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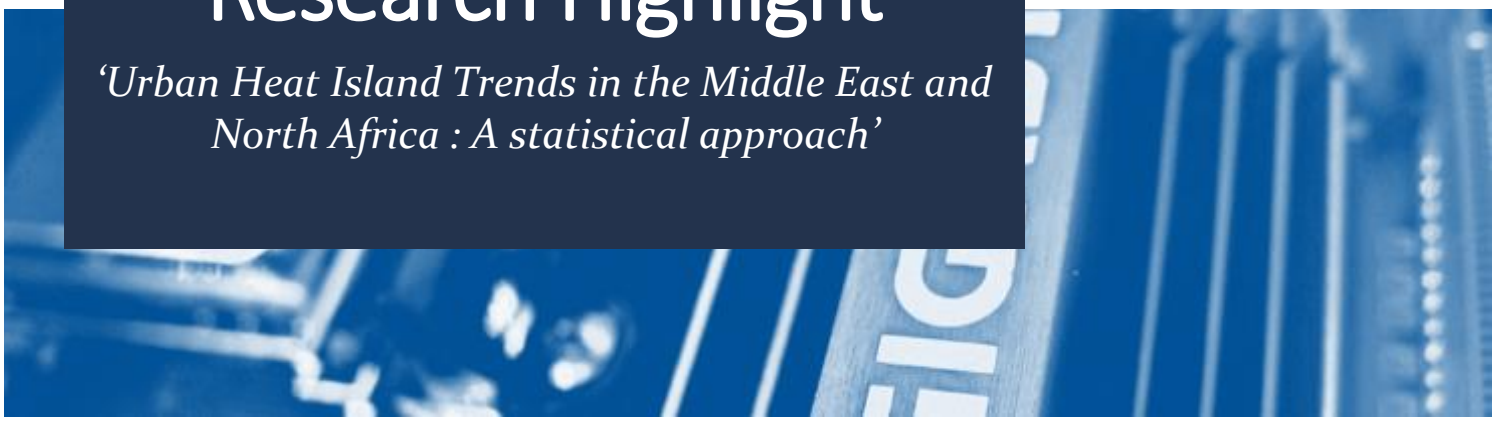
Research Highlight

'Urban Heat Island Trends in the Middle East and North Africa : A statistical approach'

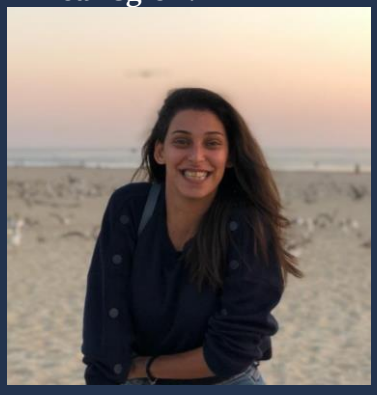


Summary

The urban heat island (UHI) effect denotes that temperatures in urban areas are often higher compared to the rural background. This human-induced phenomenon can exacerbate heat stress and adverse health impacts, adding to ongoing global warming. To examine the intensity and variability of the UHI effect, we used 40 years (1980–2019) of observational data (daily maximum and minimum temperature) from the Global Summary of the Day (GSOD), comprising about 1000 stations of varying temporal extent, spanning the Middle East and North Africa (MENA). The MENA is characterised by hot and dry summers and warms faster than other inhabited regions worldwide. The challenge in using data with diverse spatial and temporal extents is accounting for heterogeneities between each station comprising an urban–rural pair. One has to allow for differences in the distance between the pairs and, elevation, spatial–temporal changes in urbanisation as well as the distance from the coast. A new method is proposed, based on flexible statistical methods (Generalized Additive Models or GAMs), to quantify the temporal trend in the UHI effect while allowing for the aforementioned characteristics using regression splines of appropriately defined variables. A composition of highresolution satellite geospatial information, related to urbanisation properties and population data was utilised from the Global Human Settlement Layer database (GHSL-SMOD), to characterise the stations in terms of their urbanisation type. These data were also used to quantify temporal changes in the extent of urbanisation relative to the surrounding areas. Results indicate consistent upward trends of the UHI effect in the MENA (up to ~0.5C), particularly at night (daily minimum temperature) during all seasons.

Authors' bios

Anna Tzyrkalli is a PhD student at the Environmental Predictions Department of the Cyprus Institute's Climate and Atmosphere Research Center (CARE-C) with a backroung in Environmental Physics. Her research focuses on the impact of climate change in human health in the Middle East and North Africa region.



Impact

This study provides critical insights into the Urban Heat Island (UHI) effect, significantly enhancing our understanding of its impact in the heat-vulnerable MENA region. The fact that MENA region is experiencing faster rate of warming in comparison with other regions globally, our study reveals an additional city warming due to UHI effect. The findings are particularly noteworthy as they reveal that nighttime UHI is not only more pronounced than daytime UHI but also shows a positive trend over the 40-year period for coastal areas. Moreover, minimal seasonal variation was observed, underscoring the consistent nature of these trends. For non-coastal areas, daytime UHI exhibited similar patterns, though with smaller increases based on maximum temperatures. By utilizing near-ground air temperature data and applying rigorous methodological adjustments, this research delivers valuable, reliable insights into UHI dynamics in the region.

Reference

Tzyrkalli, A., Economou, T., Lazoglou, G., Constantinidou, K., Hadjinicolaou, P., & Lelieveld, J. (2024). Urban Heat Island Trends in the Middle East and North Africa: A statistical approach. International Journal of Climatology, 44(11), 3998–4008. DOI : https://doi.org/10.1002/joc.8563

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