

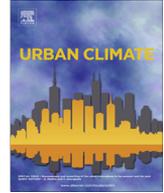


ELSEVIER

Contents lists available at ScienceDirect

## Urban Climate

journal homepage: [www.elsevier.com/locate/uclim](http://www.elsevier.com/locate/uclim)



# Urban climatology: History, status and prospects



Gerald Mills

*School of Geography, Planning & Environmental Policy, UCD, Dublin, Ireland*

### ARTICLE INFO

*Article history:*

Received 30 October 2013

Revised 8 June 2014

Accepted 18 June 2014

*Keywords:*

Descriptive climatology

Physical climatology

### ABSTRACT

This paper is a description of the historical development, current status and prospects for urban climatology, the field concerned with the study of the urban effect on the atmosphere and the application of this knowledge to the better design and planning of cities. Urban areas have a profound effect on the overlying air as a result of changes to the nature of surface cover (urban form) and emissions of heat, water vapour and materials that attend human activities (urban function). Whilst these changes have been well known and observed for over 100 years, it is only recently that urban climatology has developed a coherent structure for organising this knowledge so that urban observations can be conducted and urban models developed that are transferrable from place to place. In this paper, I give a personal perspective on the history of the field from the vantage point of its current standing. In addition, I suggest some pathways that the field may take in the near future.

© 2014 Elsevier B.V. All rights reserved.

## 1. Introduction

Urban climatology is concerned with the study of the climate effect of urban areas and the application of the knowledge acquired to the better planning and design of cities. It is defined primarily by its focus on the city and incorporates aspects of many different disciplines, including meteorology, climatology, air pollution science, architecture, building engineering, urban design, biometeorology, amongst others. Each of these disciplines has its own focus and has developed distinctive tools and methods (including vocabulary) appropriate to their interests. As a result, much of the knowledge base

*E-mail address:* [gerald.mills@ucd.ie](mailto:gerald.mills@ucd.ie)

<http://dx.doi.org/10.1016/j.uclim.2014.06.004>

2212-0955/© 2014 Elsevier B.V. All rights reserved.

that urban climatology draws upon is fragmented and is still in the process of being assimilated into a comprehensive (and coherent) field of study.

Cities modify the overlying atmosphere significantly in nearly every respect. These modifications are the result of changes the surface cover, fabric and geometry (urban form) and the attendant anthropogenic emissions of waste heat, water vapour and materials (urban function). The fact of the modifications has been well known for nearly two centuries but the nature of the processes responsible have only been explored in detail in the last four decades. In this article, I present an overview of the history of, current status of, and prospects for urban climatology (UC) based on my perspective, which is that of a physical geographer trained in the Anglo-American education system; a concern for human–environment relationships and the detectable effect of cities on local climate explains the historic link of Geography with urban climatology. Of course, there are other relevant perspectives that may emphasise other aspects of the development of UC. Meteorology, in particular, is a closely related and professional field and has many sub-fields that have urban applications; these include the study of the Earth's boundary-layer and of air quality. However, its traditional concern on forecasting weather and weather-related events has meant that (for the most part) its measurement programmes and modelling efforts have excluded city scales. Its focus on meeting user needs (which have changed over time) has also directed its resources toward other topics. Interestingly, over the last decade changing user needs (e.g., growth in urban population and concerns about the effects of climate change) and the dramatic improvement in atmospheric modelling has brought urban-scale issues to the fore (NRC, 2012). This has occurred as meteorological theories and practices have been incorporated by climatologists into UC so that today the terms 'urban climatology' and 'urban meteorology' are largely synonymous. However, the development path that is outlined here has its origin in the geographic tradition.

The fundamental motivation for the study of urban climates was outlined by Kratzer (1956): *Only when we possess sufficient knowledge of the bright and dark sides of city climate are we in a position to use this information and to formulate a technique for city construction based on considerations of climate. Yet something is already accomplished, when we realise that we do not have to accept city climate simply as a fact but can influence it.*

## 2. Historic development

Although Luke Howard may not have been the first to recognise the influence of urban areas on the climate elements (e.g., Cerveny, 2009), his study of the climate in and around London represents the scientific beginnings of UC. He maintained a meteorological station outside the city of London for 26 years and, with the help of his family, recorded air temperature, pressure, precipitation, etc. on a daily basis. The product of his work was *The Climate of London* published in three volumes in 1833. It is primarily a description and analysis of climate from the vantage of London rather than an examination of the climate in cities. However, he identifies one aspect of the urban heat island effect (UHI) when he compares his air temperature records (the 'rural' temperature,  $T_R$ ) against those maintained by the Royal Society (the official scientific body) in the centre of London (the 'urban' temperature,  $T_U$ ),

$$\Delta T_{U-R} = T_U - T_R \quad (1)$$

The evidence from plotting these data showed the urban area had a distinct warming effect on the near-surface atmosphere (Fig. 1). Howard concluded that the *Mean Temperature of the Climate... is strictly about 48.50° Fahr.: but in the denser parts of the metropolis, the heat is raised, by the effect of the population and fires, to 50.50°; and it must be proportionately affected in the suburban parts* (Howard, 1833). He speculated on the processes responsible for this UHI and correctly identified most of the causes we now study: anthropogenic heating; multiple reflection; lack of evaporation and; the retardation of airflow (Mills, 2008).

The development of the field since this auspicious beginning is summarised in Table 1, which separates the period since 1900 into two main phases. Prior to the 1970's the majority of the research was dominated by descriptive climatology and was based on observations of the weather elements, especially air temperature and humidity, at urban scales. In the period since, physical climatology, with its

Download English Version:

<https://daneshyari.com/en/article/143742>

Download Persian Version:

<https://daneshyari.com/article/143742>

[Daneshyari.com](https://daneshyari.com)