Urban Heat Islands Effect in Micro Scale Area by Using VHR RS-based Mobile Surveying: An Empirical Study of a University Campus

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(1) Motivation: In urban heat islands (UHI) as the most concerned urban climate phenomena, most of the researches focus on the big cities (areas) with low or middle resolution datasets. In order to improve the accuracy of the approach, we examined a very high-resolution remote sensing (VHR RS) based mobile surveying for UHI in a micro scale area (~1km × 4km) in the University of Tsukuba.

(2) Approach: Fig.1 shows the workflow.

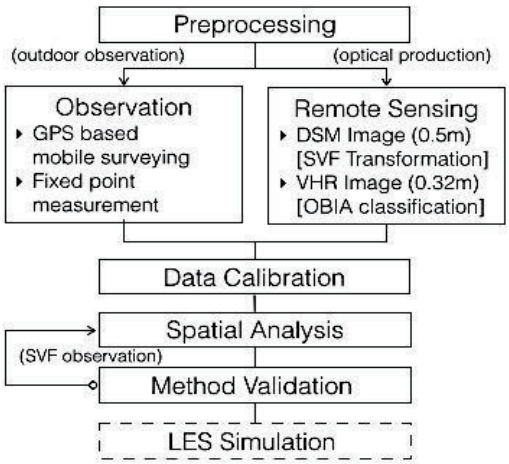

Fig.1: Workflow for this research

- Observation: Two kinds of observations (mobile surveying and fixed point observation) were conducted in 2013/12/22–12/23. For the mobile surveying, eight groups cycled around at each responsible area by using a GPS and temperature sensor loaded bicycle. A 30-minutes mobile surveying was made for three times: first day 14:30, 20:30 and the next day 5:30. For fixed point observation, 14 points were set around the study area.
- Remote Sensing: In order to get an exact surface condition, Digital Surface Model (DSM; 0.5m) and airborne (0.32m) imagery were classified by object based image analysis (OBIA).
- Spatial Analysis: Based on the RS classification and outdoor observation results, geostatistics methods were used to calculate the relationship between the land use and air surface temperature. To investigate the relationship more scientifically, spatial interpolation was utilized to generate the simulated boundary layer in 3D (Fig.2).
- Method Validation: In the end of this research, a sky-view-factor observation was made to verify the spatial analysis results.

(3) Results: This empirical study was successful. A maximum temperature difference of 6 ℃ was observed, which means that the UHI phenomena obviously appeared. As the simulated boundary layer shows, the study area can be divided into three parts, rural related, urban dense and urban sparse areas. Each area has its own characteristics. The higher the building density, the higher the air surface temperature. The height of the building also has a positive correlation with the surface thermal environment. With this method, we can overcome the shortage of the dataset resolution, get highly accurate results and even visualize the phenomena in a such accessible way.

(4) Prospect: In the next stage, we will try to simulate and predict the thermal environment based on current research results by employing a Large Eddy Simulation (LES) Model, which can predict the temperature and heat flux with high accuracy.

(5) Data:

- Data for the outdoor observation are based on the campaigns of measurements carried out by the research group members of the SIS Lab and Urban Climate Lab in the University of Tsukuba.
- DSM (0.5m) imagery and VHR airborne (0.32m) imagery were used in this study.

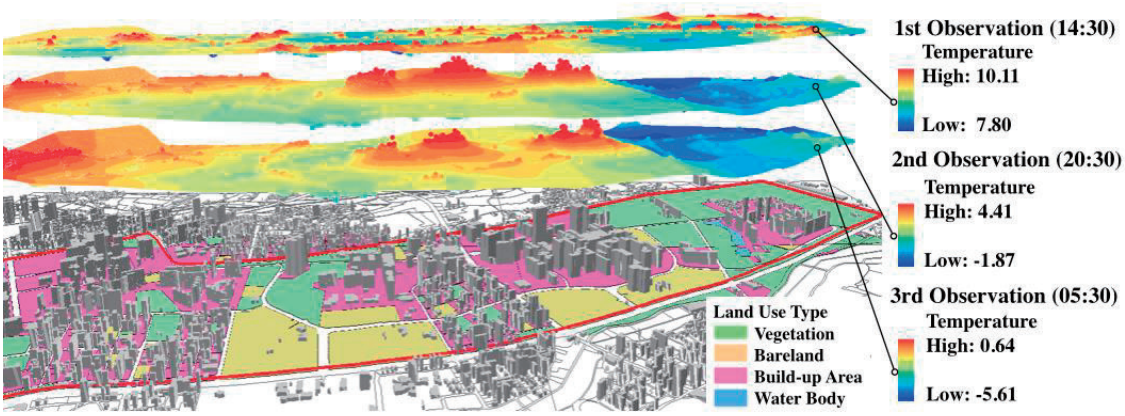

Fig.2: Simulated temperature boundary layer for the University of Tsukuba.