香港城市大學
City University of Hong Kong
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A new air monitoring system assessment and application

—— a case study of source identification in local area

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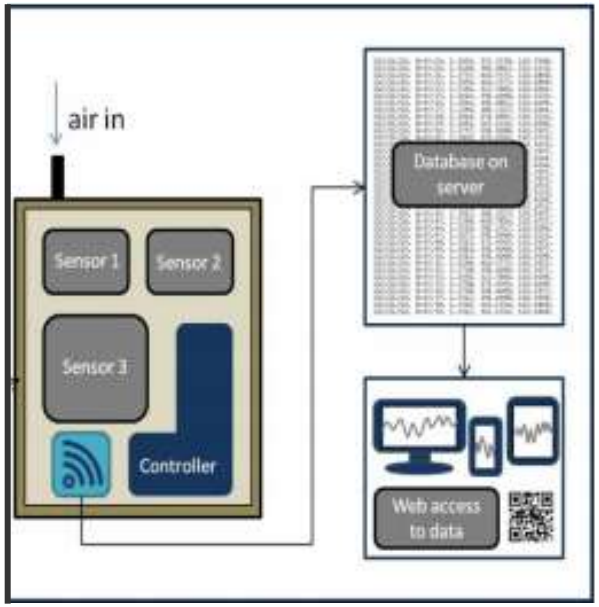
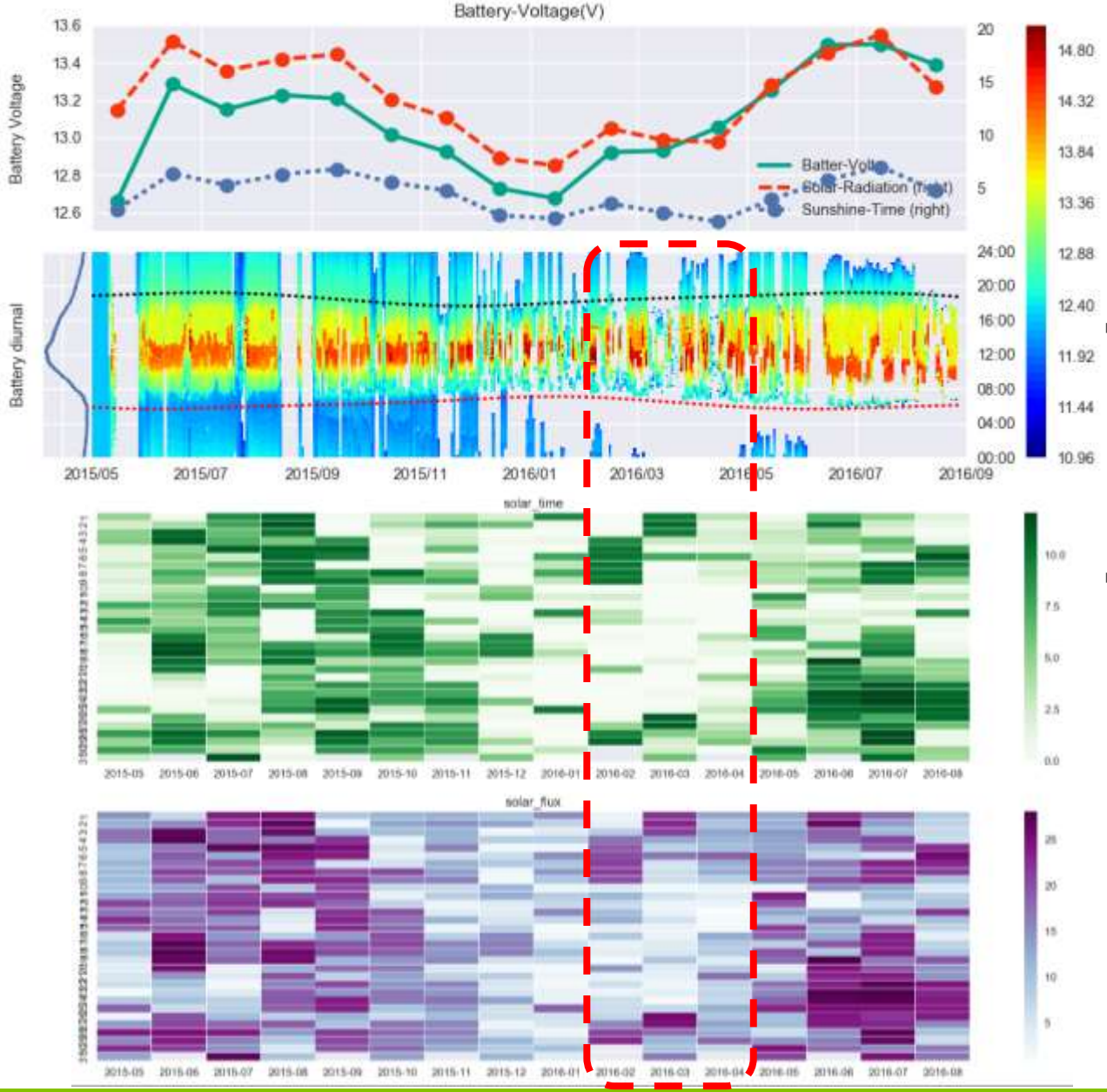
1.1 System introduction



