@ 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

Authors: Tzai-Hung Wen, Wei-Chien-Benny Chin

Benny Chin, PhD student
NTU Geography
wcchin.88@gmail.com

Wen LAB 501
Geospatial Computational Science Laboratory
NTU Geography

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

Wen LAB 501

Geospatial Computational Science Laboratory

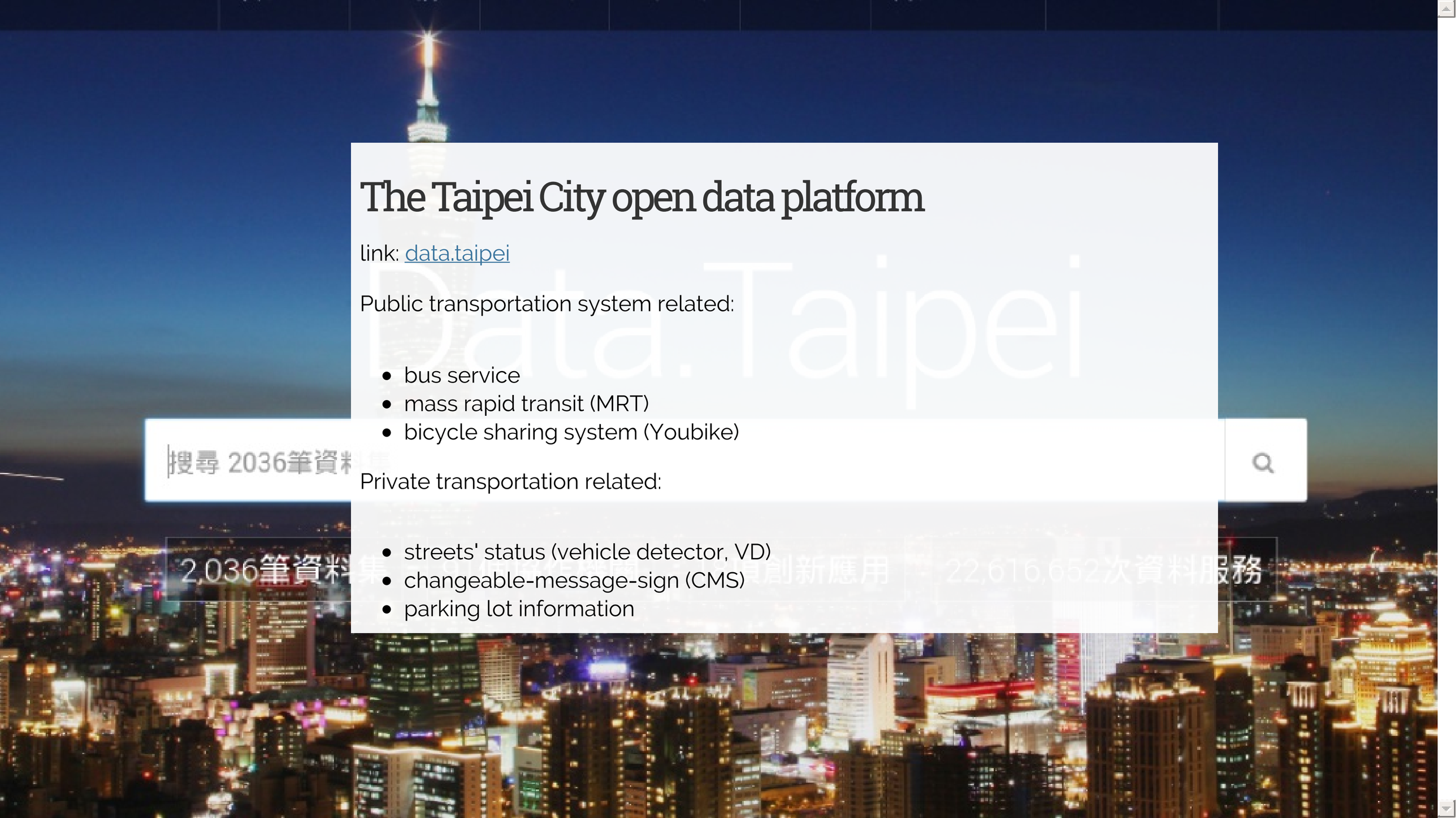
NTU Geography

detecting urban mobility

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

Geospatial
Computational
Science
Laboratory

NTU Geography



The Taipei City open data platform

link: data.taipei

Public transportation system related:

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

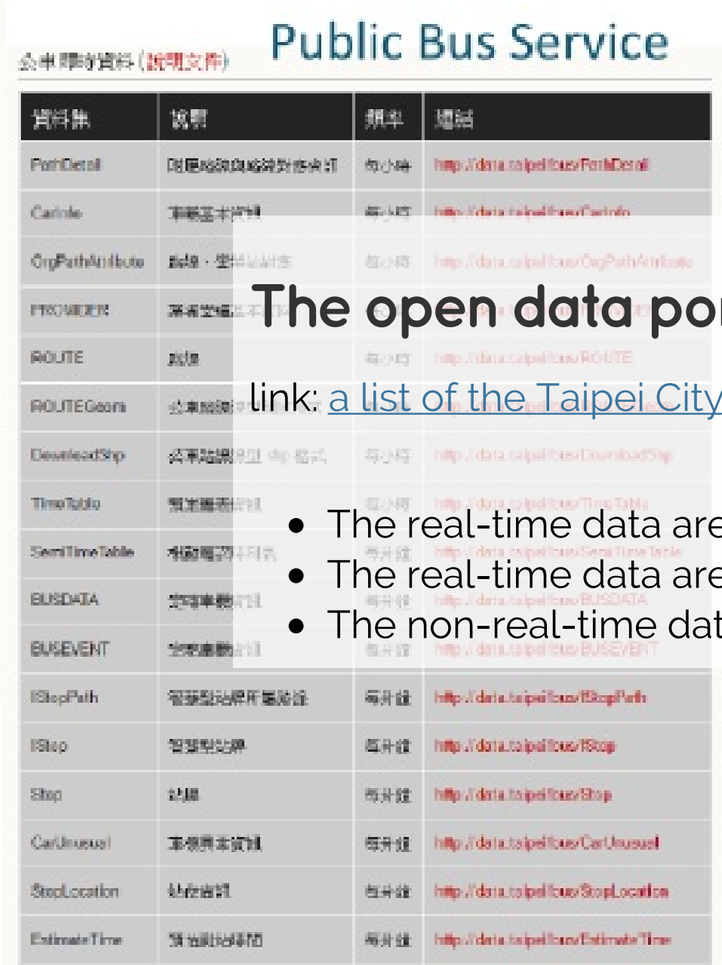
Private transportation related:

