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Contrasting interactions between urban heat islands and heat waves in Seoul, South Korea, and their associations with synoptic patterns

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This study investigates the interactions between urban heat islands (UHIs) and heat waves in Seoul, South Korea, using 25-year (1997–2021) observations. Under heat waves, South Korea is under strong influence of an anomalous 500-hPa anticyclonic high and the expanded Tibetan high. The urban heat island intensity (UHII) calculated as the difference between the urban-station average and rural-station average of the daily minimum (maximum) 2-m temperature increases by 0.53 °C (0.20 °C) under heat waves, indicating synergistic interactions in both nighttime and daytime. UHII substantially varies within heat waves. UHII tends to increase under stronger heat waves and has statistically significant negative correlation with relative humidity and cloud fraction. Among heat wave days, strong (weak) UHI days with UHII larger (smaller) than its 90th (10th) percentile are selected, and these days well represent positive (negative) interaction cases. The strong UHI days exhibit relatively hot, calm, dry, and clear weather conditions with relatively strong subsidence compared to the weak UHI days. The dominant synoptic patterns on the strong and weak UHI days are the Pacific-Japan (PJ) pattern and the expanded western North Pacific subtropical high (WNPSH), respectively. The strong UHI days are frequent in recent years.