

Self-Driving City & Parking Management



Challenges of Self-driving Cars

1. Who will own autonomous vehicles?

Private / Private fleet / Public

2. How will autonomous vehicles be used?

Personal use / Rental / Shared

3. How will they affect traffic flow?

Smooth traffic / Congestion

4. How will they operate and be stored?

Regular movement / Random passenger trips / **Parking choices**

5. How will they impact urban space?

Road planning / Drop-off space allocation / **Parking lot design**

Outline

Data
Visualization

Data
Analysis

Proposal

Self-Driving Car

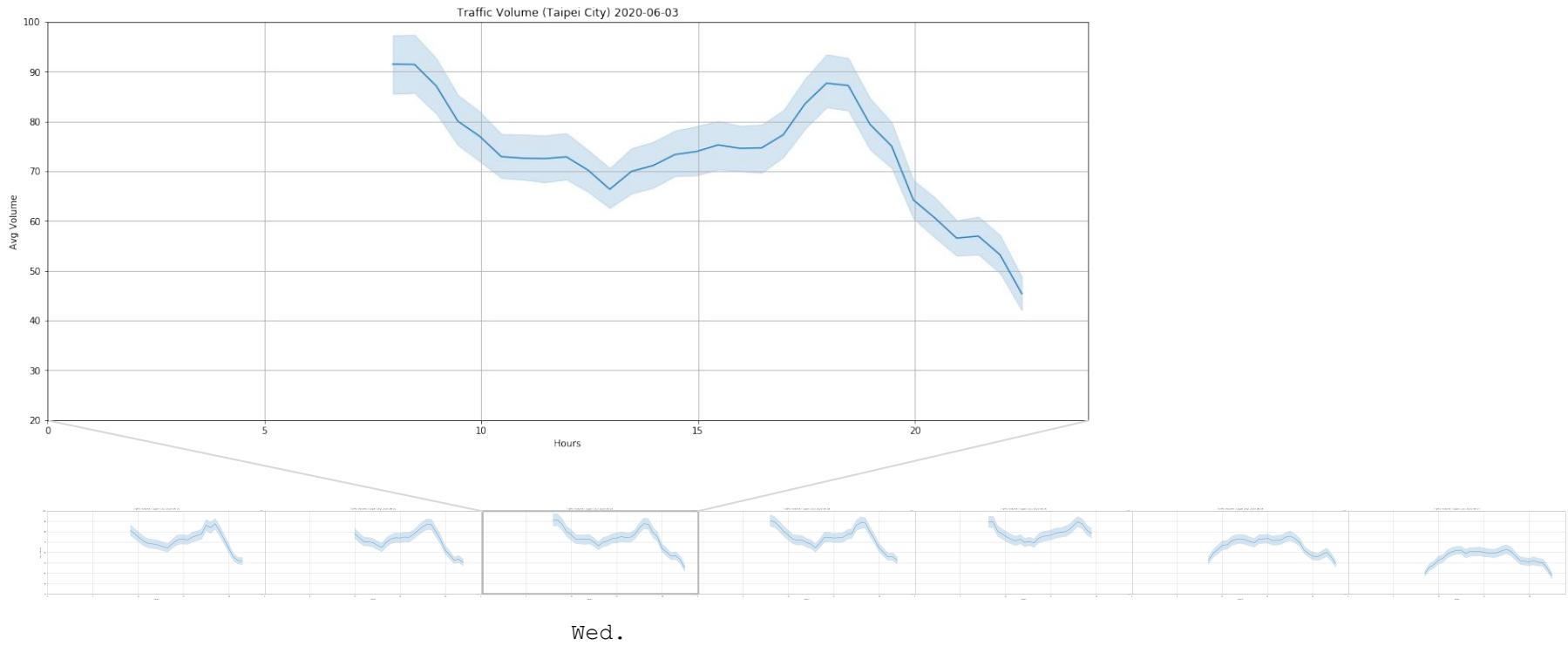


Self-Driving Bus



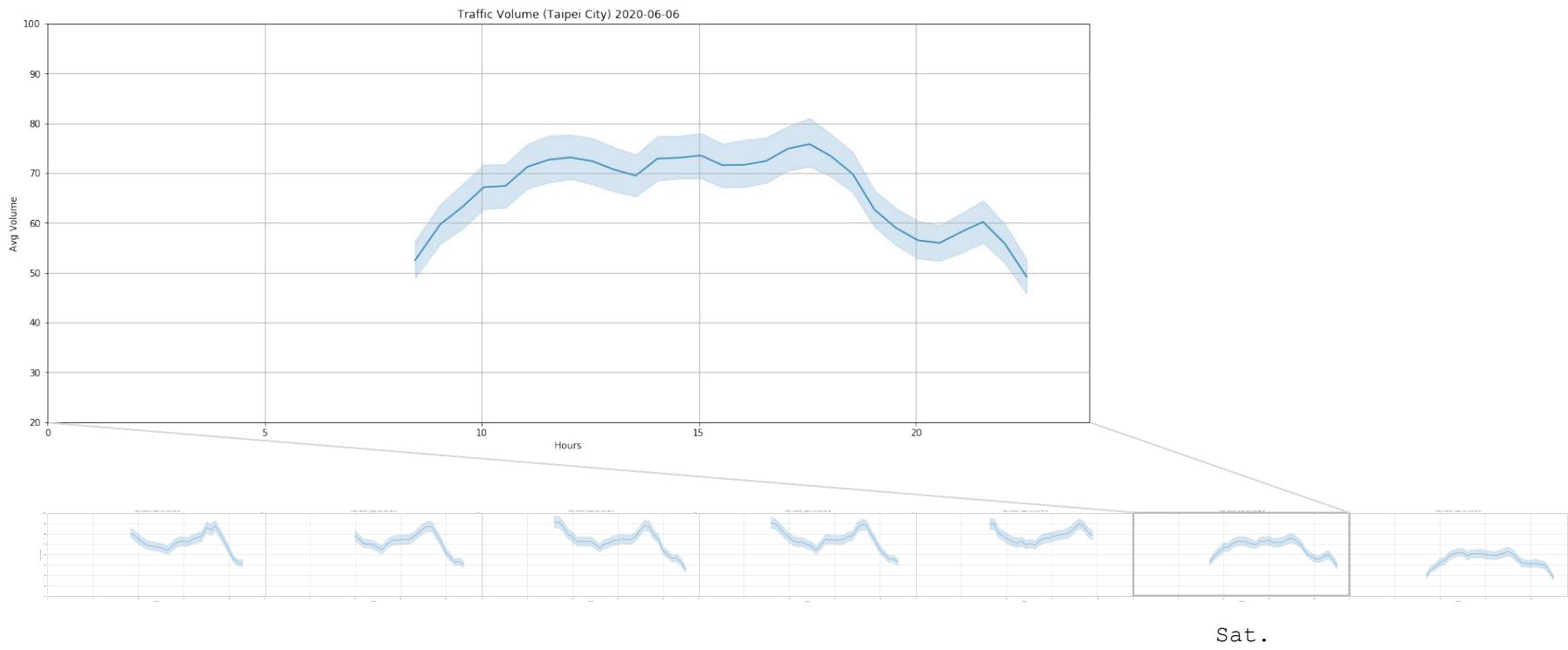
Traffic Volume

Weekdays of Taipei City



Traffic Volume

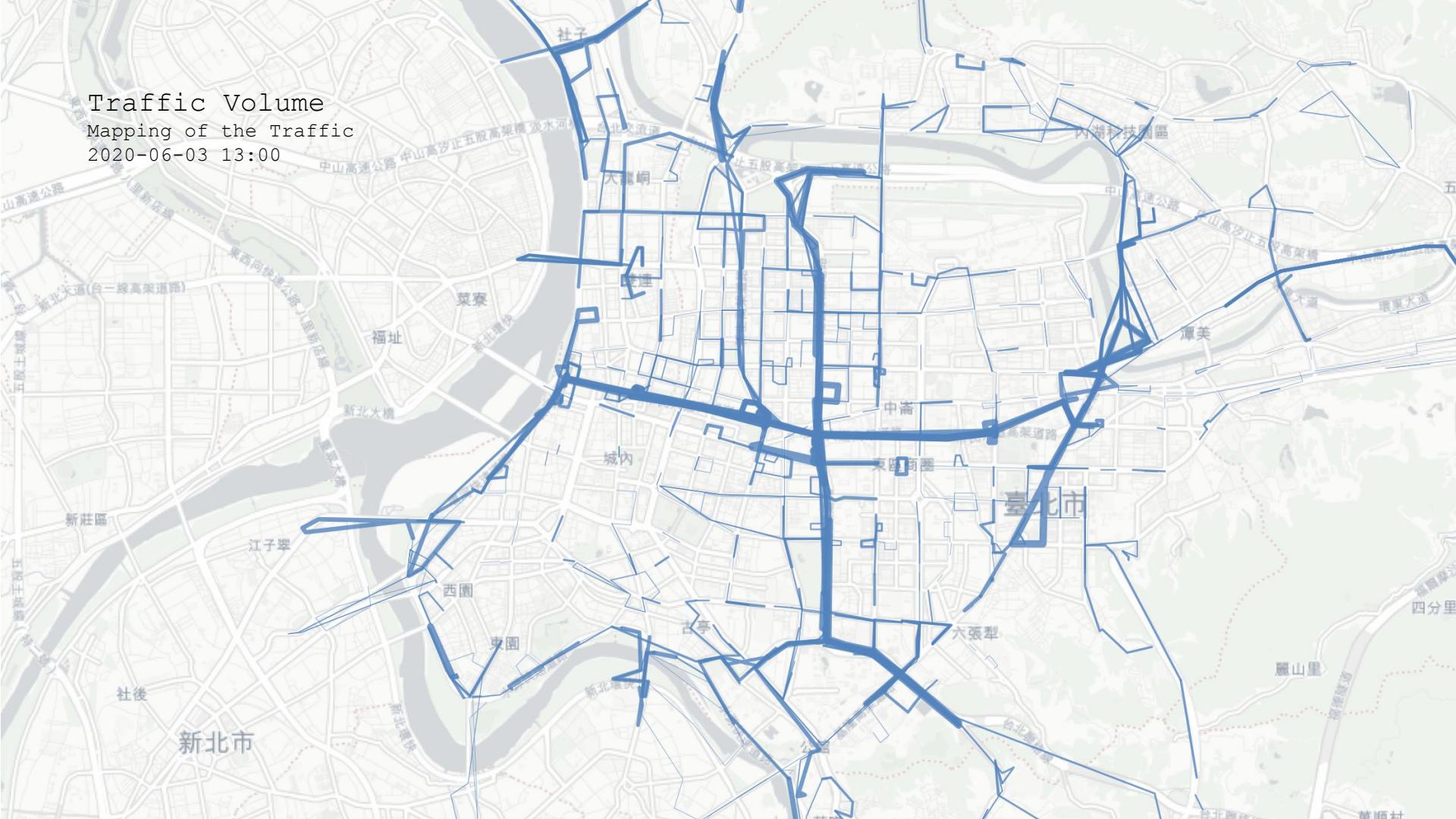
Weekend of Taipei City



Traffic Volume

Mapping of the Traffic

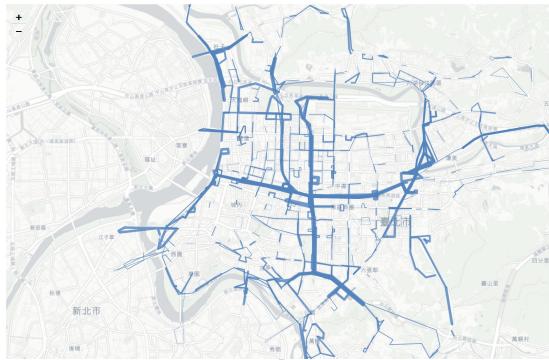
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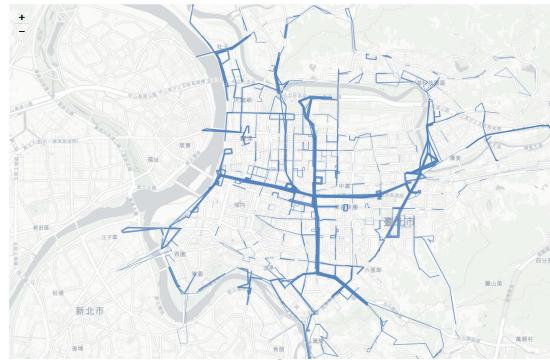
Traffic Volume