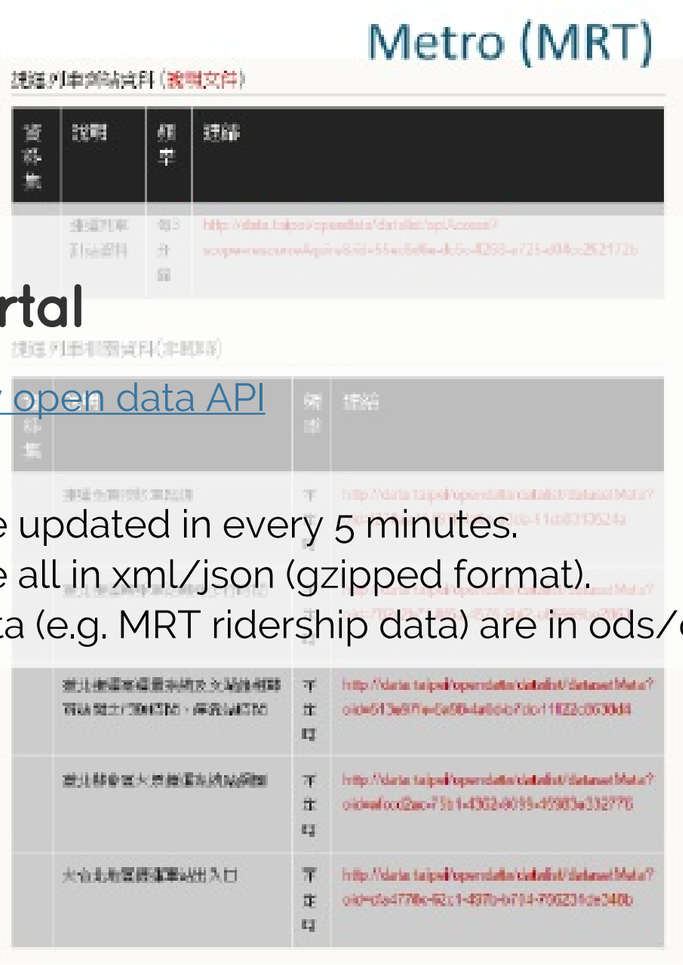
- streets' status (vehicle detector, VD)
- changeable-message-sign (CMS)
- parking lot information

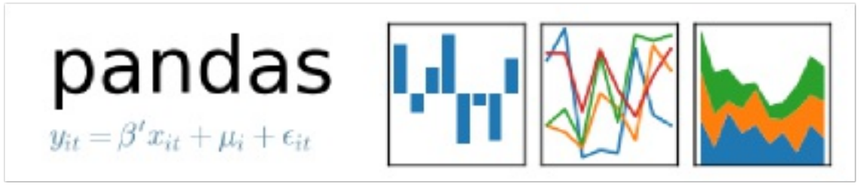
The open data portal

link: [a list of the Taipei City open data API]

- The real-time data are updated in every 5 minutes.
- The real-time data are all in xml/json (gzipped format).
- The non-real-time data (e.g. MRT ridership data) are in ods/csv format.







