Effect of policies for building low-carbon cities and evaluating them in Asia： From mitigation around buildings

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ABSTRACT

At the National Institute for Environmental Studies (NIES) Climate Change Research Hall (CCRH: ferroconcrete, 3 floors, 4900 m² total floor space), we collected a large amount of data on energy consumption, heating, ventilation and air conditioning (HVAC) operation, the indoor environment, weather etc., and used it to develop a system called Environment and Energy around Building Blocks (EEBB).

Introduction

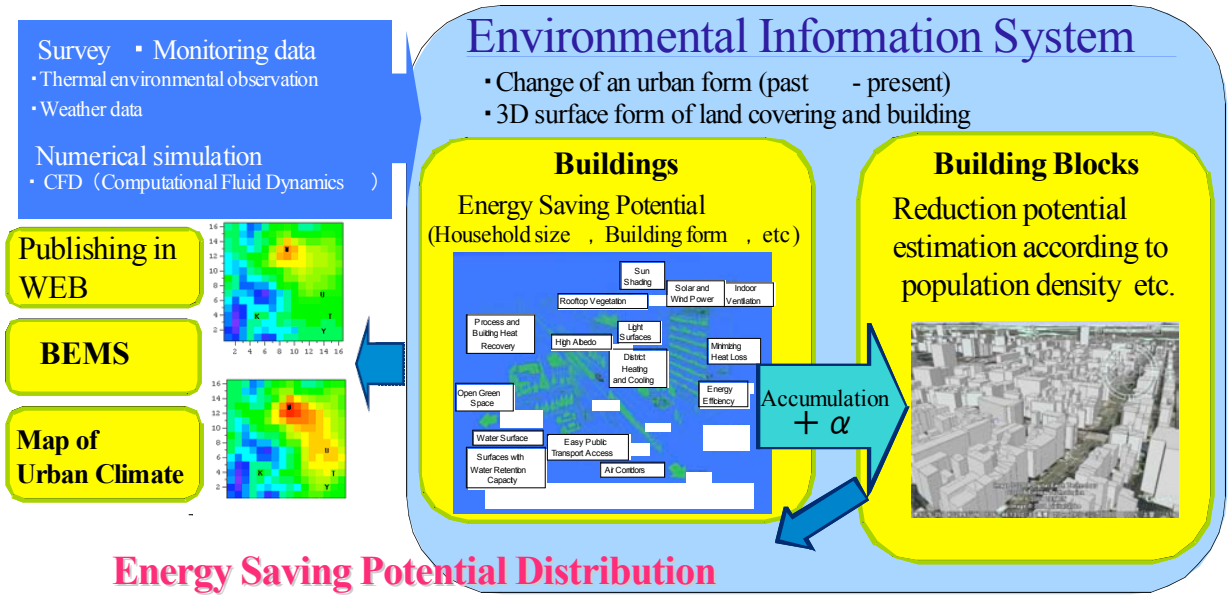
Not a few Asian cities directing to compact cities actually failed in the only cities of high population density. In building low-carbon cities, architectural methods taking into account global environmental conservation generally mean reducing the heat load of buildings. We find out the characteristics in Asian cities and after that it will be categorized. This report is a part of the results of the research project, “Study on the Strategic Urban Planning and Assessment of Low-Carbon Cities”, The Global Environment Research Fund (Hc-086: FY2008), Ministry of Environment (Head investigator: Prof. Hidefumi Imura, Nagoya University).

Concept of Environment and Energy around Building Blocks (EEBB)

First, we evaluated the reduction of energy consumption that can be achieved by improving HVAC technologies in office buildings (Yoshida. 2006). Based on our experimental data, we composed the low-energy optimal control model for each season. And, we developed an environmental information system to help the occupants of buildings to decide their behaviors for reducing the energy consumption. In this system, we found the energy savings potential derived by the visualization (Yoshida *et, al.* 2008).

