Urban Environmental Climate Maps for Supporting Urban-Planning Related Work of Local Governments in Japan: Case Studies of Yokohama and Sakai
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Designing and planning cities in consideration of urban climate is increasingly important in some Japanese cities because urban thermal environments in summer are becoming severe. However, stakeholders such as local government officials, planners, and residents cannot consider urban climate in their design and planning processes because urban climate systems are difficult to understand. Therefore, we proposed the Urban Environmental Climate Map (UECM) for supporting urban design and planning. Nevertheless, UECMs are rarely made and used by Japanese local governments now, apparently because UECMs do not conform to actual Japanese planning systems. Therefore, the authors are trying to make UECM based on discussion with local government officials in Yokohama and Sakai. In this paper authors report and discuss about the trials.

1. INTRODUCTION

Urban planning with local climates is becoming important in some Japanese cities because urban thermal environments are becoming severe. However, stakeholders such as local government officials, planners, and residents cannot consider urban climate in their planning processes because urban climate systems are difficult to understand. Therefore, the authors proposed the Urban Environmental Climate Map (UECM) for supporting urban planning (e.g. Tanaka et al. 2006). Nevertheless, UECMs are rarely made and used by local governments in Japan now, apparently because UECMs do not fit Japanese planning systems. We defined UECMs as consisting of a Climate Analysis Map (CAM) and a Recommendation Map (RM) (Fig. 1). The role of CAM is representing actual climate conditions. That of RM is presenting planning recommendations. Therefore, RM should fit the actual Japanese planning system.

In this study, the authors specifically examined the application of UECMs to urban planning-related works in a local government and elucidated how UECMs should be used for various purposes. The authors were informed by local government officials about UECMs' potential use and information that UECMs should give to them.

Fig. 1: Two maps included in Urban Environmental Climate Maps (CAM and RM)

2. OUTLINE

For this study, the authors selected Yokohama and Sakai as a study city because they are two of Japan’s hottest cities. Furthermore, local governments in those cities (City of Yokohama and City of Sakai) would like to take some countermeasures against severe thermal environments in summer. Moreover, the authors addressed mitigation of summer thermal environments, although UECM is also applicable to air pollution reduction because mitigating summer thermal environments is especially necessary in Yokohama and Sakai. In addition, in this study, the authors actually made urban-scale (1:25000) UECMs because the applications of UECMs to urban planning-related tasks in a local government are the target of this study. The authors took three steps: 1) Making a CAM, 2) Interviewing local government officials and summarizing the results, 3) Producing an example of RM. From the next chapter, each result will be described according to these steps.
3. MAKING CLIMATE ANALYSIS MAP (CAM)

For this study, according to previous studies (e.g. Tanaka & Moriyama 2004), the following four layers are overlaid on the CAM: 1) Terrain; 2) Wind; 3) Land Use, as categorized by the surface temperature change pattern; and 4) Observed Temperature. Based on this definition, the authors produced a CAM of Yokohama and Sakai. (Figure 2 is a CAM of Sakai.)

![Fig. 2: An Example of Climate Analysis Map (CAM) (Sakai)](image)

4. HEARING FROM LOCAL GOVERNMENT OFFICIALS

To elucidate the requirements for UECM from local government officials in urban planning related occupations, the authors performed an oral survey of local government officials. Target departments were the Department of Rivers and Channels, the Department of Green Space, the Department of Urban Planning, and the Department of Environmental Activity. The authors asked the following two questions in addition to others.

(a) What is the urban climate related work performed in your department?
(b) In what situations will UECM be effective? Information of what kinds should be represented on the map?

The results were summarized as follows.

1) Department of Rivers and Channels
   (a) Currently, this department is planning to restore (revitalize) water channels that have disappeared through urbanization. Furthermore, they expect some additional effects to occur through restoration, such as heat island mitigation and disaster prevention. Consequently, their duties are linked to urban climate indirectly through “Water.”
   (b) It will be effective to represent places where they should restore water channels from the view of urban heat island mitigation on UECM. Furthermore, it is better to represent areas with a psychological feeling of “Coolness” such as that which water areas provide.

2) Department of Green Space
   (a) This department performs “Green” related planning and promotion such as producing a Green Master Plan and promoting greening of private lands. Consequently, their works are linked to urban climate indirectly through “Green.”
   (b) Now this department is producing an action plan based on the Green Master Plan. Here, they want to identify places where green space should be conserved. For this purpose, UECMs are expected to serve as supporting information. In this plan, a “greening recommendation area” will be defined. This information should also be represented from the viewpoint of urban heat island mitigation on the UECM.

3) Department of Urban Planning
   (a) This department is producing an Urban Master Plan as a future vision for the entire city. Furthermore, they promote downtown redevelopment and urban facility arrangement for realizing a future vision. Consequently, their works are linked to urban climate indirectly through “Urban form.”
   (b) The UECM will help to make and remake the Urban Master Plan as part of the support information. (They have not considered urban climate yet.) UECMs on a neighborhood scale (about 1:2500) will also be effective for producing an urban re-development plan (e.g. considering wind patterns created by building site arrangements and green site arrangements).

4) Department of Environmental Activity
   (a) This department is producing a plan for mitigating urban heat island effects and global warming. Furthermore, they produce energy-saving plans for the entire city. Consequently, to some extent, their duties are linked directly to urban climate.
(b) It is good that the UECM represents recommendation areas for each countermeasure to urban heat island (e.g. recommendation areas for use of sea breezes, recommendation areas for reducing anthropogenic heat release).

Based on the results described above, the authors extract three requirements for UECMs as follows.

(Requirement A)
A UECM should represent recommendation areas for each countermeasure against urban heat island effects such as “Recommended areas for restoring water channels”, “Greening recommendation area”, “Recommended areas for using sea breezes”, and “Recommended areas for reducing anthropogenic heat release”.

(Requirement B)
Another UECM, with detailed scale (about 1:2500), will also be needed for urban redevelopment.

(Requirement C)
A human comfort element is also needed for representation on the UECM such as a psychological feeling of “Coolness” that water areas have.

5. MAKING RECOMMENDATION MAP (RM)

For matching Requirement A, the authors attempted to produce an example of RM. Sakai presents clear characteristics of summer wind flow patterns by which sea breezes blow from the west during daytime and mountain/land breezes blow from the east in the nighttime. Therefore, the authors actually produced an RM that specifically examines “Wind Use” as one RM element (Fig. 3). Furthermore, this map is produced based on results of the meso-scale meteorological model MM5 (Grell et al. 1995). Figure 4 depicts an example of the model results.

For matching Requirement B, the authors also attempted to produce an example of RM for neighborhood design. Bukko-cho neighborhood in Yokohama includes small valley. In this valley, there are many old wooden houses and summer thermal environment in the daytime is severe. Apparently, urban designers should redesign this neighborhood with local climate. Therefore the authors actually produced an RM for neighborhood design (Fig. 5). In this map describes the guidelines for mitigating severe thermal environment, based on field survey and CFD simulation.

Fig. 3: Recommendation Map (RM) for Considering Wind Use (one RM element)

Fig. 4: Example of the Model (MM5) Results.
6. SUMMARY

In this study, we specifically addressed the application of UECMs to urban-planning related duties of a local government. Actually, we extracted requirements for UECMs based on an oral survey of local government officials. As the next challenge, we will produce a new RM based on that feedback, thereby creating a UECM that is effective for actual urban planning related activities.

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