python™

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

openmediavault
The open network attached storage solution

lubuntu

rsync

Focus on the four moving modes

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

Geospatial Computational Science Laboratory
NTU Geography

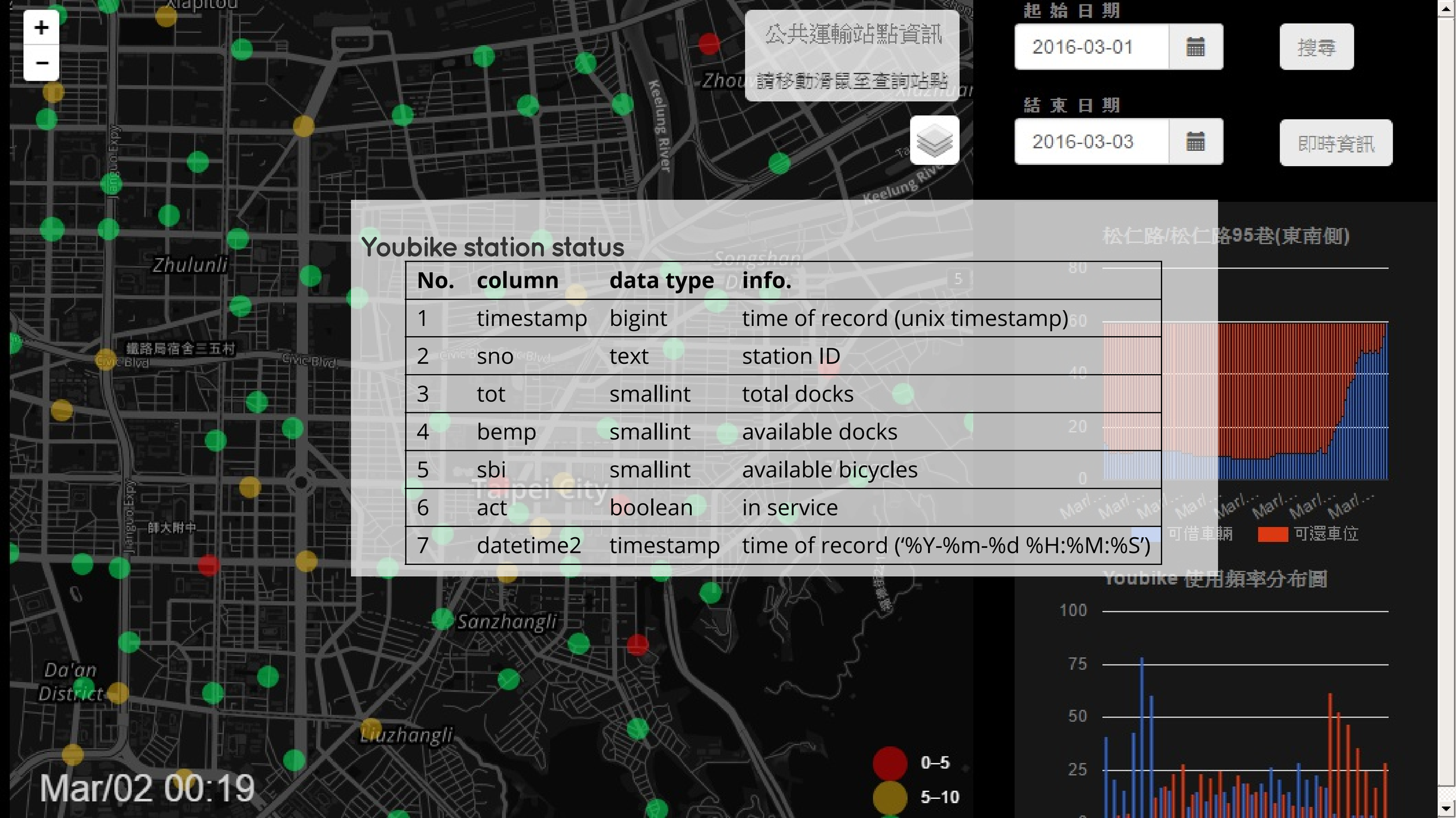
	AvgSpeed	LaneNO	Lvolume	Mvolume	Svolume	Volume	vdid	datetime2	Ltime
0	60	0	0	51	0	51	V0111C0	2016-08-01 00:03:1	14699
1	53	0	0	23	0	23	V0112A0	2016-08-01 00:03:1	14699
2	66	0	5	20	0	25	V0120C0	2016-08-01 00:03:1	14699
3	59	1	4	55	0	59	V0120C0	2016-08-01	00:03:1 14699
4	73	0	0	29	0	29	V0130A0	2016-08-01	00:03:1 14699
5	75	1	0	53	0	53	V0130A0	2016-08-01	00:03:1 14699
6	74	2	0	10	0	10	V0130A0	2016-08-01	00:03:1 14699
7	71	0	0	34	0	34	V0130A1	2016-08-01	00:03:1 14699
8	80	1	0	34	0	34	V0130A1	2016-08-01	00:03:1 14699
9	76	2	0	16	0	16	V0130A1	2016-08-01	00:03:1 14699
0	74	0	0	30	0	30	V0140C0	2016-08-01	00:03:1 14699
1	78	1	0	35	0	35	V0140C0	2016-08-01	00:03:1 14699
2	72	0	1	31	0	32	V0140C1	2016-08-01	00:03:1 14699
3	66	1	0	35	0	35	V0140C1	2016-08-01	00:03:1 14699
4	69	0	0	33	0	33	V0150C0	2016-08-01	00:03:1 14699
5	75	1	0	53	0	53	V0150C0	2016-08-01	00:03:1 14699
6	74	2	0	29	0	29	V0150C0	2016-08-01	00:03:1 14699
7	67	0	11	12	0	23	V0150C1	2016-08-01	00:03:1 14699
8	66	1	16	30	0	46	V0150C1	2016-08-01	00:03:1 14699
9	61	2	8	23	0	31	V0150C1	2016-08-01	00:03:1 14699

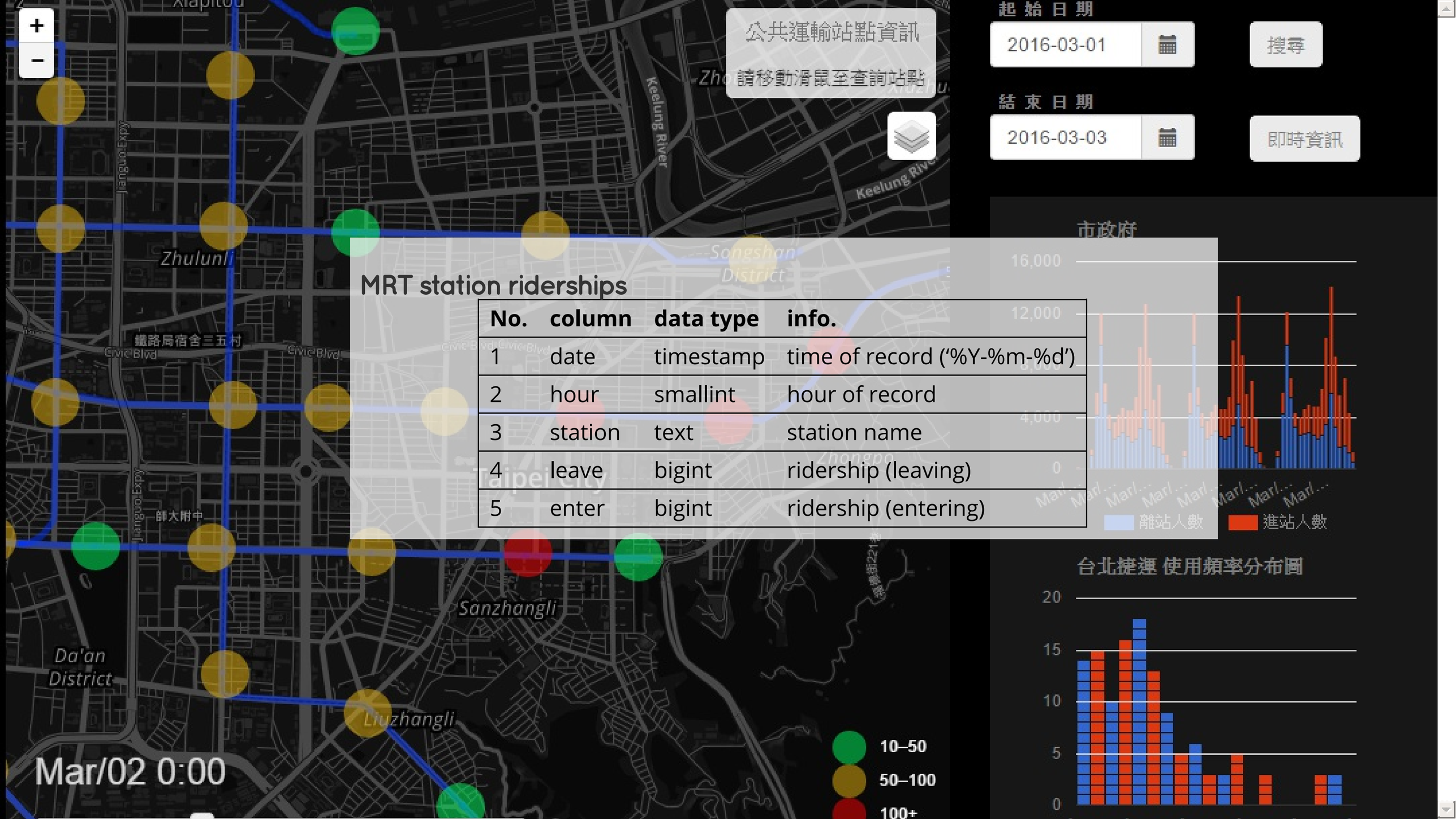
Street status (Vehicle Detector)