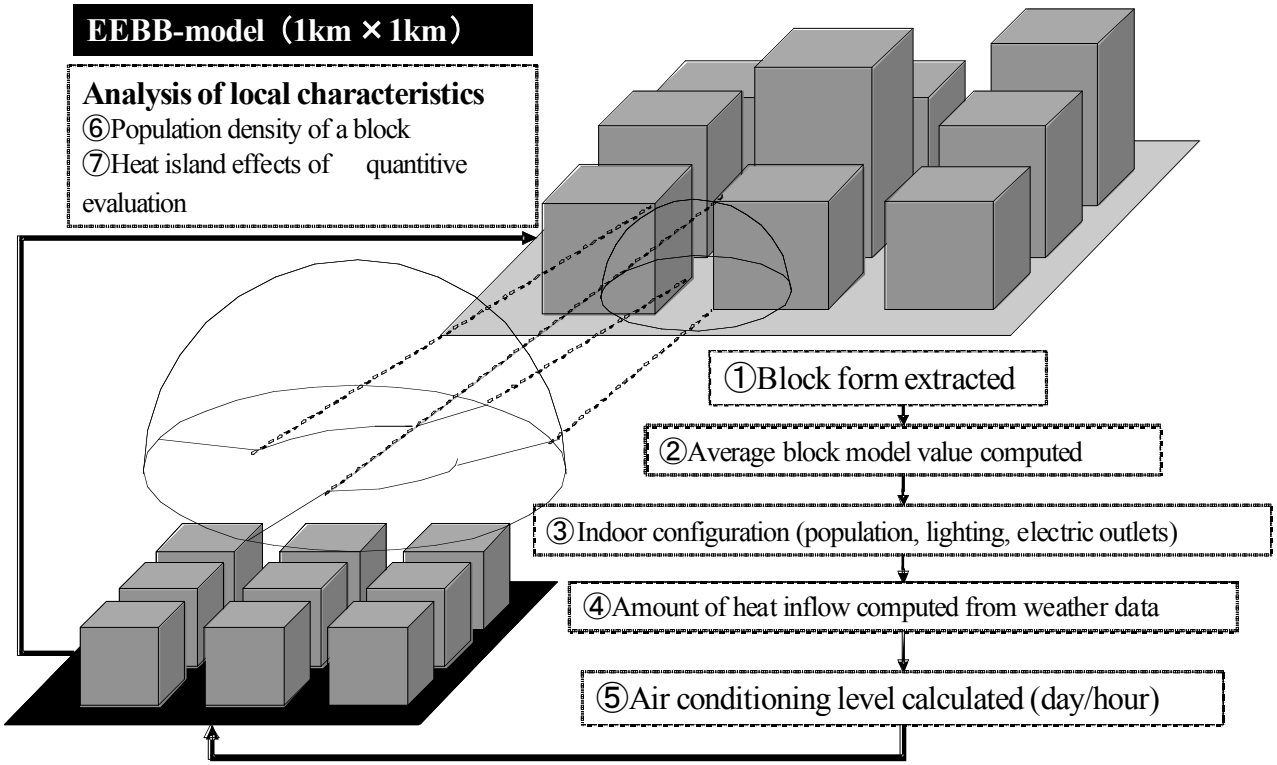
Additionally, now we try to extend this EEBB to urban scale. We think that emission density of anthropogenic heat is proportional to population density in the case of no improvement of heat source equipment, buildings and occupant’s behavior. Now, feedback is a keyword to connect the buildings-urban evaluations. Wisely choosing countermeasures in applying this EEBB improves the thermal environment and realizes low-carbon society (Figure 1). Data flow is figured as Figure 2. Analyzing data in a case study of Nagoya, we attempt to spread to Asian cities.

Figure 1. Concept of a developing system EEBB



Source: Yoshida *et al.* 2008, Ichinose *et al.* 2008

Figure 2. Building Blocks (Research Flow)



Source: Yoshida *et al.* 2008

Case study through EEBB in Nagoya

To measure an average building height, we use laser beam data monitored by Kokusai Kogyo Co., Ltd. Digital surface model makes 3D CAD easily. And, additional statistical data collected by Statistics Bureau related to Ministry of Internal Affairs and Communications in Japan. As Figure 4 shows, the higher buildings are, the larger anthropogenic heat is emitted.

Figure 3. Case study through a developing system (Nagoya, 2005)

