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Measuring the urban heat island of Rome through a dense weather station network and imperviousness Copernicus Land Monitoring Service data

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Provided that the population living in cities is increasing, projected to reach 5.2 billion in 2030, and that heat waves are getting more intense and lasting as a consequence of the global warming, the urban heat island (UHI) phenomenon is leading increasingly to extremely high temperatures within cities. It is therefore important to find reliable and simple methods for estimating and characterizing at a high resolution the UHI.

In this work we characterize the urban heat island (UHI) of Rome, Italy, during summer, through a dense weather station network. Measurements were collected in summers 2019-2020. We calculate the UHI intensity using a method that relates the air temperature to imperviousness (IMP), which quantifies the presence of artificially sealed surface in a radius around each station using Copernicus Land Monitoring Service satellite data. To assess the reliability of this method we made a comparison with the LCZ-based approach, finding compatible daily trends of UHI intensity, with a fixed bias during night. Our method both simplifies the measurement area classification and allows to determine the UHI intensity even when measurements in totally urban and totally rural areas are not available. The correlation coefficient values between IMP and daily maximum, minimum and mean temperatures were 0.17, 0.81 and 0.82, respectively, evidencing the nighttime UHI peak observed in other cities. The UHI intensity diurnal cycle pattern showed, starting from its minimum of -0.1°C at 10:00 (CET), a progressive increase which intensifies after sunset, reaching a maximum of 3.4°C at midnight. During the night a slight decrease is observed, which exacerbates after sunrise. We did not find a relevant correlation between UHI and heat waves.