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’)

Bus location

No.	column	data type	info.
1	timestamp	bigint	time of record (unix timestamp)
2	busID	text	bus plate no.
3	carID	integer	bus id
4	routeID	integer	route id
5	goBack	text	outbound/inbound
6	dutyStatus	text	In-service/not-in-service
7	longitude	double precision	current location (longitude)
8	latitude	double precision	current location (latitude)
9	speed	double precision	current speed
10	azimuth	double precision	Current heading (azimuth)
11	datetime2	timestamp	time of record ('%Y-%m-%d %H:%M:%S')


公共運輸站點資訊
請移動滑鼠至查詢站點
起始日期
2016-03-01
搜尋
結束日期
2016-03-03
即時資訊
松仁路/松仁路95巷(東南側)
可借車輛
可還車位
Youbike 使用頻率分布圖
Youbike station status
No. column data type info.
1 timestamp bigint time of record (unix timestamp)
2 sno text station ID
3 tot smallint total docks
4 bemp smallint available docks
5 sbi smallint available bicycles
6 act boolean in service
7 datetime2 timestamp time of record ('%Y-%m-%d %H:%M:%S')
Zhulunli
Sanzhangli
Liuzhangli
Da'an District
Taipei City
Keelung River
Civic Blvd
Jhongxiao Expy
Jianguo Expy
鐵路局宿舍三五村
師大附中
0–5
5–10
Mar/02 00:19



MRT station riderships

No.	column	data type	info.
1	date	timestamp	time of record (‘%Y-%m-%d’)
2	hour	smallint	hour of record
3	station	text	station name
4	leave	bigint	ridership (leaving)
5	enter	bigint	ridership (entering)