Mapping of the Traffic

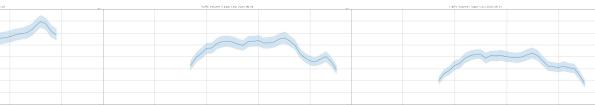
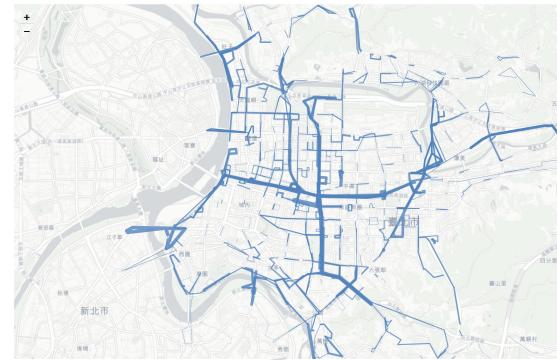
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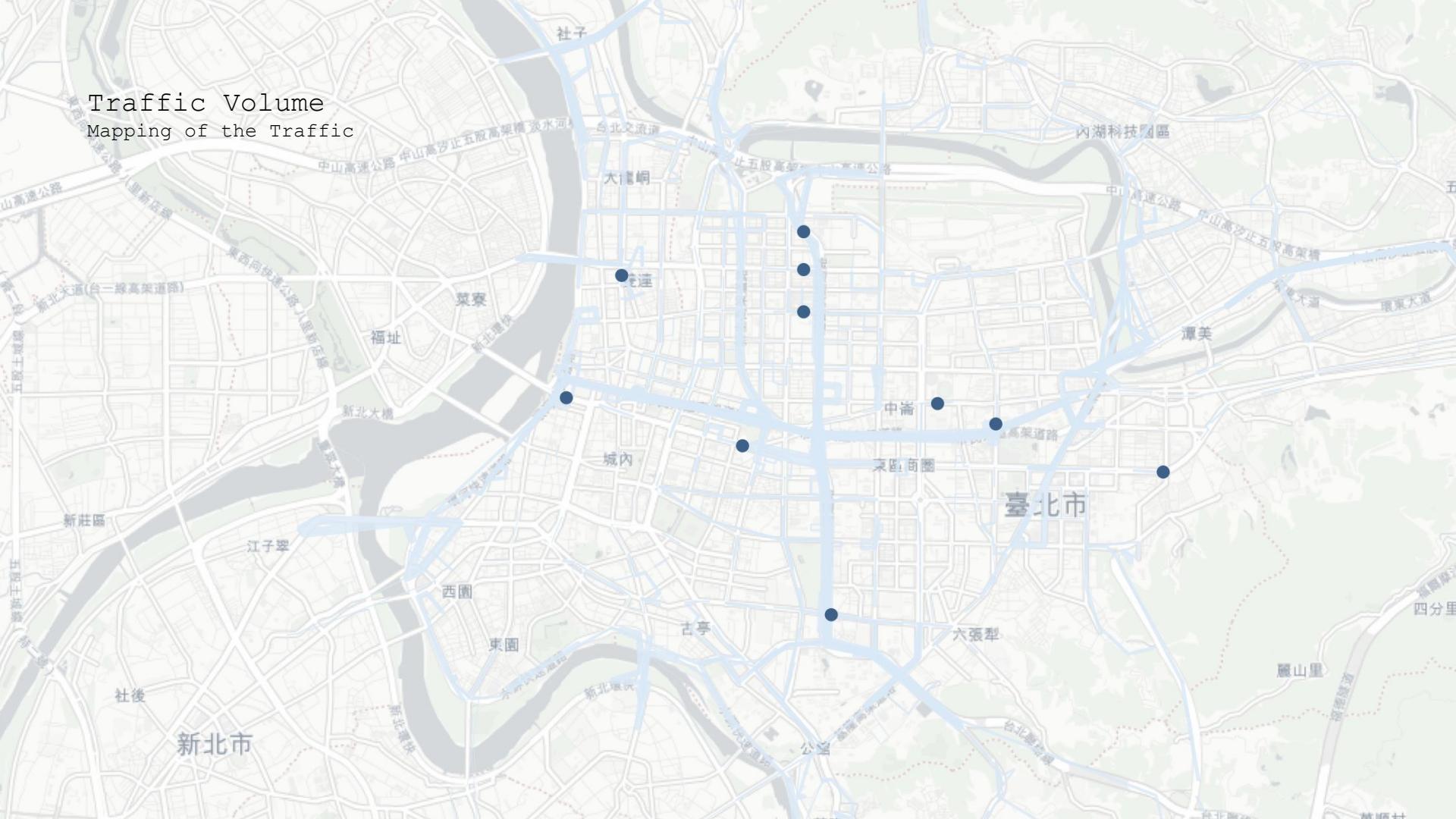


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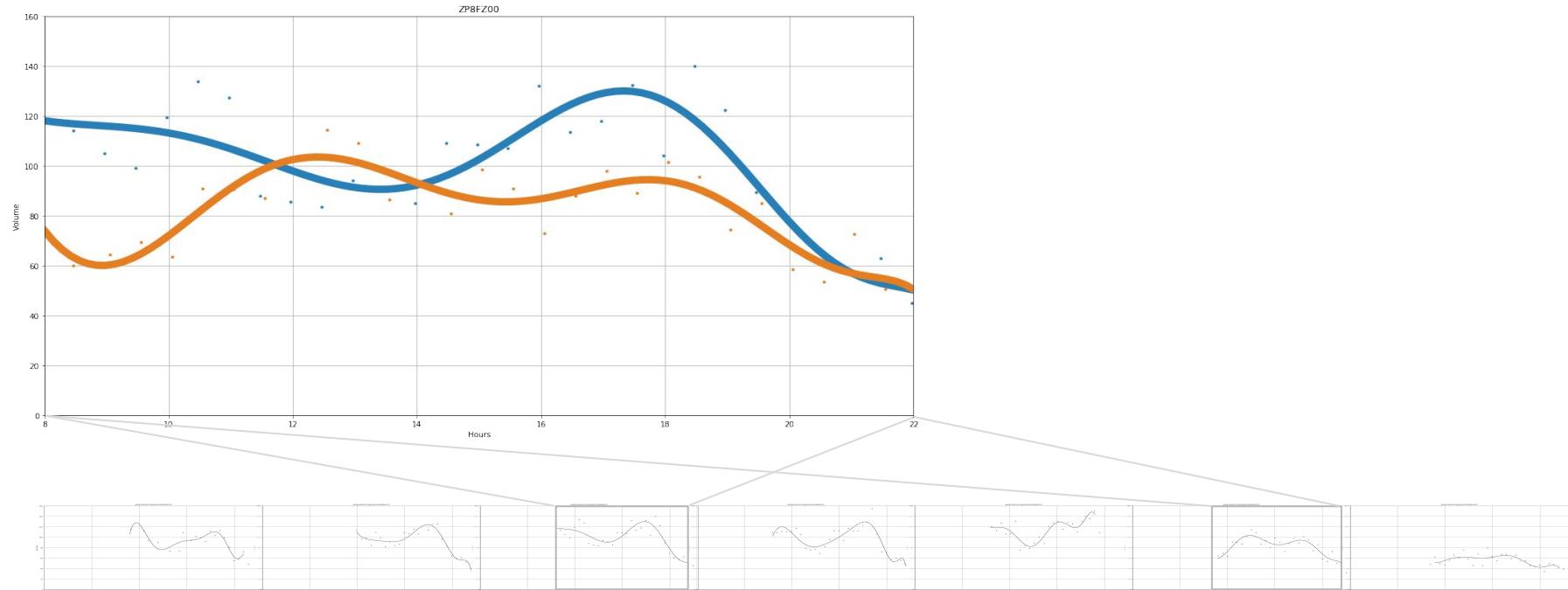
Wed.

