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Outdoor Thermal Comfort Autonomy: Performance Metrics for Climate-Conscious Urban Design

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The consideration of thermal comfort and thermal stress in urban environments is gaining widespread attention as the rate and strength of heat waves, and consequently, the heat-related mortality, are increasing dramatically around the world. Accordingly, comprehensive analyses are needed to ensure that acceptable criteria of thermal comfort are defined and met in urban environments. The main objective of this study is to define such performance metrics and measures of outdoor thermal comfort (OTC) that can be used for climate-conscious urban design. This presentation first discusses the motivations and needs for introducing a comprehensive thermal comfort metric, addressing the shortcomings of conventional thermal comfort evaluations which concentrate on one location or one time of the day. It then introduces four performance metrics, which collectively can inform urban planners and designers on the performance of an outdoor space with regards to thermal comfort. These metrics build upon the concept of “autonomy" previously introduced for indoor spaces, specifically for daylighting, and further expand to include the unique characteristics of outdoor thermal comfort. We also discuss the capability of these metrics given the limitations of certain modeling tools used for urban microclimate analysis, and evaluate the critical factors that should be included for an accurate evaluation of Outdoor Thermal Comfort Autonomy (OTCA). Lastly, we use the clustering of weather types for the comprehensive yet optimized evaluation of OTCA map for a specific design over the entire year. By discussing the capability as well as the limitations of these metrics we aim to promote a climate-conscious urban design using metrics that can be tangible and accessible to non-simulation experts.