Precinct Information Modelling

Collaboration:

Microclimate and Urban Heat Island Decision-Support Tool (RP2023)

Introduction

This report sets out the role to be played by the PIM project in the planned UHI project work. It summarises the goals and organisation of that work and then outlines the contribution to be made by PIM. Importantly, while the PIM project contribution to the ETWW project has come after the initial work is complete, there is an opportunity to tightly integrate a PIM-based solution into the workflow of the UHI project.

UHI project goals

The "Microclimate and Urban Heat Island Decision-Support Tool" project (RP2023) is summed up as follows in the project proposal:

> Various research projects on microclimate and urban heat island (UHI) analysis have been carried out by CRC for Low Carbon Living (CRCLCL) and CRC for Water Sensitive Cities (CRCWSC), with considerable experimental evidence along with advanced analysis models having been achieved.

> In alignment with CRCLCL's utilisation plan, this project aims to develop a robust and tangible microclimate and urban heat island mitigation decision-support tool which utilises such evidence and models, making it accessible to built environment industries and governments in order to support evidence-based decisions and enhance low carbon and climate adaptation outcomes in urban redevelopment processes. Expected outcomes will be addressing the gap which currently exists between research on urban microclimates and its practical application.

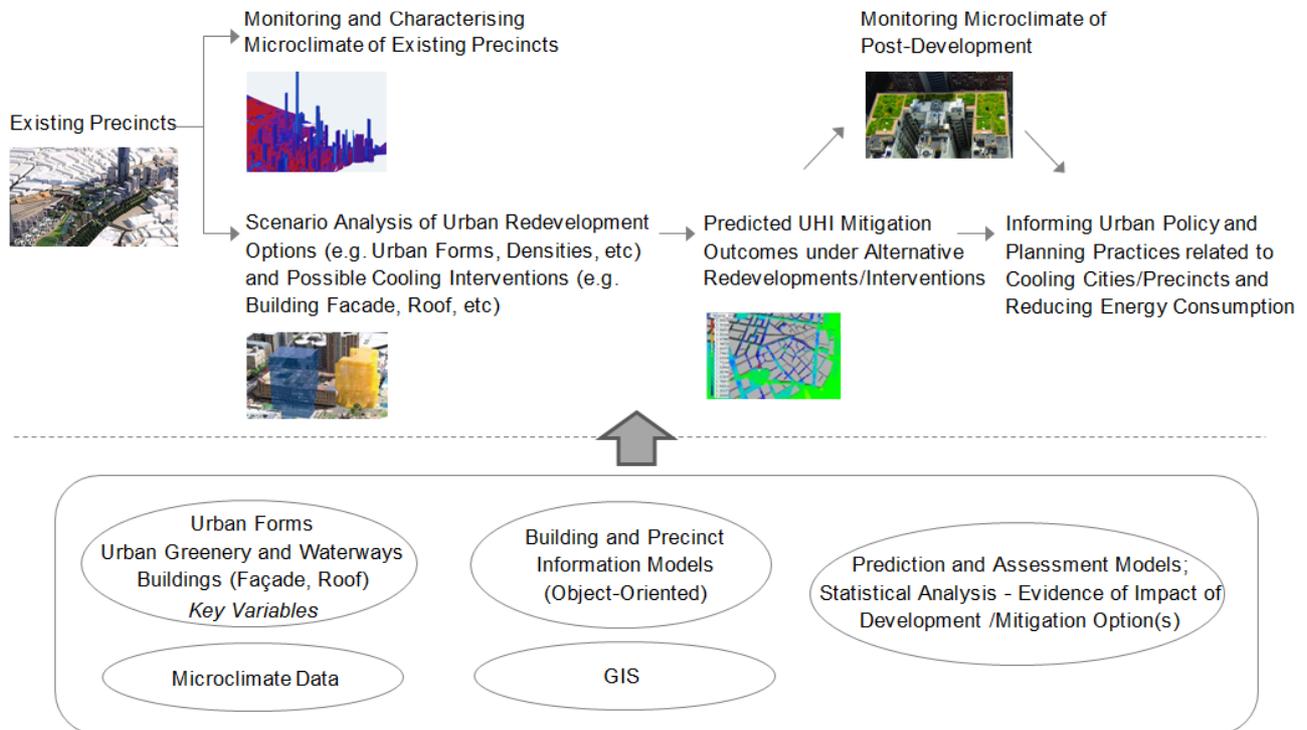The project framework is described in the following diagram (Figure 1)

Figure 1 Initial Project Framework as defined in the Project Proposal

PIM Contribution

Within the framework shown in Figure 1, the PIM project will contribute three essential components:

- An object-based model repository for exemplar precincts used to implement and test both the scenario analysis and the assessment of the predicted UHI mitigation outcomes. Importantly, these precinct models will be based on an open standard format (the PIM schema) so that the information can be shared with other precinct analysis tools. The PIM project will provide an on-line portal that allows researchers and other stakeholders to access the precinct models database remotely.

- Support within the PIM concept model for the specific precinct entities (at appropriate levels of granularity) that are used to represent the physical environment for UHI analysis. The "key variables" identified as part of the project will

be expressed as properties of those precinct entities, forming the basis for determining the UHI mitigation index. These entities fall broadly into two categories: built form and vegetation features that provide shading and localised microclimatic effects (air movement and humidity); and, the surfaces that radiate, absorb or disperse heat within the built environment.

- A repository for reference data that holds the relevant property values for precinct entity types. This will be accessed by the decision-support tool when performing its analysis.

Precinct Entity Types

As already stated, a key determinant of urban microclimate is the form, position and orientation of the urban fabric. This can be modelled at different levels of granularity. PIM would allow accurate representation of all the individual features that may have some impact on microclimate, including building form, street layout, vegetation (ranging from ground cover, shrubs and small tress, through to significant trees), water bodies, street furniture and other urban structures. This would allow for fine-grained analysis of localised conditions. At a coarser level of granularity, urban precincts could be organised into spatial zones that have particular characteristics, such as: open parkland; sparse bushland; dense canopied bushland; low-rise, sparse residential areas; compact, low-rise residential; high-rise commercial; airport precinct; motorway reserve. Such zones would be classified and could be treated as precinct objects for analysis purposes.

An alternative, and perhaps complementary approach, is to consider the surfaces of appropriate urban features. Such surfaces encompass roofs, walls and ground surfaces. In this case, the 3D precinct model would be used to provide the geometry and orientation of surfaces, while an extensive library of surface types would be used to store their performance characteristics. Some examples of surface materials would include: green roofs and walls; various roofing materials; varieties of vegetation ground cover; hard pavement of various types; and water bodies.

Scenario Modelling

A key aspect of the UHI project work is to provide support for testing different scenarios. This is most-easily handled by a PIM database as versions of the full model, though it could be possible to investigate the possibility of versioning each individual entity.

Conclusion

This work provides an excellent basis for a collaborative project to develop a precinct assessment tool that analyses a precinct in terms of its ability to respond to microclimatic impacts of urbanisation (e.g. urban heat island effect) and to show an exemplar of a standardized modelling approach for precinct information.

At a meeting held on Tuesday 22 Nov 2016 at the UrbanGrowth offices in Sydney, in collaboration with Dr Lan Ding, we were strongly encouraged to consider adopting the Green Square Town Centre precinct as an exemplar to test the proposed UHI decision support tool linked to a precinct model as described here. A planned site visit in early December will provide an opportunity to explore that opportunity further, as well as look at two other UrbanGrowth precincts as possible collaborations (the Bays Precinct at White Bay and Parramatta North).