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Sensitivity of tropical rainbelt over Africa and Middle East to dust shortwave absorption: Experiments using a high resolution AGCM

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Response of the rainbelt over Africa to dust direct radiative forcing has been an area of lively debate and is a subject of ongoing research. Previous modeling studies have contrasting results producing different amplitudes or even signs of responses. Uncertainties in the dust radiative forcing are thought to be the major cause of discrepancies in the simulated responses among various studies. The imaginary part of mineral dust shortwave refractive index, which defines the dust absorptivity, has a wide range of values estimated from various observational and modeling studies, as it depends on dust chemical composition and mineralogy. Balkanski et al. (2007) estimated dust shortwave refractive indices by assuming 3 different hematite contents, 0.9%, 1.5% and 2.7% by volume, which corresponds to inefficient, standard, and very efficient dust shortwave absorption, respectively. To investigate the sensitivity of the position and intensity of the tropical rainbelt over Africa and its extension to the Arabian Peninsula to dust shortwave absorption, we have conducted ensembles of numerical simulations for each of the three dust absorptivity scenarios using a high resolution Atmospheric General Circulation Model (AGCM), GFDL's High Resolution Atmospheric Model (HiRAM), at a spatial resolution of 25 km. We found that the strength and the latitudinal extent of the rainbelt are very sensitive to dust shortwave absorption, as well as circulations at various spatiotemporal scales that drive the climate of the region.

Reference: Balkanski, Y., M. Schulz, T. Claquin, and S. Guibert (2007), Reevaluation of mineral aerosol radiative forcings suggests a better agreement with satellite and AERONET data, Atmos. Chem. Phys., 7, 81 – 95.