Simulation of mineral dust aerosol distributions and analysing their direct and semi-direct climate effects over South Africa using RegCM4

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The present study investigate the mass distribution, direct and semi-direct climate effects of desert dust aerosols over South Africa, using the 12 year runs of Regional Climate Model (RegCM4). The descriptions of RegCM4 model setup, designated model physics schemes, datasets and different dust properties that are employed in this study are described in [1]. The results of the present study have shown that the desert dust particles which burden the western regions of South Africa are predominantly produced from the Kalahari and Namib Desert areas. At the surface and within the atmosphere, the Short-Wave (SW) and Long-Wave (LW) Radiative Forcing (RF) of dust showed contrasting effects. However, due to the dominant influence of dust SW-RF, the Net-RF of dust causes a reduction on the net radiation absorbed by the surface via enhancing radiative heating within the atmosphere. The radiative feedbacks of desert dust particles mainly resulted in a positive response on net atmospheric radiative heating rate (up to 1.2 K/day). This increase instability and instigate an elevated heat-pump effect. As a result the presence of desert dust particles causes an enhancement on Cloud Cover (CC: up to 7%) and cloud liquid water path (up to 2.5 g/m^2). The CC enhancement and net surface RF of dust, cooperatively, induce reduction in surface temperature (up to -1.1 K) and surface sensible heat flux (up to -24 W/m^2). Furthermore, the dust aerosol induced adjustments on convection process and atmospheric thermodynamic structure also consequence reduction on boundary layer height (up to -90 m), surface pressure enhancement (up to +0.25 hPa) and dynamical changes. Overall, the present contribution (i.e., [1]), underscores the importance of including the effects of wind-eroded dust particles in climate change studies over South Africa.

[1] Tesfaye, M., et al., (2015). Mineral dust aerosol distributions, its direct and semi-direct effects over South Africa based on regional climate model simulation. J. Arid Environ. 114: 22–40, doi: 10.1016/j.jaridenv.2014.11.002.