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A New Approach to Urban Heat Island Assessment in the Context of Greater Kuala Lumpur

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ABSTRACT

Urban heat island (UHI) has become a growing concern for Kuala Lumpur (KL) as many studies reported a significant increase of air temperature in highly densified urban areas compared to its surroundings. A critical review of the recent UHI studies revealed the insufficiency of field measurements to apprehend the severity of UHI magnitude in the consecutive years. Few studies comprehensively reported the influence of urban fabrics on the development of UHI in KL. Many fundamental studies just reported the alteration to natural surfaces as the main factor while the introduction of green spaces in urban areas as a good initiative to reduce the UHI effects. This creates a gap for the future studies to investigate the overall scenario of UHI by exploring more factors and mitigation strategies. The use of Local Climate Zone (LCZ) scheme in future studies will allow the researchers to include the effects of urbanization in quantifying UHI magnitude as many studies in the past failed to account the contribution of urban fabric towards the development and mitigation of UHI. This study also highlights the expert stakeholders sharing sessions on UHI phenomenon in University of Malaya as an initial initiative to devise more advanced UHI studies in the upcoming years as a move towards sustainable KL city as stipulated in Tenth Malaysia Plan (RMK 10).

Keywords: UHI; Greater KL; LCZ; Urban microclimate; Sustainable city

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A NEW APPROACH TO URBAN HEAT ISLAND ASSESSMENT IN THE CONTEXT OF GREATER KUALA LUMPUR

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Abstract

Urban heat island (UHI) has become a growing concern for Kuala Lumpur (KL) as many studies reported a significant increase of air temperature in highly densified urban areas compared to its surroundings. A critical review of the recent UHI studies revealed the insufficiency of field measurements to apprehend the severity of UHI magnitude in the consecutive years. Few studies comprehensively reported the influence of urban fabrics on the development of UHI in KL. Many fundamental studies just reported the alteration to natural surfaces as the main factor while the introduction of green spaces in urban areas as a good initiative to reduce the UHI effects. This creates a gap for the future studies to investigate the overall scenario of UHI by exploring more factors and mitigation strategies. The use of Local Climate Zone (LCZ) scheme in future studies will allow the researchers to include the effects of urbanization in quantifying UHI magnitude as many studies in the past failed to account the contribution of urban fabric towards the development and mitigation of UHI. This study also highlights the expert stakeholders sharing sessions on UHI phenomenon in University of Malaya as an initial initiative to devise more advanced UHI studies in the upcoming years as a move towards sustainable KL city as stipulated in Tenth Malaysia Plan (RMK 10).

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1. Introduction

Rapid urbanization and population explosion is of particular concern for KL which consists of 21.96% of the total current population in Malaysia that results in a distinctive urban microclimate. Being a tropical metropolitan city with a very small variation in the monthly temperatures, KL is facing a significant elevated air temperature compared to its surrounding areas that results in UHI as highlighted in the previous studies [1]. However, there is a sensible paucity in the assessment of UHI in KL in the past before it gains its momentum recently. Therefore, tracking the association of temperature increase with urbanization is hardly attainable due to data inadequacy. Hence, this paper presents the findings of the review of past UHI studies in KL and suggests the employment of newly developed LCZ classification system [2] to describe the urban fabrics of the study areas

in KL as the first and most suitable attempt to provide an authentic assessment for the development of UHI in the city centre.

2. Literature Review

UHI phenomenon is the most obvious climatic manifestation of urbanization and defined as a 'reverse oasis' where the urban area is usually warmer than the surrounding countryside due to the lack of transpiring vegetation, use of non-evaporating dark surfaces in roofs and pavements and also due to excess generation of anthropogenic heat [3]. UHI assessment in KL was pioneered by Sham and other researchers in the early 70s-90s and they found that temperatures were normally higher in the central district than in the rural areas which became the first account to the occurrence of UHI phenomenon in KL [1]. However, successive studies over the years are not conducted and all the studies expressed

UHI magnitude similarly as the temperature difference between urban and rural areas. Technically, the term ‘rural’ does not apply into the vernacular of KL landscapes and questions the authenticity of the results produced by the previous studies. Besides, there is very limited studies accounted urbanization effects in the development of UHI in the context of KL. Hence, the LCZ classification to characterize the study sites into 17 zones according to built types, land cover types and land cover properties that influence air temperature at a screen height of two metres above ground can give a better quantification to the UHI magnitude interpretation by providing special consideration to the urban effects on UHI in KL [2].

3. Research Method

This paper reports the findings of the literature review of the previous UHI studies in KL to track down its history and to identify the potential prospects for future studies. UHI studies published from early 70s till 2014 are identified from online databases and included in the analysis. This study also elaborates on the ‘Expert stakeholders sharing sessions on UHI phenomenon towards cooling KL city’ which was conducted on March 2016 in University of Malaya as an early initiative and a driving force for more advanced studies in KL by providing an insight of existing research gaps in this subject.

4. Discussion and Conclusion

UHI phenomenon in KL is studied less intensively while it is a relatively hot topic in many tropical countries. Assessing UHI magnitude in the city centre is the main concern of the studies in the past [4,5]. However, a growing number of studies started to focus more on the contributing factors, impacts on both human health and environment as well as on the mitigation to alleviate the adverse effects of UHI. Land use and land cover changes (LULC) are reported as the main reason of UHI while the introduction of green spaces or parks in

urban areas are majorly studied as the best initiative to potentially reduce the effects of UHI in Malaysia. This creates a gap for the future studies to investigate the overall scenario of UHI by exploring more factors and mitigation strategies. Besides, many studies also failed to account the contribution of urban fabric, materials and configurations towards the development of UHI. Hence, the use of LCZ scheme in future studies will allow the researchers to include the effects of urbanization in quantifying UHI magnitude. The expert stakeholder sharing session also provided an input from experts regarding UHI phenomenon in KL and an insight of existing research gaps or what needs to be done towards sustainable KL city as stipulated in Tenth Malaysia Plan. The future studies should emphasize more on holistically exploring the impacts of UHI on many other parameters such as relative humidity, Mean Radiant Temperature and Physiological Equivalent Temperature instead of explaining it as mere temperature variations over time in order to develop pragmatic mitigation practices through modelling and simulations.

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