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Dust aerosol impact on the climate of the Arabian Peninsula simulated by a Regional Climate Model

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Dust aerosol intercepts sunlight and affects regional climate through direct and indirect radiative effects. This paper investigates the dust aerosol impact on precipitation and temperature over the Arabian Peninsula (AP) using the current version of the International Centre for Theoretical Physics (ICTP) Regional Climate Model (RegCM4) during 1998-2009. The simulated precipitation is compared with the high resolution Tropical Rainfall Measuring Mission (TRMM) data, and the temperature is compared with the Climate Research Unit (CRU) data for both the wet (Nov-Apr) and dry (Jun-Sep) seasons. The preliminary results reveal that the dust loading enhances the precipitation and reduces the temperature over the AP, particularly over most parts of Saudi Arabia where large aerosol optical depth is confined. The dust aerosol enhances the precipitation by 1.43 mm/month (4.25%) and 2.72 mm/month (44.50%) during the wet and dry seasons, respectively. It reduces the air temperature by 1.0^{o}C (1.41^{o}C) during the wet (dry) season. The results show that the enhancement of precipitation and reduction of temperature are partly attributed to the solar heating and thermal cooling. Dust aerosol over the AP increases solar heating and decreases thermal cooling, mostly in the lower atmosphere. However, in the middle atmosphere, the pronounced decrease (increase) of solar heating (thermal cooling) amplifies precipitation. The decrease of thermal cooling at the surface and thermal flux at the top of the atmosphere as well as the increase of surface albedo by dust loading in RegCM4 simulation enhance the precipitation amount, whereas the decrease of the surface radiative forcing results a decrease in the surface temperature, helping to improve the simulation of air temperature. It is concluded that dust aerosol inclusion in the RegCM4 simulation increase (decrease) the precipitation (air temperature) bias compared to the observation over the AP.