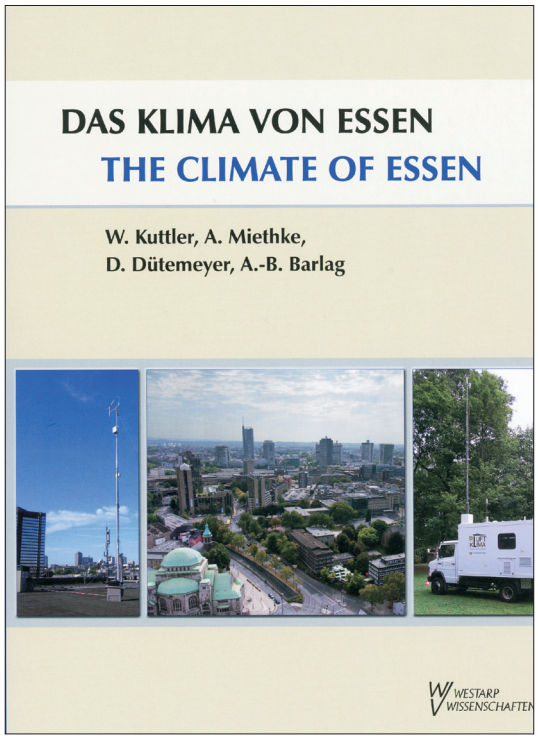
BOOK REVIEW

Kuttler, W., Miethke, A., Dütemeyer, D. Barlag, A.-B.: Das Klima von Essen / The Climate of Essen. Hohenwarsleben, Westarp Wissenschaften, 2015. 249 p.

The artificial environmental circumstances in the cities (e.g. complex surface structures, different heat capacity and run-off properties of human-made materials) result in changes of climatic and air quality conditions in urban areas. The Urban Heat Island (UHI), the degradation of the water supply, changes of the ventilation and increasing air pollution are some of the most frequently mentioned and most extensively examined modifying effects of the cities. The main principles of these phenomena are similar, but every city has its peculiarities and develops its own characteristic climate. There is a growing interest in urban climate research especially due to the strongly deteriorating macroclimatic conditions combined with negative changes in land use. Urban environment (and the billions of people living in it) is exposed to greater stress due to climate change. To achieve more efficient environmental protection and mitigation of the negative impacts of climate change we have to understand the climatic characteristics of cities thoroughly. Works like "The Climate of Essen" contribute to this need.



This book is a "classic" monograph on the urban climatology (the overview of climatic and air quality conditions) of Essen, which summarises the results achieved over 30 years at the Department of Applied Climatology at the University of Duisburg-Essen. This department was a dominating centre of German urban climate research until its activity was finally finished in February 2015. The research in Essen examined the thermal and humidity conditions and air quality of the urban environment at both the levels of basic and applied research focusing on the effects of climatic change. The latest directions of research included VOCs, NO, NO_2 and O_3 pollution in the urban atmosphere (e.g. Melkonyan, A. and Kuttler, W. 2012; Wagner, P. and Kuttler, W. 2014), and many aspects of urban thermal comfort in the light of climate change (Dütemeyer, D. *et al.* 2013; Müller, N. 2013). Besides presenting the assessment of observation data reaching back about 100 years, the book also gives a detailed analysis of data recorded at fixed stations and during mobile measurements between June 2012 and May 2013 in 33 stations over the city.

Essen was temporarily the most important, and presently is the second largest, city of the Ruhr area (the so called "Ruhrgebiet", one of the great industrial, especially coal and steel industry agglomerations of the 19th and 20th centuries in Europe) and the seventh largest in Germany. While Essen had over 700,000 inhabitants in the 1960s, there is a significant decrease of the population in the last decades (583,000 inhabitants in 2015). This phenomenon can be explained with the decreasing importance of, and job opportunities offered by, coal mining. The last mine (Zollverein Coal Mine Industrial Complex) was closed in 1986 and it is today a World Heritage site. Nowadays, the tertiary sector dominates the economy. Considerable changes of land use and corresponding changes of emission structure formed the urban climate observable today.

The volume presents the typical urban-climatological methodology, and gives an overview of climatic features (trends of air temperature, relative humidity, precipitation, wind conditions etc.) and

air quality (emission of particular matter and gases) of the region and the city of Essen, and also shows data from state-of-the-art investigations like energy flux measurements.

