



The role of the atmospheric boundary layer in cool city mornings

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The urban heat island effect is a phenomenon observed worldwide, i.e. evening and nocturnal temperatures in cities are usually several degrees higher than in the surrounding countryside. In contrast, cities are sometimes found to be cooler than their rural surroundings in the morning and early afternoon. Here, a boundary-layer explanation for this so-called daytime urban cool island (UCI) effect is presented and evaluated for the several cloud-free days in the BUBBLE campaign in Basel, Switzerland. Simulations with a bulk atmospheric boundary-layer model coupled to a land-surface model, reveal that the UCI can form due to differences between the early morning mixed-layer depth over the city (which is much deeper) and the mixed-layer depth over the countryside (shallower). This results in different heating rates for the rural (larger) and the urban (lower) areas, even if the sensible heat flux over the city is larger. The sensitivity of the UCI magnitude is tested for various boundary-layer properties (initial height, inversion strength and free tropospheric lapse rate), as well as the surface heat flux.

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