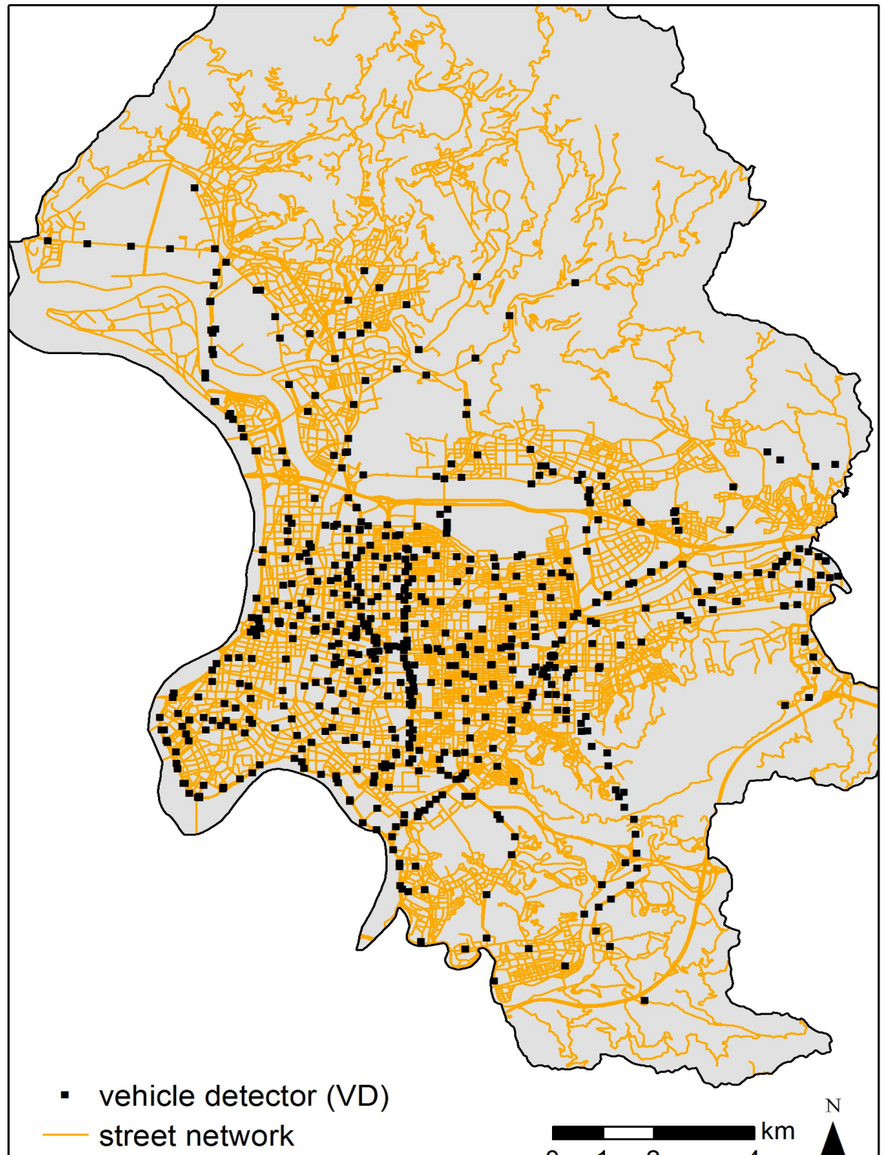
modelling movements on street system

- the movements
- the congestions

Geospatial
Computational
Science
Laboratory

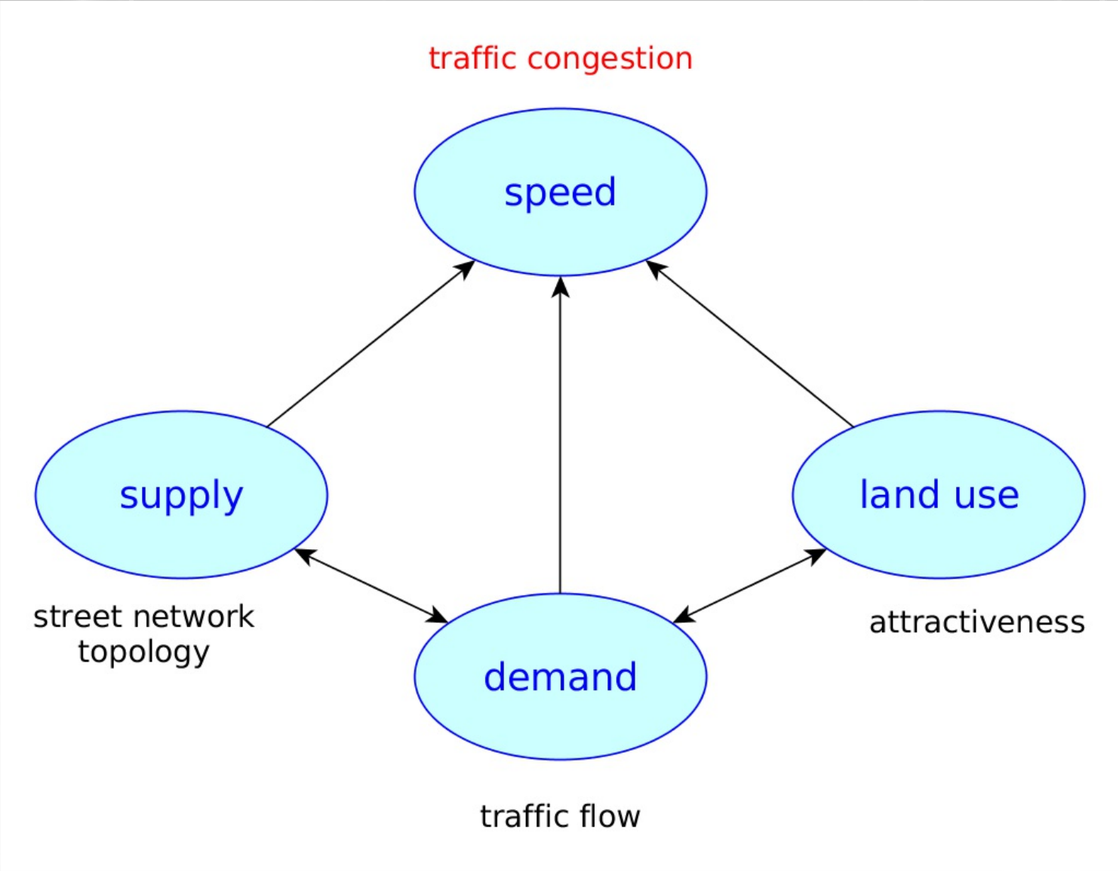
NTU Geography

Locations of Vehicle Detector (VD)



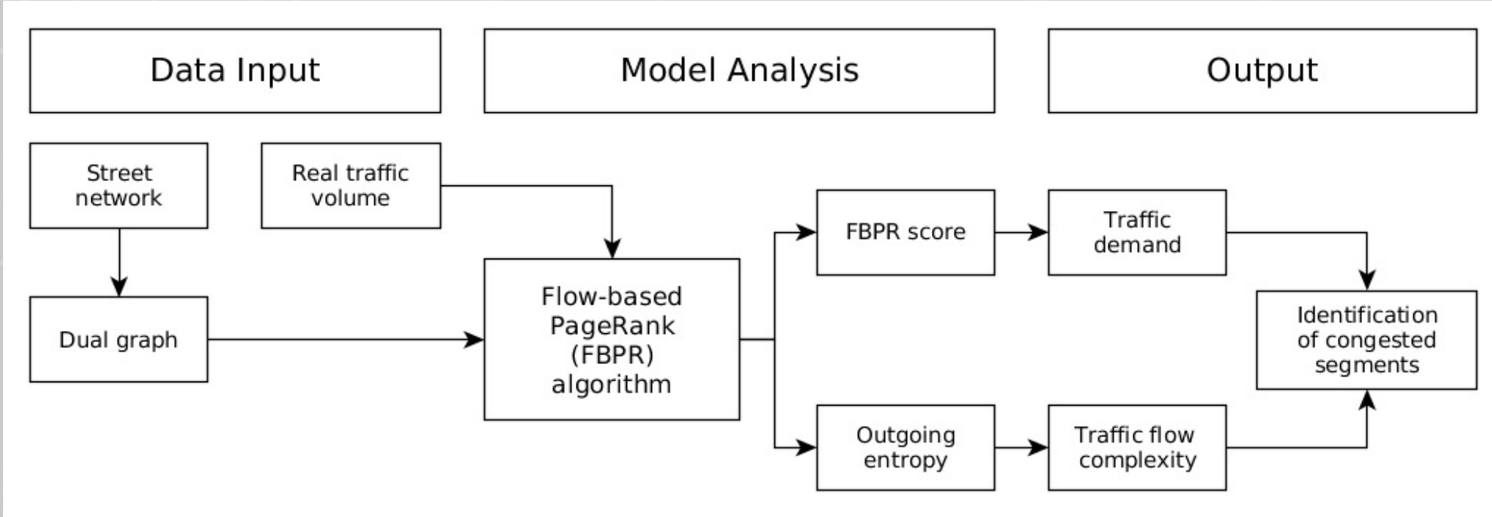
Geospatial Computational Science Laboratory
NTU Geography

modelling vehicle movements



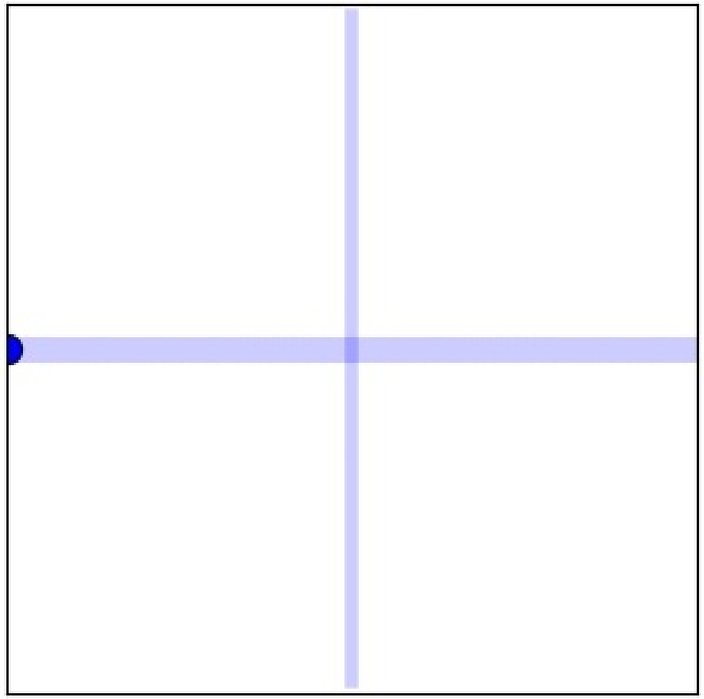
Geospatial
Computational
Science
Laboratory
NTU Geography

