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Examinations on the Meteorologic Factors of Urban Heat Island Development in Small and Medium-sized Towns of Hungary

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EXAMINATIONS ON THE METEOROLOGICAL FACTORS OF URBAN HEAT ISLAND DEVELOPMENT IN SMALL AND MEDIUM-SIZED TOWNS OF HUNGARY

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The thermal difference between the settlements and their environment is called urban heat island (UHI). Potential UHI intensities are mainly determined by the size, population and built-up structure of settlements. Meteorological conditions have a determinant impact on the development of the heat island at a certain moment. International and Hungarian studies usually deal with metropolises and big cities; much less attention is paid to medium-sized and small towns. Consequently this study has been focused on the development of UHI in such Hungarian urbanized areas as mentioned above.
Settlements, located near the city of Debrecen (ca. 220,000 inhabitants) in East Hungary, with population of about 30000, 20000 10000 and 1000 were chosen for the research.
Car-mounted digital thermometers with data loggers were used. Twenty four measurements were carried out during a one-year-long campaign in 2003-2004. Synoptic conditions, especially cloudiness, wind direction and wind speed were taken to consideration as determinant factors.
Spatial characteristics of UHI have been described. Results have proved the existence of UHI even in the smallest settlement under suitable weather conditions. The non-heating season proved to be more advantageous for the development of UHI due to stronger irradiance and frequent anticyclonic synoptic conditions. Effects of cloudiness and wind speed have been revealed as well. St type clouds have proved to be most effective in preventing the formation of UHI. A 90-100% St cover could completely eliminate the thermal differences between natural and artificial surfaces. Ci type clouds had the weakest impact, they could prevent the formation of the heat island only in the smallest settlement involved in the study. In that cases when favorable synoptic conditions prevailed within 48-72 hours before the measurements, but during the measuring cloudiness reached 50%, strong UHI could not develop in any settlement, while over 75% only weak UHI could form in the big city. Over 90% there were no heat island found in any settlements involved here.
Wind speed had a strong impact on the strength of the heat island, while wind directions affected its shape merely. It was found that winds of 1-1.5 m/s (measured at a height of 2 metres) could prevent the formation of an UHI in settlements with 10000 inhabitants and below. In such cases in settlements with 20000-300000 inhabitants, only medium intensity heat islands could develop, and the intensity curve became asymmetric as the heat island was pushed towards the lee side. In case of stronger 2.5-3 m/s winds, UHI could develop only in Debrecen. The intensity in such cases (2-3 °C) reached only about half of the characteristic intensity of ideal circumstances. The shape was usually drifted strongly lee wards. Over a wind speed 3 m/s, at a height of 2 m heat island could not develop in any settlements involved in the study.