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## Understanding within-city interaction between surface and air temperatures

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Urban heat is a local scale warming effect associated with urban areas where most of the world's population live. Due to the scarcity of air temperature ( $T_a$ ) data, urban heat studies have been mostly focused on Land Surface Temperature (LST) extracted from satellite imagery and a quantitative understanding of how LST interacts with  $T_a$  within a city is still lacking. Using crowdsourced weather station data in Sydney, Australia, combined with high resolution satellite images and urban datasets (such as Local Climate Zone (LCZ) and building-level urban data), we explore the interaction between  $T_a$  and LST, and their intra-urban variabilities during different seasons. We found that LST and  $T_a$  have different characteristics and their dependency varies by season and LCZ. When exploring the relationship between  $T_a$ , LST, and variables describing the urban structure, such as building fraction, the correlation between LST and urban structure was stronger and more seasonal dependent than the  $T_a$ -urban form relationship. Moreover, stronger correlations between LST and  $T_a$  were observed in the less built-up areas within the city. We also found that the determinants of LST variability are different from the contributing factors of  $T_a$ . These findings provide new insights for quantitatively investigating surface and canopy urban heat and their relationship with land cover, providing fit-for-purpose information to mitigate the adverse effects of urban overheating at local and global scales.