study framework



Geospatial Computational Science Laboratory
NTU Geography

A random walk model



Geospatial
Computational
Science
Laboratory
NTU Geography


A random walk model on Taipei City street system https://vimeo.com/168713881
Wen LAB 501
Geospatial
Computational
Science
Laboratory
NTU Geography

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.

Geospatial Computational Science Laboratory
NTU Geography

FBPR equation

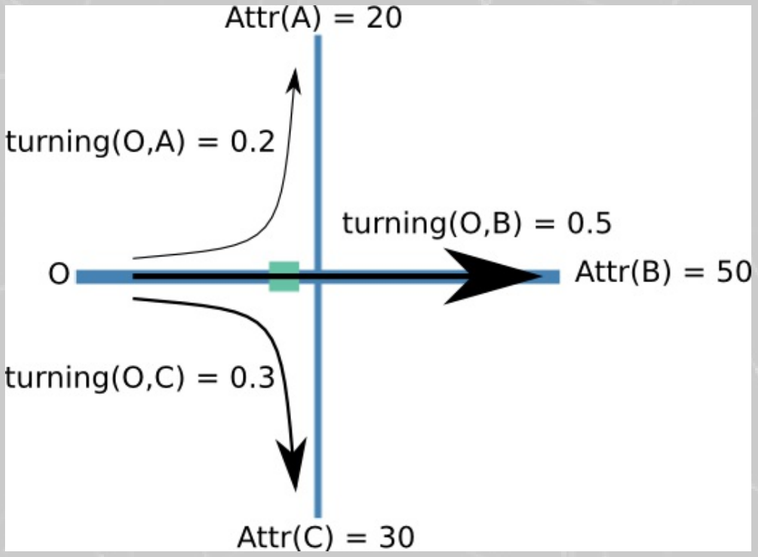
$$FBPR_t(i) = \sum_{j \in IN(i)} FBPR_{t-1}(j) \times turning(j,i)$$

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

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

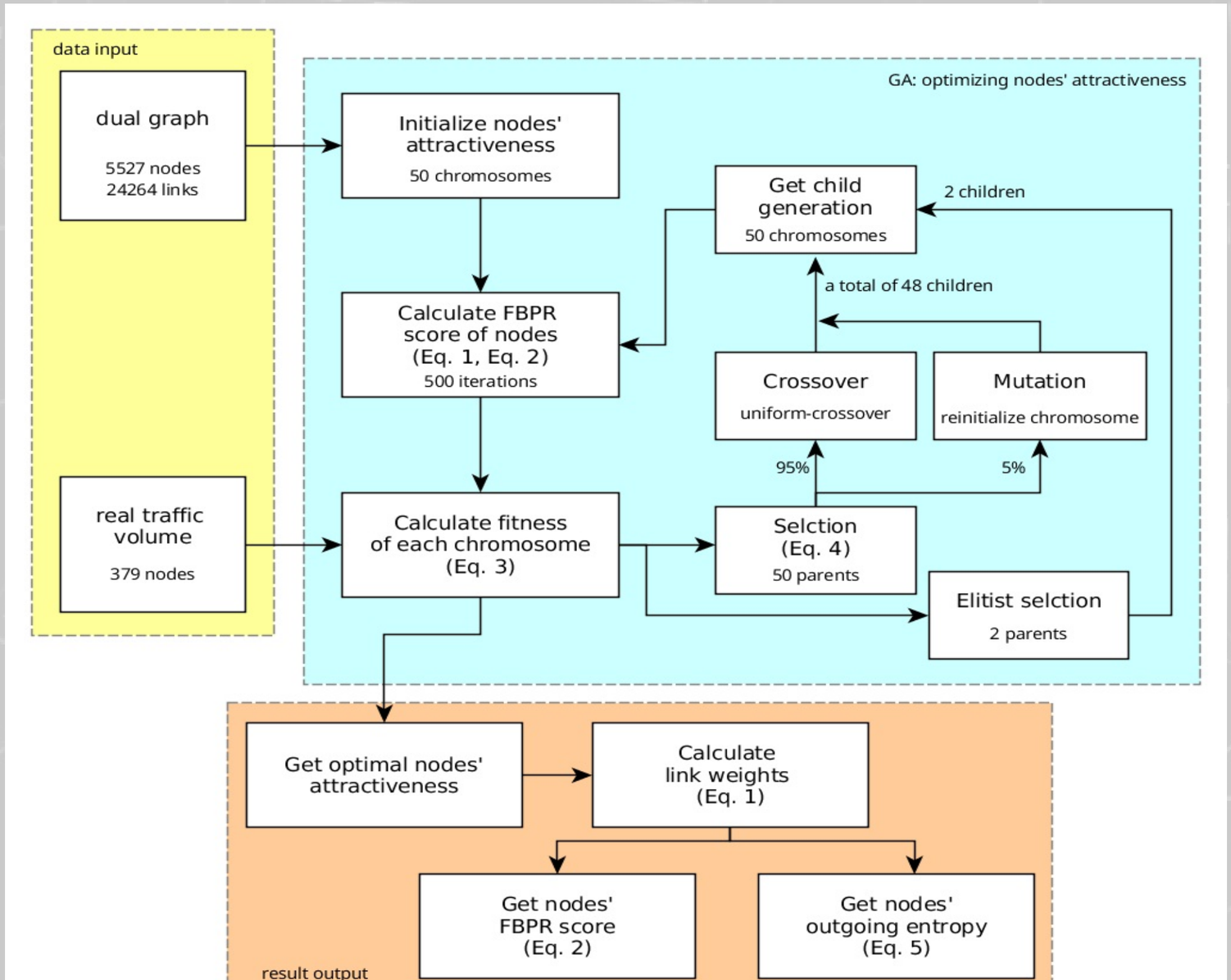
Geospatial Computational Science Laboratory
NTU Geography