	Accuracy
pDR-1500	±5%
OEM-106-L	±2%
RM Young 09101	±1%

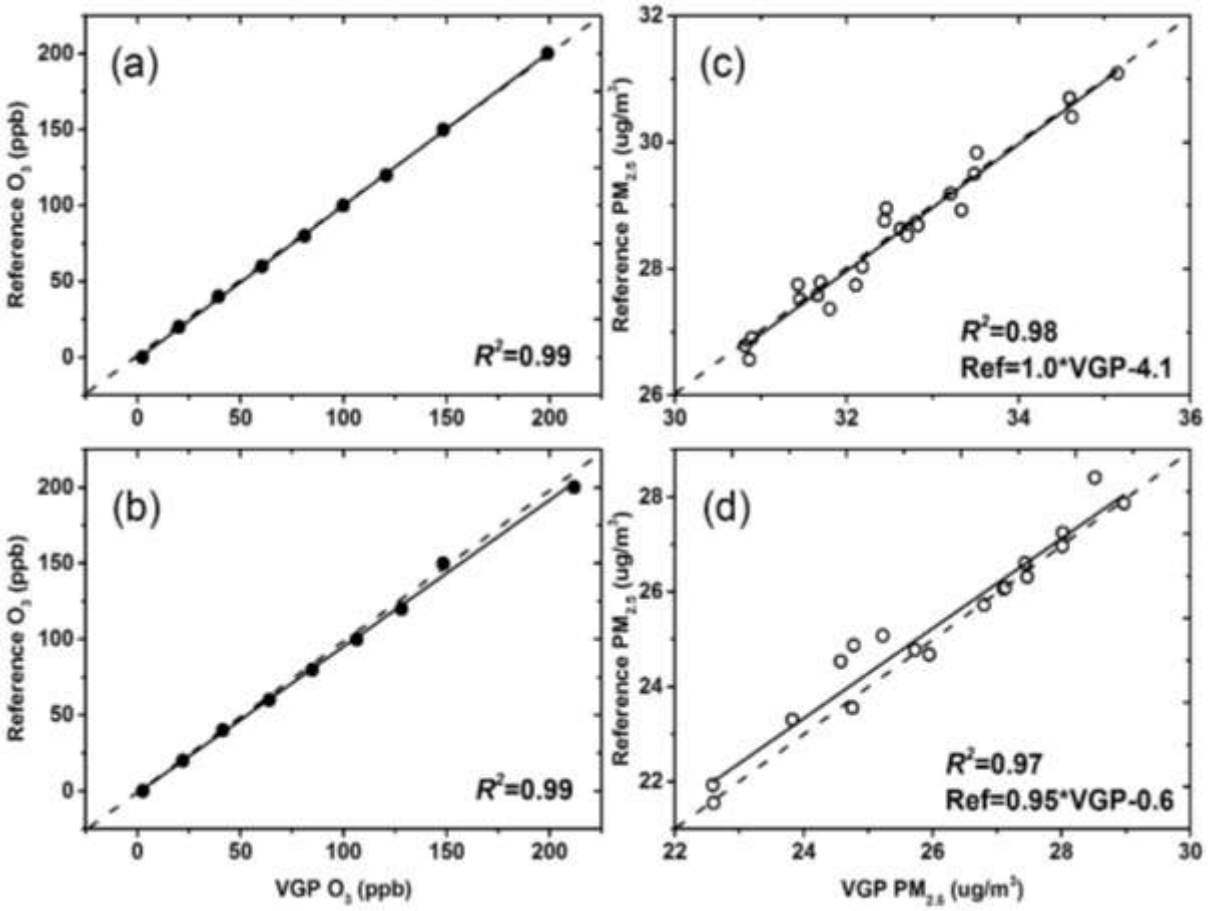
1.2 System deployment in Hong Kong

2.1 Data completeness and influence factor



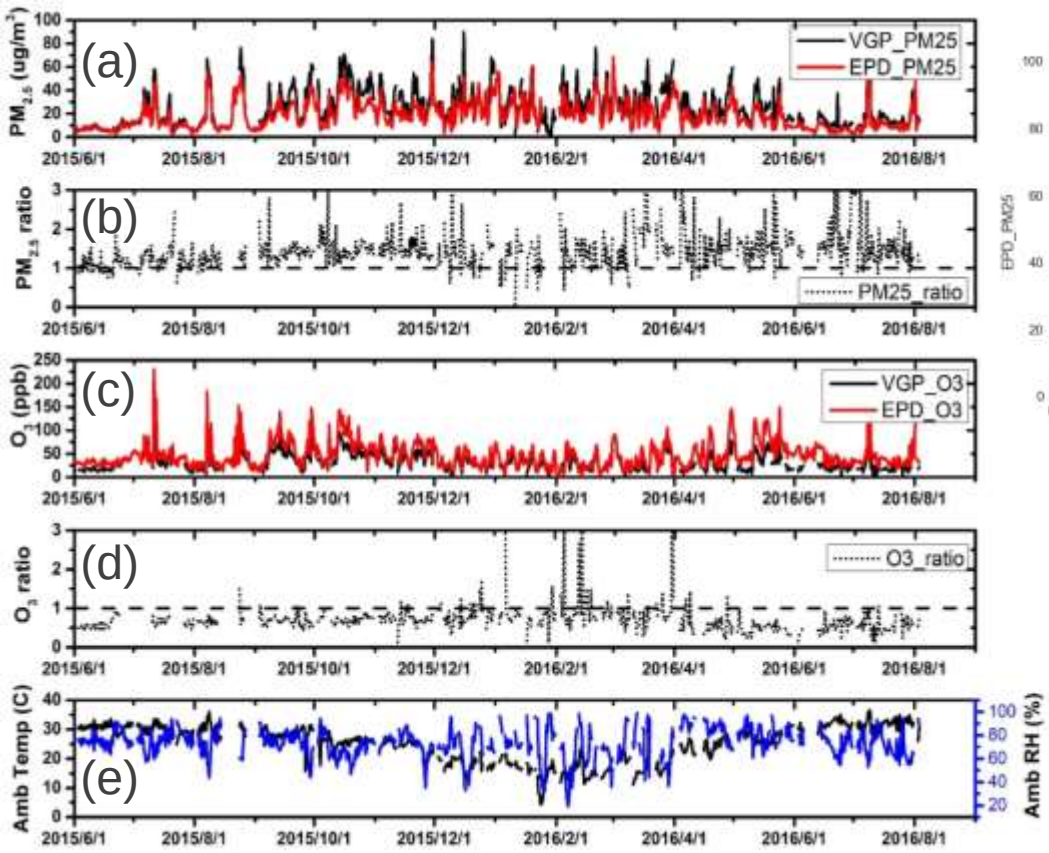
- The VGP system working power supply is a solar panel which supplies relatively stable voltage (11.5~14.5 V) for the whole system.
- The VGP system working voltage has direct relationship with solar-radiation (R^2 = 0.79) other than sun-shinetime (R^2 = 0.54).

