



Trends in surface air temperatures in an urban area

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Trends in air temperature are indices of climatic change. Analyses of global temperatures are of obvious importance, but it is equally clear that questions of warming can be examined at a local level. This work presents the study of trends in annual and seasonal air surface temperature series in the urban area of a Mediterranean representative city in terms of its structure and climate. Observations from 1938 are used. Trends are extracted in the annual series using nonparametric methods, which yield a significant trend in annual temperatures in the studied period. The increasing annual temperatures have positive correlation 0.65 with the size of the urban area. Urbanization is measured by the variation in population with time. This implies that changes in the urban area, to some extent, play an important role in the air temperature patterns. The trend visualization plots show, however that the increase in the average temperature per year is non-stationary. A test for change-point detection indicates a trend change in the series around the year 1976.

The analysis of monthly observations is also discussed. The application of a linear model gives significant linear trend, seasonal cycle and interaction between these components. Seasonal differences in trend patterns are more clearly observed when the monthly data are averaged across seasons. In the winter series a significant linear trend of magnitude $[0.023, 0.049] \text{ } ^\circ\text{C} / \text{y}$ since 1938 is detected. The spring temperatures exhibit a change-point around 1977 and a significant linear increase in the last thirty years. The estimated trend is in this case $[0.027, 0.088] \text{ } ^\circ\text{C} / \text{y}$. A nonstationary linear trend is observed in the summer averages. This trend has been around $0.08 \text{ } ^\circ\text{C} / \text{y}$ greater in the last 23 years. In comparison to other seasons the temperature increase in the last thirty years is higher in the summer. The autumn temperatures show a pattern similar to the one observed in the spring series. There is an increasing linear trend in the last three decades, but in this case of smaller magnitude ($[0.005, 0.064] \text{ } ^\circ\text{C} / \text{y}$).