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Urban microclimate modelling for evaluating the impact of heat mitigation measures on pedestrian thermal comfort: case of Vancouver's local climate zones

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Extensive urbanized land surfaces, anthropogenic heat emissions, and lack of vegetation and tree cover contribute to the formation of distinct urban climates where warmer air and surface temperatures intensify outdoor heat exposure and thermal discomfort for pedestrians. To assess outdoor thermal comfort in urban environments, mean radiant temperature (Tmrt) is a commonly used indicator. The main research questions here are:
(a) How and to what extent does Tmrt vary spatially within and between select neighborhoods in Vancouver?
(b) What are the environmental and physical factors that drive Tmrt variations?
(c) How much increase in spatial average Tmrt will occur in selected local climate zones under future climate change scenarios, without urban heat mitigation measures?
(d) To offset the effects of future climate, what changes in tree cover and albedo are required if the spatial average Tmrt are to be kept at the same level as in the current climate situation in selected local climate zones?
For this study, we classified five Vancouver neighborhoods into five local climate zones (LCZs), where each LCZ represents a unique landscape. The 3D radiation model SOLWEIG was used to simulate Tmrt in these LCZs for July 29, 2009, the hottest day on record for Vancouver.
SOLWEIG modeling results show that Tmrt varies widely between examined LCZs. The difference in Tmrt relates to the physical and environmental structure of the different LCZs. Further analysis is underway to compare the spatial variation of Tmrt among five selected LCZs in Vancouver. The significance of this research relies on the quantification of pedestrian thermal comfort in mid-latitude neighborhoods categorized into LCZs in the coastal city of Vancouver.
The solution-oriented approach proposed here will provide tools and means to facilitate the integration of microscale climate knowledge into transferable urban design and planning practices for Vancouver and other cities around the world.