Relationship between spatiotemporal changes in amounts of thermal infrared energy and land use variations in downtown Tokyo at summer midday

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We investigated spatial and temporal changes in amounts of thermal infrared (TIR) energy emitted from urban surfaces in downtown Tokyo, using 2 m spatial resolution data obtained from airborne TIR measurements at midday on the four different hot summer days: August 7, 2007, August 19, 2013, August 19, 2014, and August 19, 2015. Also, to analyze relationship between amounts of TIR energy and land use variations, we used detailed land use data provided by Bureau of Urban Development, Tokyo metropolitan government.
The results showed that amounts of TIR energy were especially large in areas with high-density wooden houses, whereas those in areas with office and commercial buildings were relatively small. The difference in average absolute values of amounts of TIR energy between the two areas were approximately 20 W/m^2.
In the areas with office and commercial buildings, amounts of TIR energy in many parts of urban renewal areas clearly decreased between 2007 and 2013. Increases in green surfaces associated with development of public open spaces would be one of the main causes of the decreases in amounts of TIR energy. The development of public open spaces has been promoted by an incentive-based policy that offers an enhancement in the floor area ratio as a reward for constructing public open spaces.
These results indicate that some governmental measures like the incentive-based policy enacted for areas with office and commercial buildings are required to reduce summer heat stress in the high-density wooden residential areas where the larger amounts of TIR energy are observed at summer midday. In downtown Tokyo, the maximum occurrence frequency of heat strokes tends to be recorded in residential areas.

Keywords: thermal infrared energy, land use, summer midday, downtown Tokyo, UHI adaptation and mitigation strategies

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