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Quantifying the impact of extreme heat and adaptation strategies on urban air conditioning use and energy consumption in Nicosia, Cyprus.

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Human-induced climate change is expected to affect the entire Mediterranean area during the 21st century; notably, the Eastern Mediterranean and Middle East (EMME) region has been recognized as a climate-change hotspot. That manifests with increased temperatures and more frequent heatwaves, posing a significant challenge for urban areas in warm periods. Furthermore, as the urban population continues to grow and urbanization expands in this area, the potential escalation of heatwaves in the already sensitive EMME environment is expected to have direct adverse effects on human health, agriculture, and the water-energy nexus. Therefore, analyzing the impact of exacerbated environmental conditions is crucial for understanding the vulnerability of cities and developing effective mitigation and adaptation strategies.

Our aim is to quantify the impact of extreme temperatures on the building energy use for space cooling, rejected heat to the ambient, and outdoor thermal comfort in Nicosia, Cyprus, over a heat wave event within the period from the 24th of July until the 10th of August 2021. To achieve this, the Weather Research and Forecasting (WRF) model is coupled with the Multilayer BEP/BEM scheme to study different adaptation and mitigation strategies evaluated against two baseline scenarios, the first without considering the air conditioning and the second where the air conditioning is on to maintain indoor thermal comfort. The adaptation/mitigation scenarios are (i) partial coverage of roofs with photovoltaic panels to increase the generation of energy from renewable energy sources, (ii) adoption of cool roofs to minimize heat absorption, and (iii) plantation of trees and expansion of green areas within the city to reduce air temperature and improve outdoor thermal comfort.

By comparing these three strategies against themselves and the baseline scenario, we can identify their contribution to reducing buildings' energy consumption and rejected heat and increasing outdoor thermal comfort. Therefore, the outcomes of this study can provide valuable insights to

policymakers and urban planners in addressing climate change impacts in city regeneration projects by increasing urban resilience against extreme heat.