Traffic Volume Mapping of the Traffic



Traffic Volume

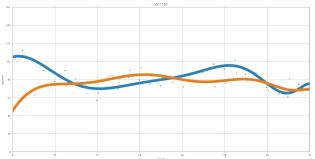
Comparison of Weekdays and Weekend



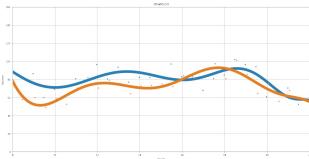
Traffic Volume

Comparison of Weekdays and Weekend

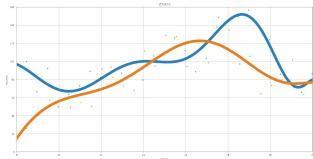
忠孝東路 松山路-松信路



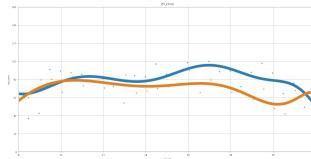
八德路 敦化南路 - 光復南路



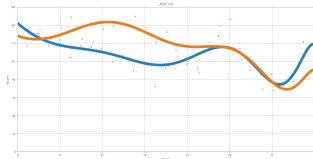
忠孝東路 杭州北路 - 中山北路



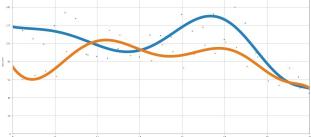
建國北路 民權東路 - 民族東路



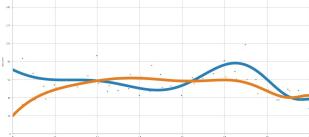
忠孝西路 環河北路 - 塔城街



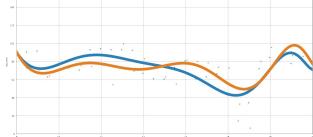
重慶北路 南京西路 - 民權西路



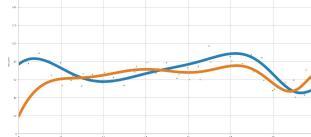
民生東路 建國北路 - 松江路



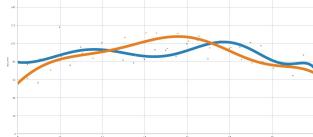
民權東路 建國北路 - 松江路



光復南路 市民大道 - 八德路



和平東路 復興南路 - 新生南路



Parking Lot Distribution



Parking Space & Parking Rates

Rate

0 200

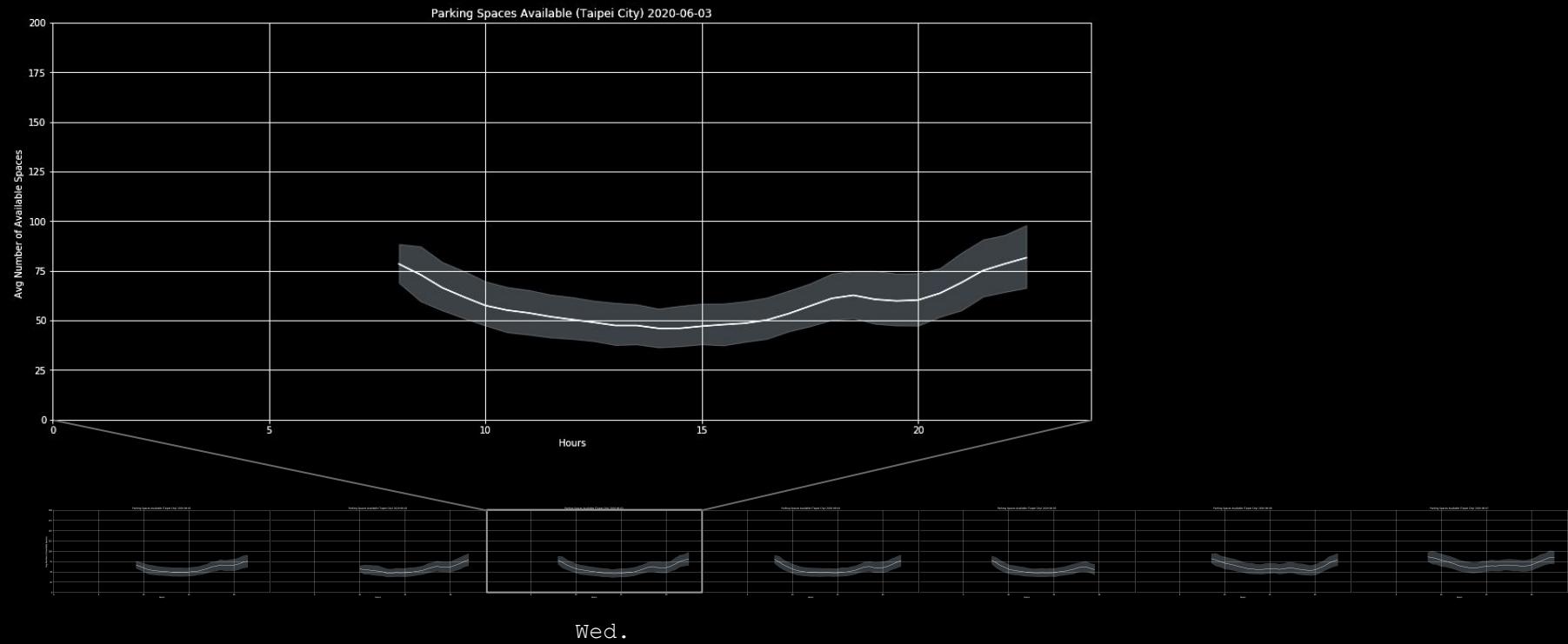
Total Space

2000
1100
544
256
88



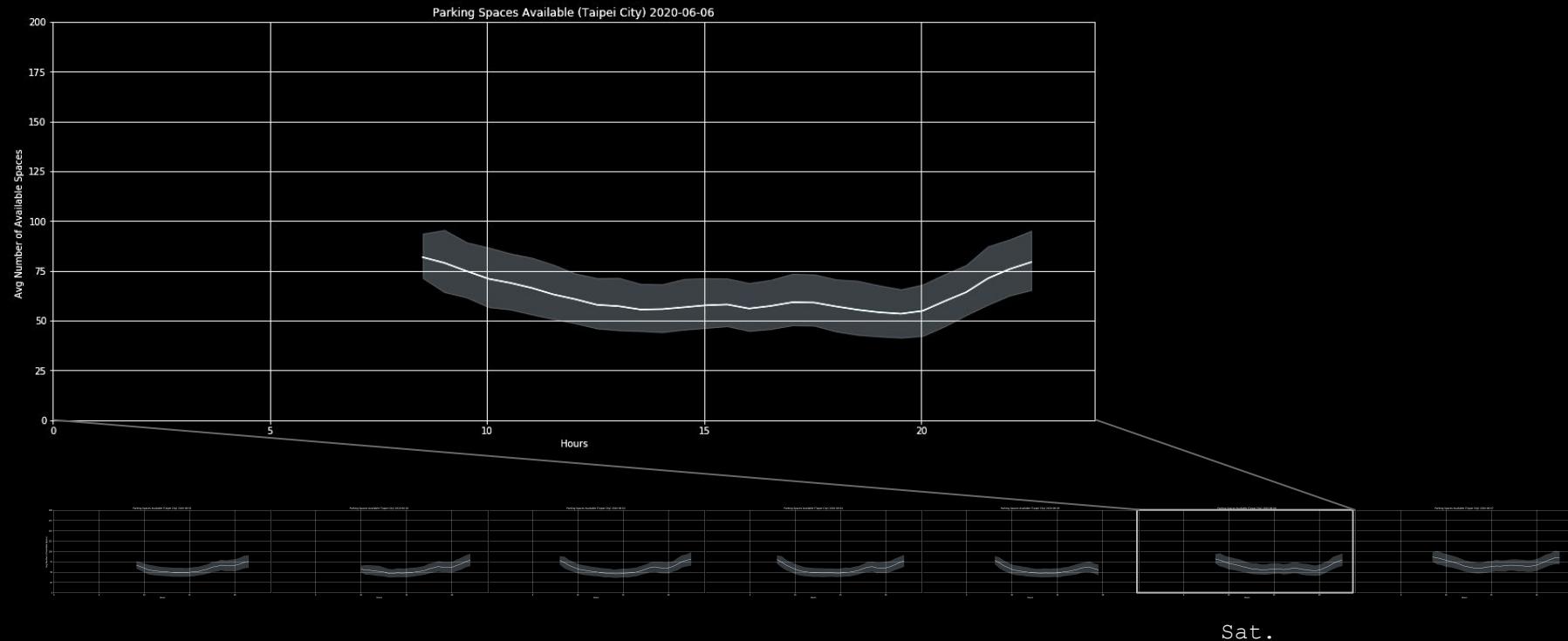
Available Space

Weekdays of Taipei City



Available Space

Weekend of Taipei City



Available Space

Mapping of the Parking Lot

2020-06-03 08:00

Available

0

1000

Total Space

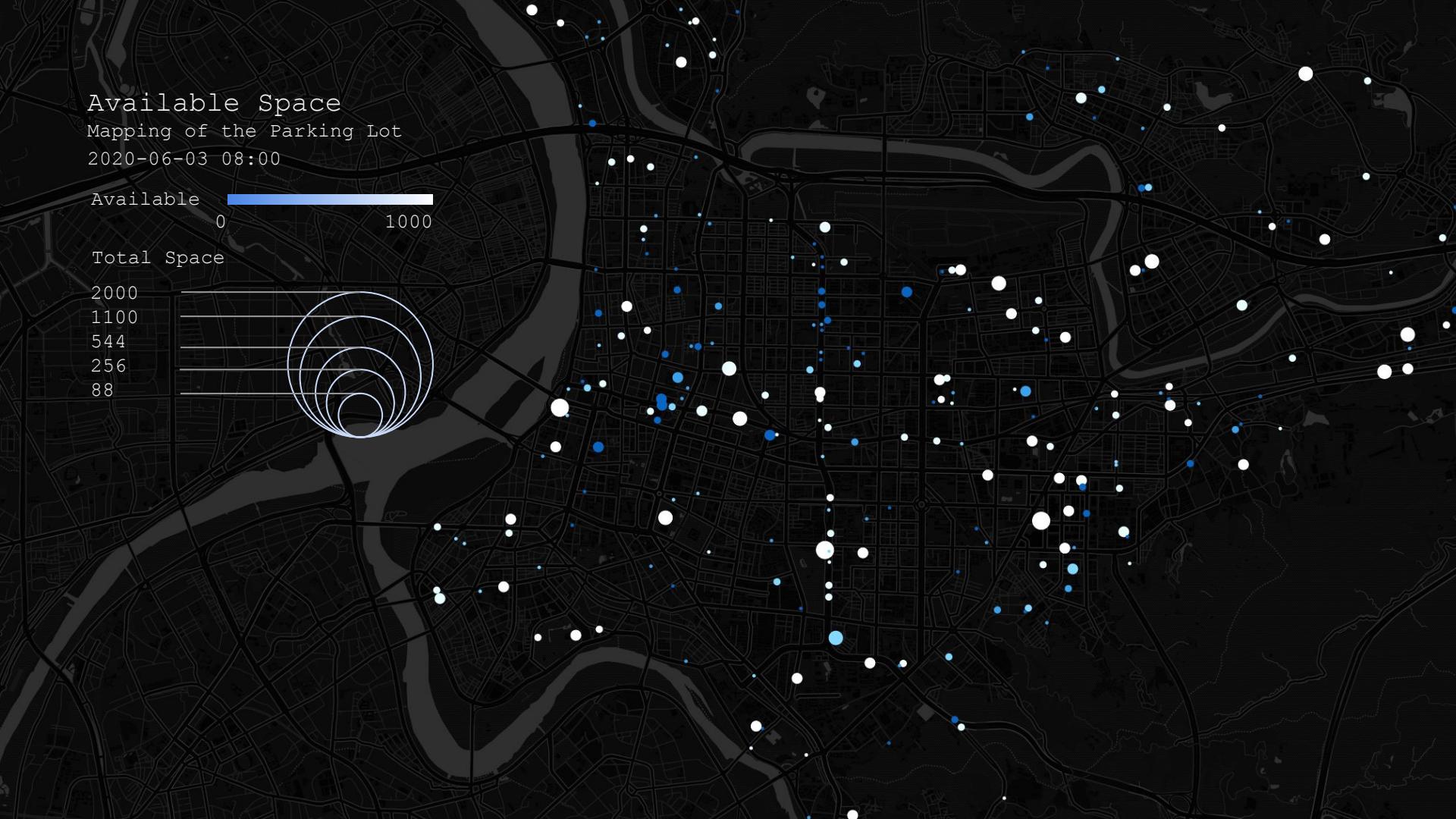
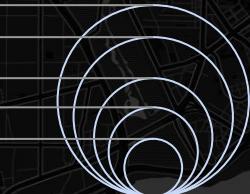
2000

