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The cumulative impact of climate change and urban heat island on Mediterranean cities' temperatures

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An assessment of the cumulative impacts of urban heat islands, climate change and anthropogenic heat emissions on the occurrence of extreme events is presented for the three CIRCE (Climate Change and Impact Research: the Mediterranean Environment) RL11 case study cities: Athens, Alexandria and Beirut.
The Mediterranean climate potentially supports a large urban heat island (UHI), though its heterogeneous nature causes it to respond in different ways.
Here, we use simulations derived from a novel climate model that includes a sub-grid urban land-surface model capable of capturing the main meteorological characteristics of a Mediterranean UHI. Specifically, daily means of maximum and minimum temperatures are used, derived from the HadRM3 climate model modified to include the MOSES2.2 land-surface scheme and urban parameterization, as developed in the Hadley Centre of the UK Met Office. Different experiments are explored both for the present day (1971-1990) and a future A1B climate (2041-2060) that include the influence of the urban surface and anthropogenic heat emissions.
The frequency of extreme temperatures, the number of hot days and nights, and the daytime and nocturnal UHI magnitude, based on the temperature differences between the city-centre gridcell and the surrounding gridcells, are analysed. Moreover, to assess the credibility of the simulations, a comprehensive comparison of the simulated present climate against observations is conducted, employing data of meteorological stations, representing urban and rural sites, respectively.
It is found that the simulated UHI is different for the three cities, though it increases the number of hot nights and days in both present and future climates. The sensitivity of extremes to the cumulative impact of climate change and urban heat islands is apparent for the frequency of hot nights in the cities. If the UHI is ignored then the frequency of extreme temperature events in the future will be underestimated. In addition, the UHI magnitude seems to be sensitive to the anthropogenic heat emissions assumptions. The main emphasis of these results is on the sensitivity to urban induced climate change and they do not represent a robust prediction of future climate change.