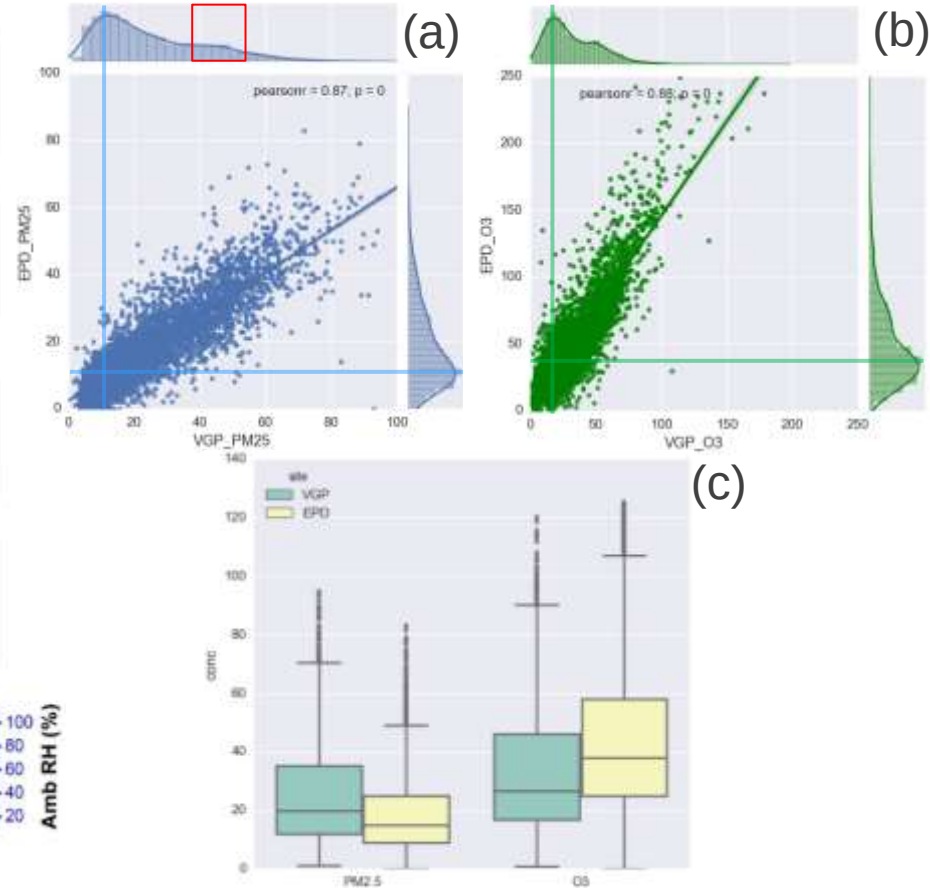
2.2 Data validity



- The calibration lasted for 2 hours, each point represented 5-min average.
- The O_3 calibrated with stand gas by steps from 0 to 200 ppb, while $PM_{2.5}$ were calibrated site-by-site with reference instruments.

3.1 Results and comparison



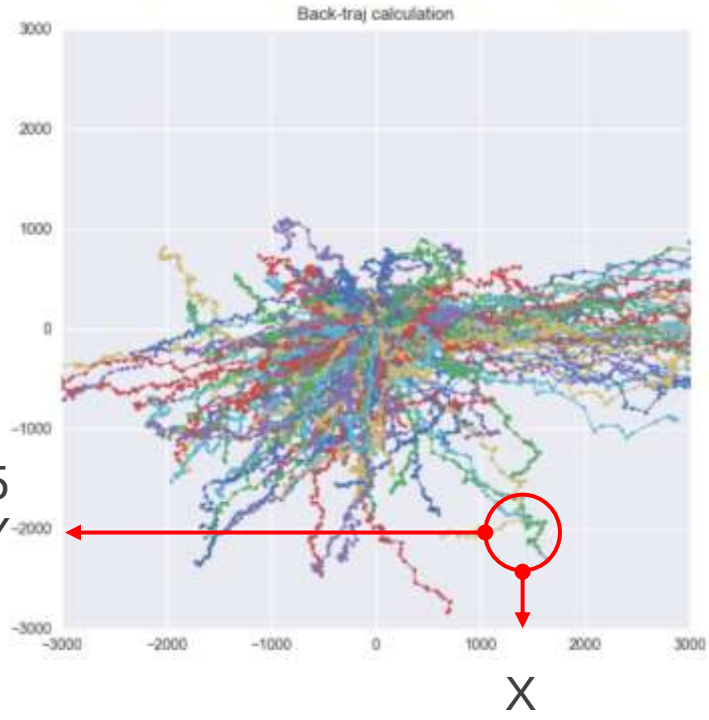


	VGP avg	EPD avg	Ratio	R^2
$PM_{2.5}$ (ug/m^3)	26	18	1.37	0.74
O_3 (ppb)	32	48	0.65	0.76

- Both $PM_{2.5}$ and O_3 show good trend with EPD measurements.
- $PM_{2.5}$ shows opposite comparison trend with O_3, while $PM_{2.5}$ nearly always higher levels in VGP site than EPD, and presented unstable ratio fluctuation relative to O_3, which indicates some unconstant pollution sources nearby VGP site.