1100

544

256

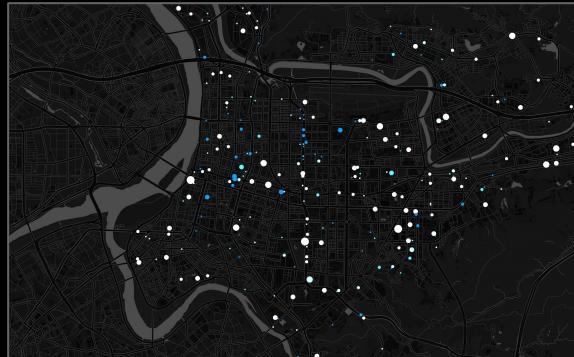
88



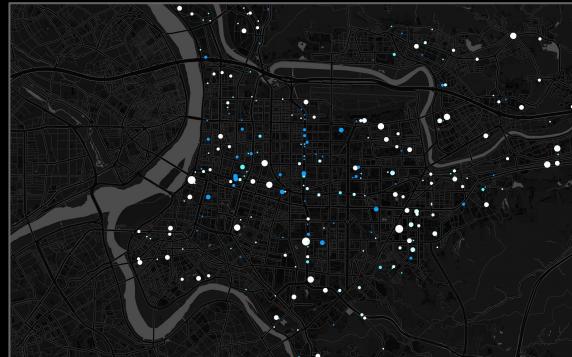
Available Space

Mapping of the Parking Lot

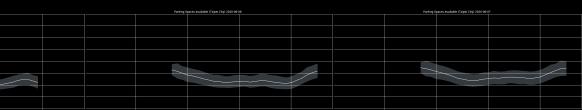
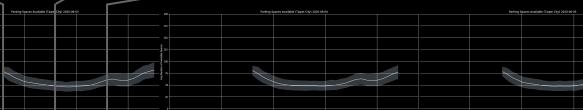
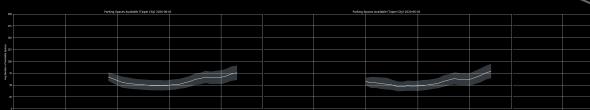
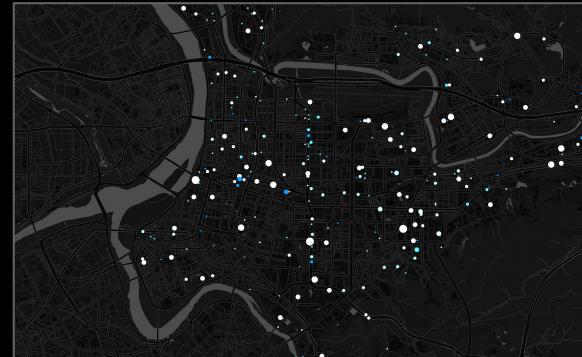
2020-06-03 08:00



2020-06-03 13:00



2020-06-03 18:00



Wed.

Increase & Decrease

in quantity of Available Space

2020-06-03 11:00-to-13:00

Delta

-180 80

Increase or Decrease Amount

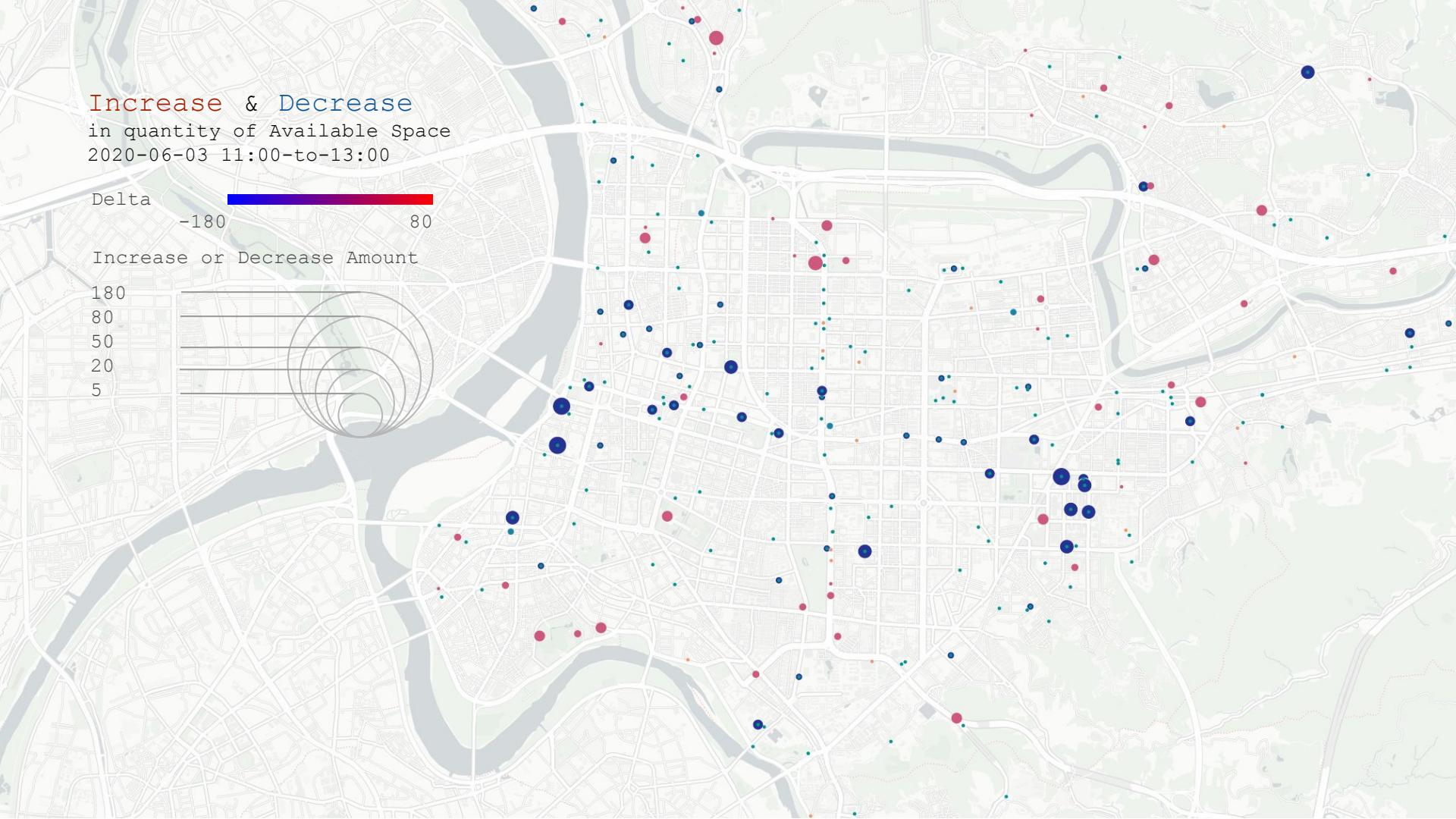
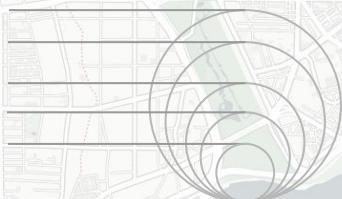
180

