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Changes in the Seoul Metropolitan Area Urban Heat Environment with Residential Redevelopment

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Since the industrial revolution, the geographical extent of cities has increased around the world. In particular, following three decades of rapid regional economic growth, many Asian megacities have emerged and continue to expand. Short-term urban redevelopment is, therefore, inevitable. However, in this region the microclimatic impacts of urban redevelopment have not been extensively investigated using long-term in-situ observations. In this study, changes in surface sensible heat exchange, heat storage, and anthropogenic heat emissions due to urban residential redevelopment were quantified and analyzed based on a three-year micrometeorological record from the Seoul metropolitan area. The results show that following urban redevelopment of compact high-rise residential buildings, 1) the daily minimum air temperature near the ground surface increased by ∼0.6 K; 2) the ratio between surface sensible heat and net radiation increased by $\sim 9\%$ (summer) to 31% (winter), anthropogenic heat emissions increased by 12 Wm^{-2} (spring) to 26 Wm^{-2} (summer), and daily maximum heat storage ranged by 35 Wm^{-2} (spring) to 55 Wm^{-2} (summer), and; 3) there was a transition of local circulation with changes in the surface properties of heat sources and roughness.