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The measurement of aerosol optical properties at a rural site in Northern China

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Abstract. Atmospheric aerosols constitute one of the largest sources of uncertainty in the estimation of radiative forcing for climate. From April 2003 to January 2005, in situ measurements of aerosol optical properties were conducted at a rural site in Northern China, Shangdianzi Global Atmosphere Watch (GAW) regional station (SDZ), about 150 km from Beijing. Mean values (standard deviation, S.D.) of scattering and absorption coefficients for the entire period are 174.6 Mm^{-1} (189.1 Mm^{-1}) and 17.5 Mm^{-1} (13.4 Mm^{-1}), respectively. These values are approximately one third of the reported values for scattering coefficients and one fifth of those for absorption coefficients obtained in the Beijing urban area. The mean single scattering albedo (SSA) for the entire period was estimated as 0.88 (0.05), which is about 0.07 higher than the values reported for the Beijing urban area, and also higher than the values (0.85) used in a reported climate simulation for China and India. Both the absorption and scattering coefficients showed a seasonal cycle with the lowest values in winter, while the highest values occurred in summer for absorption coefficients and in fall for scattering coefficients. The mean SSA values were lowest in spring and highest in winter. The daily variations of aerosol absorption and scattering coefficients were strongly influenced by synoptic changes throughout the observation period. A trajectory cluster analysis was applied to discern the source characteristics of aerosol optical properties for different air masses. The cluster-mean aerosol scattering coefficients, absorption coefficients and SSA were all high when the air masses moved from SW and SE-E directions to the site and aerosols were influenced with heavy pollution from the dense population centers and industrial areas. The cluster-mean SSA for air masses coming from the polluted areas was not only higher than those with trajectories from the "clean" directions, but also higher than the reported values for the regions with high pollution emissions (such as the Beijing urban area). This fact might reflect the substantial secondary aerosol production during transport. The characteristics of aerosol optical properties measured at this rural site suggest significant impacts of human activities on the regional aerosol.

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