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Impact of Aerosols on Cloud and Precipitation: A Review of Observational Evidences

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As a major agent for clouds to form and a significant attenuator of solar radiation, aerosols can significant alter cloud properties and precipitation. Identification of such effects has been a major challenge, for the latter two variables are dictated primarily by meteorological conditions. The availability of extensive coherent measurements of aerosol and meteorological variables from ground-based, space-borne and airborne sensors have accumulated such ample data from which it is possible to detect the impact of aerosol on cloud and precipitation from the influences of meteorological variables, although attribution and quantification are always fraught with uncertainties and difficulties. Well-designed field campaigns and careful analysis of multiple datasets are required to address this issue from observation viewpoint. In this review, I will present some sound observational evidences obtained from a variety of platforms including satellite sensors (e.g., A-train), conventional meteorological stations, and extensive and high-quality ground-based observations such as the US Dept of Energy's Atmospheric Radiation Measurement (ARM). ARM has provided such rich information, it is possible to investigate the climatological effects of aerosol-cloud-precipitation interactions beyond case-by-case studies, Despite ever-escalating efforts and the virtually exponential increase in published studies concerning aerosol-cloud-precipitation interactions, we are still puzzled by many seemingly contradictory findings, attesting to the complexity of the problem. Many findings reported are critically reviewed, especially those concerning aerosol and convective cloud and precipitation, based on a recent review study by Tao et al. (2012, Rev of Geophy.).