URBAN BIAS IN TEMPERATURE TIME SERIES – A CASE STUDY FOR THE CITY OF VIENNA, AUSTRIA

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Abstract. Compared with other large cities Vienna shows different urban development characteristics. The city has had a zero population growth during 1951–1995, a period of rapid growth elsewhere. In spite of its stagnating population of about 1,6 million Vienna has had development in other areas: a doubling of living floor space, a two and a half-fold increase in total energy consumption, a 60% rise of traffic area. In contrast, forests have been reduced by 20% and grasslands within the city borders by 30%. Of the 34 temperature recording stations in the study area of 1450 km^2, nine series passed the quality tests after careful homogenization. Three of these were in the rural environment and were used as reference series for the urban temperature excess at the other six stations in the urbanized area. The urban excess temperatures vary from site to site: from 0.2 K in suburban areas up to 1.6 K in densely built-up areas. The Vienna case study illustrates two features of more than local interest which should be considered in urban climatology as well as in time series studies where the urban temperature excess is regarded as a bias. Firstly, in a city with constant population the urban heat excess shows significant to strongly significant trends of up to 0.6 K in 45 years due to changes in urban morphology and energy consumption. Secondly, the urban heat island and its trend cannot be regarded simply for the city as a whole. There are different absolute levels, different annual variations and different increases of the urban temperature excess in different parts of a city. The urban effect is more strongly influenced by the local surroundings of the site than by the city as a whole. So, if possible, urban heat islands should not be described by a two station approach only (the typical airport-downtown comparison), nor should it rely on regression between population number and heat island.

1. Introduction

Recent climatological research pays much attention to worldwide temperature changes and the detection of an anthropogenic signal in global time series. One climatic phenomenon that is undoubtedly anthropogenic is the urban heat island. Temperature time series, especially the longer ones, usually originate from locations in or near towns. In Europe 38% of the 18th-century series and 56% of the series starting between 1800 and 1850 (after v. Rudloff, 1967) are located in towns that now have more than half a million inhabitants. The urban heat island may be regarded also as an inhomogeneity in temperature time series if the global, regional or local background signal is the aim of the study (Mitchell, 1953). In recent years the subject has been studied by Karl et al. (1988) for the United States and Jones et al. (1990) for a data set of global scale. Investigations such as these usually deal with hundreds to thousands of stations and have to use relatively simple models to measure the urban heat excess in relation to city size parameters. Linear regression models of population number and urban temperature excess are

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