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Aerosol Radiative Forcing and Heating Rates Derived from Ground-based and Space-borne Radiometers and Lidar in China

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Aerosol loading is heavy and properties are complex in China. Few observation-based studies of their radiative forcing and heating rate were conducted till recent years. To provide a quantitative estimates of aerosol radiative forcing across China, we have established a network of aerosol observation stations including a few super sites that measured a wide range of variables including lidar for observing the vertical distributions of aerosols and clouds. By combining ground-based, space-borne and model calculations, we derived aeroisol radiative forcing at the top and bottom of the atmosphere, together with the heating rate induced by absorbing aerosols. It was found that aerosols reduce the amounts of solar radiation at the surface by 16 Wm-2, which is largely absorbed in the atmosphere. The absorbed solar radiation is portioned in the lower atmosphere determined with the aid of micro pulse lidar (MPL) measurements. The vast majority of aerosol particles are below 2 km, and about 62%, 67%, 67% and 83% are confined to below 1 km in spring, summer, autumn and winter, respectively. Dust strongly impacts the vertical particle distribution in spring and autumn, with much smaller effects in winter. The mean reduction in direct and diffuse radiation reaching surface amount to 109.2±49.4 and 66.8±33.3 W/m2, respectively. Aerosols significantly alter the vertical profile of solar heating, with great implications for atmospheric stability and dynamics within the lower troposphere.