High-resolution observation of urban atmospheric environment with mobile measurement

Distribution of air temperature and PM concentration in Shinjuku

Background

- Serious environmental problems in densely developed cities.
- The placement interval of AMeDAS and general measuring stations is about one point at about 10 km.
- With this arrangement interval, it is not possible to observe local environmental pollution occurring inside the cities.

Research objective

- Proposal of environment observation system using mobile measurement
- Improvement of spatial resolution in urban environment observation
- Study of local atmospheric environmental in high density urban area.

Mobile measurement

- A measurement method using a vehicle equipped with sensors that measure temperature, pollutant concentration (PM), etc. and GPS.

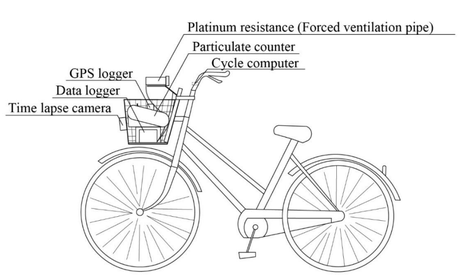
Merits of mobile measurement
A wide range of measurement is possible with one sensor.
Improvement of spatial resolution of atmospheric observation
Reduction of the cost of installing new measurement stations

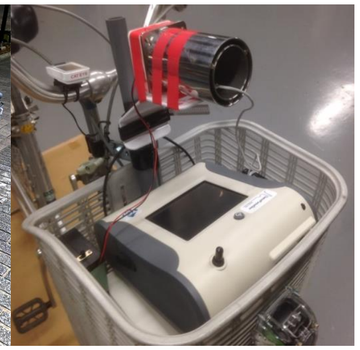
Google car

Urbmobi <Klok, E.J. et al.>

Promoting improvement
of heat environment management

Mobile measurement vehicle





Method	Instrument	Item	Specification	Interval
Mobile	Platinum resistance temp. detector	Air temp.	Time constant: 2.2 s	1.0 s
	Particle counter	Particulate matter	Time constant: 1 s, Particle diameter: 0.3~10 μm	
	GPS logger	Longitude, latitude	Precision: < 3.0 m 2D-RMS	

Results

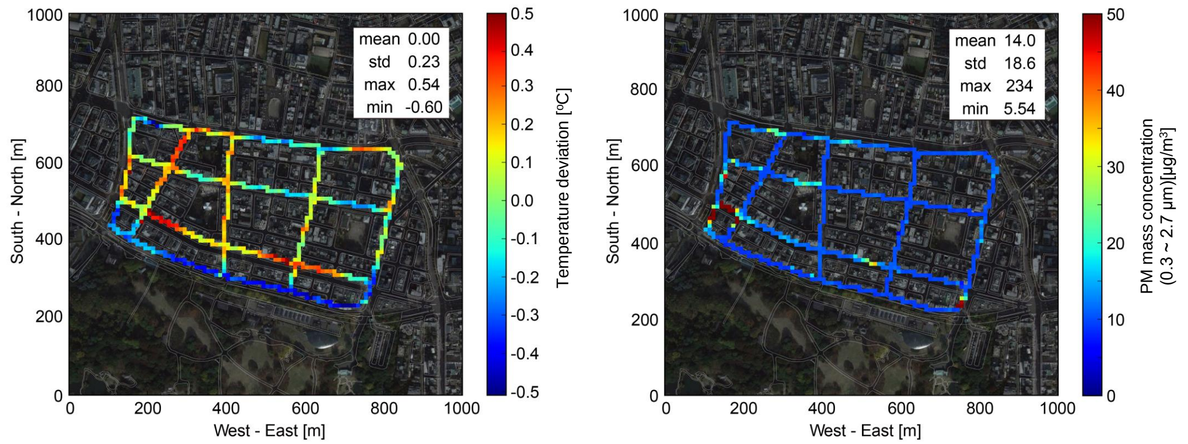


Fig. Spatial distribution in Shinjuku (Mesh size of 10 m, temperature, PM)

加藤研究室・大岡研究室・菊本研究室
Kato Lab., Ooka Lab., and Kikumoto Lab.

High-resolution observation of urban atmospheric environment with mobile measurement

Estimation of spatial distribution using ordinary Kriging

Disadvantages of mobile measurement method

- Only linear distribution can be obtained.
- It is necessary to estimate planar spatial distribution using the linear observation data.
- Application of ordinary Kriging for the spatial interpolation

Ordinary Kriging

- Values at the unobserved positions are calculated as the best linear unbiased estimator from known observations.

Merit of ordinary Kiriging

- Along with estimates at unobserved positions, their accuracy estimation by prediction error variance is possible.
- It is possible to calculate estimates taking account of the correlation structure (semivariogram function) within the target area.

Results

- A detailed spatial distribution reflecting the characteristics of the actual measurement result was estimated in the vicinity where the measured value was obtained by the measurement.
- The influence of the spatial correlation became smaller as approaching the outside of the region, and the estimated value became spatially uniform.