80

50

20

5



Increase & Decrease

in quantity of Available Space

2020-06-03 13:00-to-17:00

Delta

-150

300

Increase or Decrease Amount

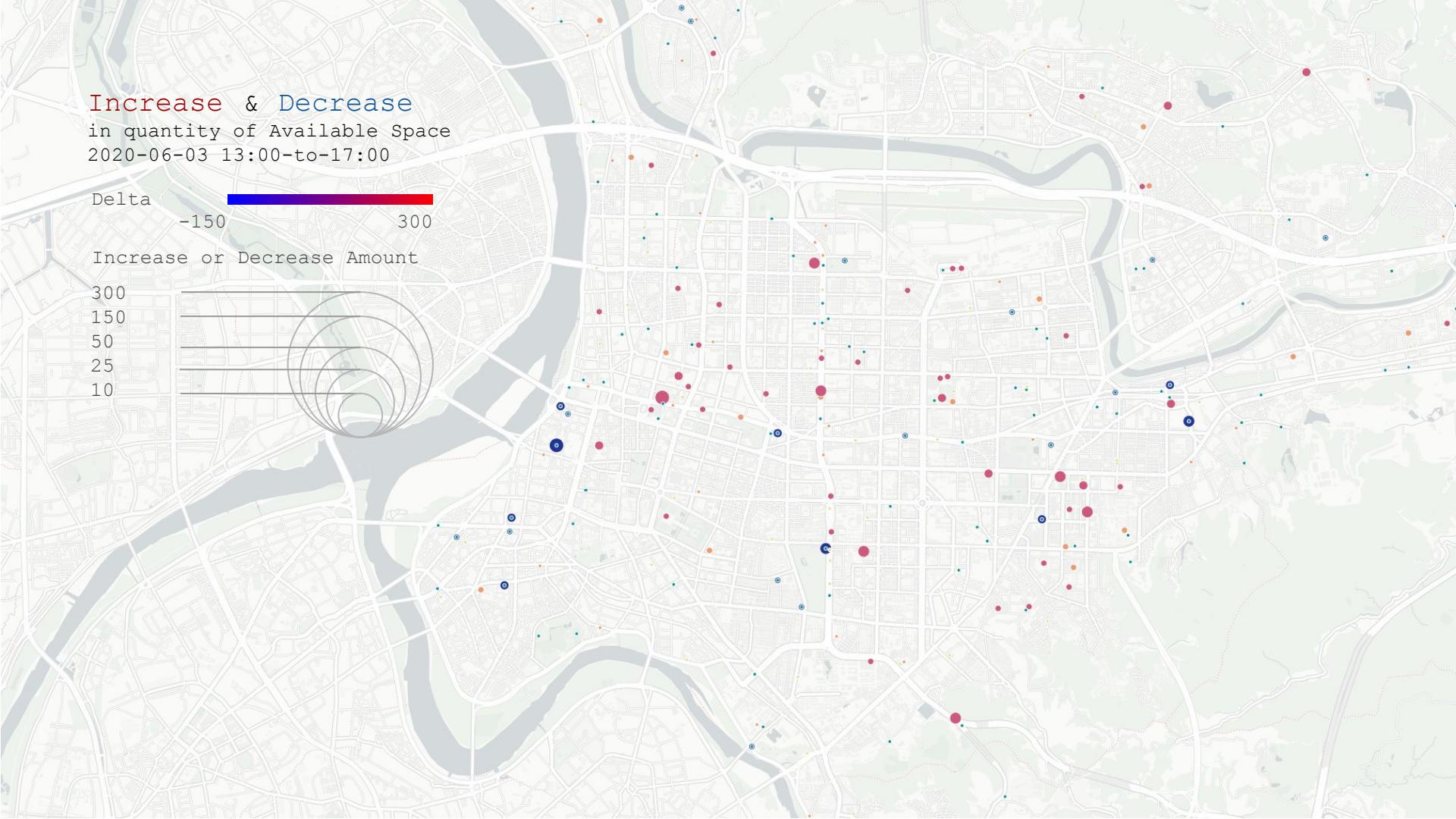
300

150

50

25

10



Increase & Decrease

in quantity of Available Space

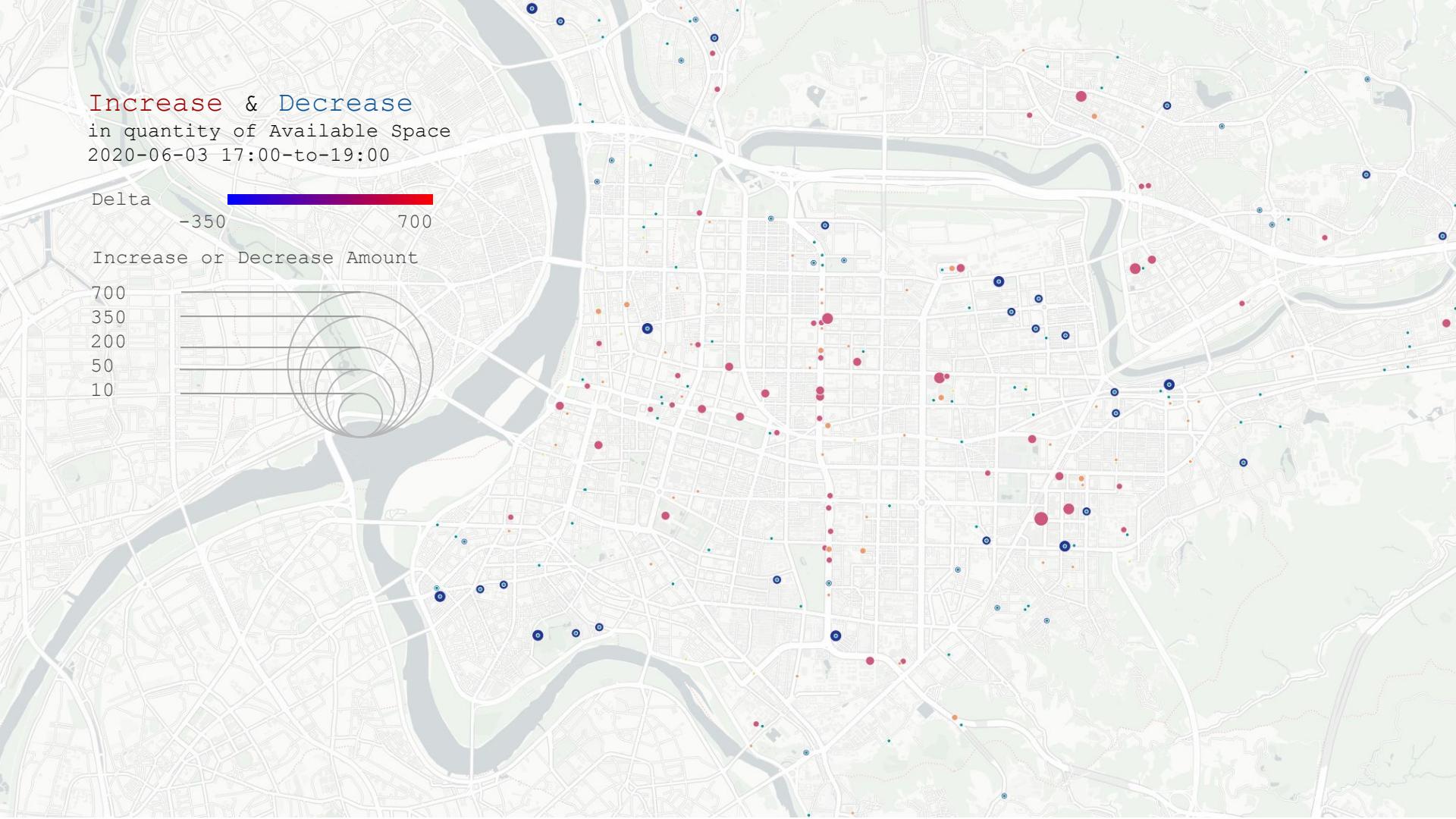
2020-06-03 17:00-to-19:00

Delta

-350 700

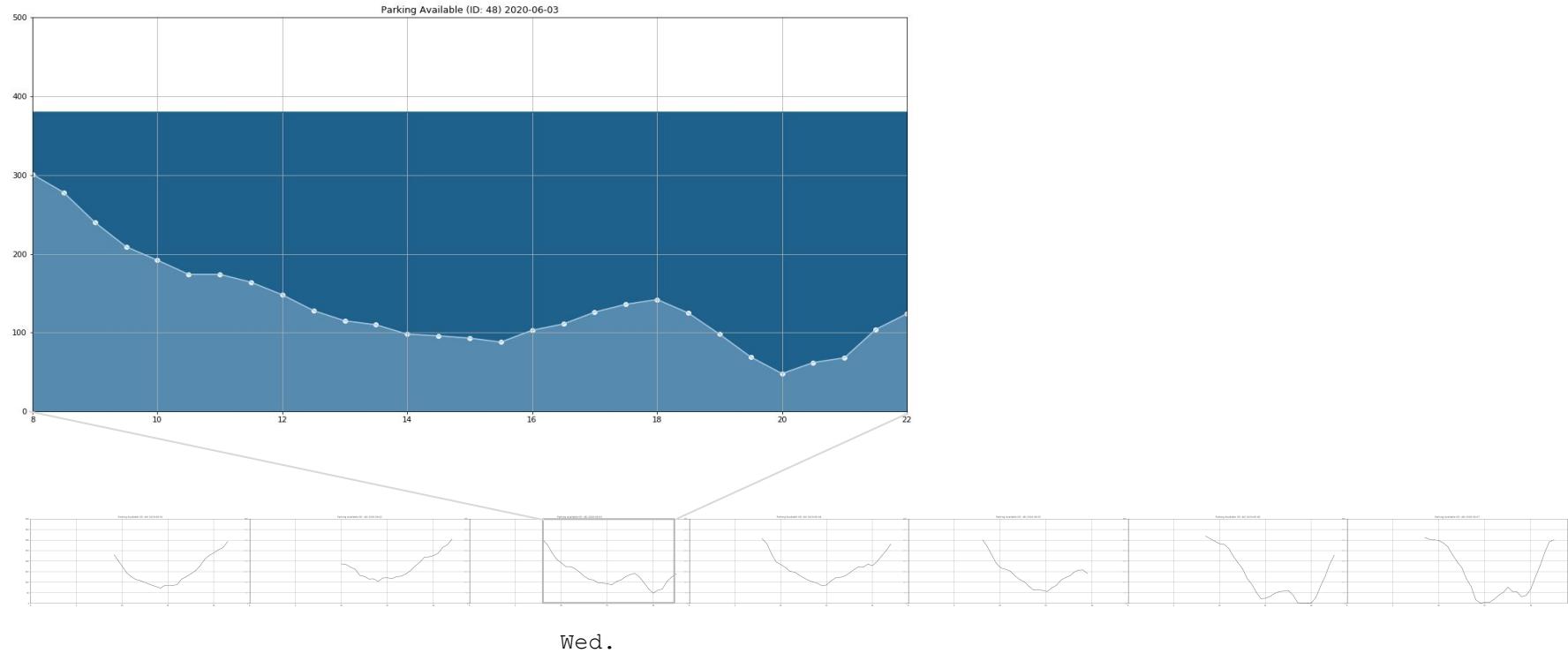
Increase or Decrease Amount

700
350
200
50
10



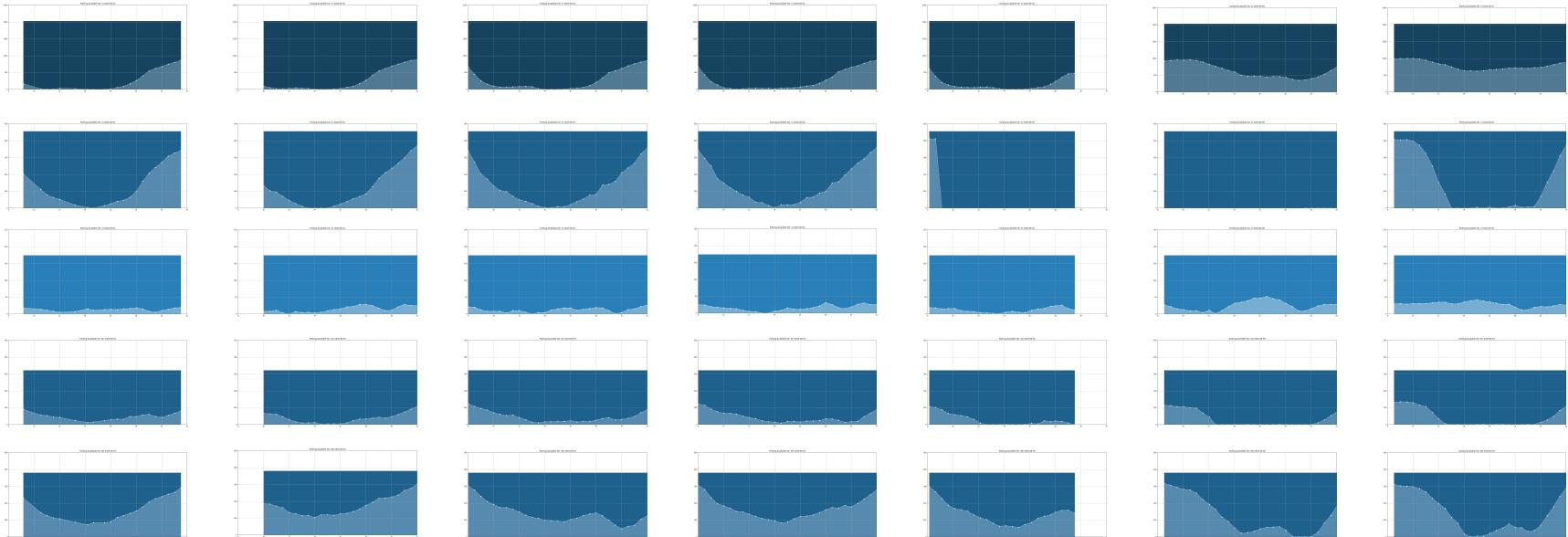
Available Space

Service in weekdays & weekend



Available Space

Service in weekdays & weekend

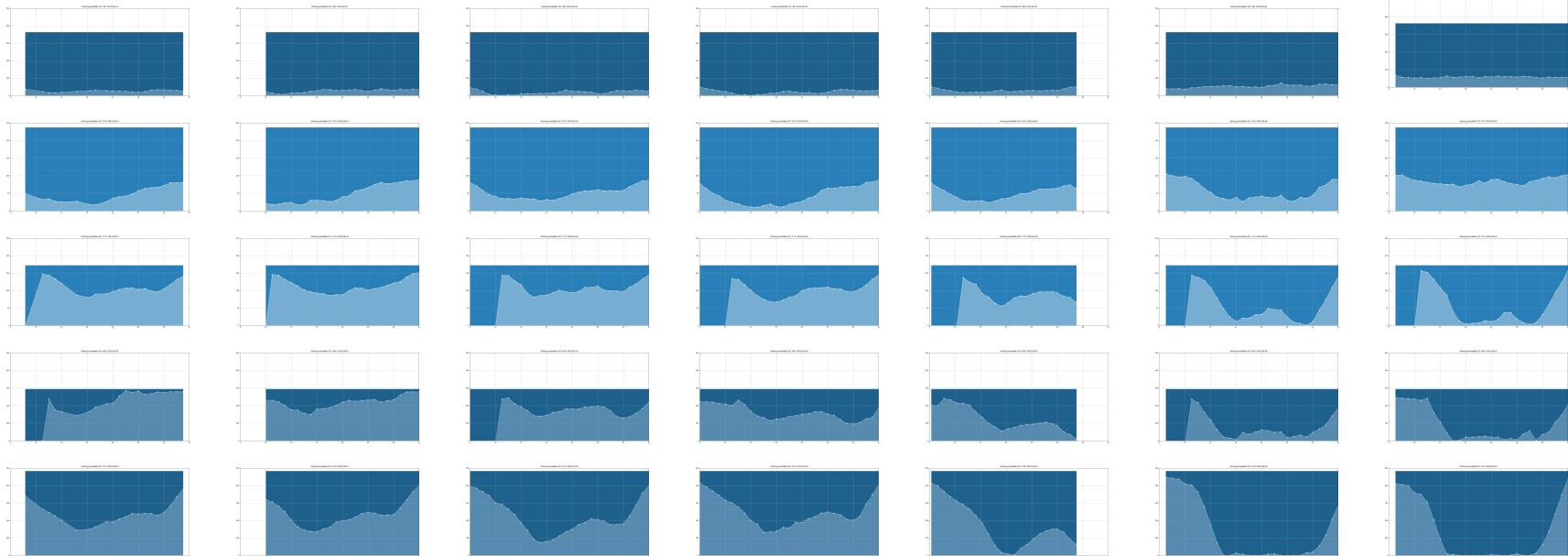


weekdays

weekend

Available Space

Service in weekdays & weekend



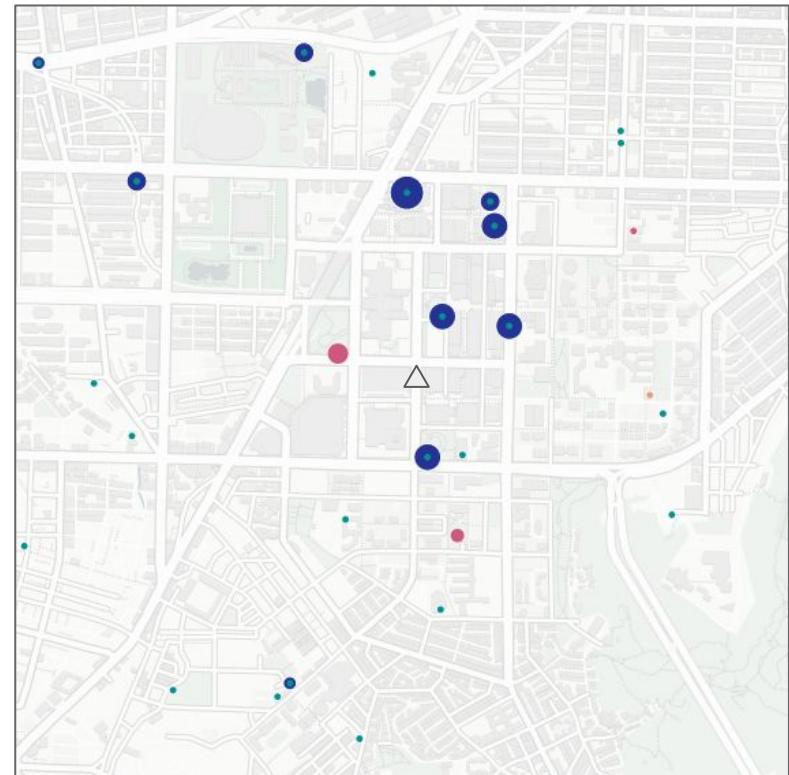
weekdays

