Formation mechanisms of the extremely high surface air temperature of 40.9 ºC observed in the Tokyo metropolitan area

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Abstract

The record-breaking daily maximum high surface air temperature in Japan of 40.9 ºC was observed on 16 August 2007 at Kumagaya, located inland of the Tokyo metropolitan area. In this study, the formation mechanisms of the phenomenon are investigated using observational data and the Weather Research and Forecasting (WRF) model. The main results obtained in this study are as follows. (1) The inertia of the mixed layer and temperature increase in the boundary layer was observed at Tsukuba during 13-16 August. It seems that the continued sunny weather contributes to this temperature increase. (2) The heat budget analysis on the mixed layer (atmospheric column) using the WRF model indicated that the mixed layer is heated not only by sensible heat from the ground surface (contributing to 50 percent) but also due to horizontal advection, turbulent diffusion and from the top of the atmospheric column (50 percent), during 0500-1500 (JST) for the case of 16th August. (3) The backward trajectory analysis is performed in order to investigate the sensible heat transfer mechanisms. The results of this analysis indicates that the two transfer mechanisms; (i) The descent of air parcels from free atmosphere, and (ii) The contributing sensible heating caused by the fetch, heated by solar radiation, increasing the transfer of sensible heat. Additionally, the analysis indicates that (ii) has a larger influence in developing the mixed layer in the leeward area. (4). (ii) (diabatic mechanism) is also indicated by forward tracer analysis and sensitivity experiment of soil moisture in the Chubu Mountain Range. (5). (ii) mechanism appears to effect the areas to the north of the convergence line formed in the vicinity of Saitama.