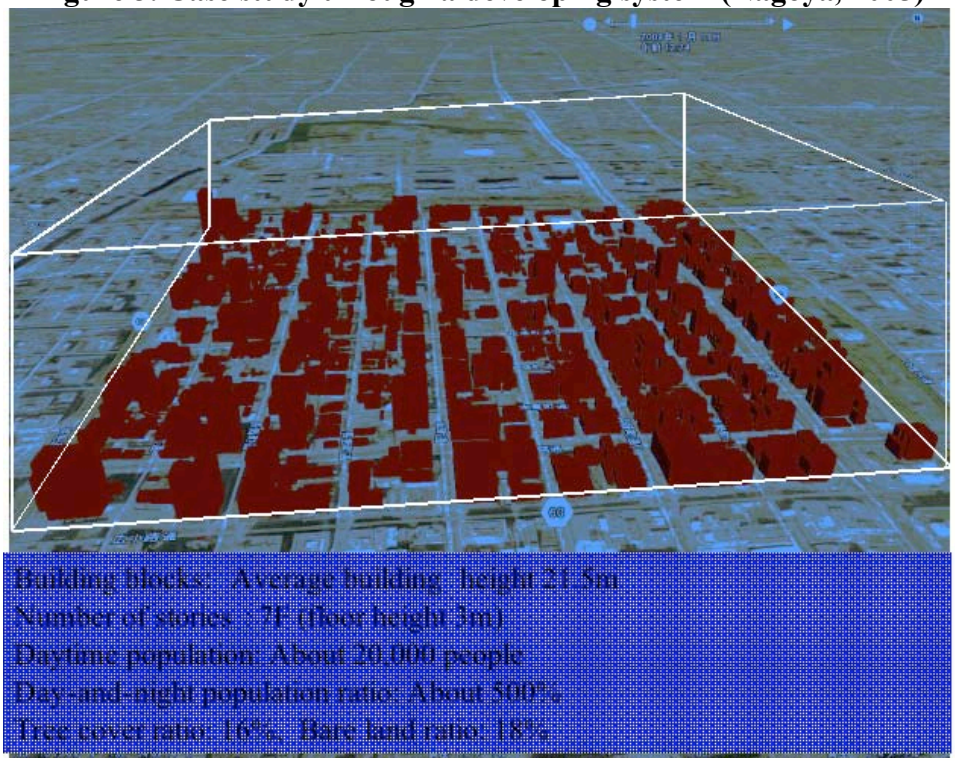
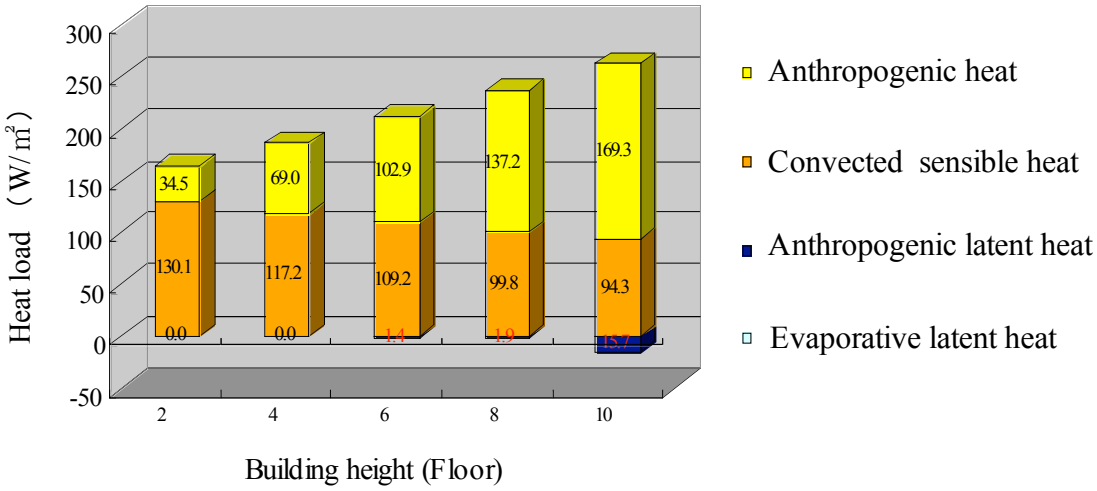


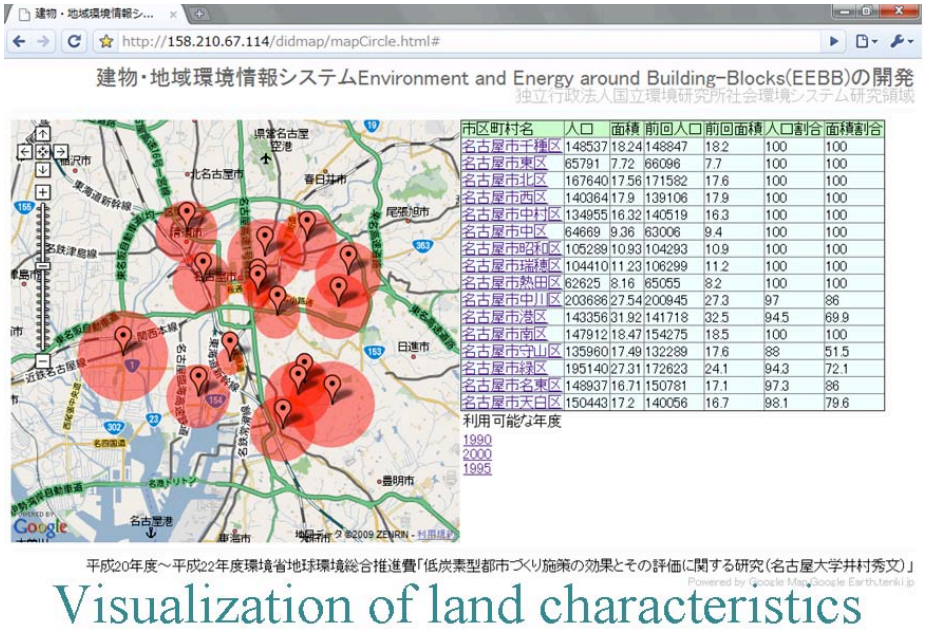
Figure 4. Heat load versus building height（Nagoya）



Reference: Urban Climate Simulation System (UCSS) developed by Dr. Ashie, Japan. MOE developed a simple calculation tool, March 2002.

But, when buildings make shadows, cooling load will be lower and people in the street feel comfortable. However, it's the best way to lead low carbon cities in Asia. Weather data in real time helps us to count energy effect clearly. This will probably lead to the practical implementation of measures, designed to combat climate change and heat island in Asia, which is our primary goal.

Figure 5. Example of demographic system EEBB using Google MAP (Nagoya)



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