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Influence of cold air from an urban green area on nocturnal temperature reduction

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Air temperature in an urban green space is generally lower than that in the surrounding built-up area and, therefore, urban green spaces have a significant role for mitigation of Urban Heat Island (UHI) which is a well known phenomenon that urban air temperature is higher than that of the rural or suburban areas. The cold air in a green space also may contribute to decrease air temperature around the green space. Especially, in clear and calm night, accumulated cold air in a green space often flows out to surrounding built-up areas.
In this study, micrometeorological observations were conducted during summer season in 2009 and 2010 to investigate the effect of cold air flowed out from the urban green area (24 ha) on nocturnal temperature reduction in the surrounding residential area. In addition to horizontal temperature measurements, vertical temperature observation using a balloon was performed in 2010 to investigate the relationship between the thickness of inversion layer formed on a grass field surrounded by trees in the green area and occurrence of the cold air flow. The both observations were done in clear and calm night.
Observed results showed that 1) temperature decrease by the cold air for the eastern and western residential areas could not be confirmed. One of the reasons for it was that heat released from road surfaces may block the penetration of cold air. 2) However, in the southern residential area, temperature decrease was observed. The maximum temperature difference between the residential area near by and distant from the green area was 0.5 oC around 2 a.m., 3) horizontal temperature distribution in the southern residential area showed that the maximum extent of temperature reduction by the cold air was approximately 140m from the south boundary of the green area and 4) the cold air flow occurred when the thickness of the inversion layer reached approximately 20m in height which corresponds to average height of trees around the grass field. This suggests that cold air generated above trees by radiative cooling may contribute to increase the thickness of the inversion layer on the grass field since theoretical prediction of the maximum thickness of inversion layer was approximately 13 m that is smaller than the observed thickness in this study.