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Simulation of dust aerosol and its regional feedbacks over East Asia using a regional climate model

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Abstract. The ICTP regional climate model (RegCM3) coupled with a desert dust aerosol model is used to simulate the net radiative forcing (short-wave and long-wave) and related climate effects of dust aerosols over East Asia. Two sets of experiments are completed and intercompared, one without (Exp. 1) and one with (Exp. 2) the radiative effects of dust aerosols. The experiments encompass the main dust producing months, February through May, for 10 years (1997–2006), and the simulation results are evaluated against ground station and satellite data. The model captures the basic observed climatology over the area of interest. The spatial and temporal variations of near surface concentration, mass load, optical depth and emission of dust aerosols from the main source regions are reproduced by model. The main model deficiency is an overestimate of dust amounts over the source regions and an underestimate downwind of these source areas, which indicates an underestimate of dust dispersal. Over the desert source regions, the net TOA radiative forcing is positive, while it is small over the other regions as a result of high surface albedo values which reduce the short-wave radiative forcing. The net surface radiative fluxes are decreased by dust and this causes a surface cooling locally up to −1°C. The inclusion of net (short-wave and long-wave) dust radiative forcing leads to a reduction of dust emission in the East Asia source regions, which is mainly caused by an increase in local stability and a corresponding decrease in dust lifting. Our results indicate that dust effects should be included in the assessment of climate change over East Asia.

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