

Development of High Accuracy Estimation Method for Carbon and Anthropogenic Heat Emissions with a Building Energy Model and Monitoring Data

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[Abstract]

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Currently, 55% of the world's population is concentrated in cities, and 70% of greenhouse gas emissions come from cities. The IPCC's Fifth Assessment Report concludes that heat waves will become more frequent in the world's major cities during this century due to not only a 2-5°C increase in temperature caused by global warming, but also a 1-2°C increase in temperature caused by the urban heat island effect. This is why urban climate change countermeasures are important. Therefore, urban climate change countermeasures are becoming more and more important, and there is a need to promote adaptation and mitigation measures against climate change, including the worsening of the heat environment.

In designing the above measures in cities, accurate estimation of anthropogenic heat and carbon emissions (hereafter referred to as heat and CO₂ emissions) as both UHI and GW factors is necessary.

In this study, we developed a new method for estimating heat and CO₂ emissions in urban areas that differs from conventional methods in that it includes quantification of accuracy and uncertainty through comparison and verification with measured heat and CO₂ emissions. In the actual measurement, we developed an original observation and analysis method that can estimate heat and CO₂ emissions for each emission source based on radiocarbon isotope ratios and oxygen concentration measurements. Using the heat and CO₂ emissions obtained by this method, we verified the prediction accuracy of the heat and CO₂ emissions obtained by improving and applying our original numerical model of urban meteorology and building energy balance. Combining the verified model calculations with readily available information on land use, building use, and population, we developed a unified method for national and local governments to estimate heat and CO₂ emissions on an urban scale. We also developed a simplified inventory tool that enables simple assessment of the impact of measures, and utilized it for policy planning by a local government.

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