



Investigation of Urbanization Effects on Climate in Istanbul: Using Statistical and Dynamical Techniques

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Statistical and numerical modeling tools were used to investigate the climate effects of urbanization in Istanbul, a Turkish city whose population was nearly doubled in 20 years between 1980 and 2000. Mann Kendall trend test was applied to minimum temperature data from stations located at urban, suburban and rural areas in Istanbul to determine the existence and significance of trends, and the approximate years abrupt changes started. In addition, using a mesoscale atmospheric model, a sensitivity experiment was carried out to explore the atmospheric effects of urbanization in the city. Both statistical and modeling analysis indicated significant warming in the atmosphere over the urbanized areas. Mann Kendall tests indicated statistically significant positive trends in the time series of the differences in minimum temperatures between urban and rural stations. Seasonal analysis showed that the urbanization effect on climate was most pronounced in summer season. In most cases, the abrupt changes in the trends occurred in the 1970s and 1980s when the population growth rate in Istanbul increased dramatically. The model results exhibited significant expansion of the urban heat island in Istanbul from 1951 to 2004, fairly consistent with the expansion of the city in this period. A two-cell structure for the urban heat island emerged at the reference level from the difference of the July simulations with current and past landscapes: one at the European side and the other at the Asian side of the city. The maximum reference-level temperature difference between past and present simulations was found to be around 1 °C. The modeling experiment also indicated that the velocity of the prevailing northeasterly wind and the specific humidity were

both reduced over the city.