Direct Radiative Effects and Climate Feedbacks of Desert Dust vs. Anthropogenic Aerosols in South Africa

M. TESFAYE[1*]

[1] South African Weather Service, Pretoria, South Africa;
(*correspondence: mela20062@gmail.com)

In this study, using twelve year runs of inline coupled Regional Climate–Chemistry model, we examine the radiative effects and climate feedbacks of desert dust and anthropogenic aerosols in South Africa. Owing to the geographical locations where the aerosol potential source regions are situated and the regional anticyclonic circulation, the South African aerosol spatial-distribution has a unique feature. Across the west and southwest areas, desert dust particles are dominant. However, anthropogenic and biomass burning aerosols are primarily distributed over the east and northern regions of the country. The Radiative Forcing (RF) results showed that aerosols in South Africa cause a reduction on net radiation absorbed by the surface via enhancing radiative heating in the atmosphere. However, the radiative influences of mineral dust particles were twice stronger than that of anthropogenic aerosols. The dust aerosol induced strong net atmospheric heating rate, promote an enhancement in tropospheric instability as well as instigates an elevated heat-pump effect. These physical processes resulted statistically significant Cloud Cover (CC) enhancement over dust aerosol dominated areas of South Africa. Whereas, due to the lack of heat-pump effect, areas dominated by anthropogenic aerosols exhibited reductions in CC. The dust aerosol induced CC enhancement and its RF jointly induced surface radiative cooling, which in turn, resulted in the reduction of Surface Temperature (ST: up to -1 K) and Surface Sensible Heat Flux (SSHF: up to -24 W/m^2). Moreover, the decrease of ST and SSHF resulted in a weakening of the convectively driven turbulences and surface buoyancy fluxes, which leads to the reduction of the boundary layer height, surface pressure enhancement and dynamical changes. Overall, the present contribution (Tesfaye et al., 2016), underscores that, in terms of aerosol-radiation-climate interaction, the dust aerosols play a leading role in South Africa. This signals the need for further research on different aspects of dust particles in South Africa.

Tesfaye, M., et al. (2016): Simulation of bulk aerosol direct radiative effects and its climatic feedbacks in South Africa using RegCM4. *Journal of Atmospheric and Solar-Terrestrial Physics, 142, 1-19*.