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Analysis of the Urban Heat Island magnitude in the Desert City of Beer-Sheva, Israel, Using a Modified Local Climate Zone Classification (Tromp Foundation Travel Award)

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The local climate zone (LCZ) classification scheme has become a tool to analyze the structure, form and function of cities and their impact on urban heat island (UHI). This tool was applied in numerous urban heat island magnitude. However, so far, few studies have been conducted in arid cities. Therefore, it is necessary to assess the UHI in desert cities using the LCZ in order to expend our knowledge about the factors that affect urban warming in arid settlements. This paper aims to examine the intensity and dynamics of urban heat island (UHI) in the desert city of Beer Sheva, Israel, using the LCZ method and determine the factors that can mitigate the urban warming.
The methodology for this investigation included three steps. In the first stage, an LCZ classification map of Beer-Sheva was created, using GIS in order to subdivide the city into different local climatic zones based on similarities in degree of land cover, urban geometry, urban morphology and land use. Each LCZ was characterized according to building fraction, Sky View Factor (SVF) and height /wide ratio (H/W). The next step was to analyze the UHI by meteorological measurements and satellites images. Air temperature data was collected by two methods: (1) fixed meteorological stations measured climatic variables during calm winter and summer weather conditions in eight case studies, and (2) mobile traverse measurements at dawn and early-afternoon were conducted in five case studies. Landsat satellite images were used in order to analyze the UHI magnitude in each LCZ in terms of surface temperature (brightness temperature). The final step was to compare intra-urban zones in Beer-Sheva according to this LCZ map and associated morphological, climate database and remote sensing images together.
Results showed that the UHI is more significant in winter than in summer. However, during winter the UHI is more dominant pre-dawn than in the afternoon, while during the summer, the UHI is more dominant at midday .A comparison between UHI intensity of the same LCZ located in different areas of the city showed that the same LCZ will have a higher temperature if it is located in the inner-city rather than at the edge of the city. We performed a comparison between two winter satellite images from different years and two summer satellite images from different years. The results showed a significance warm up of the surface temperature between the years, meaning that the changes in the built-up area of the city cause some changes in the magnitude of the UHI. It seems that in terms of UHI mitigation in desert cities there are climatic advantages to mid-compact city forms like LCZ4 whereas, low-compact forms like LCZ3 are not ideal from the climatological perspective.