



# Effect of personal and microclimatic variables on observed thermal sensation from a field study in southern Brazil

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## ABSTRACT

Urban climate, which is influenced by land use patterns, heat-generating activities, and the physical texture of urban fabric, has a great impact on outdoor comfort as well as on a building's energy consumption. A climate-responsive urban planning can provide optimal, comfortable thermal conditions not only for the permanence of humans in outdoor spaces but also reducing the need of air conditioning systems in buildings. The purpose of this article is to present results of an outdoor comfort research with passers-by in downtown Curitiba, Brazil (25°31'S, 917m elevation). Urban locations have been monitored regarding standard comfort variables: air temperature and humidity, wind speed and globe temperature. Alongside the quantitative assessment of comfort conditions, a survey of pedestrian's thermal comfort perception according to ISO 10551 was carried out on each monitoring campaign by means of questionnaires with the local population. As a whole, from fourteen monitoring campaigns using a couple of weather stations, beginning on January 9 through August 12, 1654 valid comfort votes were obtained. In this paper, we perform a data consistency check, evaluating the relationship between personal (gender and age of respondents) and objective, microclimatic (comfort variables) factors on observed thermal sensation.

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## 1. Introduction

As a consequence of global warming, several impacts have been observed in human populations worldwide over the last decade. The most severe events related to climate change occurred in the years of 1998 (the hottest year registered by the World Meteorological Organization), 2002 (the second hottest) and 2003. According to Roaf, Crichton and Nicols [1] the most dramatic summer season for Europeans was during the months of June–August 2003, when monthly average temperatures were about 5° higher than the average of all other months of that year.

From the thermal comfort point of view, impacts of global warming can be sensed by an increased need of air conditioning systems in buildings located in hot regions (or in regions with hot summer season) in order to ensure comfort conditions for their occupants. Consequences of an increased usage of air-conditioners are associated to a corresponding increase of electric energy demand. More directly, global warming will interfere with the microclimatic conditions one is exposed to in urban areas, when working or staying outdoors.

A large part of urban growth takes place in sub-tropical latitudes. Urbanization in these areas has led to both densification and urban sprawl, and these major land use changes – which are often unplanned – can have significant environmental consequences. Urban climate, which is influenced by land use patterns, heat-generating activities, and the physical texture of urban construction, has a great impact on outdoor comfort as well as on a building's energy consumption. A climate-responsive urban planning can provide optimal, comfortable thermal conditions not only for the permanence of humans in outdoor spaces but also reducing the need of air conditioning systems in buildings.

Recognizing that modifications in the physical attributes of the urban space are able to promote improved thermal conditions in the outdoor and thus positively influence the use of open spaces, two broad objectives have been sought for this research initiative: (1) to define optimal thermal comfort ranges for passers-by in pedestrian streets in Curitiba, Brazil; (2) to recommend urban design strategies and guidelines for the improvement of outdoor comfort in such location.

The present paper is concerned with the first objective and aims to evaluate the effect of gender and age differences as well as the impact of individual comfort variables on the perceived thermal sensation from an extensive series of measurements and comfort surveys with local population. It thus presents a consistency check

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