) = \sum_{j \in IN(i)} PR_{t-1}(j) \times \frac{1}{outdeg(j)}$$

$IN(i)$ : incoming node set of  $i$ ;

$outdeg(j)$ : the out-degree of  $j$ .

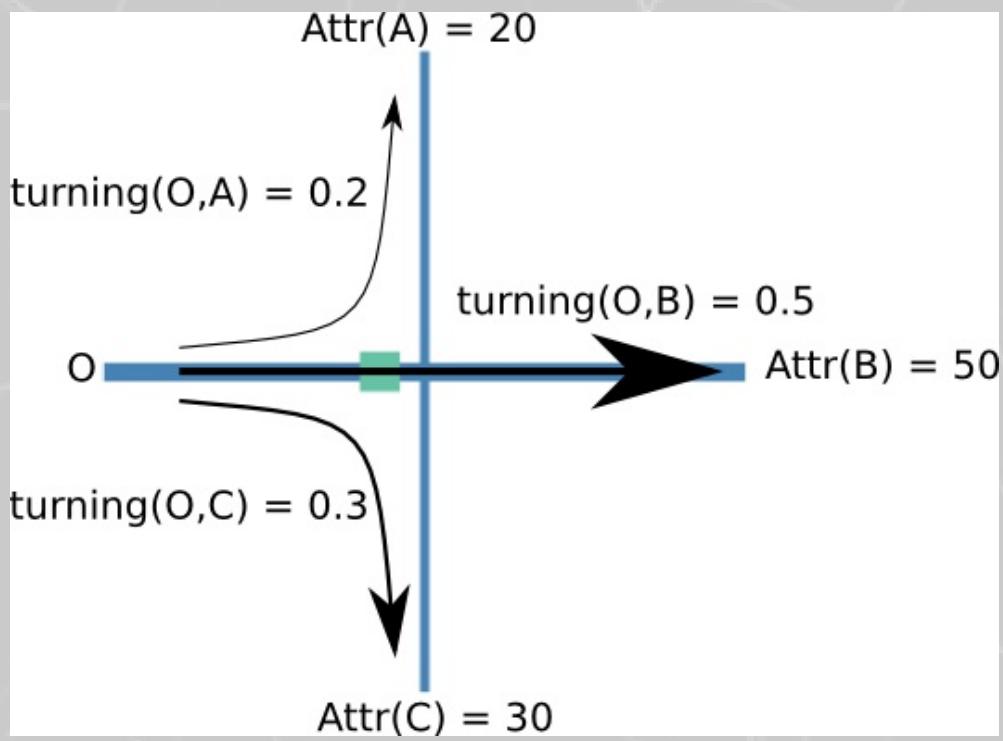
## FBPR equation

$$FBPR_t(i) = \sum_{j \in