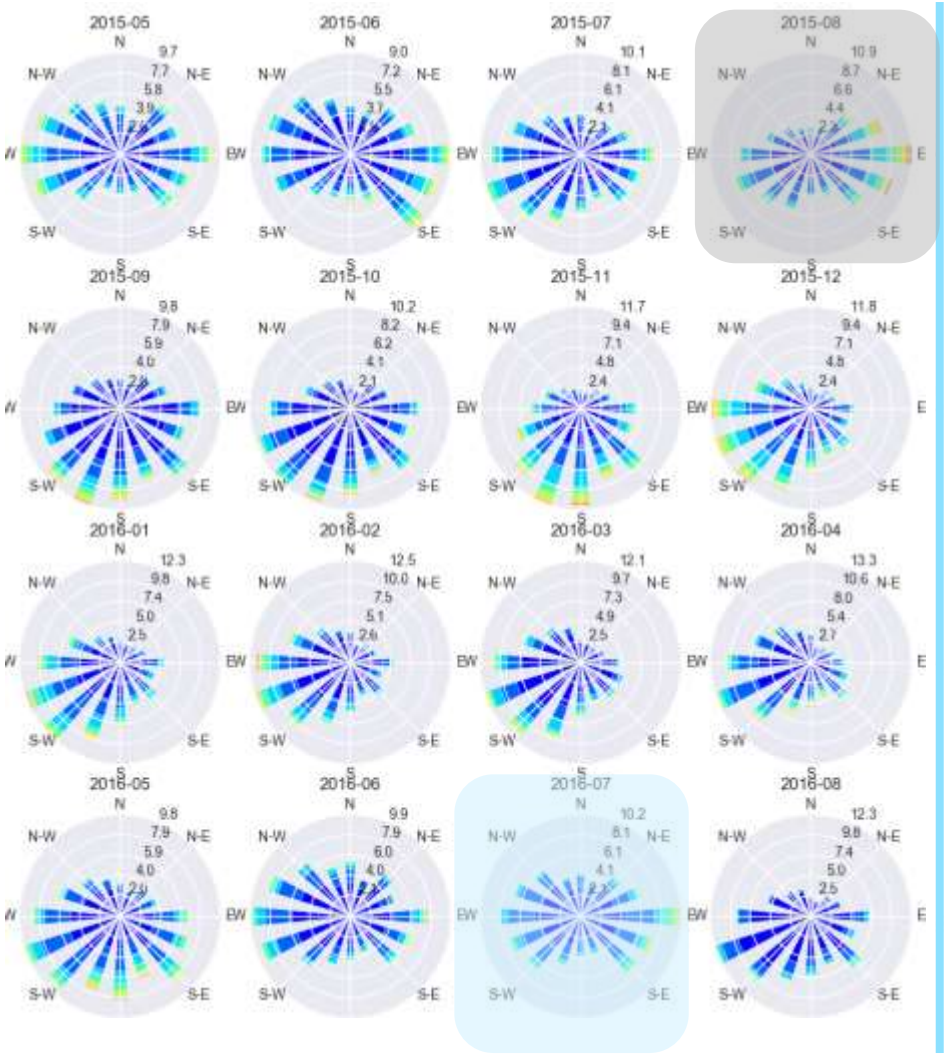
3.2 Methodology

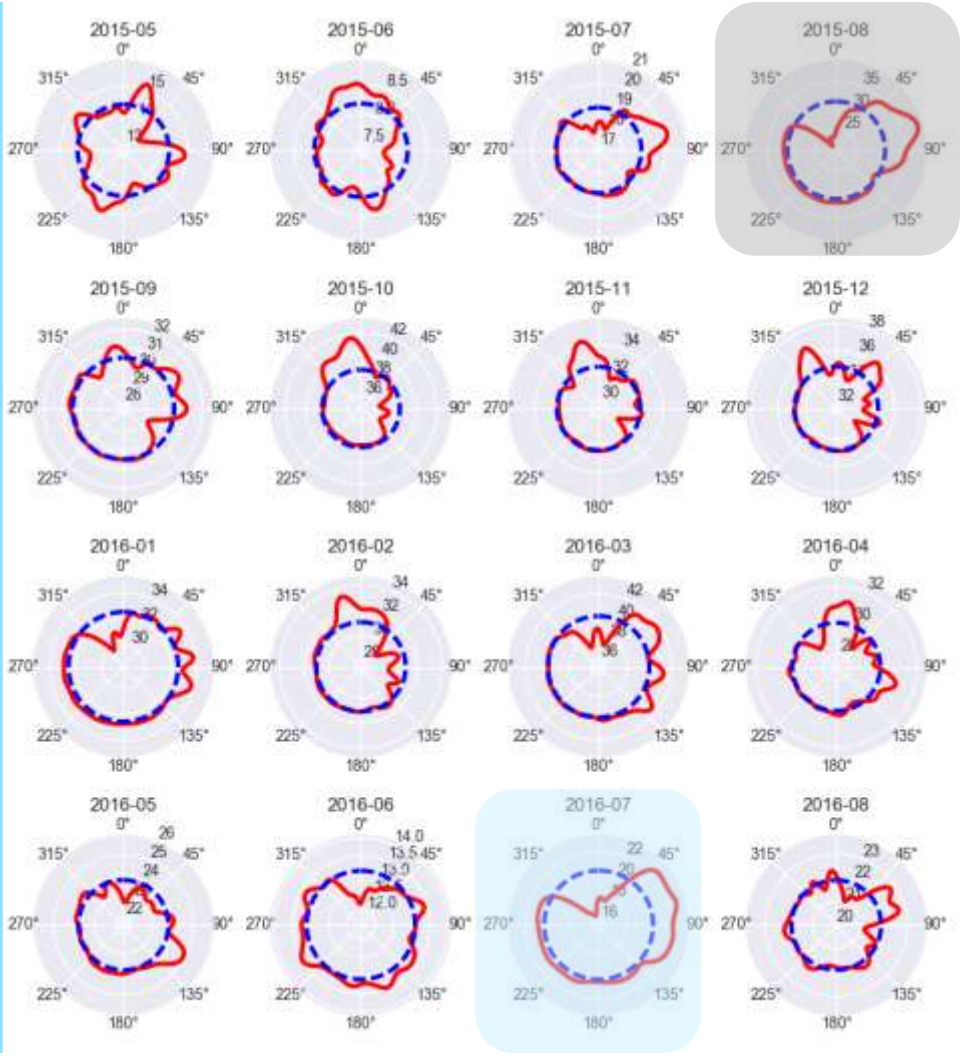
- **1 Nonparametric Regression Model (NPR)**
  - $C(\theta) = \frac{\sum_{i=1}^{n} K((\theta - W_i)/w) C_i}{K((\theta - W_i)/w)}$ (1)
  - $K(x) = 0.75(1 - x^2) \quad |x| \leq 1$ (2)
- **2 Nonparametric Trajectory Analysis (NTA)**
  - 2.1 Back-trajectory calculation
    - $x_k(t_j) = \sum_{i=0}^{k} v_x(t_{j-i})\Delta t$ (3)
    - $y_k(t_j) = \sum_{i=0}^{k} v_y(t_{j-i})\Delta t, \quad k=1,\ldots,N$ (4)
  - 2.2 NTA calculation
    - $(X, Y) = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n} K((X - x_{ij})/h) K((Y - y_{ij})/h) C_j}{\sum_{i=1}^{m}\sum_{j=1}^{n} K((X - x_{ij})/h) K((Y - y_{ij})/h)}$ (5