weekend

Self-Parking Problem

Instant Data

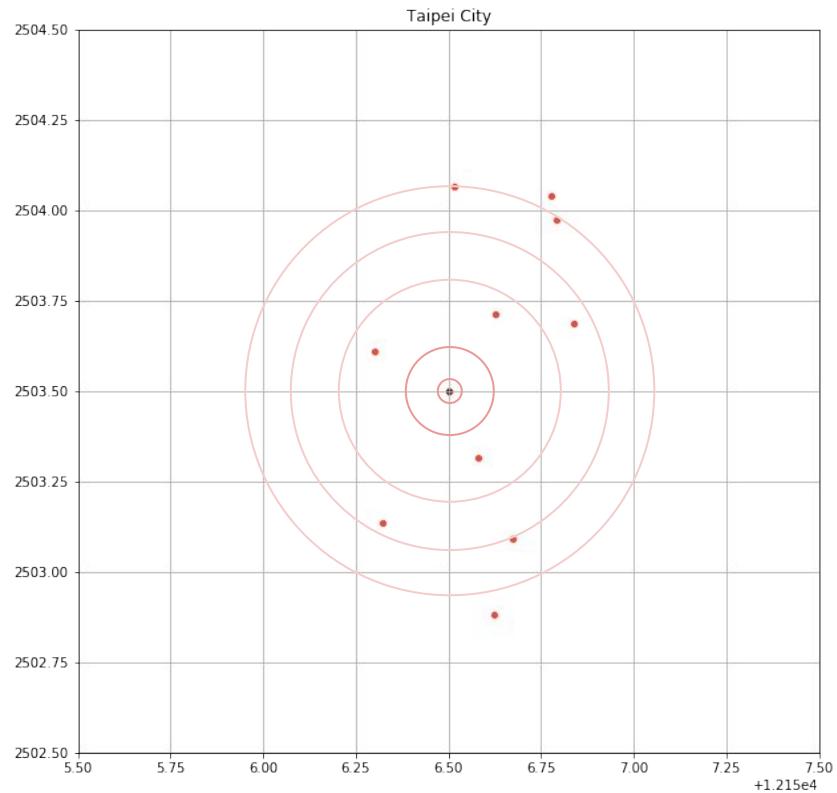
```
## Real-Time Data  
  
# Nearby Parking Lots (Location) and (Rate)  
[(12156.3, 2503.6)]  
  
# Real-Time Parking Space Prediction  
[0, 0, 0, 0, 0, 0, 0, 660, 252, 97, 65, 82,  
78, 0, 0, 26, 56, 206, 495, 620, 758, 851, 0]  
  
# Real-Time Traffic Flow Prediction  
[True, False]
```



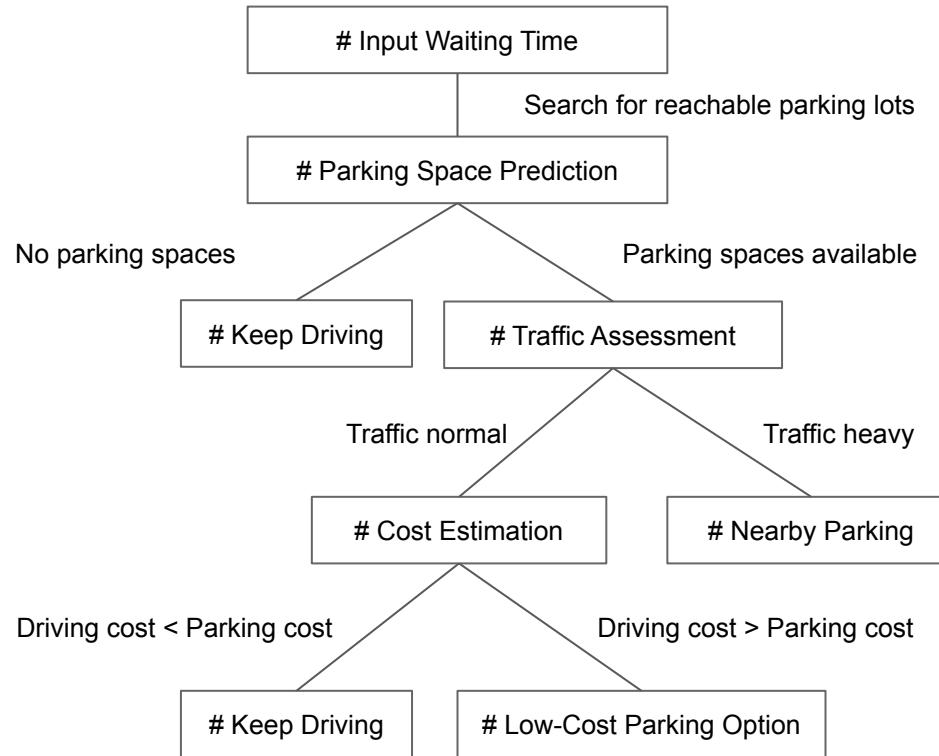
Self-Parking Problem

Parameter

```
## Input Variables  
  
# Start Time  
currenttime = 9 # O'clock  
  
# Parking Duration  
emptyhours = 2 # hours  
  
# Initial Speed  
speed = 30 # km/hr  
  
# Starting Point  
point_start = (12156.5, 2503.5)  
  
# Electricity / Fuel Cost per km  
fuelcost = 1.8 # NTD/km
```