IN(i)} FBPR_{t-1}(j) \times turning(j, i)$$

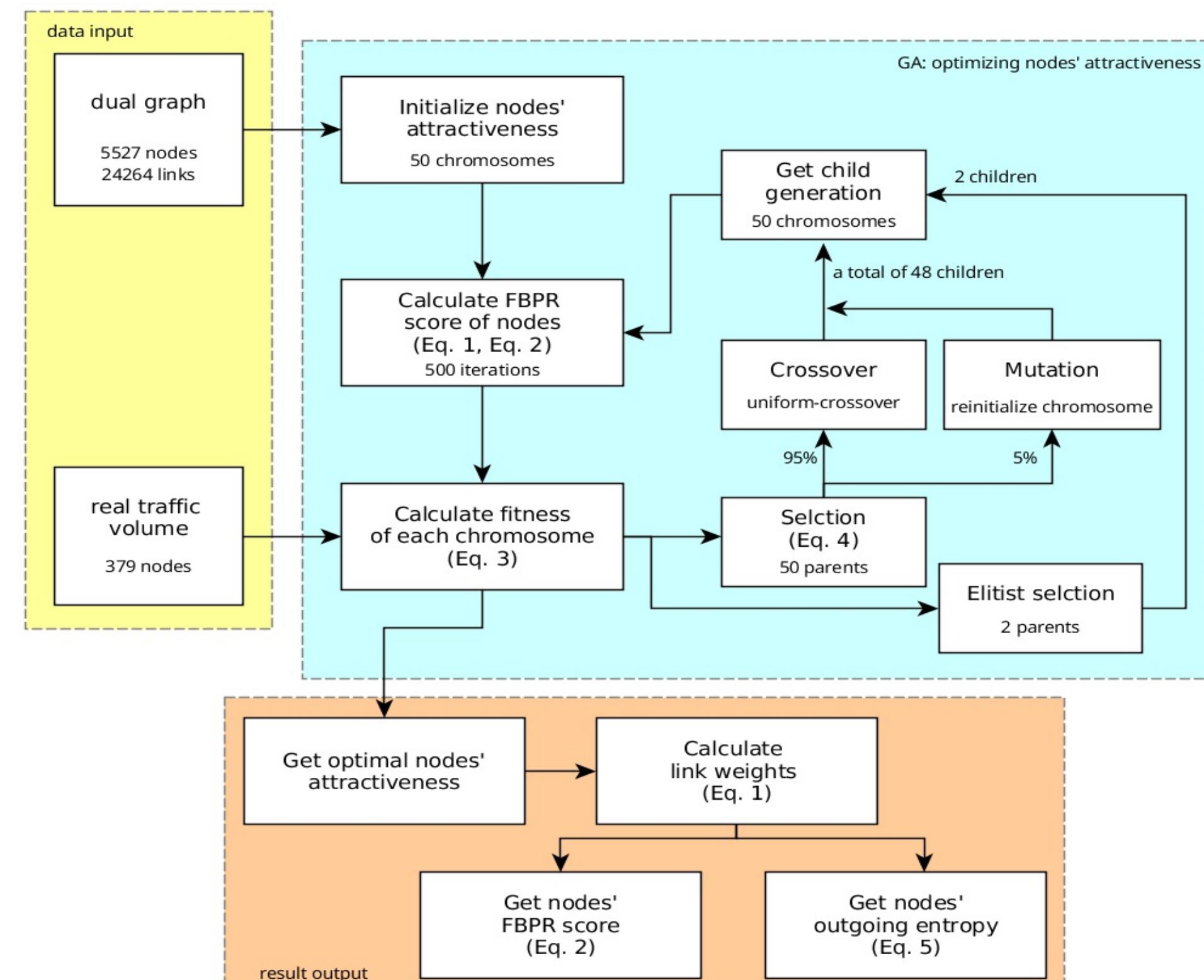
$$turning(j, i) = \frac{Attr(i)}{\sum_{p \in OUT(j)} Attr(p)}$$

$Attr(k)$ : attractiveness of node  $k$ ;  
 $out(j)$ : outgoing node set of  $j$ .