Chapter 1 and Chapter 2 describe the main geographical features and land use characteristics of the city. The urban climate phenomena cannot be understood without the background macroclimatic conditions. Therefore, Chapter 3 describes these features of the Essen region based on a long-term dataset (1881-2009). Although the basic climatic conditions are similar to those of Hungary, there is moderate continentality, thus less climatic extremism in the region. The analysis shows significant increasing trends in air temperature, in the number of summer and hot days, but decreasing trends in the number of frost days and wind speed (for the period 1935–2012). Because of the large industrial emissions in the 1960s, dust, SO_2, CO and NO_x caused the most air pollution problems and there was frequent occurrence of sulphurous smog. Recently, air quality has improved a lot, but the annual mean tropospheric ozone concentrations are still high (in context with air pollution caused by traffic).

Furthermore, the third part of Chapter 3 deals with projections of the air temperature and precipitation in Essen for the near (2041–2050) and far (2091–2100) future in comparison with the current situation (the decade from 1991 to 2000) according to four climate change models. The results indicate clear trends. The temperature is forecasted to rise by 1.6 to 2.9 K from the near to the far future, which seems to be a moderate change, but could lead to significant increases of the extreme values and thermal stress (especially in summer times). According to the calculations 9 percent annual precipitation increase is expected by for the near and 4 percent for the far future.

In the longest chapter of the book (Chapter 4, 120 pages) a very detailed analysis of a one-year-long dataset (measured between 2012 and 2013) is presented in two main sections. The first section deals with the general assessment of the data, while the second discusses selected aspects of the urban climate (including urban heat island, urban moisture excess, turbulent heat flux and carbon dioxide flux density).

The climatic overview shows that the characteristics (such as global radiation, radiation balance, temperature precipitation, precipitation, and air quality) follow a "classic" structure. UHI and the thermal stress are particularly important data for researches on the effects of climate change. In the chosen year, the maximum UHI is nearly 6 K (in Szeged, Hungary, the highest value measured is more than 8 K). The extent of this difference is similar, thus, the observations and data analysis made in Essen and described in detail in this chapter could be interesting for researchers studying Hungarian cities, especially those with a subject area located in Western Hungary. Because of the heterogeneous topography of Essen, the spatial distribution of the UHI is also not homogenous. It becomes less pronounced from the city centre to the suburb, but is interrupted by smaller cooler areas (parks, gardens). In Chapter 4.2.3 there is an interesting analysis about the "Urban moisture excess" (UME), which is particularly significant in Essen. This might be for a variety of reasons, for example (i) local precipitation events, (ii) differences between the times when changes in vapour pressure, which are caused by advection, started at the different stations, or (iii) the impact of temperature inversion at measurement stations (located at different elevations).

Chapter 4 also contains a microclimatic (ENVI-met) simulation for a city area that was earlier used as a supermarket site, to show the effect of land use changes, and to optimise the climatic conditions of this location. Such studies provide very useful data for the development of climate-conscious urban planning methodology, to locate thermally sensitive areas and improve the thermal comfort (also in Hungary).

Not only is the dataset interesting, the obtained results are also compared with other national and international studies in Chapter 5. Thus, a solid analysis in the field of meteorological parameters and human comfort is presented here. The urban climatic features of Essen are compared with other German and European cities, providing informative datasets for professionals.

Finally, Chapter 6 deals with the methods used for the collection and the analysis of the data recorded at stationary and mobile measurements. Useful tips and professional advices are presented especially for data processing (data gaps, measurements set-up, data quality control, etc.) and the widely used eddy covariance method.

The book contains 120 figures and 40 tables. Besides shedding light on the most important principles, these informative presentations can also be used for educational purposes. Because of this, the way of the presentation of the data collection and analysis methods is even more important. The book is published as a two-language edition helping to generate wider international interest.

This work can be most useful to everyone who is interested in urban climatology due to professional reasons (meteorologists, climatologists, geographers, environmental scientists, architects, and urban planners), university students who just started to learn about this scientific discipline as well as decision-makers who would like to learn more deeply about the climatic problems and phenomena arising especially in cities.

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