EMS Annual Meeting Abstracts
Vol. 12, EMS2015-417, 2015
15th EMS / 12th ECAM

Scaling the maximum Urban Heat Island for mid-latitude cities

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The most pronounced result of the difference in urban and rural microclimates is the urban heat island (UHI). Here, the UHI is defined to be the difference in air temperature between the rural environment and the urban street canyon. This difference is largest during the evening and night time. In general, the mechanisms driving the UHI are mainly caused by differences in the radiation and energy balance. Typically urban areas have a lower albedo, larger heat storage in buildings during the day and subsequent release during the night, more heat release due to human activities and less evapotranspiration due to lack of vegetation compared to the rural surroundings. As a result, the UHI changes with the size of the city, urban vegetation fraction, building materials, and anthropogenic activity. However, the location and climate of the city surroundings and meteorological conditions play important roles in the magnitude of the urban heat island as well. Due to the complexity of the phenomenon there has not yet been a simple model to forecast the temperature in the street canyon or the UHI in within the urban canopy.
Here, we use dimensional analysis to derive a simple physically based equation to estimate the daily maximum urban heat island effect. The derived equation is based on the mean incoming solar radiation, wind speed and the diurnal temperature range over the rural area. The formula is tested for 10 cities within the Netherlands and abroad and performs remarkably well. The simplicity of this analytical model allows for applications beyond atmospheric science.