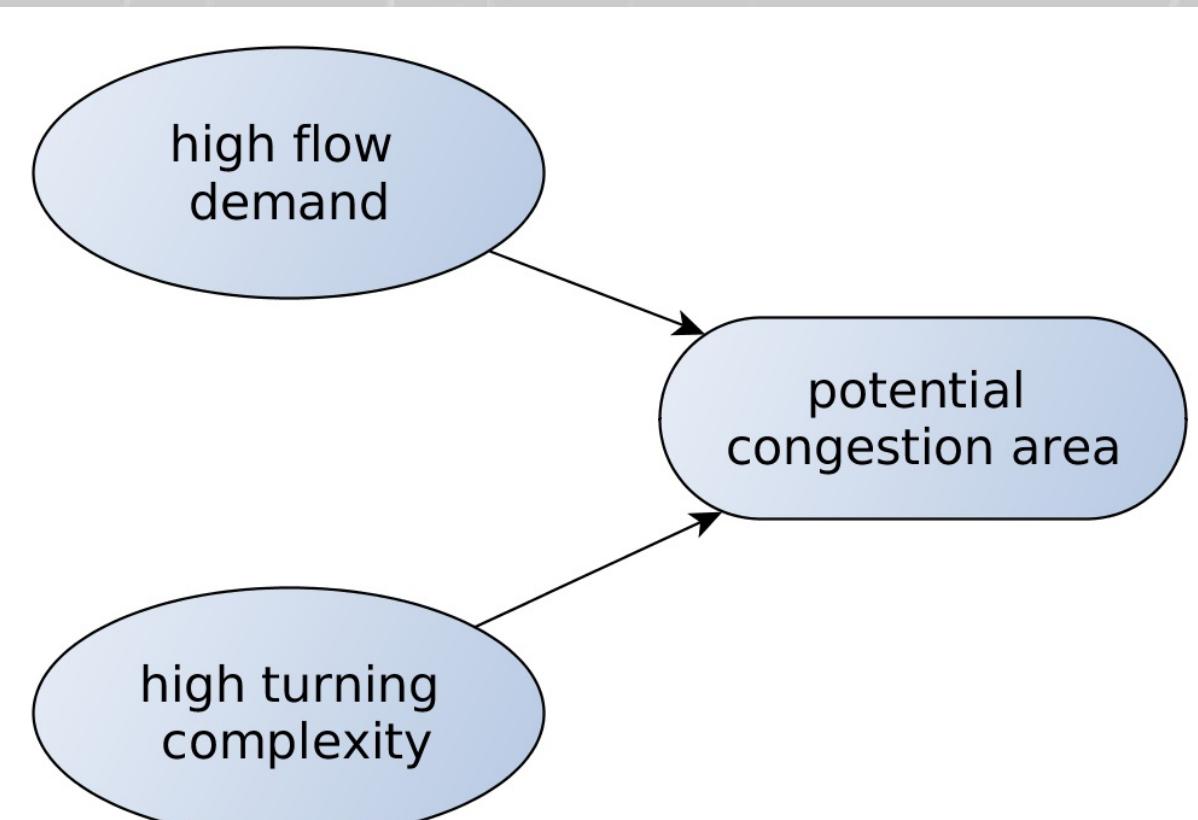
## the idea



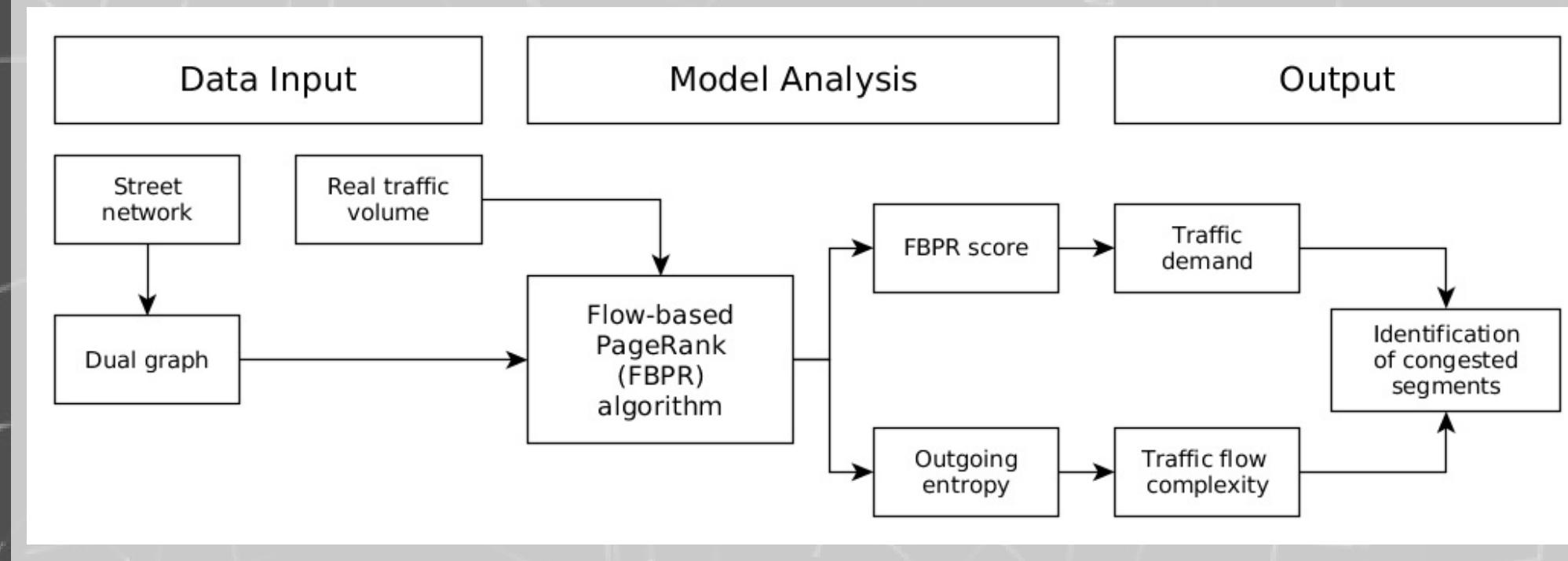