Self-Parking Problem Algorithm



Self-Parking

Decision

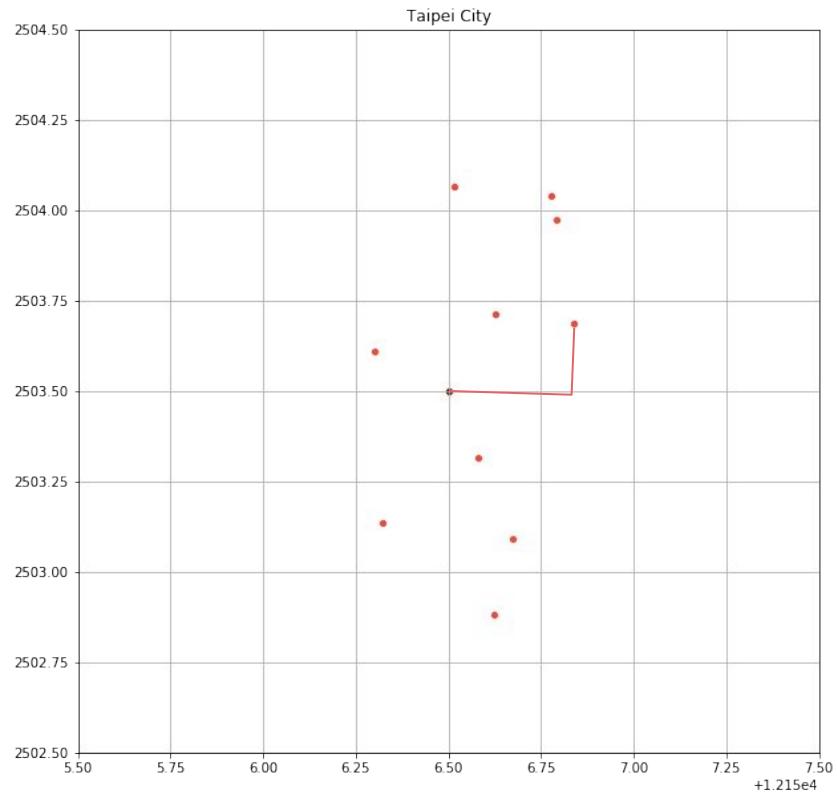
Cost & Distance

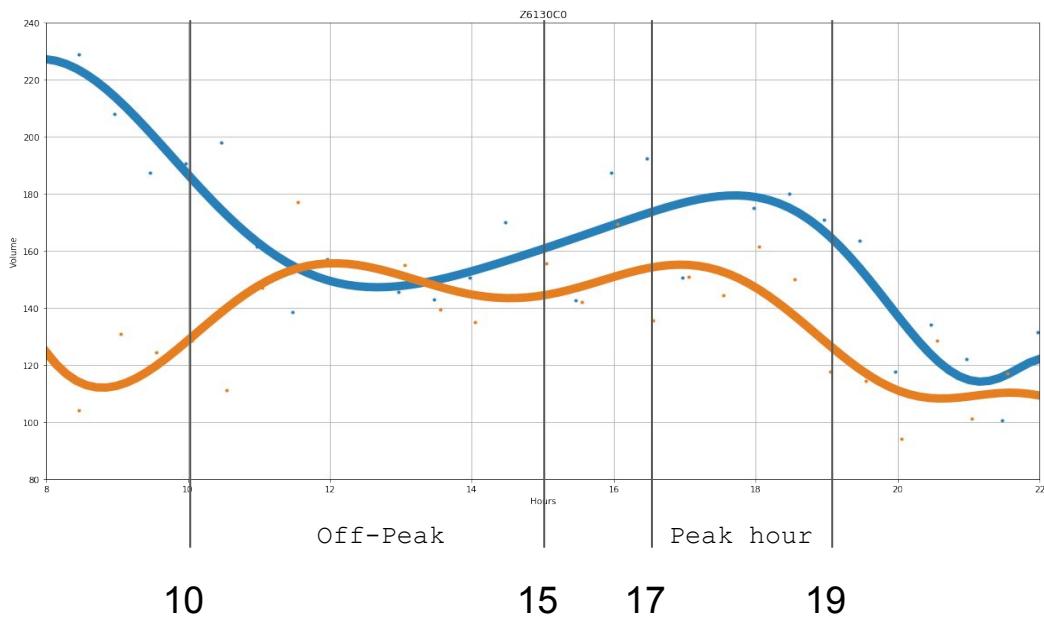
Cost Estimation

Driving distance × Electricity cost

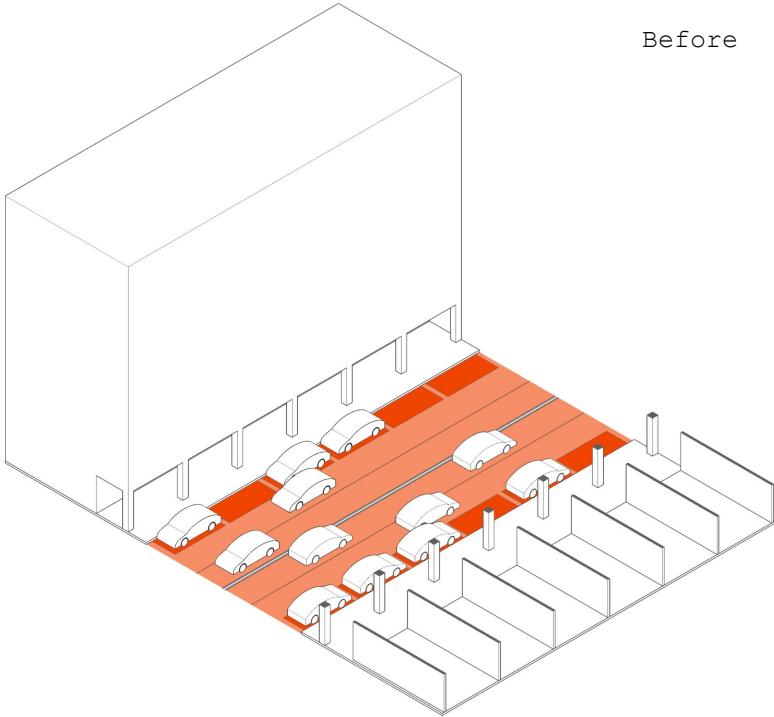
Parking rate × Parking duration

| | id | location | rate | cost |
|----|-----------|------------------------------------------|-------------|-------------|
| 0 | 1 | (12156.299732925112, 2503.608871399772) | 30.0 | 60.364715 |
| 1 | 2 | (12156.628035534453, 2503.7146696000364) | 30.0 | 60.399924 |
| 2 | 3 | (12156.62260284535, 2502.8806331929663) | 30.0 | 61.010216 |
| 3 | 41 | (12156.778319103674, 2504.0419316888965) | 40.0 | 80.568607 |
| 4 | 48 | (12156.581163492996, 2503.3146073617418) | 40.0 | 80.188889 |
| 5 | 88 | (12156.67488676518, 2503.0915461015984) | 30.0 | 60.710911 |
| 6 | 107 | (12156.322742598948, 2503.137022943796) | 40.0 | 80.377016 |
| 7 | 177 | (12156.791712976386, 2503.9730235834463) | 120.0 | 237.554741 |
| 8 | 405 | (12156.839193996428, 2503.687998053841) | 20.0 | 40.879034 |
| 9 | 472 | (12156.5163622336, 2504.066791522695) | 50.0 | 100.151207 |
| 10 | -1 | (inf, inf) | 0.0 | 108.000000 |

