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Formation Mechanisms of the Extreme High Surface Air Temperature of 40.9oC Observed in the Tokyo Metroplitan Area

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A record-breaking high surface air temperature in Japan of 40.9oC was observed on 16 August 2007 in Kumagaya, located 60 km northwest of central Tokyo. In this study, the formation mechanisms of this extreme high temperature event are statistically and numerically investigated using observational data and the Weather Research and Forecasting (WRF) model. The extreme event is caused by a combination of two particular factors: 1) Persistent sunshine and a lack of precipitation during the seven consecutive days preceding 16 August 2007 were seen in Kumagaya. This was the 12th-longest stretch of clear-sky days in July and August from 1998 up to 2008. Persistent clear-sky days allow the ground surface to dry out, which produces an increase in sensible heat flux from the ground surface. This contributes to the extreme event, and its mechanism is qualitatively supported by the results of sensitivity experiments of soil moisture on surface air temperature. 2) A foehnlike wind (Fig.1) appears in the numerical simulation, which is caused by diabatic heating with subgrid-scale turbulent diffusion and sensible heat flux from the ground surface when this airflow passes in the mixed layer over the Chubu Mountains and the inland of the Tokyo metropolitan area. Backward trajectory analysis and Lagrangian energy budget analysis show that the foehnlike wind plays a more important role in the extreme event than the adiabatic dynamic foehn pointed out by previous studies.

Keywords: Extreme high temperature, Foehn, Persistent clear-sky days, WRF, Kumagaya city