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Comparison of the urban heat island intensity in the different local climate zones of Budapest

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The built-up areas and the artificial surface covers are evidently very different from the natural environment. For instance, the energy budget, radiation characteristics, and wind field are all modified in cities, thus creating specific urban climate. The city structure is a fundamentally important factor in urban climate research. The system of the Local Climate Zones (LCZ) considers the structural elements of cities (i.e. built-up density, building height, surface coverage), that is why it is an ideal tool for the micro/mesoclimate analyses of the different parts of cities. This study uses the LCZ map generated for Budapest, which is the capital and the largest city of Hungary both in terms of the total population and the spatial extent, to compare urban effects in the different structural parts of the city. Altogether seven LCZ classes are present in Budapest: four built types (LCZ 2: compact midrise, LCZ 5: open midrise, LCZ 6: open low-rise, LCZ 8: large low-rise) and three land cover types (LCZ A: dense trees, LCZ D: low plants, LCZ G: water).
One of the most important urban climate effects is the urban heat island (UHI), which can be defined as the temperature difference between the densely built-up city centre and the surrounding rural areas. UHI can be analysed with in-situ measurements (air temperature) and satellite data (surface temperature). Here, we used surface temperature fields derived from the measurements of sensor MODIS (Moderate Resolution Imaging Spectroradiometer) on the board of satellites Terra and Aqua. We investigated the surface UHI intensity of Budapest on daily, monthly, seasonal and annual scales, and compared the results for the different LCZ classes. Our conclusions clearly show that the highest surface UHI intensities appear in the centre of Budapest, where LCZ 2 (compact midrise) class is found. If building density decreases then the surface UHI intensities also decrease. Moreover, negative surface UHI intensities occur in the vegetation-covered parts of the city. In addition to the surface UHI intensity analysis, in-situ air temperature measurements from different LCZ types are also evaluated to compare the daily cycles of UHI intensity in the structurally different parts of Budapest.