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Urban heat island and land cover-temperature interactions in desert cities

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The Urban Heat Island (UHI) effect, whereby highly dense built-up areas trap the heat, making the city center warmer than the surrounding suburban areas, has received a great deal of attention in recent decades. However, most of the literature in the field has focused on the study of UHIs in temperate climates, while only few studies addressed the micro-climate of cities located in already harsh environment such as hot deserts. Rapidly increasing urbanization rates in arid and hyper-arid developing countries could soon require more attention for the effects of urban development on arid climates, which remained mainly unexplored till now.
In a previous study, we found that the UHI effect seems to be inverted in hot desert areas implying that urban areas can generally be cooler than the surrounding rural or suburban areas in desert cities. One of the reasons of this inversion in the UHI effect is associated with the presence of vegetation: urban green areas and landscaping contribute significantly to reduce urban temperature through evapotranspiration, and this evaporative cooling effect is more evident in desert cities where the presence of vegetation is very sparse and sand is the main reflecting surface of the suburbs and rural areas.
In this work, we investigate the climatology of urban heat islands of cities located in hot desert areas across the globe. Eight cities were considered and MODIS satellite data acquired during the period 2000–2012 were processed: dense urban areas, urban areas with vegetation and rural areas were identified by analyzing the high-resolution temporal variability of day and night temporal trends and averaged monthly values of land surface temperature (LST), normalized difference vegetation index (NDVI) and land cover characteristics.
Although specific microclimatic characteristics were observed in different cities, the results show some common characteristics among all the selected test sites. An average difference of 2 °C was observed between downtown areas with at least 20 % of vegetated cover and non-vegetated suburbs, confirming an inverse UHI behavior in most of the cities during all the year and in all the cities during summer months. Vegetation was a fundamental factor, also allowing downtown areas to have less day-night temperature difference with respect to suburbs.