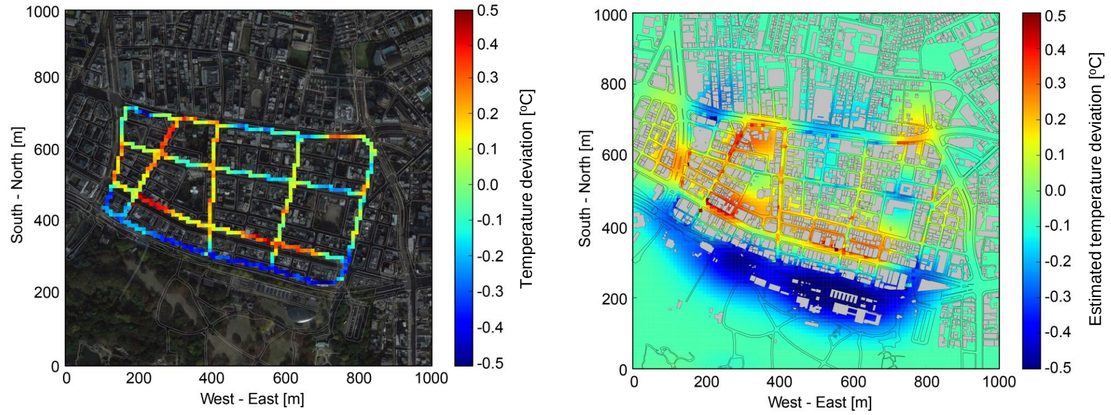


Fig. Spatial interpolation of temperature using ordinary Kriging (before, after)

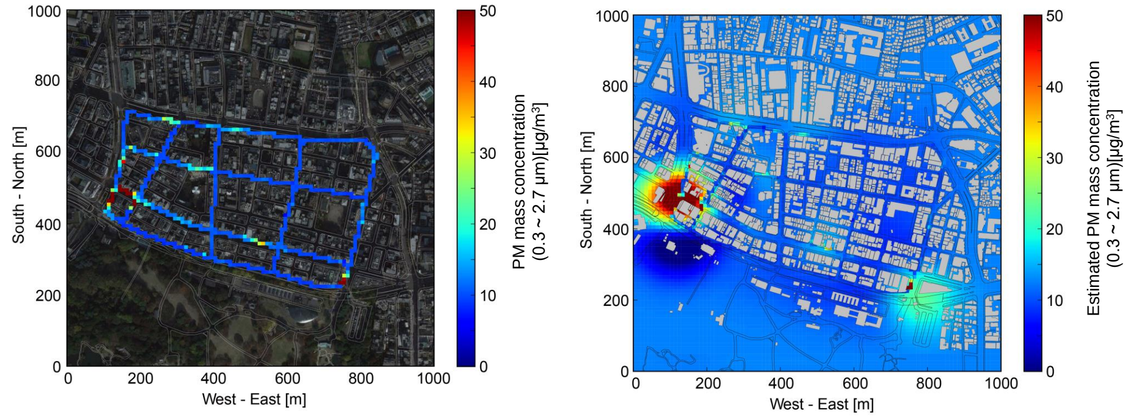


Fig. Spatial interpolation of PM using ordinary Kriging (before, after)

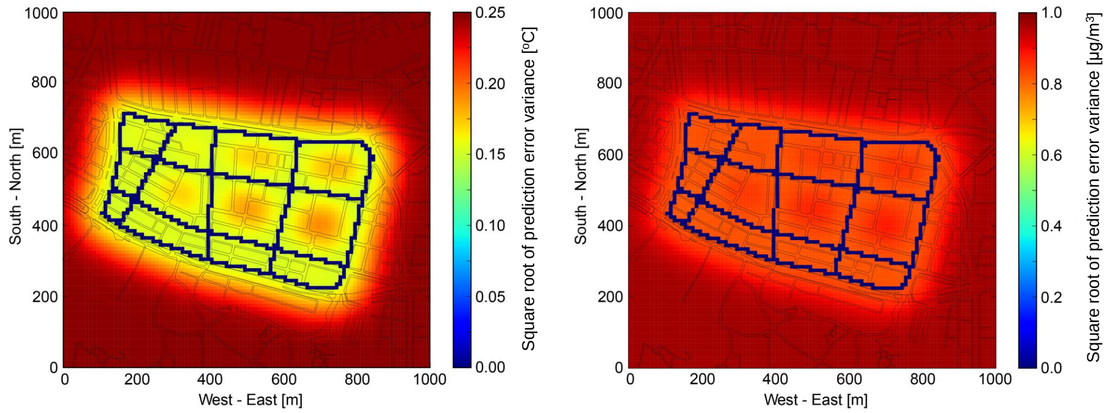


Fig. Spatial distribution of square root of prediction error variance (temperature, PM)

加藤研究室・大岡研究室・菊本研究室
Kato Lab., Ooka Lab., and Kikumoto Lab.