## the FBPR algorithm



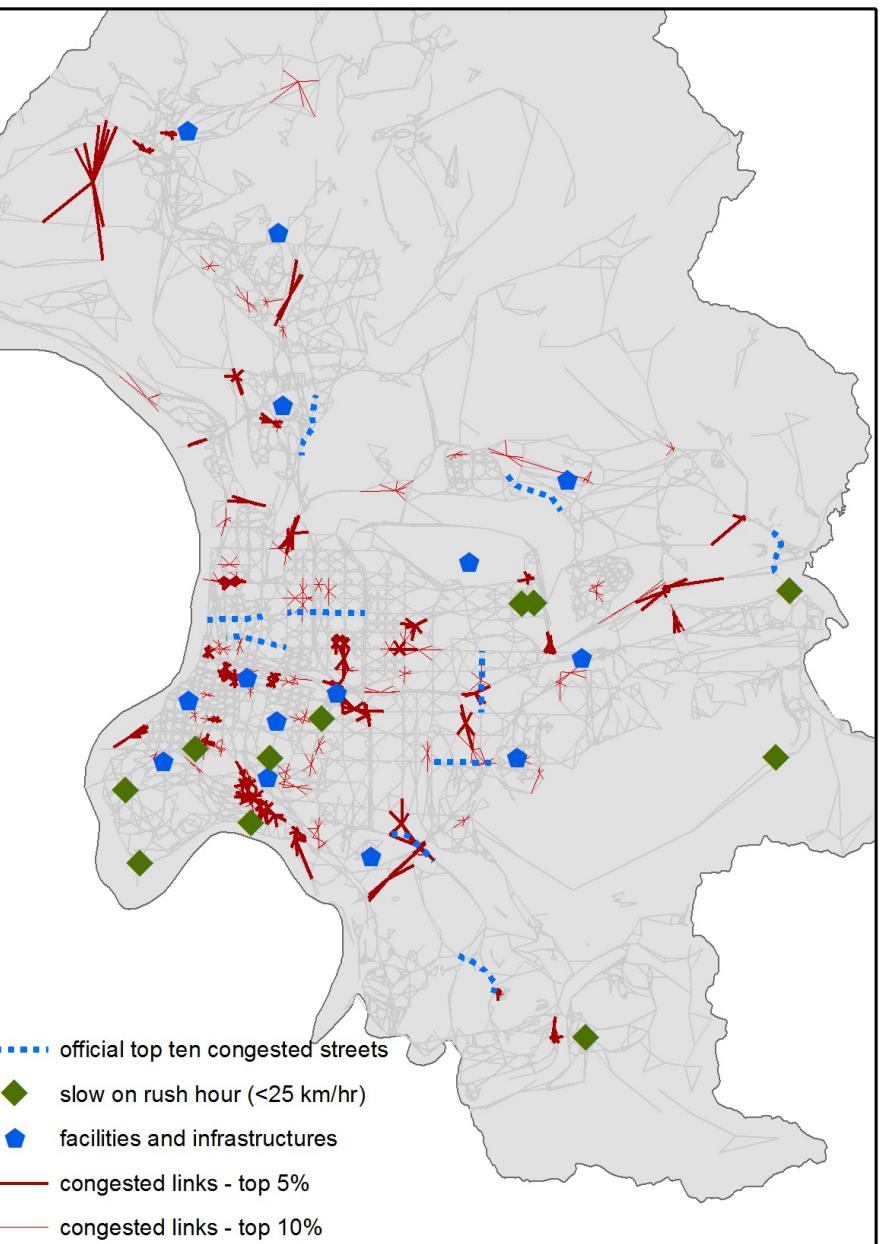
# put together the result to find congestions