the idea



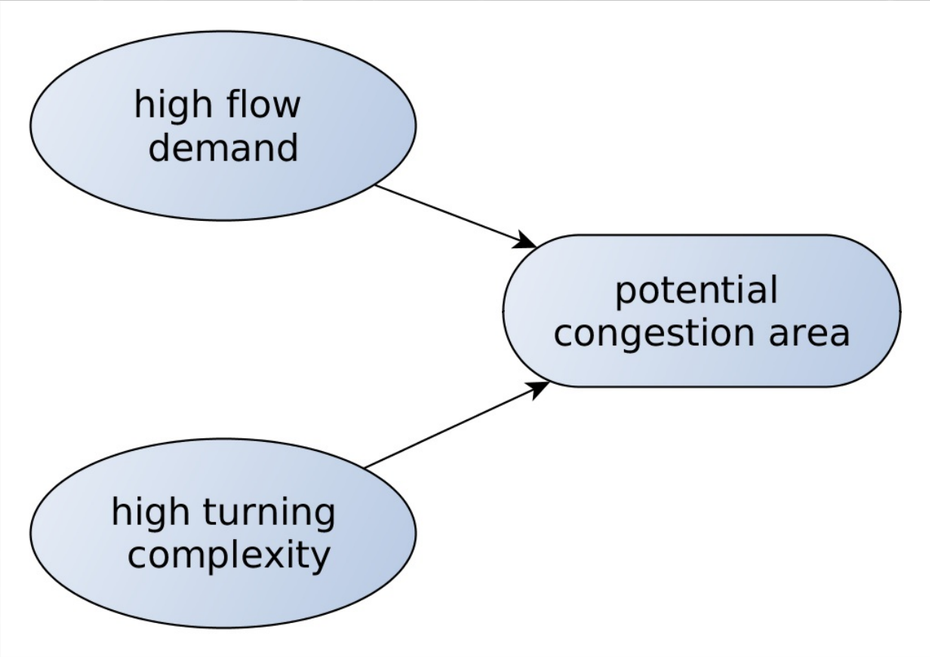
Geospatial Computational Science Laboratory
NTU Geography

