Dust Particles: Characteristics, Radiative and Climate Impact

Ramachandran S.

Physical Research Laboratory, India

Author list (excluding presenting author)

Maheswar Rupakheti

Abstract

Aerosols continue to remain a highly uncertain component in global climate and climate change. Mineral dust is the most abundant aerosol type in the atmosphere, in terms of mass loading, and affects the Earth-atmosphere radiation budget and climate by interacting with both short- and long-wave radiation. Dust particles are emitted into the atmosphere through the natural process of saltation bombardment of the soil by large wind-blown particles, such as sand grains, and from breakdown of saltating particle clusters. Thus, the occurrence and intensity of dust emissions are controlled by soil properties, vegetation and near-surface wind, making dust emissions sensitive to climate change and land use changes. Additionally, dust particles are emitted directly through human activities, such as agriculture, off-road vehicles, building construction and mining, and indirectly through hydrological changes due to human actions such as water diversion for irrigation. However, human contribution to global dust budget remains quite uncertain, and the magnitude of radiative forcing due to dust is small. Model simulations of dust differ significantly in their sources, underestimate their magnitude and long-range transport. The temporal and spatial variability of dust emissions in the dust belt (extends from the west coast of North Africa, through the Middle East, into Central Asia and China, extending almost to the Pacific Ocean) is quite large. Mineral dust particles play an important role in climate in influencing monsoon and accelerate the melting of glaciers through feedbacks. Results obtained from a comprehensive investigation on the quantification of aerosol types including dust across the globe using high-quality ground-based observations with an emphasis on Asia and radiative forcing will be presented. The challenges involved in dust aerosol characterization from observations, model simulations, and insights gained in attributing the impact of dust aerosols on climate and climate change, and associated uncertainties will be discussed.

Early Career Scientist

NO, I am not an early career scientist.

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