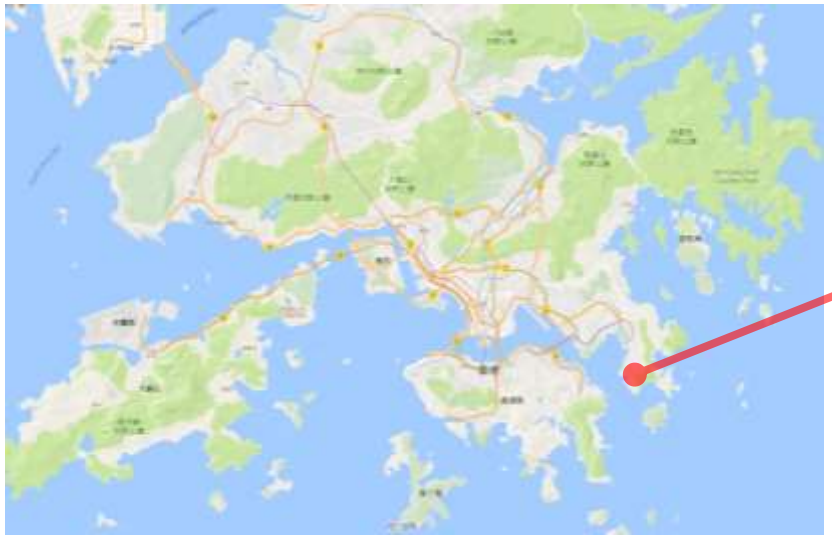
3.3 Wind-rose and NPR results

NPR-model

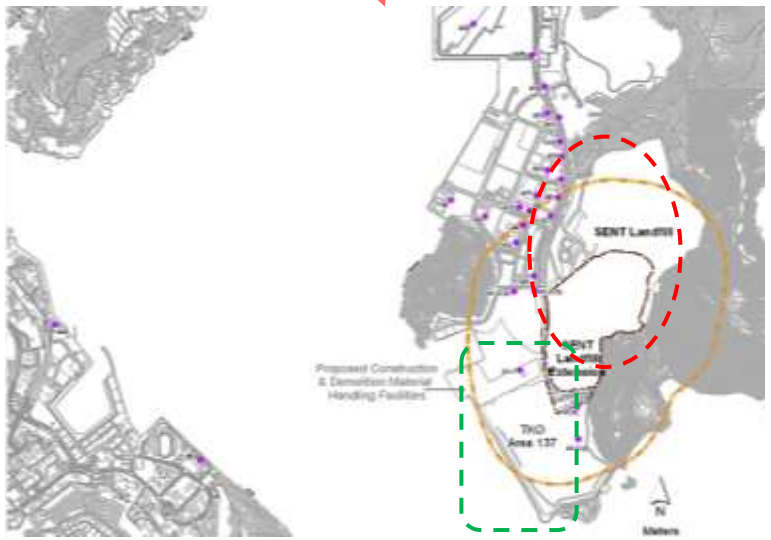




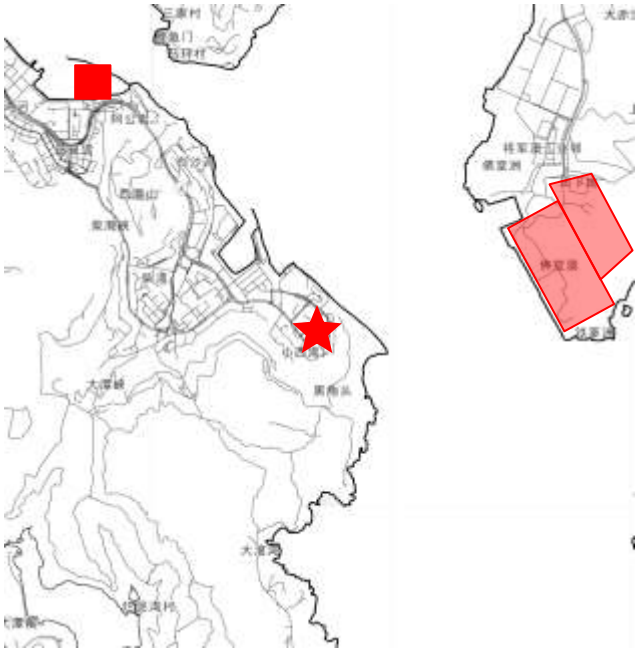
3.4 South East New Territories (SENT) landfill