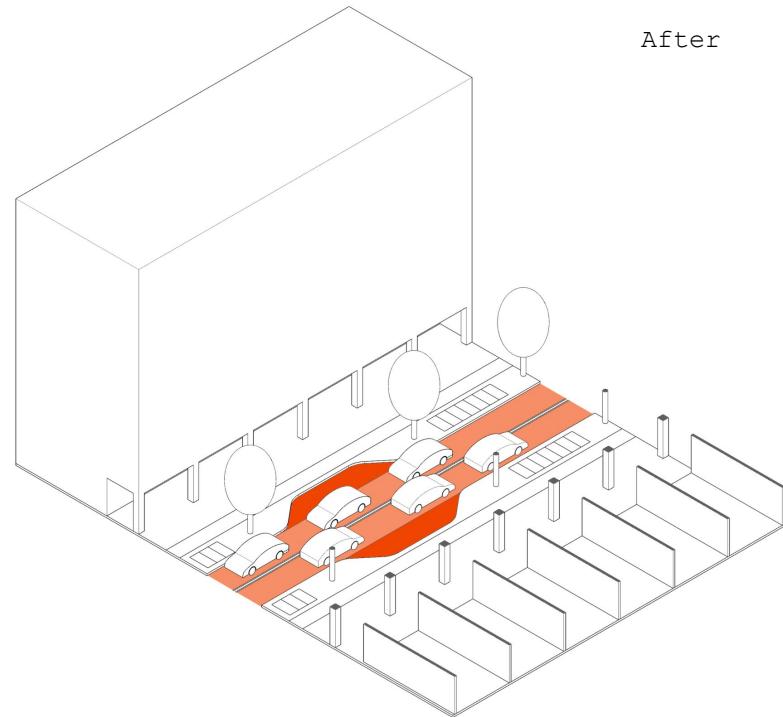




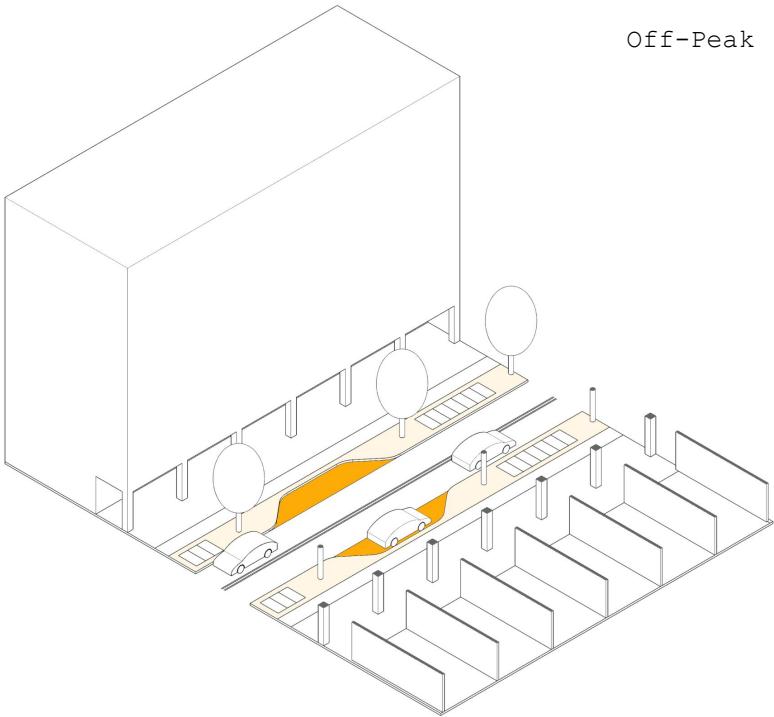
八德路四段



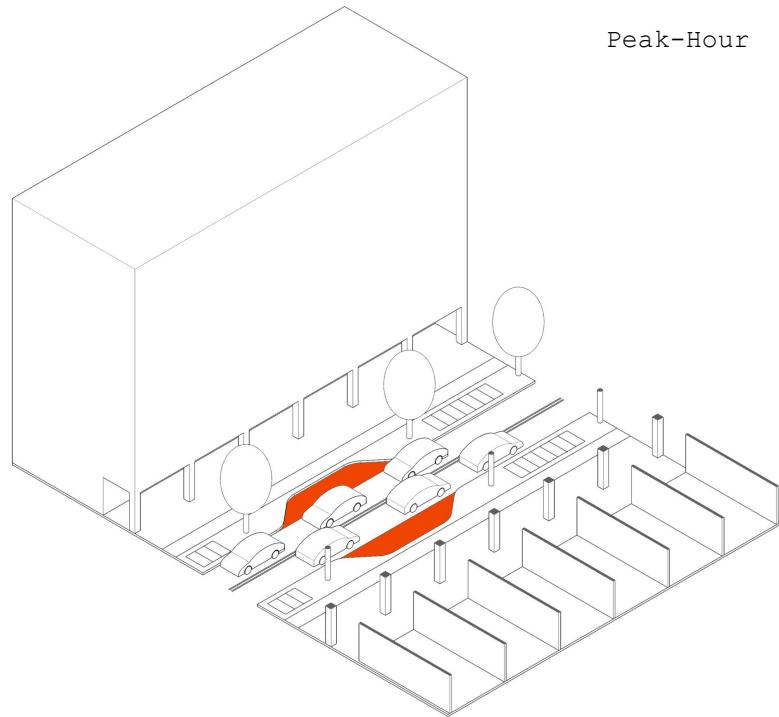
Before



After

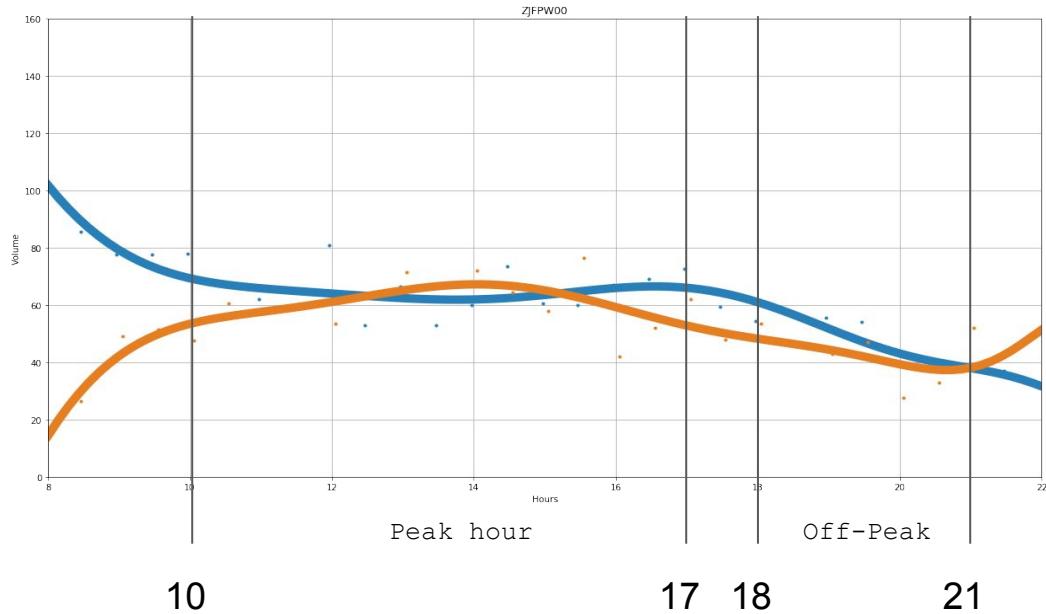


Off-Peak

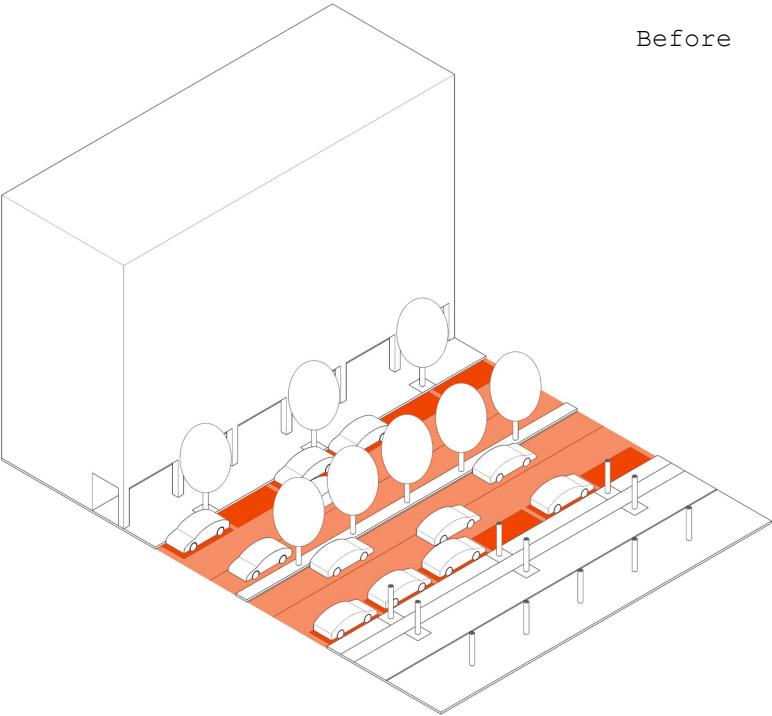


Peak-Hour

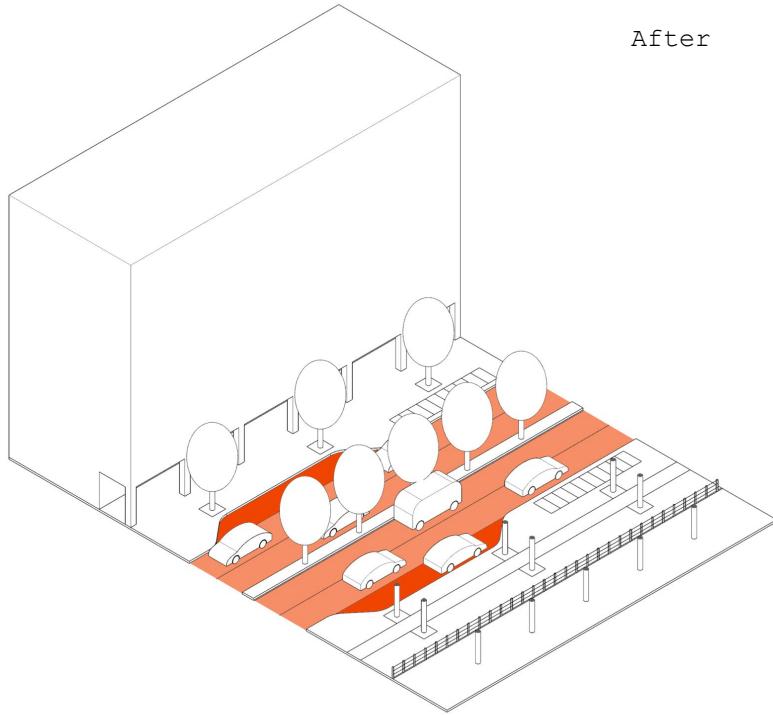
Pick-Up and Drop-Off Space Management



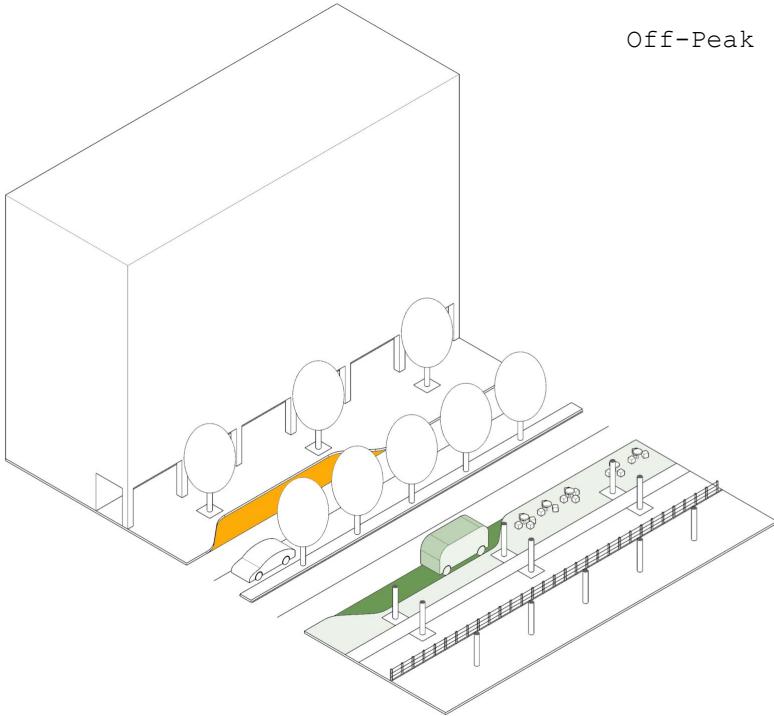
光復南路



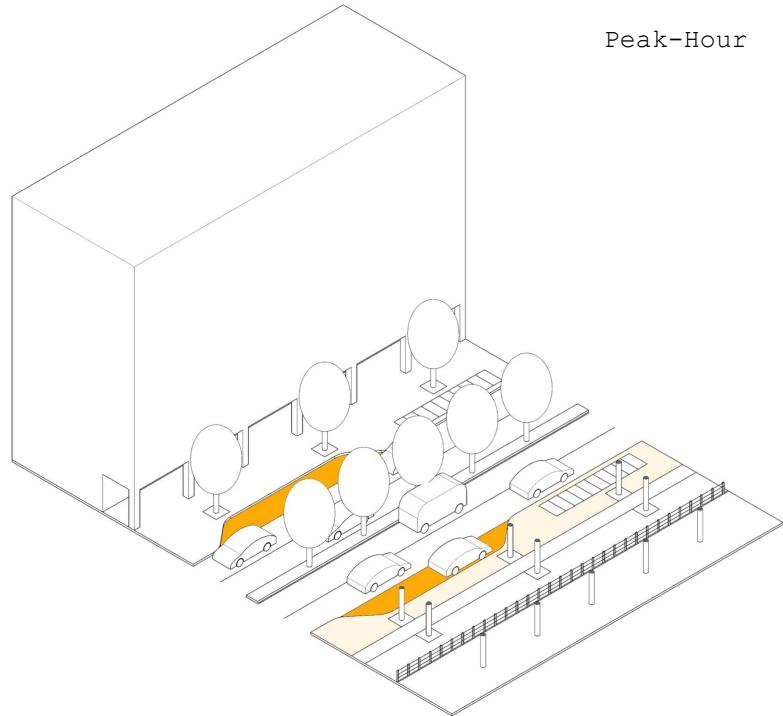
Before



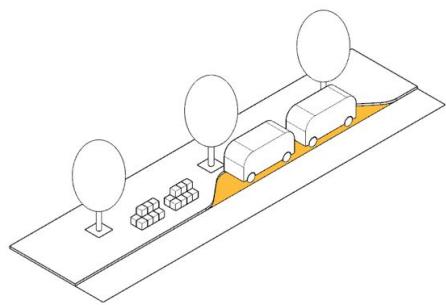
After



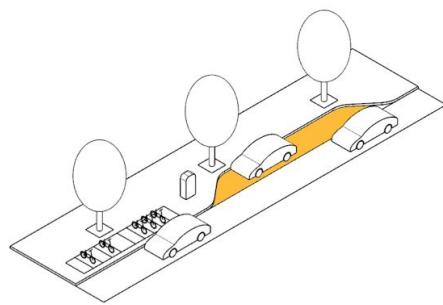
Off-Peak



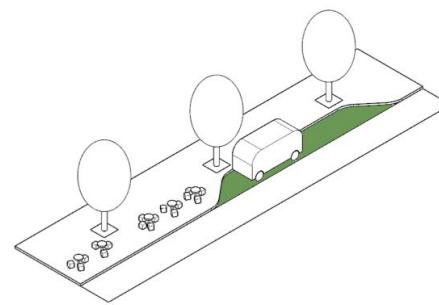
Peak-Hour



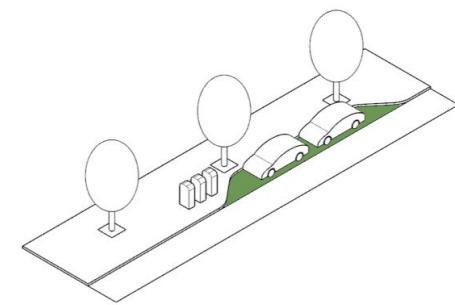
7:00



12:00



19:00



23:00

Future of Mobility

Reshaping Urban Space

