



Long-term changes in urbanization indices based on daily and nightly day-to-day temperature variability at a large urban area of the Eastern Mediterranean (Athens)

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It was about ten years ago, when for the first time global urban population exceeded rural one, while urbanization rate is still increasing worldwide. Urban environment modulates local climatic conditions, manifested mainly through the creation of urban heat islands (UHIs) that make cities hotter than surrounding rural sites. Main contributing factors are changes in the surface energy budget, reduction of evaporative cooling, differences in convective and advective flows and increased anthropogenic heat release in urban areas. Most cities experience a more pronounced UHI intensity during nighttime. A number of indices and metrics have been proposed to characterize and quantify the 'urban' or 'rural' character of a site, used for the estimation of UHI intensity.

A new index in literature is based on the idea of the different behavior and response of daily maximum (Tmax) and daily minimum (Tmin) to weather variability among urban and rural sites. The index is defined as the difference between the average day-to-day variation in Tmax (actually difference in Tmax between adjacent days) and the average day-to-day variation in Tmin over a period, and is expressed in temperature units. The higher the value of the index, the higher the 'urban character' of the site. Rural sites are characterized by lower values of the index.

The method was applied at the urban area of Athens, using daily and nightly air temperatures since 1900, derived from the historical archives of the National Observatory of Athens. Today, Athens is a large urban area of approximately 4,000,000 residents, encompassing one third of Greek population. The long-term changes and trend of the urbanization index since the early 20th century, are expected to reflect different levels of urbanization in the city over such a long period

Intra-annual (monthly variability) of the index, suggested higher values in the warm seasons of the year (late spring and summer) compared to the cold period. Regarding the inter-annual variability and trend, the index revealed a statistically significant positive trend (estimated through linear regression analysis) and an overall increase by 80% since 1900. However, the increasing rate is not steady throughout the entire study period, exhibiting higher value during the first half of the 20th century.