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High-resolution air temperature modeling during the summer 2022 heat waves over Dijon

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Heat waves (HWs) become more frequent, severe and longer under climate change. In cities, their impact is exacerbated by urban heat islands (UHIs). Proposing efficient adaptation plans necessitates upstream studies to further understand air temperature space-time variability within cities during HWs, their drivers, and associated mechanisms and processes.

This study aims at understanding 2 m air temperature (T2m) space-time variability during the four HWs that occurred in Dijon during summer 2022 based on the dense MUSTARDijon network of 92 thermometers. We used a 150 m mesoscale simulations performed with the Meso-NH atmospheric model coupled with the TEB and ISBA surface schemes optimized for urban and rural environments, respectively. First, we evaluate the capability of Meso-NH to simulate the diurnal cycle of T2m for the four HWs over urban and rural environments. We show that Meso-NH more skillfully simulates the T2m diurnal cycle over urban than rural environments, despite a systematic cold bias in early morning and late afternoon. Second, we focus on the drivers of T2m space-time variability by using different predictors including land cover, energy budget, soil and atmospheric humidity and atmospheric dynamics. Buildings and roads contribute to warm the urban environment mostly at night, but these contributions are exaggerated by Meso-NH during all HWs. By contrast, vegetation contributes to cool the urban environment all day long for low vegetation and at night only for high vegetation in both observations and simulations. Also, wind speed seems having a strong impact on UHI intensity.