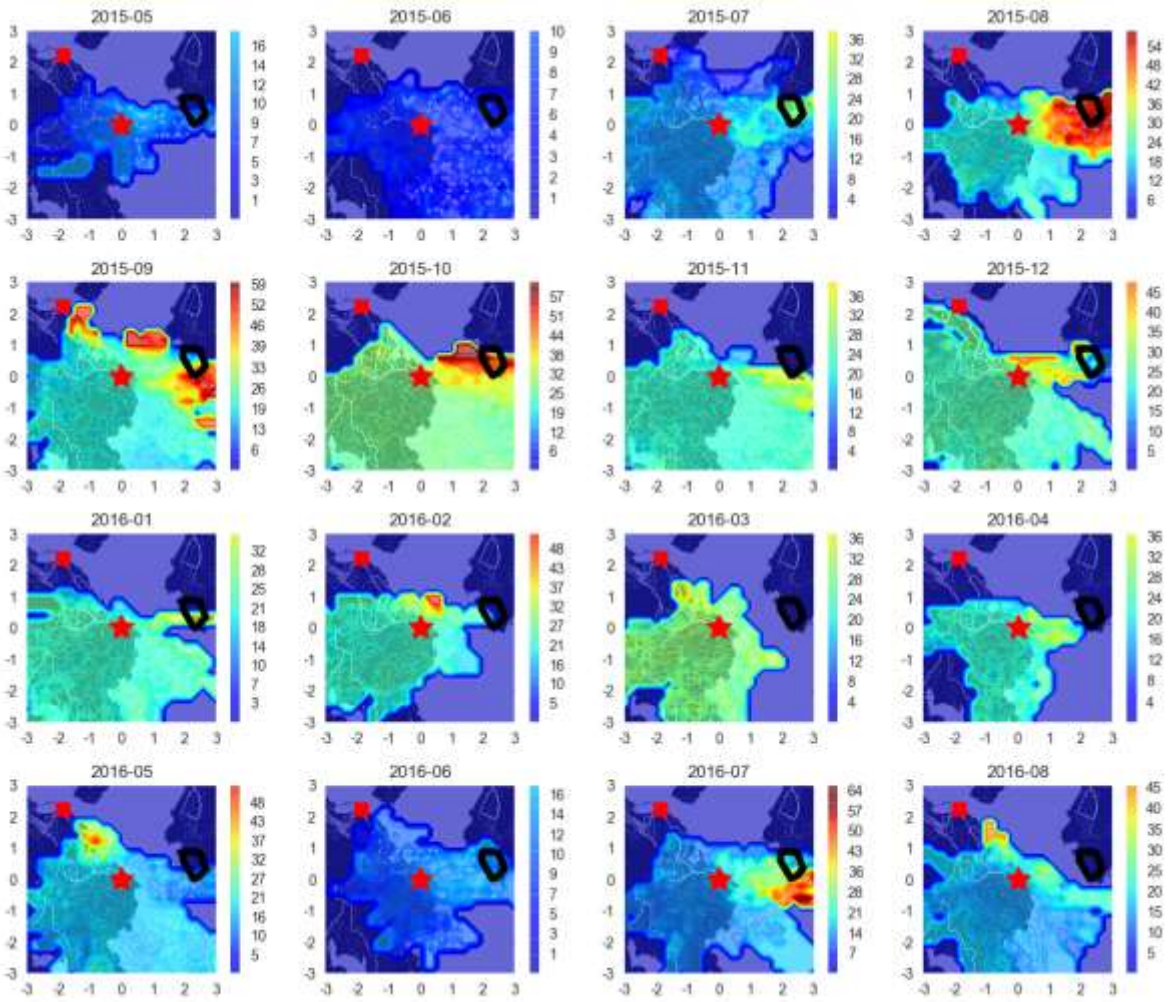


Air Pollutant	Background Concentration (ug/m^{-3})
Total Suspended Particulates (TSP)	78
Respirable Suspended Particulates (RSP)	57(33)
Nitrogen Dioxide (NO_2)	66
Sulphur Dioxide (SO_2)	18
Carbon Monoxide (CO)	1,294
Benzene	2.1



3.4 NTA model source identification





- The trajectories were 2-hour calculation.
- $PM_{2.5}$ concentrations corresponding to wind direction which faced wall were replaced with monthly average.

Conclusion and expectation

- **The VGP project deployment in Hong Kong prove the ability of low-cost air pollution measurement system in a community environment, and supply long-term credible measurements with high completeness which can be estimated based on the geographical location.**
- **A receptor-oriented model NPR were introduced for identifying pollution sources. Further, the model were calculated with back trajectories and estimated pollution sources quantitatively.**
- **The model still have some limitations, while can be improved with methods in the future, such as deploys multiple system in one area for simultaneous measurements as a network.**