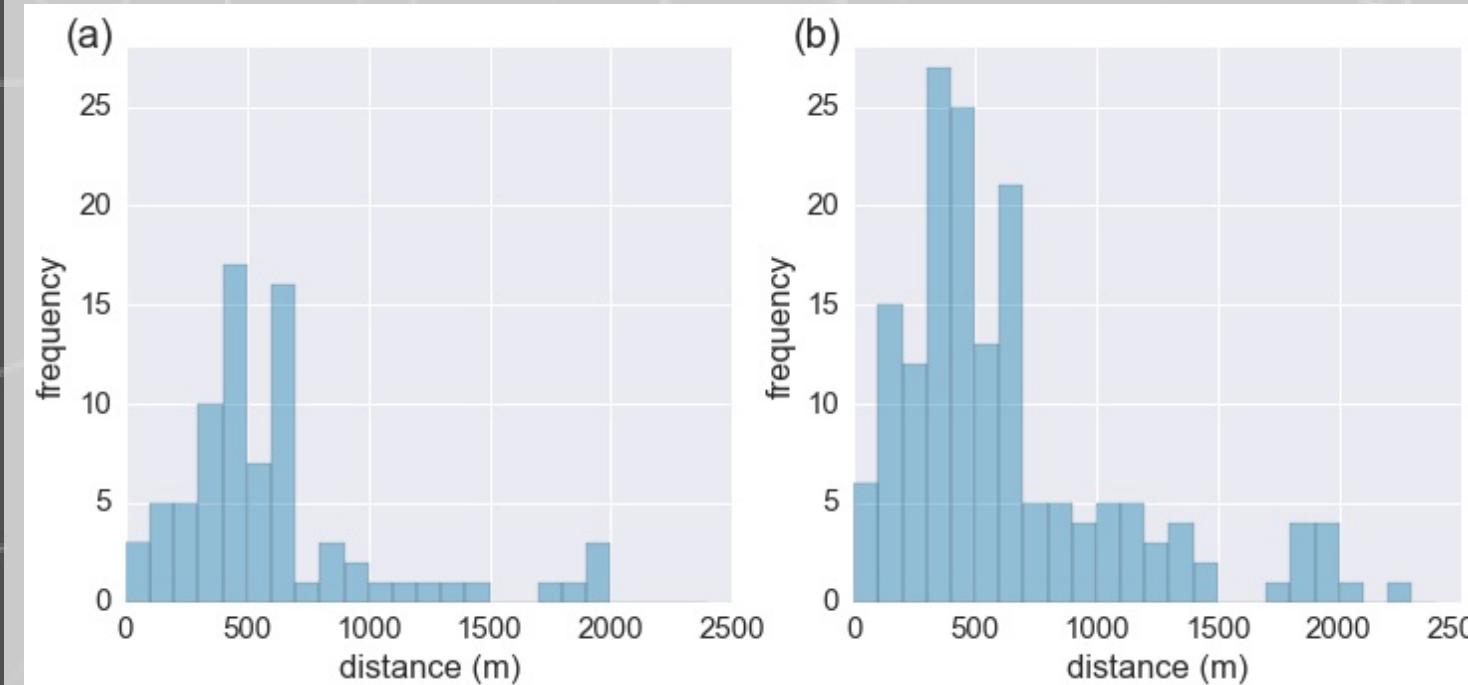
# study framework



## congested segments locations



## distances from congested segments to the important facilities



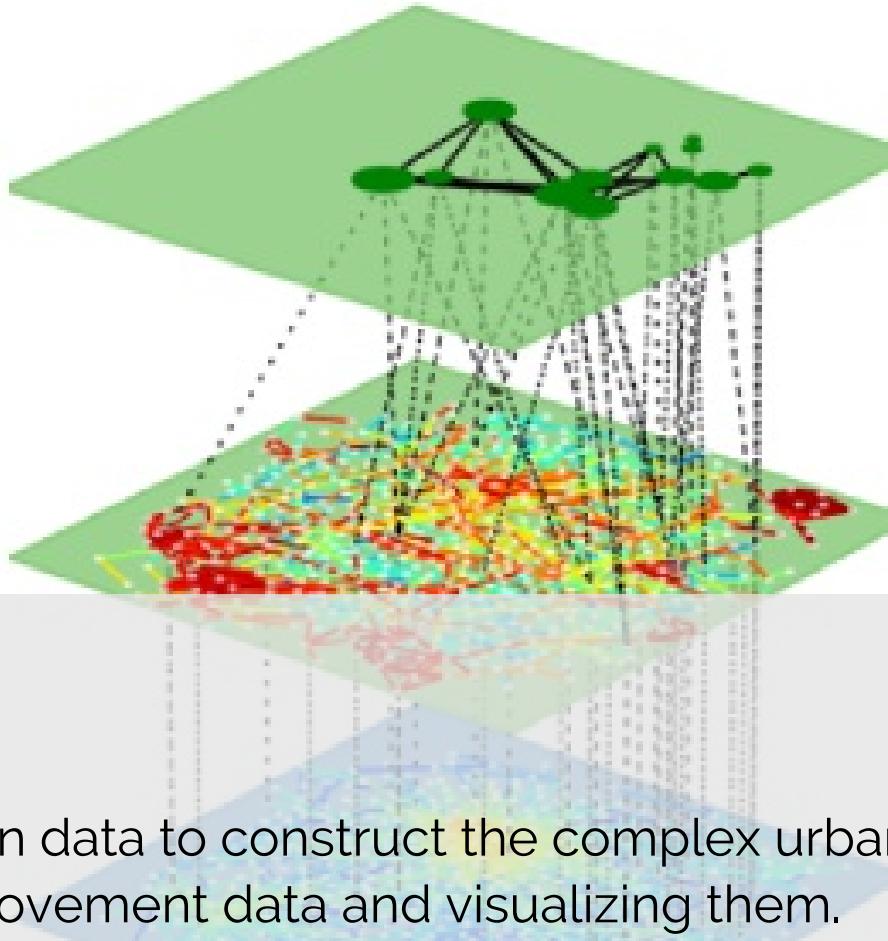


**seeing vehicle movement and congestion in urban street system** <https://vimeo.com/193470366>



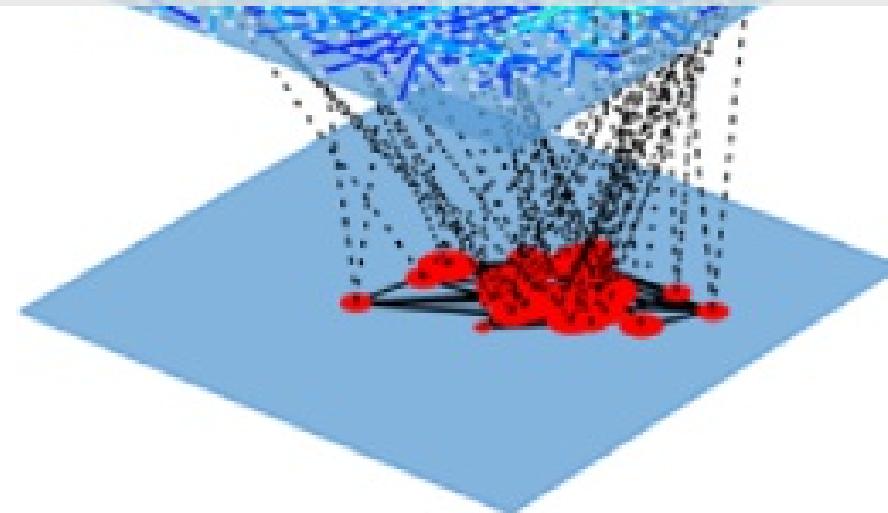
next...

- Using spatial open data to construct the complex urban mobility Network.
- Integrating the movement data and visualizing them.



Taipei MRT

Streets' vehicle



Bus service



Geospatial  
Computational  
Science  
Laboratory  
**NTU** Geography



a day of bus movement in one minute <https://vimeo.com/174331241>

**Thanks for listening!**

**Questions or Comments?**

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