the FBPR algorithm

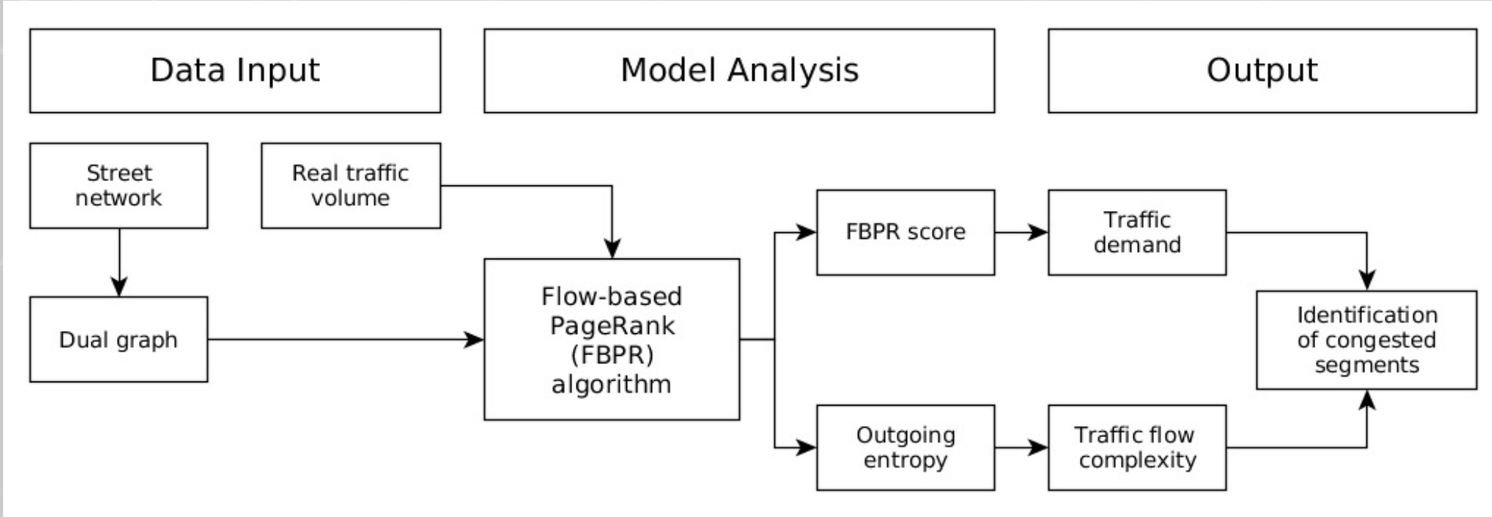


Geospatial Computational Science Laboratory
NTU Geography

put together the result to find congestions

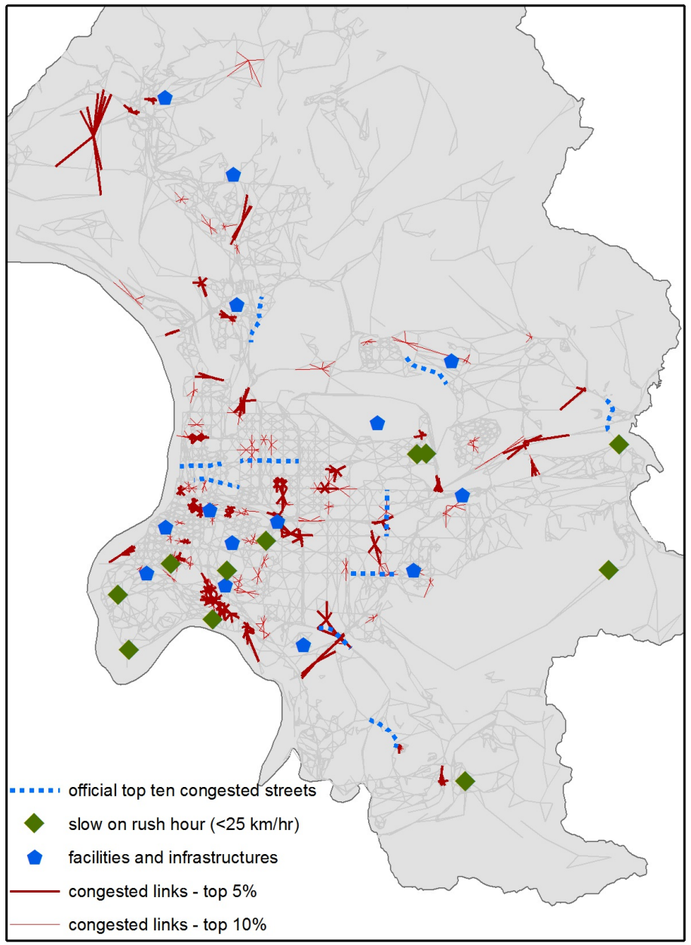


study framework



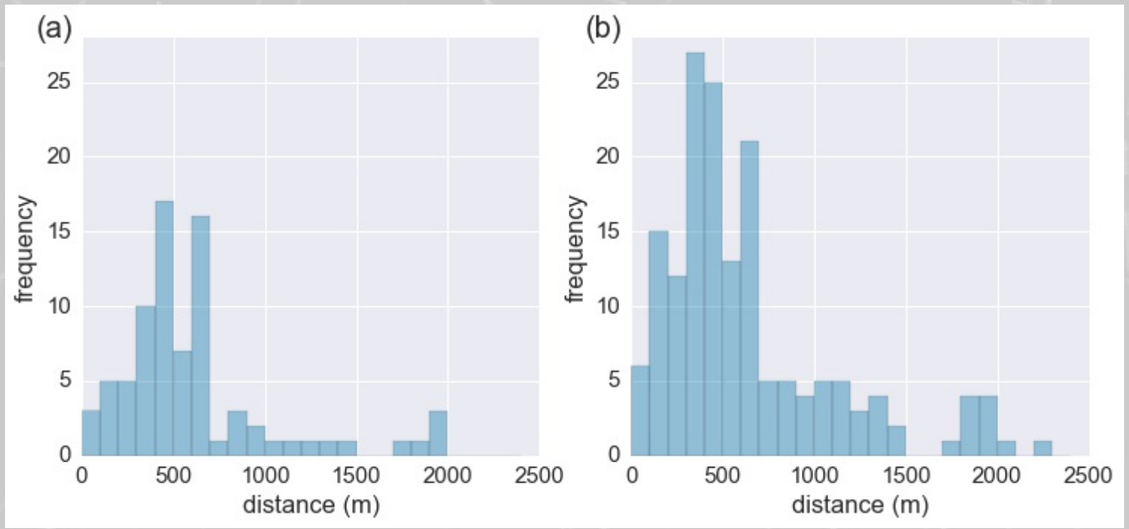
Geospatial Computational Science Laboratory
NTU Geography

congested segments locations



Geospatial Computational Science Laboratory
NTU Geography

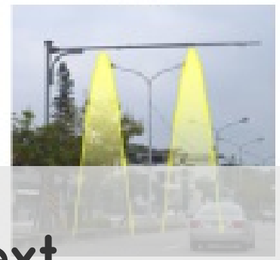
distances from congested segments to the important facilities

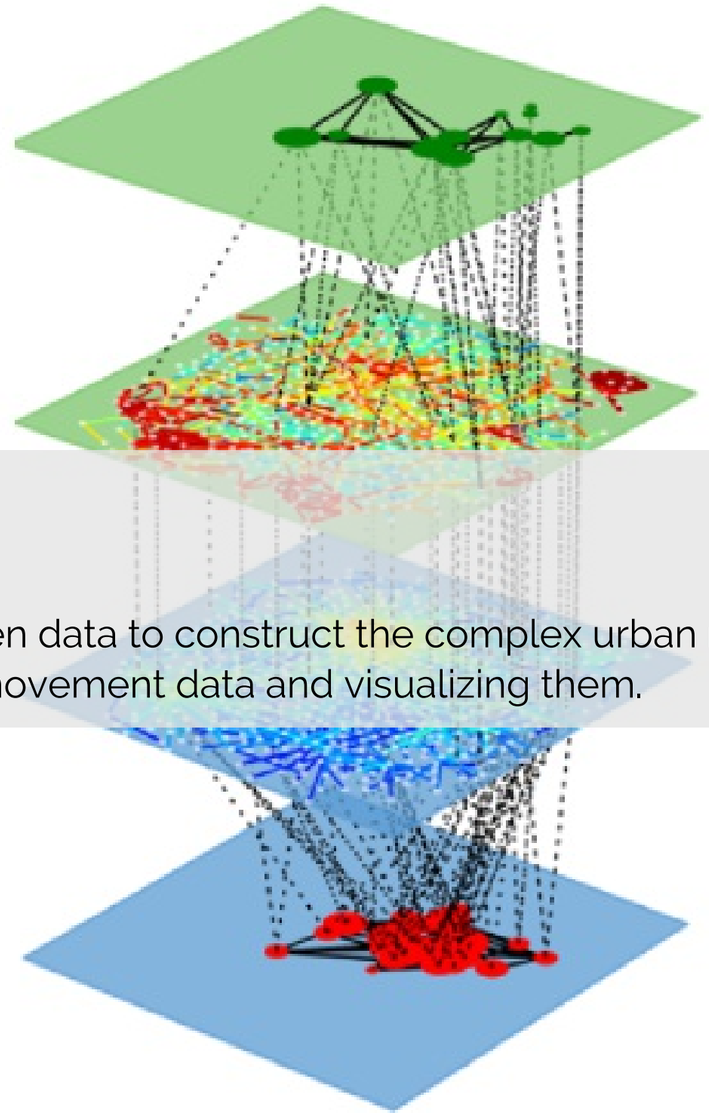


Geospatial Computational Science Laboratory
NTU Geography

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

Geospatial Computational Science Laboratory
NTU Geography





next...

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

Geospatial Computational Science Laboratory
NTU Geography

Geospatial
Computational
Science
Laboratory
NTU Geography

Thanks for listening!

Questions or Comments?

Benny Chin,
Department of Geography, National Taiwan University.
email: wcchin.88@gmail.com

Geospatial Computational Science Laboratory
NTU Geography